Montgomery County Manual for Planning, Design, and Construction Of Sustainable Buildings

Version 2010.07

Department of General Services (DGS)
Montgomery County Maryland
101 Monroe Street
Rockville, Maryland 20850

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PART 3: **Appendices**

Part 4: **References**

Notes:

1- Table of Contents are hyperlinked
2- Commissioning CHECKLIST and TEST Forms are in a separate binder. For electronic users they are in the CHECKLIST and TEST directory.
3- Short format (electronic file)

INTRODUCTION

Montgomery County Maryland Plans, Designs, Constructs, and operates numerous public facilities such as library, community and recreation center, Indoor and outdoor pool, office, clinic, emergency management center, correction facility, judicial facility, police station, fire station, laboratory, art and performing center, conference center, theater, cinema, civic building, transit center, parking garage, bus and maintenance depot, liquor warehouse and store, animal shelter, and host of other facilities that are all serving the citizens of the Montgomery County Maryland. Montgomery County has a great interest in the highest quality buildings for the comfort of its occupants and those who visit them for business. As a public developer we are very interested in the best practices to sustain the environment through energy efficiency, pollution prevention, revitalizing communities, and establish standards and policies that will enhance life in the county. One of the documents that provide us with the requirements and standards to achieve these goals is the building design manual.

The first design manual was created in 1996 by the Division of Facilities and Services, Department of Public Works and Transportation, Montgomery County Maryland, called "*Design Guidelines and Standards*". Subsequently, it was updated in 1998 and revised partially in 2002. At the same time, as part of Energy Star program and overall energy saving tasks, and in response to number of energy saving regulations another companion document was developed called Montgomery County "*Energy Design Guideline*". These two documents have been the principal guiding documents for the design and construction of county facilities. Montgomery County Maryland has been enforcing energy efficiency requirements since 1994 which has resulted in an average of $1 million dollars annual savings for the county just in the energy field.

Although the State of Maryland and Montgomery County construction codes and regulations are pioneers in the safe guarding of our natural resources, the new green building concepts and hard work and guidelines of organizations such as the US Green Building Council (USGBC) have raised everybody's awareness. In the past few years, we have been asked to explain green roofs, green designs, and green buildings to various interested groups from citizen associations to the County organizations.

In 2004, the County Council and County Executive has initiated and adopted an environmental policy called "*County Environmental Policy*". This policy indicates that "The County wishes to be recognized as a leader in the area of environmental policy by other public and private organizations that operate both in the county and the region. Adoption of a comprehensive environmental policy will better position the county to lead by example." We also read that "The County desires to increase the awareness of all county agencies, departments, and employees that their action has environmental consequences and that we all have a responsibility to promote public health, environmental resources management, and environmental protection." As a result we took the initiative to update the County's Design Guidelines and Energy Guidelines. In an attempt to include green requirements for the design and construction of our facilities, it became obvious that all sections of the manuals must be revised to include sustainability concerns.

This manual is a collection of our experiences in planning, design, construction, and operation of sustainable buildings. The purpose of this Manual (in this document and others may be referred to as "Design Manual-DM", or "Montgomery County Design Manual-MCDM") is to provide guidelines to architects and engineers designing new and renovate existing facilities for Montgomery County, Maryland. This manual is intended to summarize information on what is expected by the County, either by choice or by the specialized nature of the facility, and to avoid historical problems with planning, design, and construction, and with subsequent operations and maintenance. The DM includes information of a repetitive nature, more or less common to most County facilities and projects.

In 2007 the first new version of the design manual was published under the title of "Montgomery County Maryland, Manual for Planning, Design and Construction of Sustainable Buildings". The new manual was no longer a guideline but a set of requirements and heavily invested in the Green Design. Green Design was embedded in almost all chapters of the manual.

In preparation of the 2008 version of this manual we have utilized the fundamentals of the systematic project management such as Quality Control Management, Cost Management, Schedule Management, and Communication Management. Almost all sections of the Part 1 have been either rewritten or revised to incorporate the systematic project management. Section A outlines our goals for sustainable design. Section B explains our organization for management of projects. Section C " *Design Quality Control, Project Phases and Deliverables"* is a collection of our procedures and requirements during the design. This section is the most important section of this manual and all its requirements will be strictly enforced. Section D outlines our commissioning process. Section E is our standard for space measurement and it is tied to the Section C for delivery of the programmed spaces. Section F is a collection of our General Building Standards. This section outlines minimum quality and requirements for our facilities. Variations fro the General Building Standards are either outlined in the Program of Requirements (POR) Section G and H or written in the contract agreements.

In 2009.4 version we have included many updates and comments that were received from project managers and consultants. We have also added a new section Titled "General Building Standards". Our goal was to incorporate all standards required in this new section and reduce the number of specification section by eliminating as many as possible. In the future a summary version of standards will be in this new section and long SCI format specifications will be eliminated or be limited to those divisions and sections that must be included in the specifications verbatim.

This new 2010.07 version also includes many requested changes, additions and updates to our design process or requirements. We expanded "General Building standards" section and eliminated several specification sections. For the first time we incorporated the "Energy Design Guide Lines" into the DM. the Energy Guideline is no longer an independent document.

It is recognized that all standards indicated herein are not universally applicable to every project. Further, these standards do not replace professional design analyses. Consultants are expected to conduct independent evaluations of the requirements and to discuss with the Project Manager any difficulty in meeting these requirements. Also, it is not intended that these standards be used directly as contract specifications. For simplicity, they are devoid of the legal qualifications and language needed by contract specifications. **If there are any conflicts, the Contract Agreement signed by the County and the Consultant and or Contractor shall take precedence.**

It is further intended that these standards represent a cost-effective application of proven systems that provide sustainable facilities that satisfy the County's "Program of Requirements" (POR) and are efficient to operate and maintain. <u>Suggestions for improving these standards are encouraged and should be addressed to project managers or directly to the Chief, Office of Special Projects</u>.

Organization of this manual

The DM is dated and stamped with a version number so distribution can be monitored and revisions distributed to all current copy holders. It is imperative that the County and consultants are working with identical DM revisions so as to avoid conflicts.

The DM is divided in the following Parts:

Part 1: Protocols and Design Requirements- This part includes information related to the design process and management of the progress of the projects.

Part 2: Specification Requirements- This part includes all requirements that must be included or be considered during the project life. This part is organized per CSI divisions and sub-groupings. The A/E must verify these requirements and, upon verification during the design process enter them into the specifications. Unless changes are project specific, the project manager must obtain approval of such changes from the Chief, Design Section in writing.

Part 3: Appendices- This part includes miscellaneous drawings and diagrams, standard details and such information that the project team needs to use.

Part 4: Reference Materials- Content of this part could be articles that have been published by other agencies and are only included here for reference. The County is not responsible for accuracy or content of these materials.

Control Procedures

The Department of General Services (DGS), Office of Special projects (OSP) is responsible for the development, maintenance, revision and distribution of the DM. Periodically, the DM will be updated; however, contract requirements will take precedence on all projects.

The Project Managers will manage distribution of the DM to design consultants. Consultants must work with Project Managers to assure that their project meets all DM requirements. DM changes will be incorporated into each current project under design. <u>It shall be the prime consultant's responsibility to advise the Project Manager, in writing, if DM changes will have a major impact on the project.</u>

I must thank members of the Design Manual Committee and all staff and professionals who contributed directly or indirectly in the development of this manual.

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1. SUSTAINABLE DESIGN

A. Background

Since 1994 Montgomery County Maryland has been enforcing the "*Design Guideline*" and the "*Energy Design Guideline*", two documents that assure high quality of design, maintainability and energy conservation in County owned facilities. Between 1994 and 2003 the County has saved Millions of Dollars by enforcing the requirements of these two Guidelines and by incorporating an Energy Management Systems. This manual incorporates and enhances the two guidelines into a more comprehensive manual for planning, design, and construction of County owned facilities.

B. Why Sustainable Design?

The purpose of a County wide sustainable building is to demonstrate the County's commitment to environmental, economic, and social stewardship, to yield cost savings to the County taxpayers through reduced operating costs, to provide healthy work environments for staff and visitors, and to contribute to the County's goals of protecting, conserving, and enhancing the region's environmental resources. Additionally, the County helps to set a community standard of sustainable building.

C. What Is Sustainable Building?

Sustainable building integrates building materials, systems and methods that promote environmental quality, economic vitality, and social benefit through the design, construction and operation of the built environment. Sustainable building merges sound, environmentally responsible practices into one discipline that looks at the environmental, economic and social effects of a building or built project as a whole. The entire life-cycle of the built environment is included (planning, design, construction, operation and maintenance, and demolition or disassembly). Sustainable building design encompasses the following broad topics: efficient management of energy and water resources, management of material resources and waste, protection of environmental quality, protection of health and indoor environmental quality, reinforcement of natural systems, and integrating the design approach. ***Sustainability*** is "Meeting the needs of the present without compromising the ability of future generations to meet their own needs." The concept of sustainable building is derived from this broader definition of sustainability. Sustainability seeks to balance concerns for continuing growth and human development with concern for the well-being of the planet.
Life Cycle Cost Analysis is an inclusive approach to costing a program, facility, or group of facilities that encompasses planning, design, construction, operation and maintenance over the useful life of the facilities and finally any decommissioning or disassembly costs. Life Cycle Cost Analysis looks at the net present value of design options as investments. The goal is to achieve the highest, cost –effective environmental performance possible over the life of the building.

D. Why Is Sustainable Building Important?

The building industry is the nation's largest manufacturing activity, representing 13% of Gross Domestic Product. In addition, buildings represent more than 50% of the nation's wealth. The design, construction and maintenance of buildings has a tremendous impact on people and nature. Structures also impact areas beyond their immediate location, affecting the watersheds, air quality, and transportation patterns of communities. Buildings consume or are responsible for:

- 40 % of the world's total energy use
- 25 % of timber harvest

- 16 % of fresh water withdrawal
- 50% of ozone-depleting CFCs still in use
- 30% of raw materials consumption
- 35% of the world's CO_2 emissions
- 40% of municipal solid waste destined for local landfills

E. Benefits of Sustainable Building

1. Reduce operating costs.

a. Energy Efficiency

- Climate-sensitive design and energy technology use can cut heating and cooling energy consumption by 60 percent and lighting energy requirements by 50% in U.S. buildings.
- Returns on investment for energy-efficiency measures can be higher than rates of return on conventional and even high-yielding investments.
- Widespread participation in the U.S. EPA's Green Lights program has saved over 65 million kilowatts of electricity, and reduced the nation's electric bill by $16 billion annually. This is an old program implemented in 1991. Montgomery County has already retrofitted and savings have been accomplished. (T-12 bulbs are now considered obsolete). Energy efficient lighting is part of ASHRAE 90.1 already invoked in LEED guidelines as the minimum standard.

b. Water Efficiency

- Water-efficient appliances and fixtures, behavioral changes, and changes in irrigation methods can reduce consumption by up to 30% or more.
- A typical 100,000 square foot office building can yield annual savings of $4,393 by installing high efficiency measures and reducing water consumption by 30%.

C. Waste Reduction

- Construction and demolition waste equals from 35% to 40% of Municipal Solid Waste.
- Construction and demolition waste recycling can result in significant savings of not only landfill space but waste hauling and tipping fees. The Portland Trailblazers Rose Garden arena construction/demolition project saved an estimated $186,000 through waste diversion and recycling.
- Recycling creates jobs. Diverting these materials to local processors instead of local landfills creates new economic opportunities.[1]

2. Reduce some first costs.

- Rehabilitating an existing building can lower infrastructure and materials costs.
- Integrated design can use the payback from some strategies to pay for others.
- Energy efficient buildings necessitate sound engineering design and making good equipment choices, in order to reduce their equipment needs -- downsizing some equipment, such as chillers, pump and fan motors, or eliminating equipment, such as perimeter heating.
- Using pervious paving and other runoff prevention strategies can reduce the size and cost of storm water management structures.

3. Expand timeframe to create return on investment.

Life Cycle Cost Analysis looks at the net present value of design options as investments. The goal is to achieve the highest, most cost-effective environmental performance possible over the life of the project. Within a building's total life span, initial building costs account for approximately 2% of total life cycle costs, while operations and maintenance costs account for 6%, and *personnel costs account for 92%.*

[1] Institute for Local Self Reliance

Many green building measures make good long-term economic sense if the first cost is subtracted from all future savings, and savings are calculated with market capitalization rates. In other words, many green building measures can be thought of as investments which will gain value over time, over and above investments at market interest rates. Low up-front expenditures can often result in much higher costs over the life of a building.

4. **Help protect Chesapeake Bay.**
   This document indicates several specific areas of human activity that threaten Chesapeake Bay. Four of these areas - land use decisions, storm water management, water use, and water pollution are directly impacted by building and development. Sustainable building techniques that address these and other areas include:
   - Preserve existing vegetation and cluster development to preserve streamside habitat.
   - Minimize impervious surfaces to decrease flooding and protect base stream flows.
   - Install water efficient building systems to protect area water supplies and habitat areas.
   - Use low toxic building materials that reduce water pollution during manufacturing and installation.

5. **Improve Productivity and Human Health.**
   - Improved indoor environments[2] can increase employee productivity by up to 16%
   - Employees in buildings with healthy interiors have less absenteeism and tend to stay in their jobs
   - The US Environmental Protection Agency ranks indoor air pollution among the top five environmental risks to public health. One third of all buildings have poor indoor air quality.
   - Sick Building Syndrome and Building Related Illness are estimated to cost $60 billion per year in medical expenses and lost worker productivity in the U.S.
   - Benefits to tenants of green buildings with good overall environmental quality include reduced absenteeism and better employee morale, and community recognition.
   - Ensuring healthy indoor air can reduce insurance and operating costs and reduce liability risks. The U.S. EPA faced a lawsuit from employees who became ill after new carpet was installed during a renovation. The employees won the lawsuit, worth approximately $1 million.

6. **Provide Community Benefits.**
   Sustainable building can help to support and or protect:
   - The local economy through demand for local building materials, jobs and industries
   - Area environmental quality such as clean air and water
   - Longevity of public infrastructure, such as power plants, landfills, and water treatment plants
   - Social equity through the inclusion of community groups and special populations in design process
   - Global climate change mitigation by lowering energy and material consumption in building construction and operation, which can contribute to climate change.

F. Why the LEED™ Rating System?

LEED Rating System

LEED stands for Leadership in Energy and Environmental Design, and is a voluntary, consensus-based, market-driven green building rating system. It is based on existing, proven technology and

[2] Good indoor overall environmental quality includes effective ventilation, natural or proper levels of lighting, good indoor air quality and acoustics.

evaluates environmental performance from a "whole building" perspective. LEED is a self-certifying system designed for rating new and existing commercial, institutional, and multi-family residential buildings. It contains prerequisites and credits in five categories: Sustainable Site Planning, Improving Energy Efficiency, Conserving Materials and Resources, Embracing Indoor Environmental Quality, and Safeguarding Water. There are four rating levels: Bronze, Silver, Gold, and Platinum.

The Montgomery County Sustainable Building policy will benefit from all green design guidelines including a green building rating system, known as LEED™, which was developed by the US Green Building Council (USGBC). The USGBC was formed in 1993 to "accelerate the adoption of green building practices, technologies, policies, and standards." Their philosophy is that resources required for creating, operating, and replenishing the current level of infrastructure are enormous, yet resources available for such activity are diminishing; to remain competitive and to continue to expand and produce profits in the future, the building industry must address the economic and environmental consequences of its actions.

In 2003, the Montgomery County took the leadership and joined the USGBC and NACO Energy Group. Members support the activities of the USGBC and the implementation of LEED™ as a market transformation tool. Different levels of green building certification are awarded based on the total credits earned in each of several categories: site, energy, material resources, indoor environmental quality and water. The system is designed to be comprehensive in scope, yet simple in operation. Use of a national standard helps to establish minimum performance standards, creates a common dialogue for discussion, and allows the County to measure its sustainable building performance related to other jurisdictions that are using LEED™.

1. **Desired performance:**
   Starting FY09 (July 2008) LEED™ Silver certification will be required for all new constructions. The County constructs many projects that do not meet the given criteria. These projects may include buildings or remodels smaller than 10,000 square foot, buildings that are not occupied, or facilities such as parks, roadways, and other infrastructure. Project managers and design teams are encouraged to apply the portions of the LEED™ rating system which make sense for their project, and to seek out other project goals that increase the environmental, social, and economic benefits of the project.

G. LEED™ Rating System County Supplements

The County Supplements to LEED rating System will be created and updated as additional resources are identified. Please feel free to provide feedback or suggestions regarding changes or additions to the Supplements.

H. LEED MEASURES AND SCORES

USGBC website describes:

"LEED is a voluntary certification program that can be applied to any building type and any building lifecycle phase. It promotes a whole-building approach to sustainability by recognizing performance in key areas:

Sustainable Sites

Choosing a building's site and managing that site during construction are important considerations for a project's sustainability. The Sustainable Sites category discourages development on previously undeveloped land; minimizes a building's impact on ecosystems and waterways; encourages regionally appropriate landscaping; rewards smart transportation choices; controls stormwater runoff; and *reduces erosion, light pollution, heat island effect and construction-related pollution.*

Water Efficiency

Buildings are major users of our potable water supply. The goal of the Water Efficiency credit category is to encourage smarter use of water, inside and out. Water reduction is typically achieved through more efficient appliances, fixtures and fittings inside and water-wise landscaping outside.

Energy & Atmosphere

According to the U.S. Department of Energy, buildings use 39% of the energy and 74% of the electricity produced each year in the United States. The Energy & Atmosphere category encourages a wide variety of energy strategies: commissioning; energy use monitoring; efficient design and construction; efficient appliances, systems and lighting; the use of renewable and clean sources of energy, generated on-site or off-site; and other innovative strategies.

Materials & Resources

During both the construction and operations phases, buildings generate a lot of waste and use a lot of materials and resources. This credit category encourages the selection of sustainably grown, harvested, produced and transported products and materials. It promotes the reduction of waste as well as reuse and recycling, and it takes into account the reduction of waste at a product's source.

Indoor Environmental Quality

The U.S. Environmental Protection Agency estimates that Americans spend about 90% of their day indoors, where the air quality can be significantly worse than outside. The Indoor Environmental Quality credit category promotes strategies that can improve indoor air as well as providing access to natural daylight and views and improving acoustics.

Locations & Linkages

The LEED for Homes rating system recognizes that much of a home's impact on the environment comes from where it is located and how it fits into its community. The Locations & Linkages credits encourage homes being built away from environmentally sensitive places and instead being built in infill, previously developed and other preferable sites. It rewards homes that are built near already-existing infrastructure, community resources and transit, and it encourages access to open space for walking, physical activity and time spent outdoors.

Awareness & Education

The LEED for Homes rating system acknowledges that a green home is only truly green if the people who live in it use the green features to maximum effect. The Awareness & Education credits encourage home builders and real estate professionals to provide homeowners, tenants and building managers with the education and tools they need to understand what makes their home green and how to make the most of those features.

Innovation in Design

The Innovation in Design credit category provides bonus points for projects that use new and innovative technologies and strategies to improve a building's performance well beyond what is required by other LEED credits or in green building considerations that are not specifically addressed elsewhere in LEED. This credit *category also rewards projects for including a LEED Accredited Professional on the team to ensure a holistic, integrated approach to the design and construction phase.*

Regional Priority
USGBC's regional councils, chapters and affiliates have identified the environmental concerns that are locally most important for every region of the country, and six LEED credits that address those local priorities were selected for each region. A project that earns a regional priority credit will earn one bonus point in addition to any points awarded for that credit. Up to four extra points can be earned in this way."

It must be mentioned that the goal of the project shall not be just to score more point, but to be aware of the potentials of the building and its systems design and try to achieve the highest possible green and sustainability goals.

Project Manager and the A/E must initiate a Charrette workshop before commencing the concept design development to find out project green/LEED goals. These goals must be monitored and maintained during the design and construction of the project.

The A/E must obtain the latest and related version of LEED Score Card from USGBC.

End of section

Project Management Protocol

The Department of general Services (DGS), based on the request of various county departments and agencies on a bi-annual basis, will identify a project. As soon as a project is identified, DGS will assign the project to the appropriate office and Project Manager(s) to lead the project team. The Project Team includes many individuals involved in the process of a Capital Improvement projects (CIP). Each member of this team plays a major role in the success of the project. The Intent of this section is to outline each member's role.

1. Project Management

Following are major responsibilities for:

a. **Division of Building Design & Construction**:
   i. Planning, Design and Construction of CIP projects

b. **Office of Special Projects**:
   i. Planning, Design and Construction of selected CIP projects

c. **Division of Facilities Management**:
   i. Maintenance and Operations of all County facilities

d. Chief of Division or Office:
   i. Contract Administrator with responsibilities identified in the contract documents
   ii. Executive Director of all CIP projects and coordination at the department level and during all phases
   iii. Assignment of projects
   iv. Approval and Signing of all contracts
   v. Approval and Signing of N.T.P., Change Orders and Field Orders

e. Section Chiefs:
   i. Executive Manager
   ii. Approval of correspondences with the contractors
   iii. Approval of all contract changes for Division chief's signature
   iv. Approval of all payments to contractors
   v. Monitoring and supervising projects to insure their progress in accordance to established scope, schedule and budget
   vi. Providing guidance and directive to project teams and project managers
   vii. Signing all correspondences with the County Attorney and Office of Procurement
   viii. Review correspondences prepared for CE signature

f. Unit Manager/Team Leader:
   i. Sr. Manager of all assigned CIP projects
   ii. Approval of correspondences with the contractors for Section Chief signature
   iii. Review of all contract changes for Section Chief's approval
   iv. Review of all payments to contractors for Section chief's signature
   v. Monitoring and supervising each project to insure their progress in accordance to established schedule and budget
   vi. Providing guidance and directive to project manager
   vii. Coordination with the County Attorney and Office of Procurement
   viii. Prepare response to citizens and agencies for CE signature

g. Project Manager
   i. Managing day by day business of their projects
   ii. The Project Manager should advise all Project Team members of their participation and provide tentative scheduling information as needed

iii. Review and approve invoices and provide documentation for final approval and payment by the section chief

h. Team Members: are those who participate in the process of the design and construction of a CIP project on behalf of the county.

i. Team members shall be included in the design process and meetings and receive copies of meeting minutes. Attendance on an as-needed basis is the responsibility of each team member unless specifically requested by the Project Manager.
ii. At a minimum, each team member shall attend meetings as necessary to remain informed of project development, and to insure that their Section has adequate representation in the process
iii. Familiarize themselves with Design Manual Standards and provide critical input based upon those standards and the needs of the project

2. Planning Phase

a. Project Manager

i. Leading role
ii. Managing production/coordination of the POR
iii. Coordination with the user agency
iv. Coordination with the supporting Regional Service Center Director
v. Coordination with OMB
vi. Coordination with DTS
vii. Coordination with the Division of Facilities Management
viii. Coordination with MNCPP-C
ix. Coordination with the Real Estate Office
x. Management of cost estimating consultant
xi. Management of A/E in case they are tasked to prepare the POR
xii. Preparation and distribution of meeting reports and related documents to the team.
xiii. Publish and distribute the POR to obtain signatures

b. Real Estate Specialist

i. Provide site selection and land acquisition services

c. Division of Facilities Management

i. Provide POR input at it relates to:
Maintenance and Operations
Security
Energy
IAQ

3. Design Phase

Participation of team members is required for the duration of the project. Team members are to receive meeting minutes and other correspondence as required for adequate project tracking.

a. Project manager

i. Leading role: The Project Manager is to consider project team members for inclusion on the design consultant selection process; however the ultimate decision resides with the Section Chief.
ii. Managing the design process
iii. Chairing project progress meetings
iv. Coordination with the user agency
v. Coordination with DTS
vi. Coordination with the Division of Facilities Management

vii. Coordination with the A/E and MNCPP-C
viii. Coordination with the Real Estate Office
ix. Management of A/E and other consultants
x. Preparation and distribution of meeting reports and related documents to the team
xi. Coordination with Permitting Services
xii. Deliver drawings and specifications to Property Managers for formal review process. Include a cover memo which clearly states
   - Name of project
   - Specific review information
   - Review format
   - Specific sections applicable for review
   - Date review comments due
xiii. Coordination of documents review and comments

b. County Project Architect and Engineer

i. Review the design and provide comments to PM
ii. Provide historical facility, lease and tenant information in support of project team requirements

c. Real Estate Specialist

i. Provide site selection and land acquisition services

d. Division of Facilities Management

i. Review the project at concept design, SD, DD and CD and provide comments

4. Construction Phase

a. Project manager

i. Leading role: The Project Manager is to consider project team members for inclusion on the construction process; however the ultimate decision resides with the Project Manager.
ii. After design, and during the bid process, the Project Manager shall inform team members of the apparent low bidder and solicit information related to bidder qualifications prior to awarding the bid.
iii. Managing the Construction process
iv. Chairing construction progress meetings
v. Coordination with the user agency
vi. Coordination with DTS
vii. Coordination with the Division of Facilities Management during construction and the commissioning process.
viii. Coordination with the Division of Facilities Management for completion prior to project handover (Substantial Completion) for:
   - O/M Manuals
   - Warranty manuals and contact list
   - Training
   - Security and fire monitoring requirements
   - Keys/access to facility.

Management of A/E and Construction General Contractor

ix. Preparation and distribution of meeting reports and related documents to the team
x. Coordination with Permitting Services (to include final closeout of storm water and erosion control permits).
xi. Obtain G Number, coordinate utility account transfers, and notify the Division of Facilities Management.

xii. The Project Manager is also responsible for coordinating document review and comments
xiii. The Project Manager shall provide for full and free access to construction sites for all section representatives. Provide tours as necessary to familiarize section reps with project and site. Coordinate and schedule participation, observation, and inspection activities of staff from other sections, as provided for in Commissioning Standards.
xiv. The Project Manager shall coordinate DGS as key participants of the commissioning team, in performance of assigned tasks in the Commissioning Plan.
xv. The Project Manager shall ensure a Commissioning Plan has been properly prepared and agreed to by all parties prior to the completion of construction.

b. County Project Architect and Engineer

i. Review design changes and provide comments to PM of design

c. Real Estate Specialist

i. Provide site selection and land acquisition services
ii. Provide historical facility, lease and tenant information in support of project team requirements

d. Division of Facilities Management

i. May not directly influence or instruct the contractor. All comments and concerns are to be coordinated through Project Manager.
ii. Participate in construction meetings on a regular basis.
iii. Assist in notifying tenants of on-going construction processes and effects;
iv. Participate, and support the Project Manager in the preparation of the Commissioning Plan.
v. Alert the Project Manager to upcoming or ongoing work in a facility.
vi. Per, the Commissioning Plan, observe any system start-up activities, and perform other activities assigned under the plan.
vii. Serve as the operational leads in the commissioning process
viii. The Division of Facilities Management Engineers and technicians should thoroughly familiarize themselves with O&M Manuals, As-Built drawings, and Warrantees to acquire understanding of all aspects of the building. They should attend and participate in training provided during the Commissioning effort.
ix. Should actively participate in all phases of building commissioning.
x. Assist the commissioning agent in Conducting system tests and startups required for the commissioning.
xi. Upon Final Completion (this should be Substantial Completion for O&M manuals and warranty manuals), receive O&M manuals, as-built drawings, and warranty manuals. These manuals should reside in affected buildings and/or shops.

5. Substantial Completion – Punch List

a. Project manager

i. Leading role: The Project Manager is to consider project team members for inclusion on the construction process; however the ultimate decision resides with the Project Manager.
ii. Schedule punch-list walkthroughs as a contract requirement. Notification shall be given to project team members, and they all shall be included on the punch list walkthrough and inspection.
iii. The Project Manger shall compile a list of discrepancies, as noted by the A&E, other team members, or section staff performing inspections; to be reviewed and included in the punch list for correction.
iv. Once the contractor has completed correction to the punch list, the Project Manager shall send an itemized explanation of corrections taken, amended, or deleted that were noted on the punch list by Division of Facilities Management staff.

v. Upon Substantial Completion, send O&M manuals, as-built record drawings, and warrantees to the Division of Facilities Management with cover memo indicating sending date. One complete set each of all O&M, As-built, and Warranty documents shall reside at the building site, in the shops offices, and in the Project Manager's permanent files.
vi. The Project Manager shall schedule and coordinate system training and demonstration, in accordance with the Commissioning Plan, and otherwise act as the lead in overall execution of that plan.

b. Division of Facilities Management

i. Coordinate operational and/or safety training for maintenance staff with the PM;
ii. Participate in the punchlist process with the goal of assuring the project meets the standard set by the construction documents and the subsequent decisions made during the construction process;
iii. Perform assigned responsibilities under the Commissioning Plan.
iv. Assure that Facilities staff inspect the constructed work, and compile a list of discrepancies to be reviewed and included in the punchlist for correction (punchlist items are relative only to contract specifications
v. Division of Facilities Management staff shall participate in the punchlist process with the goal of assuring the project meets the standard set by the construction documents.

6. Warranty Period

a. Project manager

i. Shall notify the project team of substantial completion, dates of warranty, and provide specific information to the Division of Facilities Management who assumes operation of the building and initiates the coordination of any warranty issues with the contractor as appropriate.
ii. Shall follow up with the contractor to resolve warranty issues if the Division of Facilities Management' initial coordination is not responded to in a timely manner or if AE support is needed.
iii. May follow up with the AE to resolve design issues.

b. Division of Facilities Management

i. After substantial completion, the Division of Facilities Management is responsible for overall operation and maintenance of the building.
ii. When a design or construction problem arises during the warranty period, the Division of Facilities Management - engineer shall be responsible for coordinating the contractor, consultant and repair/maintenance staffs.
iii. Shall assist in resolving problems only after the Property Manager and shop staff investigation have eliminated an operational or non-contractual issue as the proximate cause of the problem.
iv. Shops/Janitors or on-site contracted maintenance personnel are to respond to calls, investigate the problem, and recommend an appropriate solution to the Division of Facilities Management - engineer. If the problem requires immediate action to insure the safety of the occupants or to prevent property damage, they shall immediately take necessary initial action as required.
v. If an outside service is required, the Shops are to monitor and/or assist as necessary until the problem is fixed.
vi. It is Shops personnel responsibility to see the problem through to a completed resolution. Shops personnel are to provide Property Managers and Project Managers with professional assistance and reliable information to correct problems that arise.

End of Section

Commissioning (Cx) Guide

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Commissioning (Cx) Guide

Introduction:

Commissioning (Cx) is the process of ensuring that all building systems are installed and perform interactively according to the design intent, the systems are efficient and cost effective and meet the user's operational needs, the installation is adequately documented and that the operators are adequately trained. Cx begins in the planning phase and proceeds through design, construction, start-up, acceptance and training. There are important differences between the construction phase commissioning activities such as construction observation, start up, and testing, adjusting and balancing (TAB) and building commissioning. These activities in themselves cannot meet the goals of the building commissioning. Building commissioning includes these construction phase activities as well as many other activities during design construction and occupancy.

1. **Purpose**:
   This guide serves as a model for the Cx process as should be applied to construction in facilities installed at Montgomery County Government (MCG).
   This guide is intended to:
   - Instruct and aid the Contract and Project managers, Architect/Engineers (A/E), Commissioning Authorities (CA), Contractors, and Operators in implementing the Cx process
   - Establish a standard procedure for Cx at MCG and as such dictate minimum requirements
   - Facilitate and expedite the preparation of the commissioning work products by providing samples, templates, tools, etc.

2. **Scope**:
   The procedures, methods, and documentation requirements in the commissioning documents cover each phase of the commissioning process for all types and sizes of building systems. They apply from facility planning through post –occupancy, including the inevitable changes in the building occupancy requirements after initial occupancy.
   The Cx documents detail:
   - Owner's assumptions and requirements
   - Design Intent/basis of design
   - Protocols for the Cx process
   - System start up and check out
   - Functional performance testing and validation requirements and record
   - Training requirements
   - Operation and Maintenance Criteria
   - Close-out Documents

3. **Commissioning Process:**
   The Cx process is in affect an implementation of enhanced quality control in the design and construction process and in the operation of the facility. While the Cx effort should continue through the life of the facility, this guide deals with the process from the early programming phases through the end of the warranty phase for the facility, which is typically the first year of occupancy.

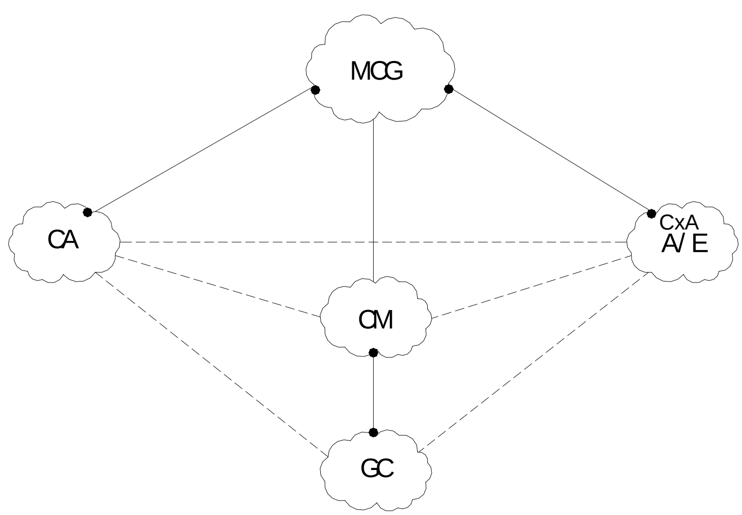
4. **Commissioning Authority (CA):**
   While all parties play a crucial role in the Cx process, the key party is the Commissioning Authority (CA). This is a team of senior specialists that will direct and oversee the process. This party could be retained in the programming phase of the project. Their role will be to provide technical and procedural oversight during all phases, perform active functional performance testing during the construction, acceptance, and warranty phases, assist in the training,

documentation, information transfer and/or general turnover of the facility, and to periodically monitor the facility during the warranty phase in order to optimize it with the actual occupancy.

5. **Commissioning Agent (CxA):**
The Commissioning Agent is the A/E representative responsible to develop the Commissioning Plan and all associated coordination and implementation during the design process.

6. **Commissioning Team (CT):**
All traditional parties to the design and construction process are vital to the Cx process and will to some degree be part of the Cx Team (CT). Cx generally will provide an extra focus to their efforts and in some cases formalize tasks and protocols that are inherently included in the traditional process but often lost sight of or performed inadequately. A special emphasis is placed on involvement of the operators as early as possible to incorporate their valuable experience in the design and to allow them to become an active participant in the initial check out and acceptance of the facility.

7. **Roles and Responsibilities:**
Details of the roles and responsibilities of the individual parties are outlined in the Model Cx Plan. In general, roles and responsibilities do not change. The facility user with their liaison and MCG are responsible for clearly communicating the facility needs and for understanding the design and functional intent. MCG via the project managers and Construction Manager (CM) (when applicable) are responsible for directing work. The A/E is responsible for designing a facility that meets the needs of MCG and the user and is in compliance with all regulations and accepted practices. Construction contractors and vendors are responsible for furnishing and installing the facility per the contract documents.
The construction contractor is not responsible to deliver the design intent. The A/E is not responsible for the installation. The Cx process is designed to ensure and validate that the design intent meets MCG's needs, the installation meets the design intent, and that the operation and use of the facility is in accordance with the design intent.
The CA should endeavor to assist other parties and facilitate the Cx process but does not direct work nor approve/accept materials, systems or equipment. The CA makes recommendations to the appropriate party who in turn directs work, etc.
The following shows the basic contractual lines between the parties. The GC hires the sub-contractors.



8. **Sequencing and Tasks:**
The following is a brief synopsis of the Cx process as it is outlined in this guide.

Project Phase and Description	**Commissioning Sequence**
Programming Phase: Owner identifies the project need, retains the design team and outlines the functional requirements of the facility. Owner and occupants work with the design team to document the requirements. Determine the scope of Cx.	
Conceptual Design Phase: Design team along with the Owner formulates the concepts upon which the design will be based. Design team prepares the Design Intent and the Basis of Design as the first components of the Building Manual.	CxA and CA meet with Owner to establish Owner requirements and protocols CxA develops initial Cx Plan
Schematic Phase: Concepts of the project are developed to the point of schematic and single line drawings.	Commissioning Kick off CxA and CA review schematic designs at all phases CxA and CA review, format and supplement design criteria documentation
Design Development Phase: Schematic and single line drawings have been finalized and advanced.	CxA and CA review Design Development designs at all phases CxA and CA review, format and supplement design criteria documentation
Construction Documents Phase: Detailed design is accomplished and Contract Documents are prepared for bidding. This phase may consist of multiple sub-phases.	CxA expands Cx Plan to include construction phase information CxA and CA review construction documents at all phases CxA finalizes the Cx specs and the Cx Plan with generic testing procedures A/E further updates the design intent narrative
Bidding Phase: Installation or construction is competitively bid and contractors/subcontractors are selected.	CxA and CA provide technical support concerning the Cx process
Construction Phase: Phase of the project during which the facility is constructed and/or systems and equipment are installed and started. Contractor and subs complete installation start up forms, submit O&M information, establish trends, etc. Contractor/Vendors conduct equipment specific training. Construction phase will generally end upon completed start up of systems and equipment and completion of trending requirements.	CA conducts construction Cx kick off meeting Contractor incorporates detailed Cx tasks in project schedule. Contractor submits shop drawings and A/E reviews and approves. CA reviews the key ones Contractor submits start up forms and manufacturer specific start up procedures and CA reviews CA reviews and approves developed detailed, equipment specific testing procedures and documentation by GC CA conducts periodic inspections and attends periodic progress meetings A/E and contractor submit O&M info and CA

	reviews, compiles, and formats
Acceptance Phase: The facility and its systems and equipment are inspected, tested, verified, etc. and when most of the formal training occurs. This will generally occur after the construction phase is complete. A/E and contractor finalize Close-out Documents such as "As Built or Record Documentation". Approved Functional Completion marks the end of this phase	CA spot checks start ups and balancing CA leads Functional Performance Testing (FPTs) in which most parties are also participants to some degree. CA documents testing and compiles all other design, operation and maintenance information CA reviews and approves developed system level training programs conducted by GC
Warranty Phase: Includes the early occupancy of the building and can continue through the warranty period and at least into the opposite season from when it was initially tested. Contractor performs warranty service and corrects deficiencies. Contractor finalizes record documentation to reflect actual conditions at the end of the warranty period. Operator's work with the CA and the design team to fine-tune the facility to meet actual occupancy.	CA observes and approves opposite season testing CA monitors facility periodically and assists the operator in optimization and fine tuning of the facility

9. **Cx Specifications:**
These specifications outline Cx responsibilities specifically associated with the construction phase of the project. They specify the contractor's involvement in the Cx process. They first detail the Cx related submittals required that document their work. They explain precedents and the extent to which the contractor must support the process.
Three sections are included:

Section 23 08 01 - Commissioning of HVAC
Section 26 08 02 - Commissioning of Electrical System
Section 26 08 03 - ATC Commissioning

Section (Division) 23 08 01 – Commissioning of HVAC.

SECTION 23 0800 – COMMISSIONING of HVAC

I. GENERAL

1. WORK INCLUDED

A. Systems and equipment testing and start-up.
B. Validation of proper and thorough installation of Division 15 systems and equipment
C. Systems balancing verification.
D. Equipment performance verification.
E. Functional testing of control systems.
F. Documentation of tests, procedures, and installations.
G. Coordination of training.
H. Sequencing

2. GENERAL DESCRIPTION

A. Commissioning is the process of ensuring that all building systems are installed and perform interactively according to the design intent, the systems are efficient and cost effective and meet the MCG's operational needs, the installation is adequately documented and that the Operators are adequately trained. It serves as a tool to minimize post-occupancy operational problems. It establishes testing and communication protocols in an effort to advance the building systems from installation to full dynamic operation and optimization.
B. Commissioning Authority shall work with the Contractor and the Design Engineer to direct and oversee the Cx process and perform functional performance testing
C. The Commissioning Plan outlines the Commissioning Process. It is part of the Contract Documents and stipulates Contractor responsibilities that are part of this project. It also indicates the details of the functional performance testing that the contractor must participate in. Refer to it for details of the Cx process.
D. This section expands on the Cx Plan and defines responsibilities of the Contractor to facilitate the Commissioning process particularly during the Construction Phase.

3. SCOPE

A. Systems to be commissioned include the following:
   1. HVAC Systems
   2. Plumbing Systems
   3. Compressed Air Systems
   4. Specialty Gas Systems
   5. Fuel Oil Systems
   6. Natural Gas Systems

4. Related Work and Documents

A. **Commissioning Plan**: This plan is part of the Contract Documents and outlines many of responsibilities, procedures and tasks throughout the Cx process. It also describes the FPTs that will be performed during the Acceptance Phase

The following section names and numbers will vary with each project. Edit them accordingly. This is one of the most challenging efforts to ensure that the requirements are incorporated in the project. Use this as a reminder of the sections to check/edit to properly incorporate the Cx procedures and requirements.

B. **Section xx -** Supplementary Conditions: Stipulates penalties for non-conformance with the Cx requirements

C. **Section xx** – Coordination: Stipulates the relationships between the parties involved with the Cx process

D. **Section xx** – Submittals: Stipulates additional copies of submittals to be submitted and refers to other sections for additional submittal requirements related to Cx.

E. **Section xx** – Project Close Out: Defines the milestones in completion incorporating the Cx process

F. **Section xx** – O&M Manuals: Refers to documentation and procedures relative to the O&M information

G. **Section xx** – General Mechanical Requirements: References other sections stipulating Cx requirements

H. **Individual Division xx Sections**: Individual sections stipulate installation, start up, warranty and training requirements for the system or device specified in the section.

I. **Section xx** – Controls Commission: Stipulates detailed requirements of Cx for the control systems.

5. DEFINITIONS and Abbreviations

A. **Acceptance Phase**: This is the phase of the project that the facility and its systems and equipment are inspected, tested, verified, etc. and when most of the functional performance testing and formal training occurs. This will generally occur after the construction phase is complete (start up and check have been accomplished). The Acceptance Phase typically begins with Substantial Completion and ends with Functional Completion

B. **ASHRAE** - American Society of Heating, Refrigerating, and Air Conditioning Engineers

C. **Contractor**: As used herein is a general reference to the applicable installing party and can therefore refer to the GC, subcontractors, or vendors.

D. **Construction Phase**: Phase of the project during which the facility is constructed and/or systems and equipment are installed and started. Contractor and subs complete installation, start up forms, submit O&M info., establish trends, etc. Contractor/Vendors conduct equipment specific training Construction phase will generally end upon completed start up and TAB of systems and equipment.

E. **Commissioning (Cx)** - The process of ensuring that all building systems are installed and perform interactively according to the design intent, the systems are efficient and cost effective and meet the MCG's operational needs.

F. **Commissioning Authority (CA)** - An individual or company who will oversee the Cx process, stipulate many of the Cx requirements and ensure and validate that systems and equipment are designed, installed and tested to meet the MCGs requirements.

G. **Commissioning Team**: The group of individuals who will collaborate to ensure the facility is fully and completely commissioned. This will include the CA, the MCG's Facilities representative, the TAB contractor, and a Cx coordinator provided by the contractor. Generally the installing contractor, subcontractor, and/or manufacturer will be an integral member of the team for any given system or equipment.

H. **Functional Completion**: A milestone which marks the successful completion of the Acceptance Phase and generally the functional performance testing of the systems in the initial season

I. **Functional Performance Testing (FPT)** - final testing of systems and equipment when performance is tested in various modes of operation and under different conditions. Both component performance and environmental objectives will be monitored during this testing.

J. **Deficiency**: an installation or condition that is not in conformance with the construction documents and/or the design intent.

K. **Facility Management System (FMS)**: the computer based control or automation system.
L. **Party** – Individual, company or entity. Refer to the Cx Plan for names and definitions
M. **Project Phases** – Phases of the project include the Construction Phase, Acceptance Phase, and Warranty Phase.
N. **Preliminary Service** - systems/equipment are being used by the occupants although final adjusting, balancing, and functional performance testing is on going.
O. **Pre-Test** - preliminary testing accomplished during a scheduled system outage to verify system functionality prior to placing the system/equipment into preliminary service.
P. **Scheduled Outage** - period of time, scheduled by MCG, in which the system is out of service or not to be used by occupants.
Q. **Start-up** - The process whereby the contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the start-up checklist, energizes the device, and basically verifies it is in proper working order.
R. **TAB** - Testing, Adjusting, and Balancing as generally specified in Section [__________]
S. **Warranty Phase**: Includes the early occupancy of the building and can continue through the warranty period and at least into the opposite season from when it was initially tested

6. REFERENCE STANDARDS

A. **ASHRAE Guideline 1-1996**, "Guideline for Commissioning HVAC Systems"
B. **NEBB** - Procedural Standards for Building Systems Commissioning
C. **AHRAE Standard 110**

7. DOCUMENTATION

A. Contractor shall send Commissioning Authority one copy of the following per the procedures specified in the Cx Plan and other sections of the specification:
   1. Shop drawings and product data related to systems or equipment to be commissioned. Commissioning Authority shall review and incorporate comments via the Design Engineer
   2. Draft equipment Start-up check lists along with the manufacturers start up procedures. CA will assist in the development and recommend approval
   3. Draft Test and Balance Reports. CA will review and recommend approval
   4. System Test reports. CA will review and compile prior to FPT
   5. Completed Equipment Start-up certification forms along with the manufacturer’s field or factory performance and start up test documentation. CA will review prior to FPT
   6. Completed Test and Balance Reports. CA will review prior to FPT
   7. Equipment Warrantees
   8. Training Plans
   9. O&M Information per the requirements of the Cx Plan, Division 1 requirements
   10. Record Drawings

B. Record Drawings: Contractor shall maintain at the site an updated set of record or "as-built" documents reflecting actual installed conditions

8. SEQUENCING And Scheduling

A. Refer to the sequencing illustration at the end of this section for a graphical representation of the precedents related to the Cx tasks. These precedents are generally to be applied per system and/or area. Where applicable, in order to expedite the close out of the facility, various systems can be in various stages of the commissioning process. CA and Contractor shall cooperate to schedule the Cx tasks to minimize the duration of the Cx activities.

B. Cx Scheduling: Contractor shall incorporate the commissioning process into the project schedule. Start up, TAB, and Functional Performance Testing shall be itemized as applicable for each system/area. CA will dictate duration for the tasks.

9. Coordination Management Protocols

A. Coordination responsibilities and management protocols relative to Cx are initially defined in the Cx Plan but will be refined and documented in the Construction Phase Cx coordination meeting. Contractor shall have input in the protocols and all parties will commit to scheduling obligations. The CA will record and distribute.

10. COMMISSIONING AUTHORITY RESPONSIBILITIES

A. Construction Phase
1. Conduct Cx meeting
2. Review applicable project documentation (shop drawings, product date, TAB reports, record drawings, O&M information, etc.) for adequacy and to ensure system functionality.
3. Review and approve start up checklist forms.
4. Inspect installation periodically.
5. Attend selected progress meetings to observe progress and help expedite completion.
6. Witness selected tests start-ups, and equipment training.
7. Compile O&M information and systems overview and format the O&M manuals

B. Acceptance Phase
1. Verify (spot check) TAB reports.
2. Verify (spot check) control component calibration.
3. Verify (spot check) equipment performance certifications.
4. Analyze trend logs
5. Functionally test systems and equipment.
6. Review training plan.
7. Coordinate training activities
8. Record commissioning procedures.

11. CONTRACTOR RESPONSIBILITIES

A. Construction Phase
1. Include Cx requirements in price and plan for work
2. Attend coordination meetings called by CA
3. Remedy any deficiencies identified throughout construction
4. Prepare and submit required draft forms and systems information. TAB shall submit sample balancing forms
5. Thoroughly complete and inspect installation of systems and equipment as detailed throughout Contract Documents, as required by reference or industry standards, and as specifically indicated in Part - 3 of this section.
6. Start-up, test, adjust, and balance systems and equipment prior to verification and performance testing by the Commissioning Authority. Start-up procedures shall be in accordance with Contract Documents, reference or industry standards, and specifically Part - 3 of this section.
7. Record start-up and testing procedures on start-up forms or checklists and certify that the systems and equipment have been started and or tested in accordance with the requirements specified above. Each form shall be signed and dated by the individual responsible for the start-up or test. Tag equipment started with individuals name and date.

8. Complete approved start up checklists and submit along with other installation certification information such as balancing reports, warrantees, testing results, etc.
9. Schedule and coordinate Cx efforts required by appropriate subs and vendors. Participate in respective portions of start ups and training
10. Demonstrate the systems as specified
11. Certify that systems have been installed and are operating per Contract Documents.
12. Maintain an updated set of record documentation
13. Copy Commissioning Authority on indicated documentation.
14. Conduct equipment specific operation, maintenance, diagnosis, and repair training as required by the respective section of the specifications

B. Acceptance Phase
1. Assist Commissioning Authority in verification and performance testing. Assistance will generally include the following:
    a. Manipulate systems and equipment to facilitate testing
    b. Provide instrumentation necessary for verification and performance testing
    c. Manipulate control systems to facilitate verification and performance testing
    d. Provide a TAB technician to work at the direction of Commissioning Authority for up to ___hours beyond assistance specified above.
    e. Provide a Control technician to work at the direction of Commissioning Authority for up to ___hours beyond assistance specified above.
2. Correct any work not in accordance with Contract Documents.
3. Participate in the systems and operational training relative to use of O&M information and the PM program
4. Compensate Commissioning Authority for site time necessitated by incompleteness of systems or equipment at time of functional performance testing.

C. Warranty Phase
1. Provide warranty service
2. Participate in the opposite season testing
3. Correct any deficiencies identified
4. Update record documentation to reflect any changes made throughout the Warranty Phase

12. Contractor Notification

A. Contractor shall completely install, thoroughly inspect, start-up, test, adjust, and balance systems and equipment. All activities shall be documented on specified forms. Contractor shall notify A/E, MCG, and CA in writing that systems are complete and ready for verification and functional performance testing.

B. Contractor shall notify CA at least 14 days in advance of any tests, start-ups, or training. CA shall witness selected tests and start-ups.

13. START-UP CHECKLISTS and Manufacturers Start up Instructions

A. Start-up checklists for each type of equipment and system shall be submitted to Commissioning Authority for approval prior to start-up. Appropriate subcontractors or vendors shall design the forms meeting the requirements of the Contract Documents. Forms shall be developed for the equipment being installed for this project.

B. Start up checklists shall generally include the following for each (as applicable):
1. project specific designation, location and service
2. Pertinent nameplate data
3. Indication of the party performing the test

4. Place for signature of the start up technician along with the date
5. Clear explanation of the inspection, test, measurement etc with a pass/fail indication a record of measure parameters
6. Include a checklist item indicating all O&M instructions, warranties, record documents have been completed and submitted.
7. Include a checklist item for proper maintenance clearances maintained
8. Include an checklist item indicating that special tools and/or spare tools required were turned over to the MCG
9. Generally include checklist items indicating that required prerequisite equipment and systems were successfully started

C. Start up checklists shall incorporate the manufacturer-specified procedures. Contractor shall compile the start up and check out procedures indicated in the manufacturer's documentation prior to designing the forms. As applicable include acceptance criteria specified therein. The manufacturers start up and check out procedures shall be submitted to the CA along with the draft start up checklists.

D. Refer to the Cx Plan for examples and minimum required content

E. Completed Start-up checklists for all pieces of equipment shall be submitted to Commissioning Authority prior to verification and performance testing.

14. Trending

A. [Trending requirements are specified in Section 15959.

B. [CA will analyze trends of the system operating parameters to evaluate normal system functionality. The requirements of the trending are specified with the FPT procedures in the Cx Plan. Contractor shall establish these trends, ensure they are being stored properly, and forward the data in electronic format to the CA.

C. Data shall include a single row of field headings and the data thereafter shall be contiguous. Each record shall include a date and time field. Recorded parameters for a given piece of equipment or component shall be trended at the same intervals and be presented in a maximum of two separate two dimensional formats with time being the vertical axis and field name being the horizontal axis.. Data shall be forwarded in one of the following formats.

1. Microsoft ACCESS Database (.mdb)
2. Microsoft EXCEL Spreadsheet (.xls)
3. Comma Separated Value (.csv or .txt) preferably with quotes delimiting text fields and # delimiting date/time fields

D. Sample times indicated as COV (☐) or change of value mean that the changed parameter only needs to be recorded after the value changes by the amount listed. When output to the trending file, the latest recorded value shall be listed with any given time increment record. If the FMS does not have the capability to record based on COV, the parameter shall be recorded based on the interval common to the unit.]

15. Functional Performance Testing

A. **Participation:** CA will direct and conduct functional performance tests after the successful start up and complete documentation of systems and equipment. Conceptual procedures for the functional performance testing are outlined in the Cx Plan. CA will generally execute the test. Contractor shall generally assist as described above with manipulation of the systems or equipment, provision of supporting equipment or materials (lifts, ladders, specialty test equipment, etc.), and on the spot remediation of minor identified deficiencies. Required participation is outlined in the Cx plan.

B. **Detailed Test Forms**: CA will prepare detailed and itemize testing procedures and forms to dictate and document the FPT. These will be developed during the construction phase and completed during the acceptance phase.

C. **Completeness**: All systems must be completed and ready for FPT. TAB must be complete and the control systems must be tested and started for the respective system or component.

D. **Test Documentation**: CA will conduct, test, and/or witness tests as applicable. CA will record test results on the forms developed for the testing. CA will Pass or Fail the testing and record the date and time of the test. Deficiencies shall clearly be indicated in when the test is failed. When all related testing is completed successfully, CA shall recommend acceptance of the system or component.

E. **Deficiencies and Re-testing**: When deficiencies are identified during testing, depending on their extent or magnitude, they can be corrected during the test and the testing can continue to successful completion. More significant deficiencies will require failure of the test and re-testing. Deficiencies of this magnitude will result in an action item on the Action List. The resolution of the deficiency will then subsequently be tracked by the CA via the Action List. All tests shall be repeated until successful completion

F. **Sampling**: Some types of identical equipment (such as terminal devices) will be tested using a sampling strategy. The sample percentage is indicated in the generic test procedure listed in the Cx Plan..

G. **Failure Limit on Sample Tests**: With the sampling percentages is listed a failure limit. This limit indicates the maximum percentage of the tested devices that may have any test that fails before an entirely new sample must be tested. This is based on the concept that if many failures occur it is a result of inadequate start up by the contractor. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.
   1. Where sample tests involve multiple systems (i.e.: checking strainers on different hydronic systems) the maximum failure limit will apply per system.
   2. The responsible contractors shall pay the CA's cost of that sample test, and redo the start up/TAB for the applicable devices/systems.
   3. All work necessitated by sample failures shall be at no cost to the MCG.

H. **Opposite Season Testing**: Testing procedures shall be repeated and/or conducted as necessary during appropriate seasons. "Opposite season" testing will be required where scheduling prohibits thorough testing in all modes of operation. Air Handler and Central heating system testing for heating related modes of operation and control loops shall be tested during outside air temperatures below 35°F.

Acceptance criteria are very important. CA must ensure that the A/E has adequately specified the acceptance criteria where applicable in the individual sections. For instance pass criteria for pipe and duct testing, capacities, efficiencies, etc.

16. FPT Acceptance Criteria

A. Acceptance criteria for tests are indicated in the Cx plan and in the specification sections applicable to the systems being tested. Generally, unless indicated otherwise, the criteria for acceptance will be that specified with the individual system, equipment, component, or device.

17. Training

A. Contractors, Subcontractor, Vendors, etc. shall prepare and conduct training sessions on the installed systems and equipment they are responsible for. Generally the CA and A/E shall conduct of the systems overview, design intent, and design criteria training. The contractor shall perform all other training.

B. GC shall compile the training plans of the subs and vendors and present a comprehensive training plan as outlined in the Cx Plan.

C. Training sessions should typically start and end in a classroom setting. Field demonstrations will also typically be conducted to demonstrate the hands-on aspects of the required tasks.

D. **Equipment Specific Training**: Appropriate contractor or vendor shall instruct the MCGs designated representative on the safe and proper operation, maintenance, diagnosis, and repair of each piece of equipment. Submitted operation and maintenance information shall be used during training. Sessions shall include as a minimum:

1. Conceptual overview of how the equipment works
2. Names, addresses, numbers etc. of sources for information, tools, spare parts, etc. for the equipment
3. Details of the warranty or guarantee.
4. Intended sequences of operation in all modes of operation
5. Limits of responsibility (ex: unit mounted control vs. FMS)
6. Sources of utility support
7. Routine operator tasks involving monitoring and operation covering all modes of operation and mode switching as applicable
8. Relevant health and safety practices/concerns
9. Common problems and their diagnosis and repair
10. Proper maintenance schedules, tasks and procedures with demonstrations
11. Emergency response, documentation and recovery procedures.

E. **Controls Contractor Training Involvement**: Training on the proper use and operation of the control system is specified in the control section. Controls contractor shall also participate in the overall systems training.

II. PRODUCTS

1. INSTRUMENTATION

A. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Generally, no equipment will be required beyond that required to perform Contractors work under these Contract Documents.

2. TEST KITS FOR METERS AND GAGES

A. Test kits for meters and gages shall be provided to the MCG new and in good condition. Previously used kits will be unacceptable. Kits shall be submitted prior to the Acceptance Phase. Kits included shall be as a minimum:

1. Digital indication of temperature and pressure with associated sensors to work with the P/T test ports
2. Companion readout kit (with fittings) for calibrated balancing valve with ranges as required by all devices on this project

III. EXECUTION

The following start up and check out procedures are provided all together in this section. It is preferable to place the applicable information in the respective spec section to ensure that the subs or vendors see it. Alternatively, at least make sure that a reference to this section include in the individual sections.

1. General

A. Part III of this section outlines specific start up, check out, testing and training requirements for systems and equipment. Generally these procedures are the direct responsibility of the contractor as a basic element of validating that the installation is correct. These items provide a minimum or guideline for development of start up procedures, checklists and tests along with the general requirements indicated above (that are common to all). Contractor shall synthesize these requirements with that of the manufacturer’s and/or applicable codes and standards to develop specific and itemized start up procedures specific to that installed on this project.

2. VALVES

A. Operate all valves, manual and automatic, through their full stoke. Ensure smooth operation through full stroke and appropriate sealing or shutoff

B. Verify actuators are properly installed with adequate clearance

C. For automatic pneumatically operated valves, verify spring range and adjust pilot positioners where applicable.

3. METERS AND GAGES

A. Adjust faces of meters and gages to proper angle for best visibility.
B. Clean windows of meters and gages and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint. For meters and gages requiring temporary manual connection of read out device such as pressure taps on a flow-measuring device, ensure threads are clean and that connection can be made easily.
C. Meters and gages requiring manual connection of readout device shall be installed with adequate access to allow connection of device with normal tools.

4. MECHANICAL IDENTIFICATION

A. Verify all valve tags, piping, duct, and equipment labeling corresponds with drawings and indexes and meets requirements specified. Correct any deficiencies for all piping and duct systems.
B. Adjusting: Relocate any mechanical identification device, which has become visually blocked by work of this division or other divisions.
C. Cleaning: Clean face of identification devices, and glass frames of valve charts.

5. MECHANICAL INSULATION

A. Examine all systems and equipment specified to be insulated. Patch and repair all insulation damaged after installation. Ensure the integrity of vapor barrier around all cold surfaces.

Ensure the design A/E has included the applicable pressure testing procedures in the respective sections.

6. PIPING - General

A. This applies to all piping systems installed including underground site utilities.
B. Inspect all piping for proper installation, adequate support with appropriate vibration isolation where applicable and adequate isolation valves for required service.
C. Flush all piping and clean all strainers
D. Ensure adequate drainage is provided at low points and venting is provided at high points. Ensure air is removed thoroughly removed from the system as applicable.
E. Ensure all piping is adequately supported and anchored to allow expansion. Bump across the line pumps and inspect for excessive pipe movement.
F. Pressure and/or leak test all applicable systems in accordance with the requirements in the applicable sections, ASME B 31.1 and 39.1 as applicable.
G. Sterilize applicable piping systems as specified in the individual sections and as required by regulatory authorities.
H. Submit test reports that document the testing results with certification of the results.
I. Verify the operation of applicable safety relief valves, operating controls, safety controls, etc. to ensure a safe installation.
J. Set and adjust fill, pressure, or level controls to the required setting.

7. AC Motors

A. Verify proper alignment, installation, and rotation.
B. Measure insulation resistance, phase balance, and resistance to ground
C. Verify properly sized overloads are in place
D. Measure voltage available to all phases. After motor has been placed in operation under load measure amps and RPM.
E. Record all motor nameplate data.

For all training requirements coordinate the requirements with those in the specification. Indicate the amount of time that is required for the project.

8. VARIABLE SPEED DRIVES
   A. **General**: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide startup service, and to demonstrate and train MCG's maintenance personnel as specified below.
   B. **Start-up Checks**: Perform the following checks before start-up and as specified in manufacturer's start-up instructions:
      1. Check nit for shipping damage
      2. Perform a point-to-point continuity test for all field installed wiring interconnections. Verify terminations of field-installed wiring.
      3. Check for proper torque on connections
      4. Verify use of shielded cable where specified and check that shields have been terminated properly
      5. Verify grounding
      6. Check motor nameplate against drive input rating
      7. Manually rotate motor shaft to ensure free rotation
      8. Check that motor leads are not grounded
   C. **Starting procedures**: Follow the manufacturers printed procedures with the following as a minimum:
      1. Ensure device and system which drive is serving is configured to withstand the device operation specified below
      2. Adjust the minimum voltage adjustment to enable starting but not to draw excessive power at start.
      3. Adjust the Volts/Hz adjustment to proper setting
      4. Adjust the accel and decel rates to the specified times
      5. Adjust current limiting to coordinate with the overcorrect device and protect the motor
      6. Set the maximum and minimum speed pots.
      7. Manually ramp fan speed from minimum to maximum and check for excessive noise and vibration
      8. Determine any critical speeds to avoid an set these in the drive
      9. Check for acceptable voltage and current distortion on the power system. Record the input and output voltages and currents showing the harmonic content as a percentage of the base frequency
      10. Measure and record overall efficiency at 50%, 75%, and 100%
      11. Record the motor terminal voltage
   D. **Training**: Train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
      1. Review data in Operating and Maintenance Manuals.

9. MEDICAL GAS PIPING
   A. Clean piping in accordance with NFPA 99
   B. Pressure test piping in accordance with NFPA 99

10. MEDICAL AIR COMPRESSORS AND VACUUM PUMPS
   A. **General**: Provide the services of a factory authorized representative to inspect equipment installation and start-up equipment, and train the MCG’s personnel
   B. Operate and adjust safety controls. Replace damaged and malfunctioning controls and equipment.
   C. Refer to AC Motors in this section
   D. **Start-up Checks**: Perform the following checks before start-up:
      1. Verify that specified tests of piping systems are complete.
      2. Check that medical air compressor inlets are properly located for clean air supply, and that medical vacuum exhausts are properly located to

prevent contamination of medical air compressor inlets and public spaces.
3. Check that medical air compressor inlet filters and piping and medical vacuum pump filters and discharge piping are clear.
4. Check for lubricating oil for lubricated-type equipment.
5. Check V-belts for proper tension.
6. Check for equipment vibration control supports and flexible pipe connectors and that equipment is properly attached to substrate.
7. Check that safety (pressure relief) valves have a setting greater than medical air compressor discharge pressure but not greater than pressure rating of system components.
8. Adjust vacuum relief valves.
9. Check for water supply to water-cooled equipment.
10. Check for water supply to liquid ring medical air compressors and vacuum pumps.
11. Drain medical air and vacuum receiver tanks.
12. Check for proper seismic restraints.
13. Check for adequate room ventilation.

E. **Starting Procedures**: Follow the manufacturers printed procedures. If no procedures are specified by the manufacturer, proceed as follows:
1. Energize circuits.
2. Start and run equipment through complete sequence of operations.
3. Check for excessive vibration and noise.
4. Check air and vacuum pressures.
5. Manually operate safety valves and vacuum relief valves.
6. Adjust operating controls including pressure and vacuum settings.

F. Test for air purity in accordance with NFPA 99 and Section [15485].

G. **Training**: Train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
1. Review data in Operating and Maintenance Manuals.

11. PLUMBING FIXTURES

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

C. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

D. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.

E. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

F. Replace washers of leaking and dripping faucets and stops.

G. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

12. High Purity Water System

A. **General**: Provide the services of a factory authorized representative to inspect equipment installation and start-up equipment, and train the MCG’s personnel

B. **Start-up Checks**: Perform the following checks before start-up:
1. Ensure piping is properly installed, sterilized, and tested.
2. Fill brine tank
3. Ensure 3 valve bypass, pressure gages, and sample valve are installed on the UV sterilizer and Pre and Final Filters

4. Ensure isolation valves are installed throughout the system as required by the specs
5. For the UV sterilizer ensures proper power source is provided and connected. Also verify the interface with the FMS for on/off, high temp alarm, and no flow alarm.
6. At the DI Columns, ensure each can be isolated for service, each column is properly secured to frame, manual isolation valve is installed on the common discharge header, resistively monitor is installed and connected to the FMS, and sample valve is provide.
7. Verify storage tank fill and level controls are installed and functional

C. **Starting Procedures**: Follow the manufacturers printed procedures as a minimum:
1. Start up and check out booster pumps in accordance with the item so labeled in this section.
2. Run pretreatment through all regeneration and backwash cycles
3. Demonstrate blending valve is operational
4. Test the storage tank make up and fill and associated alarming function
5. Calibrate all sensors including resistivity meters
6. Run system through all modes of operation and ensure that the controls, alarms and safeties are functional and properly adjusted.
7. Perform bacteria and TOC test

D. **Training**: train MCG's maintenance personnel on the following:
1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals

13. WATER STORAGE TANKS

A. Inspect the tank installation for proper installation and support in conformance with the manufacturer’s recommendations.
B. Verify that all required instrumentation is provided in installed in accordance with the project requirements
C. For pressurized tanks, pressure test the tanks per the requirements in the applicable section and per the ASME Code where applicable.
D. Non-pressure Testing: Fill non-pressure water storage tanks to water operating level to ensure structural integrity and freedom from leaks. Hold water level for 2 hours with no drop in water level.
E. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
F. Clean and disinfect water storage tanks for use with potable water systems as specified in the respective section.
G. Prepare and submit reports for all testing, purging, and disinfecting activities.
H. Check that pressure relief valves have correct setting.
I. Test operation of tank accessories and devices.
J. Adjust vacuum relief valves.
K. Manually operate relief valves.
L. Adjust pressure and vacuum settings.

14. WATER SOFTENERS

A. Sample water softener effluent at one-week intervals after start-up, for period of 3 weeks and prepare certified test report for each required water performance characteristic. Comply with the following ASTM standards:
1. ASTM D 859-80, "Test Methods for Silica in Water."
2. ASTM D 1067-82, "Test Methods for Acidity or Alkalinity of Water."
3. ASTM D 1068-87, "Test Methods for Iron in Water."
4. ASTM D 1126-86, "Test Methods for Hardness in Water."
5. ASTM D 1129-82b, "Definitions of Terms Relating to Water."

6. ASTM D 1888-78, "Test Methods for Particulate and Dissolved Matter in Water."
7. ASTM D 3370-82, "Practices for Sampling Water."

B. Start-Up Services: Provide the services of a factory-authorized service representative to provide start-up service and to demonstrate and train MCG's maintenance personnel as specified below.
   1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   2. Train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.

15. WATER HEATERS

A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate and train MCG's maintenance personnel as specified below.
   1. Check for adequate combustion air.
   2. Check for piping connections leaks.
   3. Check for clear vent.
   4. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

B. Train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
   1. Review data in Operating and Maintenance Manuals.

16. COMPRESSED AIR SYSTEMS

A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide startup service, and to demonstrate and train MCG's maintenance personnel as specified below.

B. Refer to AC Motors in this section

C. **Preparation**: Perform the following final checks before startup:
   1. Piping System Tests: Complete system test in accordance with the respective section
   2. Inspect the installation and access/clearance for service and maintenance to ensure it meets the project and manufacturer's requirements
   3. Check for piping connection leaks.
   4. Check lubricating oil for lubricated-type equipment.
   5. Check V-belts for proper tension.
   6. Check that compressor inlet filters and piping are clear.
   7. Check equipment vibration-control supports and flexible pipe connectors, and that equipment is properly attached to substrate.
   8. Check for proper seismic restraints.
   9. Check that safety valves have correct setting; greater than compressor discharge pressure, but not greater than pressure rating of system components.
   10. Test operation of equipment safety controls and devices.
   11. Check water supply to water-cooled equipment.
   12. Check water supply to liquid-ring air compressors.
   13. Drain receiver tanks.
   14. Check for adequate room ventilation.

D. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:
   1. Energize circuits.
   2. Check for proper rotation of 3 phase motors.
   3. Start and run equipment through complete sequence of operations.

4. Check for excessive vibration and noise. Correct problems.
5. Check air pressures.
6. Manually operate safety valves.
7. Adjust operating controls including pressure settings.

E. **Training**: train MCG's maintenance personnel on the following:
1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals

17. FUEL OIL SYSTEMS

A. Test oil piping in accordance with NFPA 31.
B. Remake leaking joints and connections using new materials.
C. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
D. Train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
1. Review data in Operating and Maintenance Manuals

E. Before activating system perform these steps:
1. Remove and clean strainer screens.
2. Check pump for proper direction of rotation.
3. Fill oil storage tank with proper fuel type.
4. Check operating controls of fuel burner units.
5. Check operation at automatic bypass valves.
6. Check and set operating temperature controls on oil heaters.
7. Check corrosion monitoring systems for proper operation.

18. NATURAL GAS SYSTEMS

A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.
B. Submit draft test forms and completed test forms to document and certify test results

19. HYDRONIC PIPING

A. Prepare hydronic and test piping in accordance with applicable section and ASME B 31.9 and/or B 31.1
B. Flush system with clean water. Clean strainers.
C. Chemical Treatment: Provide a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.
D. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
E. Set automatic fill valves for required system pressure.
F. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
G. Set and coordinate automatic fill pressure and relief valve settings

20. STEAM AND CONDENSATE PIPING

A. Prepare and test steam and condensate piping in accordance with applicable section and ASME B 31.9 and or B31.1 as applicable.
B. Flush the system with clean water. Remove, clean, and replace strainer screens.
C. Gradually warm-up piping and connected equipment. Introduce steam to piping system by throttling valves.
D. Take precautions to prevent water hammer or slugging in piping.
E. Vent air and non-condensable gases from system.
F. Supervise condensate removal at system traps. Temporarily, bypass traps if required.

G. Verify complete condensate removal from piping and equipment and that traps are functioning properly.

21. PUMPS

A. Check suction lines connections for tightness to avoid drawing air into the pump.
B. Clean and lubricate all bearings.
C. Refer to AC Motors in this section
D. Check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
E. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.
F. Clean associated strainers
G. Check that the proper overloads have been installed in the starter and are the correct size
H. Verify that the integrity of the vibration isolation is maintained throughout the support and the connections
I. Align pump within manufacturers recommended tolerances
J. Ensure all associated piping has been cleaned, tested deareated.
K. Start the pump per the manufacturers instructions
L. Check the general mechanical operation of the pump and motor.
M. Verify that all thermometers and gages are installed, are clean and undamaged, and are functional
N. Verify that check valve seal is appropriate
O. Check noise and vibration levels and ensure they are within the manufacturers recommended tolerances
P. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for detailed requirements for testing, adjusting, and balancing hydronic systems.
Q. Check that the NPSH is with that allowable for the operating condition

22. Steam Pressure Reducing Stations

A. Check that all piping is installed per the details
B. Check PRVs are installed in accordance with the manufacturer’s instructions and the at the ratings are per spec.
C. Verify relief valves have been installed and are of the correct size and the pressure setting is coordinated with the actual duty
D. Verify access to all items requiring maintenance.
E. Set PRV for desired pressure.
F. Verify that steam traps are installed for both upstream and downstream headers
G. Verify isolation valves, strainers and unions are in place per details
H. Verify PRVs can be serviced without taking steam system out of service. Verify bypass is installed with a throttling valve.
I. Verify all sections of pipe are properly supported to avoid stress on steam specialties
J. Verify all static sections of pipe are properly insulated and that removable insulation covers are provided for all sections and specialties needing service.
K. Verify all flash tanks are installed per the details, thoroughly insulated, coordinated with the lower pressure system, adequately trapped and drained, and properly vented to the atmosphere through appropriately sized relief valve.

23. STEAM TO HOT WATER CONVERTERS

A. Flush and clean converters upon completion of installation, in accordance with manufacturer's start-up instructions.
B. Hydrostatically test assembled converter and piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

C. Start-up converters, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
D. Refer to Division 15 Section "Testing, Adjusting, and Balancing"
E. Record all parameters (flow, temperatures, pressures, etc.) and tests and submit report.

24. STEAM CONDENSATE PUMPS

A. General: Start-up condensate pumping equipment, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements.

25. FUEL-FIRED HEATERS

A. Start-up, test, and adjust fuel-fired heaters in accordance with manufacturer's published start-up instructions.
B. Adjust air diffusion louvers for proper airflow.
C. Verify proper line and manifold gas pressure. Check and calibrate controls, adjust burner for maximum efficiency.

26. TERMINAL UNITS

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
C. Verify adequate access for maintenance
D. Install new filter units for terminals requiring same.
E. Check power and control voltages
F. Check rotation of fan where applicable
G. Check calibration and operation of the controlling elements.
H. Check control valves for required close off and fail position

27. VAV TERMINAL UNITS

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.
C. Ensure unit is properly supported and that integrity of vibration isolation has been maintained where applicable.
D. Ensure that air velocity sensor is correctly installed and that inlet/outlet restrictions for accurate measurements have been met.
E. Ensure air inlet is free of obstructions. Start fans and ensure proper rotation (as applicable). Measure and record motor amperage and voltage.
F. Install new filters where required.
G. Calibrate and adjust the airflow control parameters. Set applicable min and max set points. Coordinate with the ATC contractor as necessary to obtain flow parameters required.
H. Check the heating device and control to ensure functionality and proper installation. Check stroke and range on the valve and ensure it closes and seals tightly. Ensure the coils are undamaged, combed, and vented.
I. Refer to and coordinate with Section "Testing, Adjusting, and Balancing"

28. CENTRAL-STATION AIR-HANDLING UNITS

A. []Inspect the field assembly of components and installation of central-station air-handling units including piping, ductwork, and electrical connections.
B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face. Ensure volatile irritants are contained and kept out of occupied spaces.
C. Adjust and lubricate dampers and linkages for proper damper operation.
D. For field fabricated units, ensure the sections are properly connected within acceptable tolerances.

E. Seal the all penetrations air tight and ensure access doors seat tightly.
F. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
G. Ensure vibration isolation integrity is maintained throughout the AHU installation and the connections to it
H. Refer to AC Motors in this section
I. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
J. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
K. Comb coil fins for parallel orientation.
L. Install clean filters.
M. Ensure condensate drains properly and that trap is adequate.
N. Stroke all valves and damper to ensure free and full travel
O. Pressure test units as required in the AHU specification
P. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for procedures for air handling system testing, adjusting, and balancing.
Q. Refer to Sections 15959 ATC System Commissioning for procedures for starting the controls related to the AHU
R. Demonstration Services: []train MCG's maintenance personnel on the following:
    1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
    2. Familiarization with contents of Operating and Maintenance Manuals

29. FANS

A. []Inspect the field assembly of components and installation of fans including ductwork, and electrical connections.
B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and coils entering air face. Ensure volatile irritants are contained and kept out of occupied spaces.
C. Adjust and lubricate dampers and linkages for proper damper operation.
D. Verify unit is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
E. Ensure vibration isolation integrity is maintained with the fan installation and the connections to it
F. Refer to AC Motors in this section
G. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
H. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
I. Stroke all dampers to ensure free and full travel
J. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for procedures for air handling system testing, adjusting, and balancing.
K. Refer to Sections 15959 ATC System Commissioning for procedures for starting the controls related to the AHU
L. Demonstration Services: []train MCG's maintenance personnel on the following:
    1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
    2. Familiarization with contents of Operating and Maintenance Manuals

30. Energy Recovery Wheels

A. **Manufacturer's Start Up and Training**: Arrange and pay for a factory-authorized service representative to inspect the field assembly of components and installation of wheel, drive, controls, and electrical connections. Also train the operators as specified below

B. **Start Up Checks**: Perform the following checks before start-up and as specified in manufacturer's start-up instructions

1. Check for damage to the wheel and media and ensure media is evenly/thoroughly impregnated
2. Ensure the wheel rotates freely
3. Ensure all drive components are correctly installed, aligned and lubricated
4. Ensure air seals are tight and properly installed
5. Verify all controls are in place and that they are properly interfaced

C. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:

1. Energize circuits.
2. Check for proper rotation in all modes of operation.
3. Start and run wheel through complete sequence of operations.
4. Measure and record the sensible and latent recovery efficiency
5. Measure and record air pressure drop.
6. Adjust operating controls.

D. **Training**: train MCG's maintenance personnel on the following:

1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals

31. Desiccant Dehumidifiers

A. **Manufacturer's Start Up and Training**: Arrange and pay for a factory-authorized service representative to inspect the field assembly of components and installation of wheel, drive, controls, and electrical connections. Also train the operators as specified below

B. Refer to AC Motors in this section

C. Refer to Fans in this section

D. **Start Up Checks**: Perform the following checks before start-up and as specified in manufacturer's start-up instructions

1. Check casing and installation for damage. Ensure tight seal on all access panels
2. Ensure all gages and instrumentation are provided as required, that they are accurate and undamaged
3. Clean unit cabinet interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, and wheel. Ensure volatile irritants are contained and kept out of occupied spaces.
4. Adjust and lubricate dampers and linkages for proper damper operation.
5. For field fabricated units, ensure the sections are properly connected within acceptable tolerances.
6. Seal the all penetrations air tight and ensure access doors seat tightly.
7. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
8. Ensure vibration isolation integrity is maintained throughout the unit installation and the connections to it
9. Check for damage to the wheel and media and ensure media is evenly/thoroughly impregnated
10. Check that coils are undamaged, combed, filled, and vented

11. Ensure the wheel rotates freely
12. Ensure all drive components are correctly installed, aligned and lubricated
13. Ensure air seals are tight and properly installed
14. Verify all controls are in place and that they are properly interfaced. Check all voltages, terminations etc.. Check the stroke, range and fail position on all dampers and valves. Ensure adequate close off and seal.

E. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:
1. Energize circuits.
2. Check for proper rotation in all modes of operation.
3. Start and run dehumidifier through complete sequence of operations.
4. Measure and record all operating parameters including fan performance, air pressure drops, inlet and outlet temps and humidity levels on both process and reactivation air, etc.
5. Measure and record all air pressure drops, power draws.
6. Manually operate devices.
7. Adjust operating controls.

F. **Training**: train MCG's maintenance personnel on the following:
1. Procedures and schedules related to start-up and shut down, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
2. Familiarization with contents of Operating and Maintenance Manuals

32. AIR CLEANING

A. Operate installed air filters to demonstrate compliance with requirements. Test for air leakage of unfiltered air while system is operating. Correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with re-testing.

33. METAL DUCTWORK

A. Leakage Tests: After each duct system, which is constructed for duct classes over 3”, is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Repair leaks and repeat tests until total leakage is less than 1% of system design airflow.

B. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances, which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

C. [Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.]

D. Temporary Closure: At ends of ducts, which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering, which will prevent entrance of dust and debris until time connections are to be completed.

E. Balancing: Refer to Division-15 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

34. DUCTWORK ACCESSORIES

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

B. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
1. Label access doors in accordance with Division-15 section "Mechanical Identification".

2. Final positioning of manual dampers is specified in Division- 15 section "Testing, Adjusting, and Balancing".

C. Fire Damper Testing: For every fire damper, remove the fusible link and verify that the damper operates freely and closes tightly. Reinstall the fusible link.

D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

35. AIR TERMINALS

A. Upon completion of installation and prior to initial operation, check that air terminals are:

1. properly installed with the proper airflow direction
2. properly supported with vibration isolation integrity maintained where applicable
3. duct connections to air terminals are leak-tight
4. Operable dampers travel free
5. Airflow measuring devices are properly installed and connected.

B. Repair or replace air terminals and duct connections as required to eliminate leaks, and retest to demonstrate compliance.

C. Clean exposed factory-finished surfaces. Repair any marred or scratched surfaces with manufacturers touch-up paint.

36. CONTROL SYSTEMS

A. **Start-Up**: Refer to Section 15959 ATC System Commissioning. This generally requires manufacturers authorized representative to start-up, test, adjust, and calibrate DDC control systems and demonstrate compliance with requirements. This will include verification of sequences, normal and emergency operations, calibration, interfaces, and interlocks, etc..

B. **Cleaning**: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

37. TESTING, ADJUSTING, AND BALANCING

A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the respective section and the referenced standards.

B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

C. Patch insulation, ductwork, and housings, using materials identical to those removed.

D. Seal ducts and piping, and test for and repair leaks.

E. Seal insulation to re-establish integrity of the vapor barrier.

F. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

G. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

H. Test and adjust mechanical systems for sound and vibration in accordance with the detailed instructions of the referenced standards.

I. Training:

1. Train the MCG's maintenance personnel on troubleshooting procedures and testing, adjusting, and balancing procedures. Review with the MCG's personnel, the information contained in the Operating and Maintenance Data specified in Division 1 and Section 15010.

38. Sequencing Illustration

A. Below is a simplified diagram of the precedents involved in the Cx Process. The diagram is basically applicable on a system-by-system basis. Different systems or areas of the building may be phased or sequenced such that different systems are at different points in the Cx process. The diagram indicates tasks for the contractor, the A/E and the CA. Tasks for each are indicated vertically below their name. The individual tasks are defined in the Cx Plan. Management protocols are also covered in the Cx Plan.

END OF SECTION

Section 26 08 02 - Electrical System Commissioning.
This section specifies the Cx process as it pertains to Division 16 work.

SECTION 26 08 02 – ELECTRICAL SYSTEM COMMISSIONING

I. GENERAL

1. WORK INCLUDED

A. Systems and equipment testing and start-up.
B. Validation of proper and thorough installation of Division 16 systems and equipment
C. Equipment performance verification.
D. Functional testing of electrical systems.
E. Documentation of tests, procedures, and installations.
F. Coordination of training.

2. GENERAL DESCRIPTION

A. Commissioning is the process of ensuring that all building systems are installed and perform interactively according to the design intent, the systems are efficient and cost effective and meet the MCG's operational needs, the installation is adequately documented and that the Operators are adequately trained.
B. .
C. The Commissioning Plan outlines the Commissioning Process. It is part of the Contract Documents and stipulates Contractor responsibilities that are part of this project. It also indicates the details of the functional performance testing that the contractor must participate in. Refer to it for details of the Cx process.
D. This section expands on the Cx Plan and defines responsibilities of the Contractor to facilitate the Commissioning process particularly during the Construction Phase.

3. SCOPE

A. Systems to be commissioned include the following:
   1. Secondary Service Electrical Systems
   2. Motor Control Centers
   3. Distribution and Branch circuit panel boards
   4. Lighting Fixtures and Controls
   5. Lightning Protection Equipment and Lightning Protection Systems
   6. Equipment Monitoring
   7. Fire Alarm Equipment/Fire Alarm Equipment Monitoring System
   8. AC motors
   9. Grounding Equipment and Building Grounding System
   10. Security System
   11. Emergency Generators and Distribution System
   12. Uninterruptible Power Systems

4. Related Work and Documents

A. **Commissioning Plan**: This plan is part of the Contract Documents and outlines many of responsibilities, procedures and tasks throughout the Cx process. It also describes the FPTs that will be performed during the Acceptance Phase.

5. Related Work and Documents

A. **Commissioning Plan**: This plan is part of the Contract Documents and outlines many of responsibilities, procedures and tasks throughout the Cx process. It also describes the FPTs that will be performed during the Acceptance Phase

The following section names and numbers will vary with each project. Edit them accordingly. This is one of the most challenging efforts to ensure that the requirements are incorporated in the project. Use this as a reminder of the sections to check/edit to properly incorporate the Cx procedures and requirements.

- **B.** **Section 0080 -** Supplementary Conditions: Stipulates penalties for non-conformance with the Cx requirements
- **C.** **Section 01040** – Coordination: Stipulates the relationships between the parties involved with the Cx process
- **D.** **Section 01300** – Submittals: Stipulates additional copies of submittals to be submitted and refers to other sections for additional submittal requirements related to Cx.
- **E.** **Section 01700** – Project Close Out: Defines the milestones in completion incorporating the Cx process
- **F.** **Section 01730** – O&M Manuals: Refers to documentation and procedures relative to the O&M information
- **G.** **Section 15000** – General Mechanical and Electrical General Provisions
- **H.** **Section 16000** – Electrical General Provisions
- I. **Individual Division 16 Sections**: Individual sections stipulate installation, start up, warranty and training requirements for the system or device specified in the section.

6. DEFINITIONS and Abbreviations

- **A.** **Acceptance Phase**: This is the phase of the project that the facility and its systems and equipment are inspected, tested, verified, etc. and when most of the functional performance testing and formal training occurs. This will generally occur after the construction phase is complete (start up and check have been accomplished). The Acceptance Phase must be successfully completed prior to the award of Substantial Completion.
- B. **Contractor**: As used herein is a general reference to the applicable installing party and can therefore refer to the GC, subcontractors, or vendors.
- **C.** **Construction Phase**: Phase of the project during which the facility is constructed and/or systems and equipment are installed and started. Contractor and subs complete installation, start up forms, submit O&M info., etc. Contractor/Vendors conduct equipment specific training. Construction phase will generally end upon completed start up.
- **D.** **Commissioning (Cx)** - The process of ensuring that all building systems are installed and perform interactively according to the design intent, the systems are efficient and cost effective and meet the MCG's operational needs.
- **E.** **Commissioning Authority (CA)** - An individual or company who will oversee the Cx process, stipulate many of the Cx requirements and ensure and validate that systems and equipment are designed, installed and tested to meet the MCG/DPW requirements.
- **F.** **Commissioning Team (CT)**: The group of individuals who will collaborate to ensure the facilitate the commissioning of the facility. This team will consist of the CA, the MCG CM, the Contractors MEP Construction and Commissioning Coordinator, and the lead on-site technical person from the independent testing firm. Generally the installing contractor and/or manufacturer is also an integral member of the team for any given system.
- **G.** **Functional Completion**: A milestone, which marks the successful completion of the Acceptance Phase and generally the functional performance testing of the systems.
- **H.** **Functional Performance Testing (FPT)** - Final testing of systems and equipment when performance is tested in various modes of operation and under different conditions.
- **I.** **Deficiency**: An installation or condition that is not in conformance with the construction documents and/or the design intent.

- **J.** **Party** – Individual, company or entity. Refer to the Cx Plan for names and definitions.
- K. **Project Phases** – Phases of the project relative to the Cx process include the Construction Phase, Acceptance Phase, and Warranty Phase.
- L. **Preliminary Service -** systems/equipment are being used by the occupants although final adjusting, balancing, and functional performance testing is on going.
- M. **Pre-Test** - preliminary testing accomplished during a scheduled system outage to verify system functionality prior to placing the system/equipment into preliminary service.
- **N.** **Scheduled Outage** - period of time, scheduled by MCG, in which the system is out of service or not to be used by occupants.
- **O.** **Start-up** - The process whereby the contractor verifies the proper installation of a device or piece of equipment, executes the manufacturer's starting procedures, completes the start-up checklist, energizes the device or system, and basically verifies it is in proper working order.
- P. **Warranty Phase**: Includes the early occupancy of the building and can continue through the warranty period.

7. REFERENCE STANDARDS

- A. National Electric Code (NEC)
- B. American Society for Testing and Materials (ASTM)
- C. Electronics Industry Association/Telecommunications Industry Association (EIA/TIA)
- D. Illuminating Engineering Society (IES)
- E. Institute of Electrical and Electronics Engineers (IEEE)
- F. International Electrical Testing Association (NETA)
- G. National Electrical Manufacturers Associates (NEMA)
- H. National Fire Protection Association (NFPA)
- I. Underwriters Laboratory, Inc. (UL)

8. DOCUMENTATION

- A. Contractor shall provide for Commissioning Authority one copy of the following per the procedures specified in the Cx Plan and other sections of the specification:
  1. Shop drawings and product data related to systems or equipment to be commissioned. Commissioning Authority shall review and incorporate comments via the Design Engineer.
  2. Draft equipment Start-up check lists along with the manufacturers start up procedures. CA will assist in the development and recommend approval.
  3. System Test reports. Contractor shall compile and organize and CA will review and compile prior to FPT.
  4. Completed Equipment Start-up certification forms along with the manufacturers. CA will review prior to FPT.
  5. Equipment Warrantees
  6. Training Plans
  7. O&M Information per the requirements of the Cx Plan, Division 1 requirements
  8. Record Drawings
- B. Record Drawings: Contractor shall maintain at the site an updated set of record or "as-built" documents reflecting actual installed conditions.

9. Coordination Management Protocols

- A. Coordination responsibilities and management protocols relative to Cx are initially defined in the Cx Plan but will be refined and documented in the Construction Phase Cx coordination meeting. Contractor shall have input in the protocols and all parties will commit to scheduling obligations. The CA will record and distribute.

10. COMMISSIONING AUTHORITY RESPONSIBILITIES

A. Construction Phase
1. Conduct Cx meeting
2. Review applicable project documentation (shop drawings, product data, inspection reports, record drawings, O&M information, etc.) for adequacy and to ensure system functionality.
3. Review and approve start up checklist forms.
4. Inspect installation periodically.
5. Attend selected progress meetings to observe progress and help expedite completion.
6. Witness selected tests start-ups, and equipment training.
7. Compile O&M information and systems overview and format the O&M manuals.

B. Acceptance Phase
1. Verify (spot check) inspection reports.
2. Verify (spot check) component start-ups.
3. Verify (spot check) equipment performance certifications.
4. Functionally test systems and equipment.
5. Review training plan.
6. Coordinate training activities
7. Record commissioning procedures.

11. CONTRACTOR RESPONSIBILITIES

A. Construction Phase
1. Include Cx requirements in price and plan for work.
2. Attend coordination meetings called by CA.
3. Remedy any deficiencies identified throughout construction.
4. Prepare and submit required draft forms and systems information.
5. Thoroughly complete and inspect installation of systems and equipment as detailed throughout Contract Documents, as required by reference or industry standards, and as specifically indicated in Part - 3 of this section.
6. Start-up, test, and adjust systems and equipment prior to verification and performance testing by the Commissioning Authority. Start-up procedures shall be in accordance with Contract Documents, reference or industry standards, and specifically Part - 3 of this section.
7. Record start-up and testing procedures on start-up forms or checklists and certify that the systems and equipment have been started and or tested in accordance with the requirements specified above. Each form shall be signed and dated by the individual responsible for the start-up or test. Tag equipment started with individuals name and date.
8. Complete approved start up checklists and submit along with other installation certification information such as warrantees, testing results, etc.
9. Schedule and coordinate Cx efforts required by appropriate subs and vendors. Participate in respective portions of start-ups and training.
10. Demonstrate the systems as specified.
11. Certify that systems have been installed and are operating per Contract Documents.
12. Maintain an updated set of record documentation.
13. Copy Commissioning Authority on indicated documentation.
14. Conduct equipment specific operation, maintenance, diagnosis, and repair training as required by the respective section of the specifications.

B. Acceptance Phase

1. Assist Commissioning Authority in verification and performance testing. Assistance will generally include the following:
   a. Manipulate systems and equipment to facilitate testing.
   b. Provide instrumentation necessary for verification and performance testing.
   c. Manipulate Lighting and alarm and control systems to facilitate verification and performance testing.
   d. Provide a Monitoring Control Technician to work at the direction of Commissioning Authority for up to __ hours beyond assistance specified above and in Section 16910.
   e. Provide a Lighting Control technician to work at the direction of Commissioning Authority for up to ___ hours beyond assistance specified above
   f. Provide a Security System technician to work at the direction of the CA for up to ___ hours beyond assistance specified above .
2. Correct any work not in accordance with Contract Documents.
3. Participate in the systems and operational training relative to use of O&M information and the PM program.
4. Compensate Commissioning Authority for site time necessitated by incompleteness of systems or equipment at time of functional performance testing.

C. Warranty Phase
1. Provide warranty service.
2. Correct any deficiencies identified.
3. Update record documentation to reflect any changes made throughout the Warranty Phase.

12. Contractor Notification

A. Contractor shall completely install, thoroughly inspect, start-up, test, adjust systems and equipment. All activities shall be documented on specified forms. Contractor shall notify A/E, MCG, and CA in writing that systems are complete and ready for verification and functional performance testing.

B. Contractor shall notify CA at least 14 days in advance of any tests, start-ups, or training. CA shall witness selected tests and start-ups.

13. START-UP CHECKLISTS and Manufacturers Start up Instructions

A. Start-up checklists for each type of equipment shall be submitted to Commissioning Authority for approval prior to start-up. Appropriate subcontractors or vendors shall design the forms meeting the requirements of the Contract Documents. Forms shall be developed for the equipment being installed for this project. Forms in the Appendices of the Cx Plan may be used as examples.

B. Start up checklists shall generally include the following for each (as applicable):
1. project specific designation, location and service
2. Pertinent nameplate data
3. Indication of the party performing the test
4. Place for signature of the start up technician along with the date
5. Clear explanation of the inspection, test, measurement etc with a pass/fail indication a record of measure parameters
6. Include a checklist item indicating all O&M instructions, warranties, record documents have been completed and submitted.
7. Include a checklist item for proper maintenance clearances maintained
8. Include an checklist item indicating that special tools and/or spare tools required were turned over to the MCG
9. Generally include checklist items indicating that required prerequisite equipment and systems were successfully started

C. Start up checklists shall incorporate the manufacturer-specified procedures. Contractor shall compile the start up and check out procedures indicated in the manufacturer's documentation prior to designing the forms. As applicable include acceptance criteria specified therein. The manufacturers start up and check out procedures shall be submitted to the CA along with the draft start up checklists.

D. Refer to the Cx Plan for examples and minimum required content.

E. Completed Start-up checklists for all pieces of equipment shall be submitted to Commissioning Authority prior to verification and performance testing.

14. Functional Performance Testing

A. **Participation:** CA will direct and coordinate functional performance tests after the successful start up and complete documentation of systems and equipment. Conceptual procedures for the functional performance testing are outlined in the Cx Plan. CA will generally witness and coordinate the test. Contractor shall generally assist as described above with manipulation of the systems or equipment, provision of supporting equipment or materials (lifts, ladders, specialty test equipment, etc.), and on the spot remediation of minor identified deficiencies. Required participation is outlined in the Cx plan.

B. **Completeness**: All systems must be completed and ready for FPT. Control systems must be tested and started for the respective system or component.

C. **Test Documentation**: CA will coordinate, test, and/or witness tests as applicable. CA will Pass or Fail the testing and record the date and time of the test. Deficiencies shall clearly be indicated in when the test is failed. When all related testing is completed successfully, CA shall recommend acceptance of the system or component.

D. **Deficiencies and Re-testing**: When deficiencies are identified during testing, depending on their extent or magnitude, they can be corrected during the test and the testing can continue to successful completion. More significant deficiencies will require failure of the test and re-testing. Deficiencies of this magnitude will result in an action item on the Action List. The resolution of the deficiency will then subsequently be tracked by the CA via the Action List. All tests shall be repeated until successful completion.

E. **Sampling**: Some types of identical equipment will be tested using a sampling strategy. The sample percentage is indicated in the generic test procedure listed in the Cx Plan..

F. **Failure Limit on Sample Tests**: With the sampling percentages is listed a failure limit. This limit indicates the maximum percentage of the tested devices that may have any test that fails before an entirely new sample must be tested. This is based on the concept that if many failures occur it is a result of inadequate start up by the contractor. When the maximum number of failures is reached, testing on that sample will be terminated and re-testing will be scheduled.

1. Where sample tests involve multiple systems the maximum failure limit will apply per system.
2. The responsible contractors shall pay the CA's cost of that sample test, and redo the start up for the applicable devices/systems.
3. All work necessitated by sample failures shall be at no cost to the MCG.

15. FPT Acceptance Criteria

A. Acceptance criteria for tests are indicated in the Cx plan with the associated tests. Generally, unless indicated otherwise, the criteria for acceptance will be that specified with the individual system, equipment, component, or device, which in general conform to NFPA 70B and International Electrical Testing Association (NETA) testing specifications NETA ATS-1991.

16. Independent Electrical Testing Agency

A. The independent electrical testing agency shall be provided under the construction specifications and therefore included with the bid. Many of the aspects of the start up and functional performance testing indicated herein will be accomplished under the respective section and witnessed by the CT at the indicated sample rate. CT will include applicable test results in the functional performance testing record.

17. Training

A. Contractors, Subcontractor, Vendors, etc. shall prepare and conduct training sessions on the installed systems and equipment they are responsible for. Generally the CA and A/E shall conduct of the systems overview, design intent, and design criteria training. The contractor shall perform all other training.

B. GC shall compile the training plans of the subs and vendors and present a comprehensive training plan as outlined in the Cx Plan.

C. Training sessions should typically start and end in a classroom setting. Field demonstrations will also typically be conducted to demonstrate the hands-on aspects of the required tasks.

D. **Equipment Specific Training**: Appropriate contractor or vendor shall instruct the MCGs designated representative on the safe and proper operation, maintenance, diagnosis, and repair of each piece of equipment. Submitted operation and maintenance information shall be used during training. Sessions shall include as a minimum:

1. Conceptual overview of how the equipment works
2. Names, addresses, numbers etc. of sources for information, tools, spare parts, etc. for the equipment
3. Details of the warranty or guarantee.
4. Intended sequences of operation in all modes of operation
5. Sources of utility support
6. Routine operator tasks involving monitoring and operation covering all modes of operation and mode switching as applicable
7. Relevant health and safety practices/concerns
8. Common problems and their diagnosis and repair
9. Proper maintenance schedules, tasks and procedures with demonstrations
10. Emergency response, documentation and recovery procedures.

II. PRODUCTS

1. INSTRUMENTATION

A. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Authority. Generally, no equipment will be required beyond that required to perform Contractors work under these Contract Documents unless specifically noted otherwise.

2. Infrared Thermo graphic Scanner

A. Infrared scanning equipment shall be an AGA (or approved equal) thermo vision set capable of viewing an entire bus or equipment assembly at one time and have a sensitivity of 0.2°C with a liquid nitrogen reference.

< Quality>

B. Provide Drantez 901 or equal

III. EXECUTION

1. General

A. Part III of this section outlines specific start up, check out, and training requirements for systems and equipment . These requirements along with those specified in the individual section provide a minimum or guideline for development of start up procedures, checklists and tests. Contractor shall synthesize these requirements with that of the manufacturer's and/or applicable codes and standards to develop specific and itemized start up procedures specific to that installed on this project.

B. Refer to Section ______, which details the majority of the electrical related testing required.

For all training requirements coordinate the requirements with those in the specification. Indicate the amount of time that is required for the project.

2. Testing Procedures

A. Thermo graphic Scanning

1. In general, the scan shall be made when the equipment is energized and is operating at its normal capacity. It is intended that the scan be made after the equipment has been in full operation; however, the exact time of conducting the scan will be determined by the CT near the completion of the project.
2. Test equipment, miscellaneous tools, and materials shall be transported properly, moved, and set up by trained personnel. Equipment used in testing shall be capable to perform all recommended procedures required by the apparatus and related equipment. All test equipment shall have certification of calibration and be in working order.
3. All hot spots shall be marked, identified and an infrared thermo graphic scanning report prepared and furnished to the MCG.
4. The report shall contain infrared photos of trouble spots with temperature readings.
5. All sources of heating problems shall be promptly reported to the MCG for corrective action by the Division 16 contractor.

B. Grounding Systems:

1. Perform three-point fall-of-potential test per IEEE Standard 81 on the main grounding electrode or system. Resistance shall be no greater than 5 ohms.
2. Perform the two-point method test per IEEE Standard 81 to determine the ground resistance between the main ground system and all major electrical equipment frames, system neutral, and/or derived neutral points. Resistance shall be no greater than 5 ohms.

3. 13.8kv Feeders/13.8kv primary service feeders

A. **Start-up checklists**: Perform the following final checks before startup:

1. Inspect underground duct banks.
2. Inspect cable and perform field-testing on reels.
3. Inspect splicing and terminations.

B. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:

1. Visually and mechanically inspect to include the following: Exposed cable, compression type terminations, splices, and fireproofing in manholes, cable vaults, etc.
2. Correct identification and phasing arrangements.
3. Perform shield continuity test.
4. Perform insulation resistance test on new and existing cables.
5. Perform high potential test on new cables only.

4. 15kV primary disconnect & grounding switches/13.8kV primary service distribution

A. General: Provide the services of a factory-trained manufacturer’s representative to assist the contractor in the installation and start-up service of the equipment and train MCG's maintenance personnel as specified below.

B. **Start-up checklists**: Perform the following final checks before startup:

1. Inspect incoming power cable terminations.
2. Inspect transformer connections.
3. Inspect grounding.
4. Inspect electrical interlock wiring.

C. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:
   1. Visually and mechanically inspect to include the following: anchoring, grounding, oil level, torque of bus and cable connections, and mechanical operation of switch and operating mechanisms.
   2. Perform contact resistance test.
   3. Conduct and review oil sample tests.
   4. Perform insulation resistance tests on switch and control wiring.
   5. Perform electrical and mechanical (key) interlock system operations.

D. **Training**: Train MCG's maintenance personnel on procedures and schedules related to troubleshooting, servicing, and preventative maintenance.
   1. Review data in Operating and Maintenance Manuals.

5. 15kV-480/277V, 2500kVA liquid network transformers/13.8kV primary service distribution

A. **General**: Provide the services of a factory-trained manufacturer’s representative to assist the contractor in the installation and start-up service of the equipment and train MCG's maintenance personnel as specified below.

B. **Start-up checklists**: Perform the following final checks before startup:
   1. Inspect primary and secondary power connections.
   2. Inspect control interconnections.
   3. Inspect grounding.

C. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:
   1. Visually and mechanically inspect to include the following: anchoring, grounding, liquid levels, installation verification using manufacturer’s checklist, torque of bus and cable connections, and tap changer operation.
   2. Verify operation of temperature and liquid level controls/alarms.
   3. Perform winding insulation tests.
   4. Conduct turns ratio test.
   5. Perform power factor/dissipation test on windings and bushings.
   6. Perform HV and LV winding and core resistance measurements.
   7. Check and confirm % of impedance is identical for all three transformers comparing nameplates.

D. **Training**: Train MCG's maintenance personnel on procedures and schedules related to troubleshooting, servicing, and preventative maintenance.
   1. Review data in Operating and Maintenance Manuals.

6. 600V network protectors/480V secondary distribution

A. **General**: Provide the services of a factory-trained manufacturer’s representative to assist the contractor in the installation and start-up service of the equipment and train MCG's maintenance personnel as specified below.

B. **Start-up checklists**: Perform the following final checks before startup:
   1. Inspect transformer connections.
   2. Inspect 600V disconnect connections.
   3. Inspect grounding.
   4. Validate protector element installation(furnished loose).
   5. Verify control interconnections.
   6. Check calibration/setting of protective devices from system coordination study.
   7. Verify calibration/setting of digital metering.

C. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:
   1. Visually and mechanically inspect to include the following: anchoring, grounding, torque of bus/cable connections, operational check of draw out mechanism, manual/electrical trip/close operations, contact closure

using slow closing method, arc chute inspection, & installation verification using manufacturer's checklist.
2. Correct current transformer ratios.
3. Conduct contact resistance test.
4. Perform operational/functional tests of protective relaying.
5. Perform operational/functional tests of digital metering.
6. Perform electrical and mechanical (key) interlock system operational tests.
7. Conduct operational voltage testing with line voltage from transformer only and/or source feeder breaker open.

D. **Training**: Train MCG's maintenance personnel on procedures and schedules related to troubleshooting, servicing, and preventative maintenance.
1. Review data in Operating and Maintenance Manuals.

7. 600V disconnect switches/480V secondary distribution

A. **General**: Provide the services of a factory-trained manufacturer's representative to assist the contractor in the installation and start-up service of the equipment and train MCG's maintenance personnel as specified below.

B. **Start-up checklists**: Perform the following final checks before startup:
1. Inspect protector and Bus duct connections.
2. Inspect grounding.
3. Verify control interconnections.
4. Check installation of warning nameplates.

C. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:
1. Visually and mechanically inspect to include the following: anchoring, grounding, torque of bus/cable connections, and mechanical operation of switch and operating mechanisms.
2. Conduct insulation resistance tests on switch and control wiring.
3. Conduct contact resistance test.

D. **Training**: Train MCG's maintenance personnel on procedures and schedules related to troubleshooting, servicing, and preventative maintenance.
1. Review data in Operating and Maintenance Manuals.

8. 600V service switchgear/480V secondary distribution

A. **General**: Provide the services of a factory-trained manufacturer's representative to assist the contractor in the installation and start-up service of the equipment for a period of 3 working days in 3 visits and train MCG's maintenance personnel as specified below.

B. Start-up checklists: Perform the following final checks before startup:
1. Inspect connections to main breakers.
2. Inspect grounding.
3. Inspect feeder connections to bus ways and cables.
4. Inspect installation of main, tie & feeder breaker elements.
5. Inspect control & alarm interconnections.
6. Check calibration/setting of trip devices using system coordination study.
7. Verify calibration/setting of digital metering.

C. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
1. Visually and mechanically inspect to include the following: anchoring, grounding, torque of feeder and incoming bus duct connections, feeder cable and integral main bus connections, switchgear section alignments, electrical clearances, mechanical operation of breaker/fuse draw out elements and operating mechanisms, manual trip function, main bus safety shutters, and installation verification using manufacturer's checklist.
2. Check current and potential instrument transformer ratios.

3. Conduct insulation resistance and over potential tests on each type of each breaker element contacts, switchgear control wiring, and breaker element control wiring and each bus section.
4. Conduct resistance test through switchgear bus joints.
5. Conduct current test using primary or secondary current injection.
6. Conduct phasing test on triple-ended switchgear.
7. Conduct contact resistance test on each type breaker element.
8. Conduct ground resistance test.
9. Conduct operational/functional tests of protective relaying. Time-current tests shall be conducted and trip points shall be set per A/E direction
10. Conduct operational/functional tests of digital metering.
11. Perform electrical and mechanical (key) interlock system operational tests on generator and service switchgear.

D. **Training**: Train MCG's maintenance personnel on procedures and schedules related to troubleshooting, servicing, and preventative maintenance.
1. Review data in Operating and Maintenance Manuals.

9. 600V feeder and subfeeders/480V secondary distribution

A. Start-up checklists: Perform the following final checks before startup:
1. Inspect cable terminations.

B. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
1. Visually and mechanically inspect to include the following: large junction and pull boxes, supports of raceways and cable bus, and compression type terminations.
2. Correct identification and phasing arrangements.
3. Conduct continuity test of each feeder.
4. Conduct insulation resistance test of each feeder.

10. 600V Motor Control Centers / 480V secondary distribution (16400)

A. Start-up checklists: Perform the following final checks before startup:
1. Inspect cable terminations.
2. Check installation and setting of overload relays.
3. Inspect control interconnections.

B. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
1. Visually and mechanically inspect to include the following: anchoring, grounding, torque of feeder and incoming connections, electrical clearances, starter and feeder unit draw out mechanisms, and check installation using manufacturer's checklist.
2. Perform test of overload relays for each size starter using primary current injection methods.
3. Conduct operational tests of starters through local/remote controls.
4. Conduct insulation resistance test on MCC busing, each type motor starter unit (except for variable frequency drives), and each control circuit.
5. Conduct contact resistance and insulation resistance test of molded case main and feeder circuit breakers.

C. **Training**: Train MCG's maintenance personnel on procedures and schedules related to troubleshooting, servicing, and preventative maintenance.
1. Review data in Operating and Maintenance Manuals.

11. Distribution Transformers/480V secondary distribution

A. Start-up checklists: Perform the following final checks before startup:
1. Inspect wiring connections.
2. Insure taps are adjusted.
3. Inspect grounding.

B. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
   1. Visually and mechanically inspect to include the following: mounting, grounding, electrical clearances, and K factor and/or isolating transformers are installed where required.
   2. Perform insulation resistance, turns ratios, and polarity tests on each type /size of transformer.

C. **Training**: Train MCG's maintenance personnel on procedures and schedules related to troubleshooting, servicing, and preventative maintenance.
   1. Review data in Operating and Maintenance Manuals.

12. Distribution and branch circuit panelboards/480V secondary distribution

A. Start-up checklists: Perform the following final checks before startup:
   1. Inspect wiring connections.

B. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
   1. Visually and mechanically inspect to include the following: mounting, separate ground and neutral connections per circuit, completed circuit directories, electrical clearances, KAIC ratings of panel board and breakers.
   2. Correct surge suppression devices installed.
   3. Review current readings for each panel board to ensure loads are balanced.
   4. Conduct insulation resistance tests.

13. 600V branch circuits/480/208/120V secondary distribution

A. Start-up checklists: Perform the following final checks before startup:
   1. Inspect wiring connections.

B. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
   1. Visually and mechanically inspect to include the following: large junction and pull boxes, supports of raceways, & compression type terminations.
   2. Correct identification and phasing arrangements.
   3. Perform random continuity test of any branch circuit.
   4. Receptacle Polarity Test: Test every receptacle installed or reconnected under this contract with a receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot and ground reversed, hot or neutral and hot open. Rewire receptacles with faults and retest.
   5. Ground-Fault Receptacle Circuit Interrupter Tests: Test each receptacle or branch circuit breaker having ground-fault circuit protection to assure that the ground-fault circuit interrupter will not operate when subjected to a ground-fault current of less than 4 milliamperes and will operate when subjected to a ground-fault current exceeding 6 milliamperes. Perform testing using an instrument specifically designed and manufactured for testing ground-fault circuit interrupters. "TEST" button operation will not be acceptable as a substitute for this test. Replace receptacles that do not shutoff power with 5/1000 of an ampere within 1/40th of a second and retest. Submit test report signed by Test Engineer who performed this test.

C. **Training**: Train MCG's maintenance personnel on procedures and schedules related to troubleshooting, servicing, and preventative maintenance.
   1. Review data in Operating and Maintenance Manuals.

14. Lighting Fixtures and Lighting controls/277/120V lighting

A. General: General: Provide the services of a factory-trained manufacturer's representative to assist the contractor in the installation and start-up service of the lighting control system and train MCG's maintenance personnel as specified below. Representative will confirm the proper installation and operation of all system components.

B. Train MCG's maintenance personnel on the operation and programming of the lighting control system. Seven days of training will be provided for up to 50 users.

C. Start-up checklists: Perform the following final checks before startup
   1. Ensure all labeling is affixed and accurate
   2. Ensure all terminations are tight.
   3. Check sensor placement is adequate for required duty.
   4. Ensure adequate access is provided to all panels and that documentation of that panel is provided in it.
   5. Ensure all circuits for the loads are energized and ready for testing.

D. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
   1. .Test, calibrate, and set all digital and analog sensing, and actuating devices. Calibrate each instrumentation device by making a comparison between the graphic display and the reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range). Record the measured value and displayed value for each device in the Start Up Report.
   2. Check each digital control point by making a comparison between the control command at the control panel and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the OI display. Record the results for each device in the ATC/FMS Start-Up Report.
   3. Check loads on all breakers to ensure that the breaker is properly sized.
   4. Enter all schedules per occupant’s direction.
   5. For Operator Interfaces:
      a. Verify all elements on the graphics are functional and properly bound to physical devices and/or virtual points and that hot links or page jumps are functional and logical.
      b. Output all specified reports for review and approval.
      c. Verify the alarm printing and logging is functional and per requirements
   6. Validate all interfaces with other systems on a point by point basis

E. **Training**: Train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
   1. Review data in Operating and Maintenance Manuals.

15. Lightning Protection/Lightning Protection system

A. Start-up checklists: Perform the following final checks before startup:
   1. Inspect wiring connections.

B. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
   1. Visually and mechanically inspect to include the following: air terminal mountings, bonding connections of roof mounted HVAC equipment, down leads routing/roof penetrations, and grounding.
   2. Review UL test certification.
   3. Check for receipt of UL master label.

16. Fire alarm equipment / Fire alarm/detection system

A. General: General: Provide the services of a qualified fire alarm specialist to supervise the installation, make adjustments, and perform tests on the fire alarm system and train MCG's maintenance personnel.

B. Start-up checklists: Perform the following final checks before startup

1. Ensure all labeling is affixed and accurate
2. Ensure all terminations are tight.
3. Ensure adequate access is provided to all panels and that documentation of that panel is provided in it.
4. Review that all fire alarm devices as shown on the construction drawings and shop drawings are installed.
5. Review height and locations of pull stations and visual alarms to comply with ADA.
6. Review that smoke and duct detectors are installed according to NFPA 72E and NFPA 90A.
7. Check that fire alarm system control panel is clear with no trouble or ground faults.
8. Sprinkler flow and tamper switches have been adjusted
9. Check wire supervision on all devices.

C. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
1. Check location of all sensors and switches to ensure conformance with requirements.
2. Cause activation of all device, assure alarms are initiated and resulting response is per the requirements.
3. Verify interfaces with all other inter-related systems or equipment including FMS, sound systems, security systems, HVAC systems, vertical delivery systems, etc. on a point by point basis for all points
4. Validate all output devices (speakers and strobes) meet the code criteria (96 dba at 10’ and 117 candela at peak)
5. Activate high temperature detectors in the elevator machine room. Verify all sequences including elevator shunt off, elevator recall including alternate floors when main floor is in alarm.
6. Activate all sprinkler flow switches. Validate that appropriate zone enunciates and alarms sound.
7. Verify audio aspects of the system function as required. Verify paging messages can be heard throughout the building.
8. For announciator panels, validate correct graphic and correct identification of all zones. Test the action and interlocks of all override switches as appropriate
9. For Operator Interfaces:
   a. Verify all elements on the graphics are functional and properly bound to physical devices and/or virtual points and that hot links or page jumps are functional and logical.
   b. Output all specified reports for review and approval.
   c. Verify the alarm printing and logging is functional and per requirements
10. Validate all interfaces with other systems on a point by point basis

D. **Training**: Train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
1. Review data in Operating and Maintenance Manuals.

17. Grounding/Building grounding system

A. Starting Procedures: Follow the manufacturer's written procedures and the following as a minimum:
1. Conduct fall of potential ground resistance tests per IEEE Standard 81at each test well and at service equipment.
2. Conduct insulation resistance, short circuit, and ground tests of each motor.

18. Uninterruptible Power Systems

A. **General**: General: Provide the services of a manufacturer certified specialist to supervise the installation, make adjustments, and perform tests on the UPS and train MCG's maintenance personnel.

B. **Training**: Train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.

1. Review data in Operating and Maintenance Manuals.

19. Automatic Transfer Switches

A. **General**: General: Provide the services of a manufacturer certified specialist to supervise the installation, make adjustments, and perform tests on the automatic transfer switches and train MCG's maintenance personnel.

B. **Start-up checklists**: Perform the following final checks before startup

1. Visually inspect the systems.
2. Ensure the terminations are tight and all ancillary equipment completely installed.
3. Ensure all overloads are in place.
4. Measure contact resistance

C. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:

1. Energize Switch
2. Check positive interlock between systems
3. Set/Calibrate Voltage sensing relay, transfer time delays (in both directions), and synchronization relays
4. Measure insulation resistance and resistance to ground
5. Check manual bypass operation

D. **Training**: Train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.

1. Review data in Operating and Maintenance Manuals.

20. Emergency Power Engine Generators and Distribution systems

A. **General**: General: Provide the services of a manufacturer certified specialist to supervise the installation, make adjustments, and perform tests on the engine generators and emergency power switchgear and train MCG's maintenance personnel.

B. **Start-up checklists**: Perform the following final checks before startup

1. Visually inspect the systems.
2. Ensure the terminations are tight on power and control wiring
3. Verify all ancillary equipment completely installed.
4. Ensure all overloads are in place.
5. Verify that generator is set in place.
6. Verify fuel connections
7. Verify radiator connections
8. Verify battery connection
9. Verify exhaust connections
10. Verify block or oil heater connection.
11. Check and record engine oil level, radiator water level, and battery electrolyte level.
12. Piping System Tests: Complete system test in accordance with the respective section
13. Inspect the installation and access/clearance for service and maintenance to ensure it meets the project and manufacturer’s requirements
14. Check lubricating oil for lubricated-type equipment.
15. Check for proper seismic restraints.

16. Check that safety valves have correct setting; greater than compressor discharge pressure, but not greater than pressure rating of system components.
17. Check that all operating controls are set for initial safe operation

C. **Starting Procedures**: Follow the manufacturer's written procedures and the following as a minimum:
   1. Tested generator at 50, 75, 100, 125 percent load capacity using load banks at 100 percent power factor.
   2. Run load test at all loads except 125 percent for 30 minutes recording engine and alternator readings at the start, at 15 minutes and at 30 minutes. 125 percent load to be run for 15 minutes recording readings at the start and end of test.
   3. Simulate operation of all generator safeties such as high oil pressure, low oil pressure, high temperature, over speed, etc. Observe function of safeties under actual malfunction situation.
   4. Check for excessive vibration and noise. Correct problems.

D. **Training**: train MCG's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.
   1. Review data in Operating and Maintenance Manuals.

END OF SECTION

SECTION 26 08 03

ATC SYSTEM COMMISSIONING

I. GENERAL

1. SECTION INCLUDES

A. ATC System and equipment testing and start-up.
B. Validation of proper and thorough installation of ATC systems and equipment.
C. Functional testing of control systems.
D. Documentation of tests, procedures, and installations.
E. Coordination of ATC training.
F. Documentation of ATC Operation and Maintenance materials.

2. RELATED SECTIONS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
B. Section 15010 - Basic Mechanical Requirements.
C. Section 15950 - Automatic Temperature Control (ATC) Systems.
D. Section 15995 - Commissioning

3. GENERAL DESCRIPTION

A. This section defines responsibilities of the ATC Contractor to facilitate the Commissioning process for the Automatic Temperature Controls (ATC) and Facility Management System (FMS).
B. Refer to Section 15995 - "Commissioning" for general commissioning requirements including Definitions, Sequencing, and Commissioning Agent Responsibilities.
C. [.]

4. CONTRACTOR RESPONSIBILITIES

A. Assist Completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment
B. Commissioning Agent in verification and performance testing. Assistance will generally include the following:
   1. Attend Cx progress and coordination meetings
   2. Prepare and submit required draft forms and systems information.
   3. Establish trend logs of system operation as specified herein
   4. Demonstration of system operation.
   5. Manipulate systems and equipment to facilitate testing.
   6. Provide instrumentation necessary for verification and performance testing.
   7. Manipulate control systems to facilitate verification and performance testing.
   8. Train MCGs Representatives in systems operation and control equipment use, operation, maintenance and repair. Training shall be conducted as follows:
      a. The Control Subcontractor shall conduct control system training. Control system training shall be as specified in Part - 3 of this section.
C. Provide a Control technician to work at the direction of Commissioning Agent for software optimization assistance for a minimum of 24 hrs. Refer to Part 3 for a description of the software optimization.
D. **Compensation for Retesting**: Compensate MCG for site time necessitated by incompleteness of systems or equipment at time of functional performance testing. All testing failures, which require on-site time for retesting, will be considered actual damages to the MCG. The contract sum shall be reduced by contract modification at a rate of $100 [unless otherwise negotiated at the time of

contract) per man-hour of on-site time necessary to retest failures. All parties under contract with the MCG who are affected by the retesting shall be included in the contract modification.

5. SEQUENCING:

A. The following list outlines the general sequence of events for submittals and commissioning.

1. Submit Product data and Shop Drawings, and receive approval.
2. Submit Control Logic Documentation, and receive approval.
3. Submit Start Up checklists and manufacturers start up procedures for all equipment provided by the ATC contractor
4. Install controls.
5. Submit ATC Start up Test Agenda/schedule for review.
6. Receive ATC start up Test Agenda/schedule approval.
7. Submit Training Plan
8. Place systems under ATC control.
9. Prepare and initiate Trend Log data storage and format trend graphs.
10. Perform ATC system start up.
11. Submit completed ATC Start Up Reports
12. []
13. Receive ATC Start up Report approval and approval to schedule Commissioning Demonstrations.
14. Demonstrate systems to [ ][][.]
15. Submit trend logs in format specified
16. Receive Demonstration approval and approval to schedule Acceptance Period.
17. Train MCG on control system operation and maintenance.
18. Substantial Completion
19. Begin Acceptance Phase
20. Two weeks Operational Test.
21. Perform Functional Performance Testing
22. Receive Acceptance Period approval, which is Functional Completion for the ATC/FMS.
23. Train MCG on final Sequences and modes of operation.
24. Install Framed Control Drawings.
25. Provide password access to MCG.
26. Revise and Re-Submit Record drawings and O&M manuals.
27. Begin Warranty Phase
28. Schedule and begin Opposite Season Acceptance Period.
29. Receive Opposite Season Acceptance Period approval.
30. Submit As-Built drawings and O&M manuals.
31. Update Framed Control Drawings.
32. Complete MCG training.
33. End of Warranty Period
34. Final Acceptance.

II. PART 2 - PRODUCTS

1. INSTRUMENTATION

A. Instrumentation required to verify readings and test system and equipment performance shall be provided by Contractor and made available to Commissioning Agent. Generally, no testing equipment will be required beyond that required to perform Contractors work under these Contract Documents. All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6-month period. Certificates of calibration shall be submitted.

2. TAB & Cx Portable operators terminal

A. Contractor shall provide a portable operators terminal or hand held device to facilitate TAB and calibration. This device shall support all functions and allow querying and editing of all parameters required for proper calibration and start up.

B. Connections shall be provided local to the device being calibrated. For instance, for VAV boxes, connection of the operator's terminal shall be either at the stat or the box.

Include the following when no operator terminal is being provided in the main mechanical rooms. This requires a temporary installation proximate to the equipment to facilitate FPT

C. Temporarily establish a fully functional graphic Operator Interface in room ______ throughout the Acceptance Period. [One of the][The] graphic Operator Interface may be used to fulfill this requirement, in which case the contractor shall relocate the OI at the completion of FPT.

III. PART 3 - EXECUTION

1. ATC/FMS Start-Up TESTING, ADJUSTING, CALIBRATION

A. Work and/or systems installed under this Division shall be fully functioning prior to Demonstration and Acceptance Phase. Contractor shall start, test, adjust, and calibrate all work and/or systems under this Contract, as described below:

1. Inspect the installation of all devices. Review the manufacturer's installation instructions and validate that the device is installed in accordance.
2. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
3. Verify integrity/safety of all electrical connections.

   The following paragraph is applicable to control upgrades on existing systems. This must be incorporated only where applicable and edited to suit the job. Note that on a larger scale it is the designer's responsibility to clearly specify the requirements for the integration of what would typically be performed by the TAB on a new job. The IAQ related sequences included in the standards and generally any flow measuring I/O generally require the involvement of a TAB contractor. Where these are being implemented on an existing job, you must illuminate and emphasize the requirement.

4. []
5. Coordinate with TAB subcontractor to obtain [] control settings that are determined from balancing procedures. Record the following control settings as obtained from TAB contractor, and note any TAB deficiencies in the ATC/FMS Start-Up Report :
   a. Optimum duct static pressure set points for VAV air handling units.
   b. Minimum outside air damper settings for air handling units.
   c. Optimum differential pressure set points for variable speed pumping systems.
   d. Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.
      1. ATC/FMS contractor shall provide hand held device as a minimum to the TAB and CA to facilitate calibration. Connection for any given device shall local to it (i.e.: at the VAV box or at the thermostat). HHD or portable

operator's terminal shall allow querying and editing of parameters required for proper calibration and start up.

6. Test, calibrate, and set all digital and analog sensing, and actuating devices. Calibrate each instrumentation device by making a comparison between the ATC display and the reading at the device, using an instrument traceable to the National Bureau of Standards, which shall be at least twice as accurate as the device to be calibrated (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range). Record the measured value and displayed value for each device in the ATC/FMS Start up Report.
7. Check and set zero and span adjustments for all transducers and transmitters.
8. For dampers and valves:
    a. check for adequate installation including free travel throughout range and adequate seal
    b. where loops are sequenced, check for proper control without overlap
9. For actuators:
    a. Check to insure that device seals tightly when the appropriate signal is applied to the operator.
    b. Check for appropriate fail position, and that the stroke and range is as required
    c. For pneumatic operators, adjust the operator spring compression as required to achieve close off. If positioner or volume booster is installed on the operator, calibrate per manufacturer's procedure to achieve spring range indicated. Check split range positioners to verify proper operation. Record settings for each device in the ATC/FMS Pre-Commissioning Report.
    d. For sequenced electronic actuators, calibrate per manufacturer's instructions to required ranges
10. Check each digital control point by making a comparison between the control command at the CU and the status of the controlled device. Check each digital input point by making a comparison of the state of the sensing device and the OI display. Record the results for each device in the ATC/FMS Start-Up Report.
11. For outputs to reset other manufacturers devices (VSDs) and feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
12. Verify proper sequences by using the approved checklists to record results and submit with ATC/FMS Start-Up Report. Verify proper sequence and operation of all specified functions.
13. Verify all safety devices trip at appropriate conditions. Adjust set points accordingly.
14. Tune all control loops to obtain the fastest stable response without hunting, offset or overshoot. Record tuning parameters and response test results for each control loop in the ATC/FMS Start up Report. Except from a startup, maximum allowable variance from set point for controlled variables under normal load fluctuations shall be as follows. Within 3 minutes of any upset (for which the system has the capability to respond to) in the control loop, tolerances shall be maintained (exceptions noted):
    a. Duct air temperature: ±1□ F.
    b. Space Temperature: ±2□ F
    c. Chilled Water: ±1□ F
    d. Hot water temperature: ±3□ F.

e. Duct pressure: ± 0.25" w.g.
f. Water pressure: ±1 psid
g. Duct or space Humidity: ±5%
h. Air flow control: ±5% of setpoint velocity. []. For min OA flow loops being reset from CO_2, response to upset max time is one hour
i. Space Pressurization (on active control systems): ±0.05" wg with no door or window movements

15. For interface and DDC control panels:
    a. Ensure devices are properly installed with adequate clearance for maintenance and clearly labeled in accordance with the record drawings
    b. Ensure terminations are safe, secure and labeled in accordance with the record drawings
    c. Check power supplies for proper voltage ranges and loading.
    d. Ensure wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
    e. Check for adequate signal strength on communication networks.
    f. Check for stand-alone performance of controllers by disconnecting the controller from the LAN. Verify the event is enunciated at OIs. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection
    g. Ensure all outputs and devices fail to their proper positions/states.
    h. Ensure buffered and/ or volatile information is held through power outage
    i. With all system and communications operating normally, sample and record update/enunciation times for critical alarms fed from the panel to the OI.
    j. Check for adequate grounding of all DDC panels and devices
16. For Operator Interfaces:
    a. Verify all elements on the graphics are functional and properly bound to physical devices and/or virtual points and that hot links or page jumps are functional and logical.
    b. Output all specified FMS reports for review and approval.
    c. Verify the alarm printing and logging is functional and per requirements
    d. Verify trend archiving to disk and provide a sample to the CA for review
    e. Verify paging/dial out alarm enunciation is functional
    f. Verify functionality of remote OIs and that a robust connection can be established consistently.
    g. Verify that required third party software applications required with the bid are installed and functional.
17. [Start up and check out control air compressors and air drying and filtering systems in accordance with the appropriate section and manufacturer's instructions]
18. [Verify proper interface with fire alarm system.]

B. Submit Start-Up Test Report. Report shall be completed, submitted and approved prior to Substantial Completion.

2. Sensor Checkout and Calibration

A. **General. Checkout**: Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable, are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.

B. **Calibration:** Calibrate all sensors using one of the following procedures:

1. **Sensors Without Transmitters** Make a reading with a calibrated test instrument within 6 inches of the site sensor at various points across the range. Verify that the sensor reading (via the permanent thermostat, gage or FMS) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor.
2. **Sensors With Transmitters** Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 ma is read by the ammeter. Repeat for the maximum temperature matching 20 ma to the potentiometer span or maximum and verify at the OI. Record all values and recalibrate controller as necessary to conform to tolerances. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor reading (via the permanent thermostat, gage or FMS) is within the tolerances specified. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.

C. Sensor Tolerance: Sensors shall be within the tolerances specified for the device. Refer to Section 15951

3. Coil Valve Leak Check

A. Verify proper close off of the valves. Ensure the valve seats properly by simulating the maximum anticipated pressure difference across the circuit. Calibrate air temperature sensors on each side of coil to be within 0.5°F of each other. Via the OI, command the valve to close. Energize fans. After 5 minutes observe air temperature difference across coil. If a temperature difference is indicated, and the piping surface temperature entering the coil is within 3°F of the water supply temp, leakage is probably occurring. If it appears that it is occurring, close the isolation valves to the coil to ensure the conditions change. If they do, this validates the valve is not closing. Remedy the condition by adjusting the stroke and range, increasing the actuator size/torque, replacing the seat or replacing the valve as applicable.

4. Valve Stroke Setup and Check

A. For all valve and actuator positions checked, verify the actual position against the OI readout.

B. Set pumps to normal operating mode. Command valve closed, verify that valve is closed and adjust output zero signal as required. Command valve open, verify position is full open and adjust output signal as required. Command valve to a few intermediate positions. If actual valve position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics)..

5. ATC/FMS DEMONSTRATION

A. Demonstrate the operation of the ATC/FMS hardware, software, and all related components and systems to the satisfaction of the [][][]. Schedule the demonstration with the MCG's representative 2 weeks in advance. Demonstration shall not be scheduled until all hardware and software submittals, and the Start-Up Test Report are approved. If the Work fails to be demonstrated to conform to Contract specifications, so as to require scheduling of additional site visits by the Commissioning Agent for re-demonstration, Contractor shall reimburse MCG for costs of subsequent Commissioning Agent site visits.

B. The Contractor shall supply all personnel and equipment for the demonstration, including, but not limited to, instruments, ladders, etc. Contractor supplied personnel must be competent with and knowledgeable of all project-specific hardware, software, and the HVAC systems. All training documentation and submittals shall be at the job site.

C. Demonstration shall typically involve small representative samples of systems/equipment randomly selected by the MCG and CA.

D. The system shall be demonstrated following the same procedures used in the Start-Up Test by using the approved Commissioning Checklists. Demonstration shall include, but not necessarily be limited to, the following:

1. Demonstrate that required software is installed on FMS workstations. Demonstrate that graphic screens, alarms, trends, and reports are installed as submitted and approved.
2. Demonstrate that points specified and shown can be interrogated and/or commanded (as applicable) from all workstations, as specified.
3. Demonstrate that remote dial-up communication abilities are in accordance with these Specifications.
4. Demonstrate correct calibration of input/output devices using the same methods specified for the start-Up tests. A maximum of 10 percent of I/O points shall be selected at random by Commissioning Agent and/or MCG for demonstration. Upon failure of any device to meet the specified end-to-end accuracy, an additional 10 percent of I/O points shall be selected at random by Commissioning Agent for demonstration. This process shall be repeated until 100 percent of randomly selected I/O points have been demonstrated to meet specified end-to-end accuracy.
5. Demonstrate that all DDC and other software programs exist at respective field panels. The Direct Digital Control (DDC) programming and point database shall be as submitted and approved.
6. Demonstrate that all DDC programs accomplish the specified sequences of operation.
7. Demonstrate that the panels automatically recover from power failures, as specified.
8. Demonstrate that the stand-alone operation of panels meets the requirements of these Specifications. Demonstrate that the panels' response to LAN communication failures meets the requirements of these Specifications.
9. Identify access to equipment selected by Commissioning Agent. Demonstrate that access is sufficient to perform required maintenance.
10. Demonstrate that required trend graphs and trend logs are set up per the requirements. Provide a sample of the data archive. Indicate the file names and locations.

E. ATC/FMS Demonstration shall be completed and approved prior to Substantial Completion.

F. Any tests successfully completed during the demonstration will be recorded as passed for the functional performance testing and will not have to be re-accomplished.

6. ATC/FMS ACCEPTANCE PERIOD

A. After approval of the ATC/FMS Demonstration and prior to Contract Close out Acceptance Phase shall commence.

B. **Operational Test**: At the beginning of the Acceptance Phase, the system shall operate properly for two weeks without malfunction, without alarm caused by control action or device failure, and with smooth and stable control of systems and equipment in conformance with these specifications. At the end of the two weeks, contractor shall forward the trend logs to the CA for review. CA shall determine if the system is ready for functional performance testing and document any problems requiring contractor attention.

1. If the systems are not ready for functional performance testing, Contractor shall correct problems and provide notification to the MCG's

representative that all problems have been corrected. The Acceptance Period shall be restarted at a mutually scheduled time for an additional one-week period. This process shall be repeated until Commissioning Agent issues notice that the ATC/FMS is ready for functional performance testing.

C. During the Acceptance Period, the contractor shall maintain a hard copy log of all alarms generated by the FMS. For each alarm received, contractor shall diagnose the cause of the alarm, and shall list on the log for each alarm, the diagnosed cause of the alarm, and the corrective action taken. If in the contractor’s opinion, the cause of the alarm is not the responsibility of the contractor, contractor shall immediately notify the MCG’s representative.

D. During the Acceptance Period, the contractor shall maintain all controller network and workstation hardware and software in a state that will allow remote access by Commissioning Agent to Trend Logs as specified below.

7. Trend Logs

A. Trend logs are databases of ASCII characters (usually numbers) representing a historical record of the systems operation. Contractor shall establish and store these trend logs.

B. CA will analyze trend logs of the system operating parameters to evaluate normal system functionality. The requirements of the trending are specified with the FPT procedures in the Cx Plan. Contractor shall establish these trends, ensure they are being stored properly, and forward the data in electronic format to the CA.

C. Data shall include a single row of field headings and the data thereafter shall be contiguous. Each record shall include a date and time field. Recorded parameters for a given piece of equipment or component shall be trended at the same intervals and be presented in a maximum of two separate two dimensional formats with time being the vertical axis and field name being the horizontal axis.. Data shall be forwarded in one of the following formats.

1. Microsoft ACCESS Database (.mdb)
2. Microsoft EXCEL Spreadsheet (.xls)
3. Comma Separated Value (.csv or .txt) preferably with quotes delimiting text fields and # delimiting date/time fields

D. Sample times indicated as COV (□) or change of value mean that the changed parameter only needs to be recorded after the value changes by the amount listed. When output to the trending file, the latest recorded value shall be listed with any given time increment record. If the FMS does not have the capability to record based on COV, the parameter shall be recorded based on the interval common to the unit.

E. Contractor shall provide the CA with required passwords, phone numbers, etc. to allow the CA access to the trend log data and allow downloading to a remote location. Contractor shall also provide step-by-step written instructions for accessing the data. (not required for projects that do not have a remote connection requirement)

8. TREND Graphs

A. Trend graphs shall generally be used during the Acceptance Phase to facilitate and document testing. Prepare controller and workstation software to display graphical format trends during the Acceptance Period. Trend graphs shall demonstrate compliance with contract documents. Trended values and intervals shall be the same as those specified for the functional performance tests.

B. Lines shall be labeled and shall be distinguishable from each other by using either different line types, or different line colors.

C. Indicate engineering units of the y-axis values; e.g. degrees F., inches w.g., Btu/lb, percent wide open, etc.

D. The y-axis scale shall be chosen so that all trended values are in a readable range. Do not mix trended values on one graph if their unit ranges are incompatible.

E. Trend outside air temperature, humidity, and enthalpy during each period in which any other points are trended.

F. All points trended for one HVAC subsystem (e.g. air handling unit, chilled water system, etc.) shall be trended during the same trend period.

G. Each graph shall be clearly labeled with HVAC subsystem title, date, and times.

9. Warranty Phase ATC/FMS OPPOSITE SEASON Trending and Testing:

A. **Trending:** throughout the Warranty Phase, trend logs shall be maintained as required for the Acceptance Period. Contractor shall forward archive trend logs to the CA for review upon CA’s request. CA will review these and notify contractor of any warranty work required.

B. **Opposite Season Testing**: Within 6 months of completion of the Acceptance Phase, CA shall schedule and conduct Opposite Season functional performance testing. Contractor shall participate in this testing and remedy any deficiencies identified.

10. SOFTWARE OPTIMIZATION ASSISTANCE

A. The contractor shall provide the services of a controls technician as specified above at the project site to be at the disposal of the CA. The purpose of this requirement is to make changes, enhancements and additions to control unit and/or workstation software that have been identified by the CA during the construction and commissioning of the project and that are beyond the specified Contract requirements. The cost for this service shall be included with the bid. Requests for assistance shall be for contiguous or non-contiguous 8-hour days, unless otherwise mutually agreed upon by contractor, Commissioning Agent, and MCG. The MCG’s representative shall notify contractor 2 days in advance of each day of requested assistance.

B. The controls technician provided shall be thoroughly trained in the programming and operation of the controller and workstation software. If the controls technician provided cannot perform every software task requested by the Commissioning Agent in a timely fashion, contractor shall provide additional qualified personnel at the project site as requested by the Commissioning Agent, to meet the total specified requirement on-site.

11. ATC/FMS OPERATOR TRAINING:

A. Provide services of controls contractor’s qualified technical personnel for 6-hour days to instruct MCG's personnel in operation and maintenance of FMS. CA shall witness selected sessions. Instruction shall be in classroom setting at the project site for appropriate portions of the training. Training may be in non-contiguous days at the request of the Commissioning Agent or MCG. The MCG’s representative shall notify contractor 1 week in advance of each day of requested training.

B. Provide up to 4 complete sets of the approved Operations and Maintenance Manual to be used for training.

C. Contractor shall submit a Training Plan as outlined in the Cx plan for the scope of training he is responsible. Training Plan shall be forwarded to the Division 15 contractor who will compile, organize, format, and forward to the CA.

D. The contractor’s designated training personnel shall meet with the Commissioning Agent and MCG’s representative for the purpose of discussing and fine-tuning the training agenda prior to the first training session. Training agenda shall generally be as follows:

1. Day 1:
    a. Brief walk-through of building, including identification of all controlled equipment and condensed demonstration of CU

portable and built-in operator interface device display capabilities.

   b. Brief overview of the various parts of the O&M manual, including hardware and software programming and operating publications, catalog data, controls installation drawings, and DDC programming documentation.
   c. Demonstration of workstation login/logout procedures, password setup, and exception reporting.
   d. Demonstration of workstation menu penetration and broad overview of the various workstation features.
2. Day 2 & 3:
   a. Introduction to CU programming.
   b. Review of sequence of operation, CU programming, standalone modes, fail modes and graphic workstation screen for each HVAC subsystem.
3. Day 4:
   a. Review of alarm feature
   b. Review of diagnostics features
   c. Review of I/O hardware testing, calibration, and replacement.
   d. Review of trend feature.
   e. Review of workstation reports.
   f. Review of setpoint optimization and fine-tuning concepts.
4. Day 5:
   a. Review of all remaining miscellaneous workstation features.
   b. Question and answer period.

END OF SECTION

1. **Model Commissioning Procedures:**
These procedures are grouped by Category and then Type. For instance, Air Handling Units (AHU) is a category and SVSOGC_L is a type which is a large (over 15,000 cfm) single duct VAV 100% OA unit with glycol preheat, chilled water cooling, and a variable frequency drive. Other Type codes are more descriptive and therefore more obvious.

Each Type includes typical checklist items and typical tests. Tests are further segregated into those related to start up (Start) and those related to functional performance testing (FPT).

To view these tests select the applicable Category and click either "Checks" or "Tests" from the desired type.

AHU

SCEEFCHL1	Large Single Duct CV 100% OA w/ EF, F&B Prht, & Space Temp control	Checks	Tests
SCEEFCHL2	Large Single Duct CV 100% OA w/ EF, F&B Prht, discharge control	Checks	Tests
SCR2GC_L	Large Single Duct CV AH w/ RA Fan and Economizer	Checks	Tests
SCSMGC_L	Large Single Zone CV w/ glycol preheat and chilled water cooling	Checks	Tests
SVBEWCPL	Large Single Duct 100% OA w/HR (Ht Wheel) VAV Blow through unit with chilled water cooling	Checks	Tests
SVR2GC_L	Large Single Duct VAV w/economizer and flow tracking glycol preheat and chilled water cooling	Checks	Tests
SVSOGC_L2	Large Single Duct 100% OA, VSD, 2 CHWs, Gly Preheat, Chilled water cooling, Serving Terminal units	Checks	Tests

Air System

Exh 2Fan IV	Exhaust system 2 fans w/ IV serving term	Checks	Tests
Exh 2Fan VSD	Exhaust system 2 fans w/ VSD serving term	Checks	Tests
Exh Air Sys	Standard Room Exhaust System	Checks	Tests
Exh Air Sys-TC	Standard Room Exhaust System temp controlled for heat removal	Checks	Tests

Chiller

WCCent	Water cooled centrifugal chiller	Checks	Tests

Compressed Air System

CA Duplex-Desiccant	Control Air system w/ Duplex air compressor and Desiccant Dryer	Checks	Tests
CA Duplex-Refrig	Control Air system w/ Duplex air compressor and Refrigerated Dryer	Checks	Tests

Hydronic System

CHW Bldg Loop Btndr	Building CHW Loop w/Bridge Tender Concept	Checks	Tests
CHW Primary	Chilled Water Primary hydronic system	Checks	Tests
CHW Secondary	Chilled Water Secondary System	Checks	Tests
CHW/Cndsr System	Condenser System as a mixed zone off CHW System	Checks	Tests
HW Prim-Stm Conv	Typical HW System using Steam Converters (2 pumps)	Checks	Tests
HW Prim-Stm Conv-VS	HW Primary Sys with Stm Cnvt and VSDs	Checks	Tests
HW Primary	Hot Water Primary hydronic system	Checks	Tests
HW Secondary	Hot Water Secondary System	Checks	Tests

Plumbing System

Pure Water	Pure Water Systems	Checks	Tests

Steam Systems

H-M-L Press Sys	High-Med-Low Pressure Steam Sys	Checks	Tests

Terminal Units

2FCU	2 Pipe Fan Coil Unit	Checks	Tests
2FCU-Clg	Cooling only Fan Coil Unit	Checks	Tests
4FCU	4 Pipe Fan Coil Unit w/CHW and HW	Checks	Tests

CRAC	Computer Room AC w/CHW and HW	Checks	Tests
CRAC-E	Computer Room AC w/CHW and Electric heat	Checks	Tests

VAV Terminal Units

Vbx	Single Duct VAV Box	Checks	Tests
Vbx-CvRH	Constant Volume Reheat Terminal Box	Checks	Tests
VBx-Exh	Single Duct Exhaust VAV Box	Checks	Tests
Vbx-FP	Fan Powered VAV Box	Checks	Tests
Vbx-RH	Single Duct VAV Box with HW reheat	Checks	Tests
VBx-RH-E	Single Duct VAV Electric Reheat Box	Checks	Tests

Zone

Cold Room-Gly	Cold Room Cooled by Glycol	Checks	Tests
FT-Exh-Sup RH	Air flow tracking zone where Exhaust leads a supply with reheat	Checks	Tests
Garage (Parking)	Enclosed Parking Garage requiring ventilation	Checks	Tests
Mech Rm	Typical Mechanical Room with ventilation and Unit Heater	Checks	Tests
Warm Room-HW	Warm Room with hot water and glycol	Checks	Tests

Glossary of Terms

ATC: Automatic Temperature Control
CM: Construction Manager
A/E: Architect/Engineer
CA: Commissioning Authority
CX: Abbreviation for Commissioning
Functional Performance Testing: The detailed and thorough testing of the building systems and their interactions with the building components and other building systems.
IAQ: Indoor Air Quality
RFP: Request for Proposal
Start-Up: Generally the act of taking a piece of equipment or a system from installed (static) to initial operation (dynamic). This is basically making it run and is typically done by the installing contractor. This does not typically involve running it through all sequences and optimizing it.

END OF SECTION

Design Quality Control

Process & Deliverables

Department of General services
DGS

Table of Contents

PROCEDURE

General

A. General Scope of the Work

1. The A/E must provide complete design services including but not limited to all major and minor disciplines such as:
   a. Architecture
   b. Structural engineering
   c. Mechanical engineering
   d. Electrical engineering
   e. Plumbing engineering
   f. Civil engineering
   g. Code analysis
   h. Cost estimate
   i. Interior design
   j. Furniture layout, selection, and specifications (for renovation projects existing furniture analysis)
   k. Interior and exterior signage
   l. Geotechnical engineering
   m. Survey
   n. Landscape architecture and design
   o. Fire protection engineering
   p. Life safety
   q. Security
   r. Acoustical engineering
   s. Lighting and special lighting design
   t. Audio video design
   u. Communications
   v. Information technology engineering
   w. Commissioning
   x. Energy engineering
   y. LEED
   z. Food service design
   aa. Vertical transportation
   bb. Equipment
   cc. Hardware
   dd. Traffic engineering
   ee. Construction administration
   ff. Construction quality control
   gg. and other design and construction services as needed for the design of a complete facility.
2. The end result of any contract with the A/E must be documents that provide a complete and fully functional facility.
3. The A/E team (architects and engineers that are selected to design a project) must read and comply with these requirements.
4. County project manager will enforce these requirements.
5. These procedures shall be strictly adhered to during all phases of the project.
6. These requirements are not to restrict or limit requirements that are necessary to obtain building permit or other permits required for the design and construction of buildings in Montgomery County Maryland. Design shall conform to all applicable codes, regulations and requirements of the agencies that issue various permits.

7. Upon analysis of all available information and prior to initiation of any design tasks, the A/E shall participate in an orientation meeting and if offered in a quality control training workshop scheduled by the County. The A/E shall have in attendance the individuals who will represent the primary planning, architectural and engineering disciplines on the project and others as may be requested by the County.
8. The A/E must participate and attend in all meetings required during the design and construction with the governing regulating agencies and code officials and applicable utilities.
9. Normally a project design starts with clarification of the POR, then site is analyzed and then building is located on the site, and eventually all systems of the building must selected leading to other aspects of the design. In order to make an incremental progress with assured steps, design activities are divided in various phases. In each phase specific goals are achieved and progress is carefully monitored.
10. It is expected that progress meetings be held at least on a bi-weekly basis throughout the project including construction phase.
11. Consultant must coordinate and arrange for all necessary design development, work sessions, charrette workshops, fact finding, data collection, and interviews. These meetings are not part of the progress meetings and must be scheduled separately. All related disciplines must attend all such meetings. Participation of various related disciplines is mandatory.
12. All work sessions and design meetings must be held in the County offices unless otherwise agreed by the County managers.
13. Meetings with Chief Administrative Office, M-NCPPC, and other public bodies should be provided as part of basic services as required for up to ten (10) additional meetings.
14. Consultant must coordinate with the County for sub-phase activities and deliverables as indicated in the **Table of Deliverables During the Design Phases**.

DELIVERABLES/ SUBMITTALS

Drawing Requirements

B. Production

1. The outside dimensions of drawings, including schematic design, design development and construction documents drawings, shall not exceed 36x48 inches and are preferred to be a maximum of 30x42 inches. Within these dimensions, there shall be a 1/2-inch border at top, bottom, and right side, and a 1.5-inch border at the left side.
2. The title block of each drawing shall conform to the sample. An electronic copy will be provided to the A/E.
3. Title sheet lettering shall be simple line or block lettering arranged in accordance with the sample.
4. The name of the architect and each of the consultants shall appear clearly on the title sheet. The seal of registration and signature shall appear directly below each name. A facsimile signature stamp will not be accepted. On the title sheet Professional Engineers shall stamp in the discipline in which they are registered.
5. Drawings shall be clear and legible.
6. Scale of floor plans shall be 1/4" =1'-0" wherever feasible and not less than 1/8" =1'-0".
7. The system of numbering and sequence of drawings for projects shall use a discipline identification and a 3 digit drawing identification number (2 digits may be acceptable for small projects). The discipline identification will define the discipline, i.e. Civil = C, Structural = S, and etc. The 3 digit drawing identification number will define the drawing type, variation, and drawing sequence. The first digit of the drawing identification number defines the type of drawing such as, general = 0, composite plan = 1, plans = 2, and etc. The second digit of the drawing identification number defines the variation of the drawing, such as, E201 = Electrical first floor lighting plan, E211 = Electrical first floor power plan,

and etc. The third digit of the drawing identification number defines the sequence, such as, E201 = Electrical first floor lighting plan, E202 = Electrical second floor lighting plan, and etc. For demolition plans the discipline identification shall have a D added, such as CD = Civil Demolition, AD = Architectural Demolition, and etc.

a. General — G
   1) General Information — G001
   2) Code/Life Safety — G101
b. Civil — C
   1) General Survey — C001
   2) Composite Plans — C101
   3) Site Plans — C201
   4) Sections — C401
c. Site — L
   1) General — L001
   2) Composite Plans — L101
   3) Site Plans — L201
   4) Sections — L301
   5) Details — L401
d. Landscaping — L
   1) General — LS001
   2) Composite Plans — LS101
   3) Site Plans — LS201
   4) Sections — LS301
   5) Details — LS401
e. Structural — S
   1) General — S001
   2) Foundation Plans — S101
   3) Framing Plans — S201
   4) Framing Diagrams — S301
   5) Foundation Details — S401
   6) Super Structure Details — S501
   7) Detail Schedules — S601
f. Architectural — A
   1) General — A001
   2) Composite Plans — A101
   3) Floor Plans — A201
   4) RCPs — A301
   5) Enlarged Plans — A401
   6) Exterior Elevations — A501
   7) Interior Elevations — A601
   8) Sections — A701
   9) Exterior Details — A801
   10) Interior Details — A901
g. Furniture — F
   1) Follow similar format to Architectural
h. Interior Design — ID
   1) Follow similar format to Architectural
i. Food Service — FS
   1) Follow similar format to Architectural
j. Signage — SG
   1) Follow similar format to Architectural
k. Mechanical — M
   1) General — M001
   2) Composite Plans — M101
   3) Floor Plans — M201
   4) Enlarged Plans — M301

5) Sections M401
6) System Diagrams M501
7) Details M601
8) Control Diagrams M701

l. Fire Protection FP
   1) Follow similar format to Mechanical
m. Plumbing P
   1) Follow similar format to Mechanical
n. Electrical E
   1) Follow similar format to Mechanical
o. Security SU
   1) Follow similar format to Mechanical
p. Telecommunication T
   1) Follow similar format to Mechanical
q. Audio Visual AV
   1) Follow similar format to Mechanical

8. Each of the consultants, sub-consultants, etc., must include in their working drawings a site drawing identifying work germane to their part of the contract, including appropriate details. The prime consultant must prepare two specific site drawings in addition to all others. One must be the demolition drawing for the site that shows all site features (general construction, mechanical, electrical, utilities, irrigation, lighting, paths, roads, curbs, etc.), that occupy the site with appropriate notations for removal, retention, protection - whatever the disposition may be. The other must be a drawing that shows the finished site including the existing to remain and the new work to be done by all contractors and sub-contractors on the site - even though this may represent some duplication of other drawings. This drawing must specifically identify the precise location and routing for all site features and the relative coordination. Details unique to the installation, which do not affect location coordination, need not be included herein. In order to appreciate the true impact of various installations, all must be shown to true scale (by line thickness or double-line as appropriate).

9. Drawings submitted shall be black line prints on white.

10. Reproducible drawings shall be black line on Mylar (4 mil.).

11. An arrow indicating true North shall be shown on all floor plans (for green design analysis). Sheet North arrow can be used in addition to true north but must be clearly delineated.

12. Pressed lettering is not acceptable. All drawings must be prepared with CADD.

13. Key plans and key sections shall be shown on all sheets.

14. Documents shall provide all information required by agencies issuing the permits.

15. All drawings for all phases must have adequate legends, symbols and annotations to fully describe the design and materials on the drawings. Unused legends and icons must not be shown.

a. The A/E must provide the number of sets of documents as identified in the ***Table of Deliverables During the Design Phases***. Unless otherwise noted in the contract the following quantities must be delivered:
b. Minimum **6** sets of full size drawings
   1) 2 for Facilities Management
   2) 3 for PM team
   3) 1 for the user agency
c. Minimum **4** sets of half size drawings
   1) 1 for the file
   2) 1 for the user agency
   3) 1 for PM team
   4) 1 for the Section Chief
d. Minimum **2** sets of small size drawings (8.5x11 for typical scale projects or 11x17 for large scale projects)

1) 1 for the file
2) 1 for the Section Chief

16. With each submittal to the County the A/E must deliver electronic files of the documents in their native format and Adobe PDF format. Electronic format requirements are specified within this document.

C. Electronic File Format and CADD

1. Format

a. Files shall be submitted on CD-ROMs (not on DVDs).

b. Consultants and/or A/E acknowledges that all these files may be used by the County for marketing, presentation, project documents, meeting handouts, and all other needs that the County may have as an owner. In case if in the future there is a need for renovation or repair of the building, CADD drawings may be used by County employees or consultants for the production of such drawings as background information. The intent is not to design and construct other facilities by duplicating a consultant's design or violating the A/E's copyright.

c. Consultants are responsible for the accuracy of electronic documents and must verify they match printed submittals specifically, 100% construction documents, permit set, bid set, and as-built drawings.

d. Text files shall be in a format compatible with the Microsoft Windows operating system. The compatibility of files created on computers using other operating systems shall be verified prior to delivery.

e. Files may be provided in either a standard .zip archive file format or a self-extracting .exe archive file format. Other archiving and/or compression formats are not acceptable.

f. 2D, 3D, and animated renderings shall be submitted in the following three formats:

1) Native file system (format generated by the software)
2) JPG
3) Adobe PDF.
4) Renderings shall be produced in high resolution.

g. All drawings, reports, specifications, booklets, and etcetera shall be submitted in the following formats:

1) Native file system (format generated by the software)
2) A single PDF file that includes the entire document and matches the printed copy including cover sheet.
3) AutoCAD 2004 .DWG (or current version if approved by the Project Manager)

2. Computer-Aided Design and Drafting (CADD)

a. Before start of CADD production, A/E shall provide the County with a booklet of CADD standards and procedure that complies with these requirements.

b. This document describes the standards for CADD. Submittals that deviate from these standards shall be deemed unacceptable and will be returned to the consultant.

c. All review submittals and record drawing submittals shall be provided in the form of CADD files. The requirement to provide CADD record drawings may be waived by project managers where production of said drawings is impractical and/or inappropriate, such as manufacturers' catalog sheets.

d. CADD drawings may be created using any software capable of meeting the defined standards, but all submittals shall be provided in .DWG format and shall be compatible with the latest AutoCAD or ADT version. Additional CADD software or add-on software packages shall not be employed if their use creates proxy objects or other entities which cannot be fully manipulated using only AutoCAD. Consultants using software other than AutoCAD are responsible for confirming, prior to distribution that all CADD files comply with these standards.

e. If BIM software is used, the A/E must provide all data base related to the project in order to be able to reproduce charts and schedules by using the software.

Submission of information in .DWG format is still required.

f. Record drawings shall not contain layout lines or other extraneous elements. Files shall be purged of unused blocks, layers, line types, fonts, or similar elements.

g. Drawings for projects involving renovations shall differentiate between existing, new, and demolished construction.

h. The sheet set title-block shall be coordinated and approved by the county prior to use on drawings.

i. All CADD drawings shall conform to the latest American Institute of Architects (AIA) layering guidelines, as defined in CADD Layer Guidelines published by the American Institute of Architects Press, Washington, D.C.

j. All fonts and external reference files that are used in the drawing files shall be included with their respective drawings. Wherever feasible, only standard AutoCAD fonts shall be used; non-standard fonts that cannot be provided without violating software licensing agreements or copyright regulations, shall not be used. Font and external reference addresses shall be relative to a directory on the delivery disk, not to a directory on the consultant's computer.

k. All drawings shall be drawn at full scale in the model space. When a drawing contains elements to be plotted on the same sheet but at differing scales, AutoCAD's layout must be used.

l. Entity colors shall be defined "by layer", not by the entity.

m. Dimensions shall be associative, relating directly to the actual dimensions of CAD entities. The values of dimensions shall not be overridden or edited by hand.

n. Site plans, building plans and the plans for specific disciplines shall all have the same origin point, such that drawings can be overlaid exactly. Drawing elements shall all lie in the positive portion of the drawing coordinate system.

o. Entities that are supposed to be grouped into one unit shall remain in this form. Text, dimensions, and blocks shall not be exploded, either manually or automatically during a conversion process.

p. A documentation file named "readme.txt" that contains important project and associated computer files shall be included with the drawing and project files on the delivery disk(s). At a minimum, this file shall contain the following:
   1) County's project number and project title
   2) Tenant Agency
   3) Name of the facility if different from the project name
   4) Consultant name, address, and phone number
   5) Name of County Project Manager and Tenant Agency contact person
   6) Contractor name, address, and phone number
   7) Scope of work / project description.

q. The file name for each drawing shall match the sheet number as indicated in the final documents.

Specification Requirements

D. Format

1. All specifications must be in the latest CSI format.
2. The technical arrangement of the CSI MASTERFORMAT and the Three Part Section Format are explained in detail in the CSI manual.
3. Provide the County with a copy of the specification on CD in MS Word (.DOC). File names must include the CSI section number and title.
4. Provide an original copy of the Specification for printing on high quality bond paper, not bound.
5. The section numbers and titles established at the beginning of the project must conform to the latest CSI system and shall be the same as for section numbers and titles throughout the project.

6. The format of specification documents must be:

a. Black on white, clear and legible.
b. Letter size (8-1/2 inches x 11 inches) neatly bounded on the left side.
c. Double sided and paginated so new sections begin on the right page.
d. Have protective cover and back
e. Sufficient margins shall be maintained to allow for binding and printing on both sides of each sheet.
f. Page number must appear on each page. Page numbers shall be indicated as Page X of X.
g. Project name must be on all pages.
h. RFP/IFB number if available must be on all pages.
i. Data date and phase must be on all sheets.
j. All sections must use the same font type, font size and format. Headers and footers must match between sections. Do not include consultant firm names in headers or footers. Footers must contain the section number and title.

7. The cover sheet must include the following information:

a. Name of the project
b. User agency name
c. County seal
d. RFP/IFB number
e. Montgomery County Maryland
f. Office of Planning and Development or Division of Building Design and Construction
g. Date of submittal
h. Design phase

8. The following general information applies to the development of specifications:

a. Describe the extent of the work, the materials and workmanship, and include the work under the proper section. If any portion is covered by another section, there shall be clear and distinct cross-referencing between the sections. Merely to state "by others" is not acceptable.
b. Provide for a minimum of three manufacturers of material except as directed by the County. DO NOT USE terms such as “EQUIVALENT” or “OR EQUAL”.
c. Do not use general clauses intended to be all-inclusive in lieu of complete descriptions.
d. Do not duplicate standard requirements that are contained in the contract form.
e. Use consistency throughout, the word "will" to designate what the County or the Designer can be expected to do, and the word "shall" what is mandatory for the Contractor to do.
f. Use the same term throughout for the same subject and the term shall be the same as that used on the drawings.
g. Do not use the term "etc."
h. Avoid such terms as "to the satisfaction of the Designer," as directed by the Designer," "as approved," and "as required."
i. Specify work in appropriate Sections according to local trade jurisdiction.
j. Symbol:

1)	Do not use	Use Instead
2)	#	Number, no., or pounds
3)	%	Percent
4)	"	Inch or in.
5)	x	by
6)	'	Feet or ft.
7)	+	Plus
8)	-	Minus
9)	o	degree

10) / per or at

k. Alternates shall be fully and properly described and cross-referenced in the specifications and drawings.

l. The A/E must provide as minimum number of sets of documents as identified in the ***Table of Deliverables During the Design Phases***. Unless otherwise noted in the contract as the following quantities must be delivered:
   1) 4 set for PM team
   2) 1 set for the file
   3) 1 set for the Facilities Management

Cost Estimating Requirements

E. General

1. At the beginning of the project there is usually a 10% design contingency reserved for the project. This contingency is usually not built into the CCAP (Construction Contract Award Price). As project progresses through the design phases the design contingency can only be counted as construction cost by permission of the Contract Administrator. This design contingency is not the same as an estimating design contingency.

2. The A/E must identify deduct alternates for the Project which amount to ten percent (10%) of the Construction Contract Award Price (CCAP). All other above and beyond POR or standards requests by the County must be identified as add alternates.

3. The initial 10% design contingency must be replaced with the 10% alternate deducts at the end of the design. Deduct alternates are part of the base bid.

4. Alternates are priced separately by the consultant and contractor. They can be accepted as a line item and become part of the construction contract amount.

5. These alternates, if taken, must not affect the project's programs. All alternates shall be denoted on the construction documents and indicated on the cost estimate in detail.

6. Cost estimates must be delivered to the County concurrently with the rest of deliverables at the end of each phase. It is not acceptable to deliver the estimate after the submission deadline.

7. The A/E must establish a cost control plan and present it to the County at the middle of Concept Planning Phase.

8. If the County requests, the design documents must be provided to the County's independent cost estimator two (2) weeks prior to submittal of all documents to the County.

9. Cost estimator must attend all cost estimating and verification meetings and must reconcile all questions and incorporate all modifications and value engineering items into a revised copy and resubmit for review as soon as possible so that project schedule is not delayed.

10. A/E is responsible for adhering to the CCAP budget. Projects that are estimated above CCAP shall be revised free of charge to the County. It is essential that the A/E should review the CCAP before signing the contract. A signed contract is a commitment on behalf of the A/E that the project can be designed within the CCAP budget and in accordance with all codes and the requirements of this manual.

11. Cost estimates at each phase must contain a market analysis to determine the cost escalation factor to the mid-point of construction. Appropriate back-up data must be included to substantiate the market analysis.

F. Format

1. The cover sheet must include the following information:
   a. Name of the project
   b. User agency name
   c. County seal
   d. RFP/IFB number
   e. Montgomery County Maryland
   f. Office of planning andf
   g. Date of submittal

h. Design phase
i. Estimator's name

2. Each cost estimate sheet must include the following information in the header or footer of each page:
   a. "Montgomery County Maryland" (header).
   b. Name and number of the project (header).
   c. Project phase and date (footer).
   d. Division and section per CSI format (footer).
   e. No name of the cost estimator on individual sheets.
   f. Page number of total -Page X of Y- (footer).
3. Cost estimate data must be presented in the following format:
   a. The estimate shall reflect the current construction cost.
   b. All cost estimates shall be in CSI format.
   c. Each item must show unit labor, unit material, quantity, unit, extended labor, extended material, and total cost.
   d. Each section must have a grand total.
   e. Each division must have a grand total.
4. The summary sheet must include the following:
   a. All information must appear in the header or footer of each sheet as described above.
   b. Total cost of each CSI division including General Conditions.
   c. Overhead, Profit, Insurances, and Bonds (OPIB) must be shown independently and after total of division costs and on the summary sheet only.
   d. Design contingency must be shown at after OPIB items.
   e. Construction cost escalation must be added after the design contingency and on the summary sheet only.
   f. Total cost of building and site must be separately shown in the summary.
   g. The estimated number of calendar days required for construction of the project.
   h. Number of days to mid point of construction from the cost estimate date.
   i. Cost of building construction per gross square foot of the building.
   j. Cost of site per square foot of site.
5. Report Format:
   a. All cost estimates must also be submitted in a format approved by the County for comparison of various cost estimates done in phases. This can be accomplished by using pre-approved Excel forms or software approved or recommended by the County. The purpose of this requirement is that various versions of cost estimates in the separate phases could be compared in detail. Cost estimator through A/E must provide the following reports:
      1) Summary of each CSI format showing total cost of CSI divisions.
      2) A report that compares cost of divisions in various phases of design.
      3) A report that filters and compares the previous cost estimate with the most recent one and showing all items with equal or more than %5 variance. A/E must work with the project manager to define the variance range.
   b. The A/E must provide as minimum number of sets of documents as identified in the ***Table of Deliverables During the Design Phases*** at the end of this document. Unless otherwise noted in the contract as an exception the following quantities must be delivered:
      1) 2 set for the PM team
      2) 1 set for the file
      3) 1 set for the Section Chief

Presentation Requirements

G. Renderings

1. All projects must have renderings to illustrate and delineate the design in the best manner

possible

2. Following are the list of full colored renderings required for all projects:
   a. A site plan showing the mass of the building with the roof plan, landscaping, and all major site elements with sun shadows.
   b. All elevations
   c. At least one section
   d. At least one exterior perspective of the entire building, including the main entrance.
   e. Renderings must be of professional quality.
   f. 3d animation of the interior and exterior of the building (large projects).
   g. If renderings are not computer generated, then the A/E must digitally photograph the rendering and submit the digital format (JPG) as well as printed format.
   h. In addition to electronic format on CD-ROM, all renderings must also be provided in the printed format for presentation (large size, board size, etc) as well as 8.5x11 for the record.
   i. At least one rendering by the choice of the County must be framed for display.

H. Slide Show

1. There are many occasions during the design that the A/E team is required to present the project by use of video projection. These presentations must be done in a slide show format. The most commonly used formats are Adobe PDF, and Microsoft PowerPoint. The A/E must provide an electronic copy as well as printed copies of such presentations to the County prior to such presentation. If not possible the A/E must arrange with the County project manager for immediate submittal of such presentations not later than the day of the presentation.
2. All presentations must be submitted on CD-ROM and either in .PDF or .PPO format.

I. Material Boards and Samples

1. A/E must present all materials selected for review and approval by the County in a format that is portable and presentable to others such as material boards and binders.
2. Heavy building materials such as masonry can be presented in actual size.
3. All interior finishes must be presented on board tagged with where it is used and primary specifications.
4. Furniture selections must be presented in a binder and include pictures of the furniture, finish samples, and specifications. This binder must be updated at all times and delivered to the County per the **Table of Deliverables During the Design Phases**.

J. Model Requirements

1. Format
   a. All projects must have a model developed by the A/E
   b. Large projects must have a working model and also a final presentation/ professional quality model. Working model is for use during the design process. The final model must be delivered to the County with a protective clear case or cover in a scale that is movable.
   c. Materials for the final model must be durable and withstand time and movement.
   d. Final model must be photographed by the A/E and a set of prints as well as digital files in JPG format are delivered to the County.
   e. Final model must be delivered before the final payment for the CD phase.

Design Quality Control (DQC) Requirements

K. General

1. Montgomery County requires a high degree of design and quality control during the design process. In this section all required deliverables that relate to design quality control are described. A/E must be clear about these requirements and if there are any questions they must be forwarded to the County before start of the design phase.
2. It is intent of the County to assist the A/E in providing the County with high quality

Construction Documents. Non-coordinated, low quality drawings and specifications are the first contributors to the cost overrun of the projects. Montgomery County has a specific process in conducting progress meetings and review of drawings.

3. Quality assurance and quality control must be consciously considered throughout all design and construction phases of each project. Completeness and thoroughness of the work at each design phase will be critically reviewed and acceptance delayed until requirements are met.

4. Orientation meeting

a. As soon as the design contract is signed, the County Project Manager will schedule the orientation or kickoff meeting. The Design Section Chief and staff of Division of Facilities Management will attend the meeting and must be notified. Agenda for this meeting includes:

1) Introduction of the team including the tenant and other stakeholders as well as DGS staff involved in the project and their roles. All consultants must be attend this meeting. The intent is to know those who make decisions as well as those who design the project. Therefore attendance of project managers and project architect/engineers of various disciplines is mandatory.
2) Review of the County project management process with accompanying charts.
3) Review of the project schedule.
4) Review of the project budget and means of cost control including cost estimating for various phases and alternate adds and deducts.
5) Establishing progress meetings and who should attend.
6) Review deliverables.
7) Review the review process
8) Answer any questions that the A/E or tenant may have.

5. One of the principle roles of the prime consultant is to take charge of overall project coordination. Accordingly, the prime consultant must take responsibility for schedules, costs, sub-consultants, permit submittal, and all aspects of project management; and final contract documents must give clear evidence that such has been the case. The County will require that the prime consultant develop and use a project coordination and plan checking program that includes all disciplines.

6. The contractual direction to the consultant will come from the County's Project Manager. The consultant shall confirm any perceived change in project direction or scope with County's Project Manager prior to proceeding with each new direction. In issues of technical design and submittal approvals, the Project Manager will have primary responsibility. The Project Manager will have the responsibility to assure all issues and concerns raised by the County staff have been satisfactorily resolved. The Project Manager will also be responsible for assuring that all interested parties are involved as needed in the project discussions and reviews.

7. Sub-consultants must also bear considerable responsibility for design coordination. As facilities become more complex, the work of the sub-consultants generally requires more space. That space must be thoroughly defined and properly incorporated into the building. The space required is not only to house the equipment but also must provide for convenient operation, maintenance and repair over the years to follow. Each consultant is responsible for coordination of documents with all other disciplines with which their work is to be integrated.

8. The A/E must furnish for review by the County, not later than 2 weeks after receipt of a Notice to Proceed, its Design Quality Control (DQC) plan. The plan must identify all items listed in this document and must include sample forms where forms are required.

9. Submit the name, qualifications (in resume format), and responsibilities of each person assigned a DQC function. Staff must include:

a. Design Quality Control Manager - The DQC Manager must report directly to a Principal of the firm. DQC Manager can not be the Project Manager. The Principal in this context shall mean the individual with responsibility for the overall management of the firm including quality production. The DQC Manager must be a registered architect or engineer, and an experienced design person with a minimum of 10 years experience in architectural or engineering design, 5 years of which must be in DQC.

b. Supplemental Personnel - The A/E must provide as part of the DQC organization, as a minimum, specialized personnel for the following areas:

c. HVAC Engineer - Registered P.E. with minimum 10 years design experience to provide quality control review, checking and coordination of HVAC system.

10. At the end of each phase there will be an A/E performance evaluation in which completeness and timeliness of these requirements play an important role.

11. A/E must complete and submit the design check list included in this manual at the end each phase.

12. County project manager will adhere to and enforce these requirements.

L. Submittal Tracking Plan

1. A/E must submit a checklist identifying agency, agency contact, submittal format, comments, submittal, follow-up, re-submittal, and final approval dates. A listing of submittals being tracked, including permits, utilities and County review submittal. (see sample at the end of this document)

M. Scope Tracking System:

1. The A/E must create a system of tracking the scope changes during the design. All deviations from the POR must be recorded and tracked until the end of design process. The tracking log must include the impact of such change on the other aspects of the project including schedule and cost.

N. Coordination Plan:

1. A checklist or matrix format identifying design elements requiring coordination by phase, consultants responsible for coordination sign-off, coordination issues, check dates, follow-up, and final resolution.

O. Space Calculation Charts:

1. The A/E must present to the County a full area calculation and tabulation report at the end of each phase. This report must show the result of calculations in the previous phases as well. Report must be generated in a spread sheet format -Excel- (print copy & electronically) and be organized by operational groups as presented in the POR or agreed by the County. Calculations must be accompanied with a floor plan graphic showing various categories of tabulations in color. The floor plans must be precise and show programmable areas for each space. The list and graphics must be updated at all times. Refer to the end of this section for samples and examples of these charts.

P. Review Process

1. Progress Review Meeting

a. Throughout the design process the AE team and not just the prime consultant, must attend a bi-weekly meeting to review, coordinate, and monitor the progress of the project. These meetings are for the benefit of the owner and all stockholders should attend them. There might be a need for more meetings such as weekly meetings to meet the review process requirements and Design Quality Control. It is imperative that these requirements be met in order to assure timely and thorough review and compliance with the project schedule.

b. Design sub-consultants must be included as integral members of the project team in the early stages of design. They must attend all progress meetings. Most often a simple issue has been forgotten to be relayed to subs or simply their absence in the design progress meeting deprives the team from their early reaction to issues and ultimately the project suffers from the lack of integration and coordination. Due to the increasing intensity of technical requirements in buildings of all types, it is mandatory that each technical field be fully represented even in the early stages of design to assure that adequate provisions are included in the floor plans.

2. Informal Reviews

a. In addition to the formal progress review periods it is important that many less formal reviews occur. It is imperative that thorough communication and understanding exist between County staff and consultants. This process is to assure that the County's needs are understood, accommodated, and that each new facility be designed with maintenance and operation requirements fully recognized. These considerations are best dealt with via a series of on-the-board reviews with the consultants to consider design options and make decisions while the design is still flexible. More review and concurrence achieved mid-phase will help minimize the end-of-phase comments.

3. Quality Control Review

a. National statistics have shown that 80% of documents errors and omissions occur in only 20% of the items on a given set of documents and this 20% tend to be repeated with each project. Of these errors and omissions, over 50% are directly related to interdisciplinary coordination issues. The design consultant shall implement a document quality control plan to minimize the impact of poor coordinated documents.

b. In the case of large size projects, a formal Document Quality Control Review (DQCR) is required by the County to assist the consultant in realizing quality contract documents. This review is not intended to relieve the consultant of their responsibility for producing complete and integrated documents. Based on the Multi-Check™ team review methodology, the QC Review is a three-step process of 1-check, 2-correct, and 3-re-check. The QC team will use detailed discipline-based checklists, color coded annotation, and narrative comments to identify conflicts, errors, and or omissions from, and between the various elements of the bid documents. The Design Team will respond to all QC checks and comments, resolving interferences and conflicting design while expanding and completing gaps and omissions in the documents. As a final the QC team leader will recheck the corrected documents to verify that corrections were made.

c. The County has a Design Review Check List included in this manual. This check list is tied to this document. A/E team must review, complete and respond to the completeness of this list. The County will review all submittals at the end of each phase. A team of professionals will review all documents submitted by the A/E and will provide a set of comments for revision/ correction to the documents. The A/E must resolve issues and incorporate requested comments into the documents.

d. At the end of each phase of the project the A/E must present the design documents to the County. Reviewers will ask questions to better familiarize themselves with the design.

e. County will review contract documents for overall completeness and compliance with the functional program and County standards, due to staffing limitations this is not intended to be the comprehensive plan checking/coordination process. The prime contractor shall check the plans and coordination before submission to the County for review. Documents that are incomplete or poorly coordinated will be returned to the consultants until they are deemed ready for review by County staff.

f. Two to three weeks are required for the County to review the drawings and prepare a set of consolidated comments to the A/E. The County project manager is encouraged to meet with all reviewers and go over all comments and filter out similar or non related comments.

g. Consolidated comments shall be forwarded to the A/E for preliminary review.

h. The A/E is responsible for distribution and coordination of all comments among various consultants involved in the project.

i. The A/E must respond in writing to each comment. If a comment is not incorporated the A/E must provide a rationale for not incorporating the comment. This response must be provided within one week after comments provided to the A/E.

j. Project manager, reviewers and the A/E will meet in a comments review session. Comments shall be divided in the following categories:
   1) **Will Comply**: A/E will comply but can be deferred to the next phase. Written PM approval is needed and should be noted.
   2) **Incorporate**: A/E will comply and must be incorporated in the documents before notice to proceed to the next phase.
   3) **Dismissed**. Written PM approval is required.
   4) **Not Feasible**: If the work is required but for some reason can not be done, the Section Chief of Design must approve all deviations from the County standards and requirements in writing.

k. If revisions are needed the A/E must present an updated schedule to show that the project will not fall behind the contract master schedule. If the schedule needs to be compressed it is not acceptable to shorten the review periods. All deviations from the master schedule must be approved by the Chief of Design Section. The A/E must understand that any delay of the master schedule is in conflict with the contract and all requests for extension of time must be approved by the Contract Administrator.

4. Architectural Review Committee

a. At the end of each phase and before NTP, Section Chief of Design will establish a panel of reviewers called “Architectural Review Committee”. This committee will review and approve the design for the following:
   1) Design Philosophy
   2) Building style and appearance
   3) Urban design compliance
   4) Adherence to the scope, budget, and schedule
   5) Other issues and factors that they may seem relevant to the project

b. At the end of the review the Section Chief of Building Planning and Design will complete and issue the Project Evaluation Form.

c. Materials for ARC review are rendered site plan, floor plans, elevations, sections and slideshows, models, summary of the design to budget, schedule and scope variances.

5. Other Reviews

a. In addition to the document reviews noted above, sustainability review, ADA review, constructability review, commissioning review, Permit review, Mandatory Referral and historical review may be necessary.

Q. Minutes of Meetings

1. A/E must provide minutes of the meetings not later than 3 working days after such meeting to the County. Large projects are required to have the meeting minutes typed electronically during the meeting so they can be verified before the end of the meeting. This will minimize confusion and provide clear direction to all parties.

2. Minutes of the meetings should include the following information: (Refer to appendices)

a. Name of the project
b. Date and time of the meeting
c. Name of attendees
d. Location of the meeting
e. Agenda
f. Every subject or issue must be numbered sequentially.
g. At the following meetings if an issue is resolved it must be grayed out and after 2 meetings it should be deleted from the list.
h. A list of actions required for the following meetings including responsible party and time frame and deadline to perform the task.

3. County and recipients of the minutes should have 5 calendar days to respond and or correct the minutes.

4. Minutes of the meeting must be distributed to the entire team including the County team.

R. Decision Log

1. Decision Log is a mechanism to record all important and incremental decisions that are made during the design process. Most often there are members of the team that miss few design progress meetings and later on they may comment or request items that are previously decided and approved to be completed in a certain way.
2. A/E must provide Decision Logs not later than 3 working days after such meeting to the County.
3. Decision Log is an independent document from the minutes of the meeting.
4. All decisions made (approved by the County) must be logged sequentially in a table format.
5. All logs must include:
   a. Title
   b. Date of the decision made
   c. Approving party
   d. Affecting disciplines for coordination.
6. County and recipients of the Decision Logs should have 5 calendar days to respond and or correct the minutes.
7. Decision Logs must be distributed to the entire team including the County team.
8. Decision Logs must be generated during each progress; however, a complete and most updated Decision log must be submitted by the A/E to the County with each request for payment. Invoices will be rejected if not accompanied with this log.

S. Project Schedule

1. Project schedule is a mechanism to follow the production of the design and assure that all activities are happening within the required time frame. Montgomery County requires that all projects have a detailed project schedule indicating all activities. Project schedule must be in Primavera or compatible format approved by the County.
2. Initial project schedule must be delivered to the County not later than two (2) weeks after the initial orientation meeting.
3. Project schedule must be updated as soon as a change in the schedule is apparent.
4. A complete and most updated Project Schedule must be submitted by the A/E to the County with each request for payment. Invoices will be rejected if not accompanied with this schedule. Incomplete and not updated schedules will not be accepted for payments.
5. All schedules must also include:
   a. Name of the project
   b. Date of data entry
   c. Print date
   d. Project phases
6. Schedules must be provided to the County in the following formats:
   a. A complete color print including all activities, duration, early start, early finish, late finish, dependencies, time bars with the name of activity on the left side and critical path in red color, and dependency links.
   b. A base line of the original schedule must be kept and an actual bar must be shown for each activity. This way the progress of the project is compared to the original schedule.
   c. A typical (template) project schedule will be provided to the A/E for modification and use. This template is in Primavera format and must be modified or used as needed for the project.
   d. Schedules must include activities and tasks for documents submissions to the County, state and other reviewing and permitting entities.

T. Schedule Log

1. Schedule Log is a mechanism to record all important and incremental events and decisions that changes the project schedule during the design process.

2. A/E must provide Schedule Logs not later than 3 working days after the change to the County.
3. Schedule Log is an independent document from the Project Schedule.
4. All schedule changes (approved by the County) must be logged sequentially in a table format. (Refer to appendices)
5. All logs must include:
   a. Title
   b. Date of the schedule change
   c. Approving party
   d. Affecting disciplines for coordination.
6. County and recipients of the Schedule Logs shall have 5 calendar days to respond and or correct the log.
7. Schedule Log must be distributed to the entire team including the County team.
8. Schedule Log must be generated during the project progress; however, a complete and most updated Schedule Log must be submitted by the A/E to the County with each request for payment. Invoices will be rejected if not accompanied with this log.

K. Design Document Progress Log

1. Design Document Progress Log (DDPL) is a mechanism to record and keep track of progress for all disciplines and all design documents including but not limited to drawings, specifications and any other documents that are submitted at all incremental submissions.
2. A/E must provide the "Design Document Progress Log" with all incremental design submittals according to “Table of Phases and Deliverables”. No progress submittal shall be accepted unless accompanied by the Design Document Progress Log.
3. A typical template is provided at the end of this document.
4. Design Document Progress Log must include:
   a. Title, project name and CIP number
   b. Date of current submission
   c. Date of last submission
   d. County PM, A/E firm and A/E PM name
   e. Document reference numbers and titles
   f. Status of the documents using action codes as designated in the log.
   g. Brief description of what has been changed or updated since the last submission for each document.
5. A/E PM shall review and sign the DDPL in the designated area of the Log.
6. Design Document Progress Log must be generated during the project progress however; a complete and updated DDPL must be submitted with each request for payment. Invoices will be rejected if not accompanied by this log.

L. Life Cycle Cost Analysis (LCCA)

1. LCCA is a decision making tool for building owners and designers. The analysis accounts for initial costs associated with constructing or renovating a facility as well as the cost of owning and operating a facility over its useful life. The LCCA report provides a method of evaluating the various systems so a building owner can select the best system for the building. The analysis should be based on the comparison of minimum of three (3) options or alternatives selected. The three chosen systems must be different from each other, such as a central chiller plant and a heat pump split system. For example a heat pump split system and an air conditioning split system with gas or electric furnace are essentially the same systems and may not be used for comparison with each other.
2. The ELCCA process must be complete, accurate, and timely to benefit the design team and the facility's decision makers. It is important to complete this part of the ELCCA submittal prior to the beginning of design development stage so that any recommended changes can be easily incorporated into the design.
3. The LCCA must be done by a qualified professional accepted by the project manager.

4. A list of systems and components that require LCCA must be prepared during the Schematic Design phase. Before engaging in the LCCA, the three options must be approved by the project manager.
5. For selection of items that relate to the energy use in the building LCCA must be done using computer modeling and simulation (major mechanical components or systems, envelope, lighting, power, etc.).
6. For selection of other components and elements of design a simple LCCA is sufficient and must include the following;
    a. Present value of the item
    b. Life expectancy of the item
    c. Operational and maintenance cost of the item during it's expected life
    d. Non quantifiable qualities such as aesthetic or compatibility must also be mentioed
    e. Reason for selection of one over the other options.

M. Construction Cost Change Log

1. Construction Cost Change Log is a mechanism to monitor the design and its conformance to the established construction cost budget.
2. This document includes: (Refer to appendices)
    a. A list of all items that caused the CCAP (Construction Cost Award Price) to change.
    b. Cost change for each item.
    c. A log of all alternate Adds (additions) with their cost, date added and approving party.
    d. A log of all alternate Deducts with their cost, date and approving party.
    e. A chart comparing change in the construction cost escalation since the project start date.
    f. A chart indicating use of design contingency. An incremental reduction of percent allocated must be shown with date and approving party.
    g. Change in overall cost per square foot since start of the project.
    h. Construction Cost Change Log must be generated during the project progress; however, a complete and most updated Construction Cost Change Log must be submitted by the A/E to the County with each request for payment. Invoices will be rejected if not accompanied with this log.

PROJECT PHASES

Phases

N. General

1. The project is broken down in to individual phases to describe significant portions of work and project milestones. The phases are described using stages and submittal requirements. Stages are defined as periods of work within a phase. Each stage has a minimum set of requirements but does not have a specific time period assigned to it. One stage within a phase may be 2 weeks and another stage within a phase may be 6 weeks. Ultimately stage duration will be determined by the amount of effort required to complete that stage. Information listed under each phase/stage is intended to help define the County's minimum requirements for the phase/stage. Some of the information under the phase/stage is listed in CSI format, which is a mechanism to organize the information. Use of the CSI format is as an informational tool and is not meant to be all inclusive. The A/E must provide all information required, whether listed or not, to complete a fully functional building. Any work that is not listed must be provided in a timely manner so the County can review and comment on the work.

O. Conceptual Planning Phase

1. In this phase program of requirements is validated and site and building mass and siting is decided.

P. Schematic Design Phase

1. In this phase site is fully analyzed, building systems are selected, floor layouts are

generated. There is some understanding of building and finish materials.

Q. Design Development Phase

1. In this phase all systems are fully developed, all details are designed and communicated, interior design is finished, furniture layout is prepared and furniture plan is completed, Materials and finishes are selected. <u>There shall be no design decisions left after this phase.</u>

R. Construction Documents Phase

1. In this phase the A/E team will develop a complete construction documents for the purpose of permitting as well as bidding. <u>No design decisions shall be left for this phase.</u>

S. Bidding and Negotiations Phase

1. In this phase the project is bid and the team will evaluate the bids and engage in cost control activities including value engineering and cost reduction with the contractor if needed.

T. Construction Phase

1. In this phase the A/E will perform construction administration, quality control of construction, and commissioning.

U. Post Construction Phase

1. In this phase the A/E is required to assist the County in warranty period checks.

Phase 1: Conceptual Planning – CP

V. Stage 1: Program and Data Verification-CP

1. Division 01: General Requirements
   a. The purpose of the Conceptual Planning Phase is to establish the basic site design concepts, verify and establish the capability of the site to meet the program parameters, and arrive at possible solutions. The A/E's solutions will be reviewed by the County.
   b. Unless otherwise specified in the Contract, the A/E must present at least three conceptual design schemes for County review and selection.
   c. Verification Requirement
      1) In accordance with the County's A/E contract for design services, the A/E team must meet, as necessary, with the Project Manager, other agents of the County and representatives of the User Agency in work shop sessions to validate the POR, validate spaces and their size, and validate the total programmable, net and gross square feet for the building.
      2) The A/E team must also attend in a meeting coordinated by the County Project Manager to meet with representatives of local, state, Federal, M-NCPPC, DPS, HPC, and other code enforcing and regulatory agencies to clarify and verify permitting requirements and jurisdictions. Results of this meeting must be recorded and shared with all participants for future reference during the design and construction of the project. The intent is to become aware of all requirements and mitigate project delays...
      3) The A/E must collect, verify, and document all legal documents such as property plans, deed line demarcation, utility company's Right of Way and easements, zoning requirements, master plan, sector plan, leases and any contract or agreement that exists between the County and other parties that may have an impact in one form or other on the project. This information must be presented to the County in the submittal binder.
      4) Validate the information given to the design team including the Program of Requirements. A critical function of this phase is to reconcile the programmed need to the proposed design. It also serves to clarify the functional program, identify functional program oversights or excesses, and generally verify that the proposed program is feasible from a facility development perspective.
      5) If the project is a renovation, the County may have facility drawings, specifications, design computations, maintenance manuals, air balance records, etc. Consultants are expected to fully utilize these resources, in conjunction with thorough hands-on review of existing conditions, to ensure that alterations of and additions to existing facilities do not over tax existing systems to meet new requirements. The Project Manager will provide assistance

as available to allow consultants to obtain all necessary information germane to the project program. It is mandatory that consultant's field-verify all reference information and as-built conditions since the County cannot guarantee that all conditions have remained static since last time that they have been "officially" altered or documented. The Consultant shall provide a copy of the field-verified conditions to the Project Manager. If existing drawings of the facility do not exist, it is the A/E's responsibility to investigate measure, document and draft the existing conditions.

d. Submittal Requirement
   1) Provide the County with a progress report.

2. Division 01 81 13: Sustainable Design Requirements

a. Conduct a charrette meeting to establish LEED certification points and green design goals.

3. Division 02: Existing Conditions

a. For renovation projects, A/E must start mobilizing and sending technical staff to the site/Building to collect all necessary information and start documentation of the existing conditions as needed and stipulated in the POR template for renovation projects.

4. Division 02 21 00: Site Survey

a. The A/E shall complete a boundary topographic survey of the existing site including all existing element of the site required for the design and construction of the Project. The survey shall be submitted to the County for review and approval.
b. Verify and document all right of ways that might exist.
c. Verify and document zoning requirements.
d. Verify and document property lines, deed lines and possible legal or permitting issues that need attention.
e. Verify and document possible pedestrian safety issues.
f. Verify and document building location.
g. Verify and document vehicular access.
h. Verify and document pedestrian access.
i. Discuss security needs for the site and building and how it might impact the site configuration and building location design.

5. Division 02 30 00: Subsurface Investigation

a. Start process of geotechnical analysis of the site.

6. Divisions 10 and 11: Specialties and Equipment (including equipment in Divisions 27 and 28)

a. Review existing specialties and equipment with Project Manager and User Agency to determine items for reuse, define list of future items to be included, and confirm programmed space sizes are adequate.
b. Prepare consolidated list (existing to be reused and items projected to satisfy future requirements) of specialties and equipment with associated critical dimensions. List of equipment may be included on the drawings or provided as supplemental information.
c. The Project Manager may deem it necessary for certain projects, to require additional equipment information be assembled at this stage in the process. Reference requirements for equipment schedule defined in 'Submittal Requirements for Schematic Design Phase' if appropriate.

7. Division 12 50 00: Furniture

a. Review existing furniture/furnishings with Project Manager and User Agency to determine furniture/furnishings for reuse, define list of additional items to be included, and confirm programmed space sizes are adequate. Assign item numbers and photograph existing pieces if deemed appropriate by Project Manager at this stage.
b. The Project Manager may deem it necessary for certain projects, to require additional furniture/furnishings information be assembled at this stage in the process. Reference requirements for furniture inventory defined in 'Submittal Requirements for Schematic

Design Phase' if appropriate.

c. Prepare preliminary furniture budget.

d. Binder shall include:

1) Preliminary furniture budget;
2) Projected list of reused and new furniture with critical dimensions.

W. Stage 2: Site and Building Concepts-CP

1. Division 01: General Requirements

a. Plan and start process of geotechnical analysis of the site.

b. Verify Availability of utilities (Water, electricity, telephone, fiber optic line, gas, and other features that might be over or under ground)

c. Verify Presence of wetland, streams, etc.

d. Conduct a preliminary code analysis and report.

e. Explore and document options of building massing that conform to the zoning and easement requirements.

f. Explore and document locations of the building on the site that conform to the zoning and easement requirements.

2. Division 01 81 13: Sustainable Design Requirements

a. Full analysis of what can be done to the site and building location to meet and exceed green and LEED requirements.

b. Register project with USGBC.

3. Division 02 22 19: Traffic Assessment

a. MNCPP-C (or authority having jurisdiction and the State Highway Administration must be consulted in this matter to find out if they require a traffic study for this project.

b. Analysis that based on the adjacent roads if traffic study is needed or not. If needed, provide the consultant and arrange for a traffic study based on use of facility.

4. Division 02 24 00: Environmental Assessment

a. Verify existence of any champion trees on the site.

5. Division 02 30 00: Subsurface Investigation

a. Provide seismic geotechnical surveys of the site. This is to verify the three dimensional configuration of the subsurface conditions. Also provide a limited number of spot boring verifications. Further boring test will be done after SD phase.

6. Division 27: Communications

a. Verify and document existence of fiber optics and telephone lines.

7. Division 32 70 00: Wetlands

a. Document and present wetlands, streams and all other environmentally sensitive features of the site.

8. Division 33: Utilities

a. Verify and document availability of utilities (water, electricity, telephone, fiber optic line, sanitary sewer ,storm drain, natural gas, ponds and reservoirs, and other features that might be over or under ground)

b. Verify and document utility right of ways that might exist

9. Division 34: Transportation

a. Verify and document public transportation and closest bus stops and metro station.

X. Submittal Requirements for the Conceptual Planning Phase-CP

1. Division 01: General Requirements

a. Submittal Requirement

1) All revisions, validations, verifications, and conceptual drawings and sketches and reports must be presented to the County in a booklet format (8.5x11 with 11x17 inserts if needed) for review and record. Changes to the original program must be clearly identified.
2) A/E must produce as many sketches and concepts as necessary to satisfy the County that the concepts of the design are acceptable.

3) Cost estimates must be provided for major CSI divisions (a list is provided at the end of this section. At this point cost estimates are most probably in SF format.
4) A/E shall not proceed to the schematic phase unless Contract Administrator is satisfied that CCAP can be met and a notice to proceed is issued.
5) A/E will present the conceptual design to the DGS Architectural Review Committee (ARC).
6) The A/E must provide as minimum number of sets of documents as identified in the ***Table of Deliverables During the Design Phases*** at the end of this document. Report must be delivered to the County in a 3 ring binder format. Unless otherwise noted in the contract as an exception the following quantities must be delivered:
    a) 2 set for the PM team
    b) 3 sets for QC reviewers
    c) 1 set for the file
    d) 2 sets for Facilities Management
    e) 1 set for the Section Chief
    f) 2 sets for the user agency
    g) 1 set for Division Chief

2. Division 01 81 13: Sustainable Design Requirements
  a. Report of green/LEED requirements.
  b. Prepare preliminary LEED score card.
  c. Estimate costs for individual LEED points.
  d. Copy of project registration with USGBC.

3. Division 01 91 00: Commissioning Requirements
  a. Report documenting that the A/E has started working on the commissioning plan.

4. Division 02 22 19: Traffic Assessment
  a. Report on the status of traffic study.

5. Division 02: Existing Conditions
  a. Document results of building condition assessments and survey.

6. Division 02 21 00: Site Survey
  a. Provide results of all various site survey and verifications.

7. Division 02 24 00: Environmental Assessment
  a. Provide results of all verifications.
  b. Verify and present existence of any champion trees on the site.

8. Division 02 30 00: Subsurface Investigation
  a. Provide results of the geotechnical surveys.

9. Division 27: Communications
  a. Document existence of fiber optics and telephone lines

10. Division 32 70 00: Wetlands
  a. Document and present wetlands, streams and all other environmentally sensitive features of the site.

11. Division 33: Utilities
  a. Document availability of utilities (Water, electricity, telephone, fiber optic line, sanitary sewer , storm drain, natural gas, ponds and reservoirs, and other features that might be over or under ground)
  b. Document utility right of ways that might exist

12. Division 34: Transportation
  a. Document public transportation and closest bus stops and metro station.
  b.

Phase 2: Schematic Design – SD

Y. General

1. Division 01: General Requirements
  a. The purpose of the Schematic Phase is to establish the basic design concepts, develop and implement the program parameters, and arrive at solutions. The designer's solutions will be reviewed by the County. No significant departure from the

approved schematic submittal will be allowed unless prior written approval is obtained from the County.

b. Unless otherwise specified in the contract, the A/E must present at least three design schemes for ideas and concepts for the County to review and choose.
c. The A/E shall interface with all Agencies requiring permits and approvals for the Project as to the progress of the design and incorporate comments as required.
d.

Z. Stage 1: Site Design & Building Layout-SD

1. Division 01: General Requirements

a. In this stage the A/E must develop conceptual building layout and locate the building on the site. Following are brief description of items to be considered:
   1) Building mass
   2) Location of the building on the site
   3) Site features that will impact the design
   4) Sun movement and shadow analysis
   5) Possible major landscaping features and elements to assist green design
   6) Pedestrian and vehicular movements on the site
   7) Location of major utilizes on the site
   8) Completing floor layouts responding to the program of requirements.
   9) Recognizing historical issues.
   10) Parking layout
   11) Entrance to the building
   12) Possible type of roof
b. All Conceptual Planning Phase comments must be incorporated at this stage. Delay to incorporate CP comments later is not acceptable since it will create confusion in reviewing the documents.
c. Civil engineer must start survey and recording site elements to inform the design.
d. A progress set or report must be delivered to the County to show progress in the schedule and as prerequisite for payment.
e.

AA. Stage 2: Systems Selection-SD

1. Division 01: General Requirements

a. The A/E must continue on all elements of the design, but in order to ensure full coverage of all aspects of the design, the County requires the A/E to specifically concentrate on the following elements of design in this stage. In this stage the A/E must develop building systems selection:
   1) Building structure
   2) Mechanical system
   3) Electrical system (need for transformer, size of service, entry point, emergency generator, etc.)
   4) Plumbing system (entry point, sewer, location of meter, pressure, etc.)
   5) Roof type
   6) Envelope type
b. Civil engineer must be finished with the survey of the site.
c. A progress set or report must be delivered to the County to show progress in the schedule and as prerequisite for payment.

BB. Submittal Requirements for the Schematic Design Phase

1. Division 01: General Requirements

a. One (1) set of the drawings shall be of presentation size and quality in color as necessary to brief the project design committee concerning the quality and scope of the project.
b. A/E will present the schematic design phase to the DGS Architectural Review

Committee (ARC).

c. Unless otherwise specified in the contract, the A/E must present at least three design schemes for ideas and concepts for the County to review and choose.
d. The schemes will be evaluated by the DGS and the user agency to determine a workable and appropriate design solution in respect to site conditions, program of requirements and funds available.
e. To show conformance with the Program of Requirements (POR) a report must be generated to validate programmable, net and gross area calculations for each space including building core spaces and circulations.
f. The A/E shall assist the County in conducting a public presentation meeting.
g. The A/E shall establish communication with the M-NCPPC (or local planning commission) through County project manager for the Mandatory Referral process and prepare all required documents to obtain M-NCPPC approval of the project.
h. Provide phasing plan and analysis of the construction sequencing.
i. Documents prepared by the A/E for the schematic design submittal and approval shall include a report. The report shall include, but not be limited to, graphic representations of the results of the various environmental planning and design studies to assure the feasibility of site development. It shall also include review of available geologic and geotechnical information and test borings applicable to establishment of facilities location.
j. Should the documents submitted not conform to the requirements outlined in this manual, the A/E must revise, correct and complete the documents and reprint at its own expense and with no additional cost to the County as required to obtain the County's approval.
k. All drawings must have adequate legends, symbols and annotations to fully understand the design and materials on the drawings.
l. Floor plans
   1) Develop floor plans for all levels showing walls, major wall types, room name and number, room size, door swings, major mechanical equipment, and etc.
   2) Floor plans delineating programmatic functional divisions in filled colors with full legend.
m. Possible materials and finishes must be discussed and presented.
n. Specification Requirements -SD
   1) Outline specifications for each CSI section used.
   2) Outline specification requirements shall consist of design narrative as described in the commissioning program.
   3) The specifications shall be comprehensive and complete as the schematic documents permit and shall address all relevant component/sections of the work and where required by the scope of the project.
o. Estimating Requirements - SD
   1) The estimate shall be developed in as much detail as the schematic drawings and specifications permit. Cost for each section of the specification shall be included.
p. Renderings – SD
   1) Variety of renderings can and must be presented at this phase suitable for public presentation including:
      a) Elevations
      b) Sections
      c) Floor plans
      d) Site plan with roof, shadow and landscaping
      e) Axonometric or perspective view of the building on the site
      f) Axonometric or perspective view of interior spaces
q. Model – SD
   1) A working model must be prepared by the A/E to show site contour and building mass and location with enough details to be able to relay the site and building concepts. Major site elements such as roads, wetland, wooded areas, etc. must be clearly delineated. This

model should be transportable to various meetings for presentation. Although this is not a final professional model, it cannot be rough or amateurish.

2. Division 01 81 13: Sustainable Design Requirements
   a. The A/E shall prepare all the necessary documentation for LEED certification to USGBC. Provide a copy of the LEED binder to the County.
   b. Detailed cost analysis of the cost impacts for each LEED credit.
   c. Detailed calculations for each credit to be pursued.

3. Division 01 91 00: Commissioning Requirements
   a. Major goals for the commissioning must be outlined at this phase. This is the foundation for the next phases and focuses the attention of the design team on the possible commissioning issues.

4. Division 02: Existing Conditions
   a. When providing new layouts and design all existing conditions must be fully considered.
   b. If project is a renovation, SD package must include a report of existing situation and issues. There should also be draft construction phasing plan.

5. Division 02 21 00: Site Survey
   a. Site survey must be completed.
   b. Provide all documentations for site survey.

6. Division 02 22 19: Traffic Assessment
   a. Final traffic study must be presented.

7. Division 02 24 00: Environmental Assessment
   a. Final environmental assessment report must be presented.

8. Division 02 30 00: Subsurface Investigation
   a. Provide results of the geotechnical surveys.

9. Division 03: Structural System
   a. Provide structural systems layout with overall dimensions and floor elevations.
   b. Identification of structural system, i.e., precast, structural steel with composite deck, structural steel with bar joists, etc.
   c. Identification of foundation requirements: i.e., fill requirements, piles, caissons, spread footings, etc.

10. Division 07: Envelope
   a. Provide envelope system such as façade cladding, widow system, roof system and green/ LEED/energy efficiency discussions for the envelope design.

11. Division 07 71 00: Roof
   a. A roof plan showing slopes, drains, parapets. Annotate all features.

12. Division 07 77 00: Exterior Walls
   a. Develop elevations of all sides to show the design intent, style, height, materials, colors, and other devices on the façades.
   b. Preliminary exterior wall cross sections and elevations indicating location and size and type of fenestration, and indicating overall thermal transfer value for the exterior wall envelope along with each type of proposed insulating material.
   c. Minimum of two cross-sections with floor heights, including basement spaces identifying program spaces and relationship to site configurations.
   d. Delineate day-lighting features.

13. Division 08: Openings (Doors & Windows)
   a. All doors smaller or larger than 36 inches wide must be annotated.

14. Division 08 70 00: Hardware
   a. Hardware information to be collected.

15. Division 09 50 00: Ceiling
   a. Provide a ceiling plan showing major ceiling types, light fixtures, and ceiling height.

16. Division 09 60 00: Flooring

a. Provide a flooring layout showing various possible finishes and materials.

17. Division 10 06 10 Exterior Signage

a. Provide locations of exterior signs.

18. Division 10 06 11 Interior Signage

a. Start planning for interior signs

19. Division 10 21 00 Toilet Compartments

a. Show toilet partitions.

20. Division 10 22 26 Operable Partitions

a. Show operable partitions on layouts

21. Division 10 71 13 Exterior Sun Control Devices

a. Schematic sections and elevation should show sun control devices to be fully developed in later phases.

22. Division 10 73 00: Protective Covers (Canopies, etc.)

a. All protective covers must be delineated.

23. Divisions 10 and 11: Specialties and Equipment (including equipment in Divisions 27 and 28)

a. Prepare spread sheets to include designated item number, type, manufacturer, model number, size, clearances, electrical and mechanical requirements for all specialties and equipment intended for reuse and projected for future requirements. Spread sheets shall include but are not limited to; office equipment, residential appliances, vending machines, audiovisual specialties and equipment, special equipment, data and voice communications equipment, and electronic security equipment. Schedules may be included on the drawings or provided as supplemental information.

b. Compile manufacturers' cut sheets of scheduled specialties and equipment.

c. Floor plans should delineate all equipment including office equipment, AV equipment, etc. to be fully developed in later phases.

24. Division 11 26 00: Kitchen Equipment

a. If project has a large commercial kitchen, the kitchen layout must be provided.

25. Division 12 50 00: Furniture

a. Prepare inventory of furniture/furnishings (free-standing and systems) identified for reuse and coordinate with planned dimensions of intended spaces. Furniture Inventory to include:

1) Assigned item number (if tagging is deemed appropriate);
2) Current location / user;
3) Item type and description (i.e. Chair, Task);
4) Dimensions;
5) Manufacturer and product number (if available);
6) Electrical and tel/data components particulars (if applicable);
7) Material(s) / finish;
8) Quantity;
9) Condition;
10) Refurbishment and/or reupholstery notes (where applicable);
11) Photo;
12) Intended or possible location(s).

b. Furniture and loose equipment layout plans indicating size and location of all furniture and equipment. Existing furniture to be reused shall be distinguished from furniture to be purchased.

c. Furniture budget based on proposed layout that identifies new or reused/refurbished furniture (free-standing and systems) in all spaces; budget list prices; budget net prices; quantities; total cost; taxes; delivery and installation charges; and product that proposed budget is based on.

d. Preliminary furniture timetable identifying timeframes for design phase activities, preparation of specifications/bid documents, order placement/confirmation, manufacturing lead times, and delivery and installation in coordination with Project Schedule. Identify product selection options that present challenges to the schedule and/or anticipated pricing increases that may impact timing of procurement process.

e. Binder shall include:
   1) Furniture inventory;
   2) Furniture and equipment plans;
   3) Furniture budget;
   4) Cut sheets of product that budget prices are based on.
   5) Furniture timetable.

26. Division 12 3 13: Bicycle Racks

a. Provide bicycle racks outside

27. Division 13: Special Construction

a. If any special construction system is designed it must be clearly outlined in this phase for closer attention in the next phases.

28. Division 14: Conveying Equipment

a. All vertical circulation elements must be clearly identified and dimensioned on the drawings.

29. Division 21; Fire Suppression

a. Provide floor plans analyzing exit routs and major life safety features.

30. Division 22: Plumbing

a. As indicated above a site utility master plan showing sanitary and storm sewer layout.
b. Drawings showing locations of sewage ejectors and grinders (if required), and storm manholes.
c. Plumbing/sprinkler design schematic diagrams showing service entry, etc.
d. Green and LEED analysis of the plumbing system.

31. Division 22 40 00: Plumbing Fixtures

a. All plumbing fixtures must be shown.

32. Division 23: HVAC

a. Submit preliminary HVAC calculations to document the following:
   1) Envelope: U values utilized for the walls, roof and U values and Shading Coefficients for windows and skylights.
   2) HVAC Zones: Preliminary zone HVAC calculations to document the sizing of the HVAC equipment.
   3) Block Load: Preliminary block load calculations to document total building loads. Provide necessary engineering calculations to determine heating and cooling loads of the building.

b. HVAC System Selection:
   1) Propose three (3) alternate HVAC systems that apply to this particular type of facility.
   2) Perform an Energy Simulation and Life Cycle Cost Analysis of the three (3) proposed systems. All systems shall as a minimum comply with ASHRAE 90.1-2004 (latest) energy efficiencies and lighting power budgets.
   3) Provide general written description of each system, describing its major components, major operating features and why it was selected for this particular facility.
   4) Provide one line schematic diagram showing major components and a brief sequence of operations.
   5) Listing of the major equipment associated with each HVAC system and quantification of capacities. (Example: 100 tons air cooled chiller, two each 1000 MBH gas fired boilers, etc.)
   6) Provide floor plan showing location of all equipment (indoor & outdoor) for each system. The schematic diagrams shall indicate approximate available spaces for servicing the major equipment.
   7) Provide description of all energy conservation features included in the Energy simulation for each system.
   8) Provide utility Rates: Rates employed in the life cycles cost analysis.
   9) Provide operating/Occupancy schedule utilized in the Energy simulation.
   10) Provide preliminary Cost estimate for each HVAC system.

11) Provide results of the Energy Simulation for each system.
12) Provide life cycle cost analysis for each system.
13) Provide written report summarizing all of the above and recommending one system for the facility.

c. The AE during the SD phase is preparing three (3) alternate layouts (schemes) for the County to consider. These three schemes will be submitted at the end of the SD phase with the AE's recommendation for one scheme. Since the Mechanical SD analysis will run concurrently with the AE's analysis, the Mechanical Engineer will select one of the three layouts that is the most representative of what will be recommended. During this phase, the Architect will need to provide the Mechanical Engineer with the following:
   1) Area of each function and its orientation.
   2) Grouping of functions.
   3) Block layout to scale. The engineer will utilize this for their preliminary HVAC calculations.
   4) Special requirements.

d. Technique indicating overall combined heat transfer coefficient for roof/ceiling composite and roof area including the proposed insulating materials.

e. The A/E shall develop an overall strategy for energy conservation to meet the energy budget included with the Program of Requirements including building thermal envelope, HVAC system selection, heat recovery options, lighting design and day lighting design. The A/E shall simulate proposed building strategies using a computer based version of DOE2 as specified by the County, in order to influence the building design and attain compliance with the County's desired energy budget. The A/E will prepare and submit an energy analysis report to document the design strategy, life-cycle analyses, and annual energy consumption for the Schematic Design. The A/E shall review County Guidelines for Energy Conservation and incorporate required features in the project design, including design of an Energy Management System compatible with County central computers.

f. The schematic diagram shall show duct layout.

33. Division 26; Electrical

a. Lighting on separate distribution, roughly sized.

b. Major electrical equipment roughly scheduled indicating size, capacity and total loads.

c. A one-line diagram should be drawn in which a single line represents three phases of power system and it should be properly drawn, showing correct power distribution path from the normal power source and generators to *each* downstream load panels—including the ratings and sizing of each piece of electrical equipment, their circuit conductors, conduit size and their protective devices.

d. Low voltage systems: Identify all low voltage systems and their requirements.

e. Provide electrical design load calculations. The following basic electrical system design calculations and information must be performed by the consultant for all projects, during the preliminary phase and prior to the final completion of design. Load calculation documentation to be submitted will include.
   1) Load calculations and building power requirements for sizing of electrical distribution equipment, transformers, motor, and feeders. Including running and starting load requirements
   2) Emergency and legally required standby power requirements including equipment type and sizing.
   3) Preliminary estimate of annual energy consumption; include a list of potential energy savings options.
   4) Load analysis to support selection of equipment efficiency and conductor sizes including cut sheets. Group load calculation to (Power, lighting, HVAC, and Elevator)
   5) Verification of compliance with current code and standards.
   6) Lightning protection risk assessment and recommendations study.

34. Division 26 50 00: Lighting

a. The A/E is to provide Lighting Design strategy for the building to meet energy conservation goals set by the County.
b. Documentation to be submitted at this stage will include:
   1) Statement of foot- candles to be maintained for each type of task surface in the building.
   2) Calculation based on the latest required ASHRE of lighting wattage budget and current established standards (IESNA Standard) of lighting quality and illumination level for the building interior and exterior. Including catalog cut sheets
   3) Strategy for meeting lighting budget.
   4) Day-lighting design and analysis.
   5) Implementation of lighting control requirements
c. Photometrix Analysis: Provide drawing and analysis in graphic and text using light distribution software (photometrix) to show point to point light distribution in FC. The analysis should include the following:
   1) Photometrix drawings indicating FC and height of point values
   2) High lighting below and above standard (or requirement) points
   3) Light level at building perimeter (exterior windows)
   4) Light level at property lines
   5) Strategies for light pollution control
   6) Various type of light source
   7) Blocking of lighting concern zones (areas that in the program require certain lighting level) both for interior of the building and site
   8) Manufacturer light distribution cut sheets for each light fixture clearly correlated with light fixture types on the drawings
   9) On large projects provide a rendering of site night lighting plan by using appropriate software.

35. Division 27 20 00: Data Communication
   a. Computer system must be identified. Possible entry point for the data line to the building must be identified.
   b. Conduct a meeting with the County DTS to review the data system and where major related equipment should be located.
   c. Verify all electrical needs for the computers and peripherals.

36. Division 27 30 00: Voice Communications
   a. Telephone system must be identified. Possible entry point for the telephone line must be identified.
   b. Conduct a meeting with the County DTS to review the telephone system and where major telephone equipment should be located.

37. Division 28: Electronic Safety and Security
   a. Outline of the security systems for the project including locking, control, observation, central control, and materials to be used.

38. Division 31: Earthwork
   a. Identify possible grading, cut and fill, erosion and sediment controls

39. Division 32: Exterior Improvements
   a. Site plan with building footprint and grading plan with a minimum of 2'- 0" contour lines showing cuts and fills, entrance driveway, parking and circulations.
   b. Site plan delineating all legal parameters of the property including all public, private, and utility right of ways.
   c. Site plan for the storm water management, erosion and sediment control plans.
   d. File for the site concept plan with the County Department of Permitting Services or the municipal code enforcing agency.
   e. Site plan indicating all major utilities and entrance location to the building such as Water, electricity, telephone, fiber optic line, gas, and other features that might be over or under ground.
   f. Geotechnical report outlining findings resulting from soil borings, test pits, sonar

analysis of the soil layers, soils analyses, soil bearing values, and other geotechnical studies of the affected area.

g. File for NRI/FSD with M-NCPPC.
h. A report of pedestrian safety.
i. Way finding and signage plan.

40. Division 32 70 00: Wetlands

a. Site plan showing wetland

41. Division 33: Utilities

a. Show location of all utilities.
b. Present intended location of utilities to utility companies for preliminary approval.

Phase 3: Design Development – DD

CC. General -DD

1. Division 01: General Requirements

a. Upon written notice to proceed from the County, the A/E shall start the Design Development Phase.
b. The purpose of the Design Development Phase is to select all building systems, present them to the County in series of progressive meetings, and finalize all design elements and components of the building. No design decision, selection of systems, materials and or finishes may be left for the next phase.
c. Upon County acceptance and approval of the schematic design, the building systems and exterior wall locations (building "footprint") may be changed only as approved in writing by the County. No significant departure from the approved design development submittal will be allowed during the next phase, unless prior written approval is obtained from the County.
d. During this phase A/E must submit progress documents at various stages. The intent of these submittals is for the County to monitor progress of the work and while the A/E is proceeding with the work to provide comments. Theses incremental in-phase submittals are not the same as 100% submittal at the end of Design Presentation Phase which will be reviewed by a team of County professionals to assure compliance with all requirements and control the quality of design. In no circumstances County's review of documents substitutes the A/E's coordination and responsibility of compliance with all requirements.
e. The A/E shall interface with all agencies requiring permits and approvals for the Project as to the progress of the Design and incorporate comments as required.
f. The A/E shall assist the County in conducting a public presentation meeting.
g. The A/E shall establish communication with the MNCPPC through the County project manager for the Mandatory Referral process and prepare all required documents to obtain M-NCPPC approval of the project.
h. The A/E shall interface with all agencies requiring permits and approvals for the Project as to the progress of the design and incorporate comments as required so as not delaying the Project.

2. Division 02 30 00: Subsurface Investigation

a. Provide any other required spot borings based on the building layout.
b. Provide waterproofing recommendations.
c. Provide drainage information.
d. Provide water table information.
e. Provide test pits.
f. For existing buildings, provide test pits at foundations to determine existing conditions and capacities.

DD. Stage 1: Floors Layout & Site Coordination - DD

1. Division 01: General Requirements

a. In this phase the A/E and must mostly concentrate on completing the floor layout responding to the program of requirements.
b. All Schematic Design Phase comments must be incorporated by the end of this stage. Delay to incorporate SD comments later is not acceptable since it will create confusion in reviewing the documents.
c. All site issues must be coordinated. Mechanical, electrical, utilities, environmental issues must be finalized.
d. Site concept plan approval must be at hand.
e. Civil engineer must be already completed all site plans.
f. A progress set or report must be delivered to the County to show progress in the schedule and as prerequisite for payment.

EE. Stage 2: Systems Coordination - DD

1. Division 01: General Requirements

a. In this stage all building systems must be coordinated. An integration sheet must be prepared showing various systems in different colors and updated in the next stages to coordinate at the minimum the following systems:
   1) Structural beams and joists.
   2) Lighting
   3) Mechanical ducts and diffusers
   4) Sprinkler pipes

FF. Stage 3: Interior Systems & Materials- DD

1. Division 01: General Requirements

a. In this stage all interior systems must be designed including:
   1) Interior layout
   2) Signs. Room signage numbers shall be shown on all plans.
   3) Furniture
   4) Finishes
   5) Lighting
   6) Electrical
   7) Communications
   8) Doors, windows and hardware
   9) All materials (interior or exterior)

GG. Stage 4: Design Coordination - DD

1. Division 01: General Requirements

a. In this stage A/E must coordinate all design elements to make sure that all disciplines are coordinated and no information is missing.

HH. Stage 5: Design Presentation - DD

1. Division 01: General Requirements

a. In this stage A/E concentrates in production of all design development materials for submittal and presentation to the County.

II. Submittal Requirements for the Design Development Phase

1. Division 01: General Requirements

a. One (1) set of the drawings shall be of presentation size and quality in color and as necessary to brief the project design committee concerning the quality and scope of the project.
b. A/E will present the design development phase to the DGS Architectural Review

Committee (ARC).

c. All design solutions must be evaluated by the DGS and the user agency for approval.

d. To show conformance with the Program of Requirements (POR) a report must be generated or the previous report must be updated to validate gross and net area calculations for each space including building core spaces and circulations.

e. Provide updated phasing plan and analysis of the construction sequencing.

f. Documents prepared by the A/E for the design development submittal and approval shall include a report. The report shall include, but not be limited to, graphic representations of the results of the various environmental planning and design studies to assure the feasibility of site development. It shall also include review of available geologic and geotechnical information and test borings applicable to establishment of facilities location. The written report must describe the project in greater detail than the schematic design document report, and shall take into account the County’s comments on the previous submittal.

g. Should the documents submitted not conform to the requirements outlined in this manual, the A/E must revise, correct and complete the documents and reprint at its own expense and with no additional cost to the County as required to obtain the County's approval.

h. A/E must provide the County cut sheets and catalogues of materials, finishes, equipment, furniture, or other design components that are selected during the design for review and approval.

i. Floors plans layouts for all levels in sufficient detail and dimensions showing walls, major wall types, room name and number, room size, door swings, major mechanical equipment, other appliances and equipments that take floor space, bulkhead dash lines, etc.

j. Floor plans delineating programmatic functional divisions identified by colored shading with full legend.

k. Partially dimensioned floor plans, final room and partition locations including all openings.

l. Gross net, and programmable area calculations for each space to show conformance with the Program of Requirements as amended. A chart must be produced to analyze various space elements as identified in the space measurement section in this manual.

m. Complete code analysis consisting of all fire walls and partitions, building areas, egress paths and capacities, construction and use types, etc. – Fully coordinated with all permitting authorities.

n. Specification Requirements – DD

1) Specifications for each CSI section used.

2) Specification requirements shall consist of design narrative as described in the commissioning program.

3) The specifications shall be comprehensive and complete and shall address all relevant component/sections of the work and where required by the scope of the project.

4) Specifications that are to accompany design development drawings shall consist of a comprehensive description of the project and the materials proposed for use in the work. The general scope shall be indicated by Sections as required for Construction Specifications. The "PROJECT DESCRIPTION" shall be a narrative description of the project and shall include all applicable architectural, civil, structural, mechanical and electrical programs and/or systems.

o. Estimating Requirements – DD

1) Cost estimates shall include complete breakdowns of each CSI section indicating materials, labor, units, unit costs and total cost. The total cost shall include in the labor item all insurance, state and federal payroll taxes, and any payments to the unions. The total cost shall include all General Contractors' and Subcontractor's overhead and profits.

A/E must also submit completed cost estimating summary in Excel file as provided by the county.

p. Renderings – DD
   1) Variety of renderings can and must be presented at this phase suitable for public presentation including:
      a) Elevations
      b) Sections
      c) Floor plans
      d) Site plan with roof, shadow and landscaping
      e) Axonometric or perspective view of the building on the site
      f) Axonometric or perspective view of interior spaces

q. Model – DD
   1) A working model must be prepared by the A/E to show site contour and building mass and location with enough details to be able to relay the site and building concepts. Major site elements such as roads, water bodies, wetlands, wooded areas, etc. must be clearly delineated. This model should be transportable to various meetings for presentation. Although this is not a final professional model, it should present a finished appearance.

2. Division 01 81 13: Sustainable Design Requirements

a. The A/E shall prepare all the necessary documentation for LEED certification.

b. A separate LEED verification and green design control meeting must be conducted to verify all green goals.

c. Submit LEED/ Green design binder to the County. This binder must include:
   1) Minutes of all green meetings and discussions.
   2) Score cards. Keep score cards of various phases unchanged for tracking.
   3) A section must be devoted to each requirement of LEED with explanation of design decisions as to how meet LEED Silver certification or more.
   4) Documentation to be submitted for LEED certification which includes among other things; cut sheets of selected materials and equipment; and energy calculations, all energy efficiency data and energy design documents.

d. Energy Conservation:
   1) Continuation of design strategies for energy conservation approved in the prior phase.
   2) Submit for review and approval an energy analysis report reflecting the increased level of detail of the Design Development Phase. Report must be based on actual window areas & type, light fixtures specified, etc. and plug loads. It will reflect user pattern and a more refined occupancy schedule. Form and content of the report shall be as described in the County's Energy Program of Requirements.
   3) The report will utilize efficiencies (EER) based on the actual equipment selected as the Basis of Design.
   4) The report will include and list energy strategies that were investigated for the building and applicable to the selected HVAC system. The report will describe each item considered, show its first costs, simulate and quantify its energy reduction contribution in terms of annual BTUH and dollars and calculate its economic payback.
   5) The report will recommend the energy conservation strategies that should be incorporated to the design and will incorporate them into a final Energy Simulation run utilizing a DOE2 computer simulation program or equivalent.
   6) The report will utilize the actual light power budgets of the selected fixtures and those shown in the reflected ceiling plans.
   7) Data on major types of light fixtures and lamps showing Efficiency (lumens/watt), Lamp Output (lumens/lamp), and photometric reports for fixture and diffusers.
   8) Actual efficiencies of all HVAC equipment selected as basis of design.
   9) Actual window area and glazing types from architectural design development plans.
   10) Realistic schedules and usage patterns on a zone-by-zone basis.

e. The A/E will prepare and submit a design development energy analysis report, to document the design strategy, life-cycle analysis, and annual energy consumption for the project.

f. The A/E shall review County guidelines for energy conservation and incorporate required features in the project design, including design of an energy management system compatible with County central computers.

3. Division 01 91 00: Commissioning Requirements
   a. Major goals for the commissioning must be outlined at this phase. This is the foundation for the next phases and focuses the attention of the design team on the possible commissioning issues.
4. Division 02: Existing Conditions
   a. All existing conditions must be fully presented on drawings.
5. Division 02 30 00: Subsurface Investigation
   a. Final report of the subsurface investigation must be presented.
6. Division 03: Structural System
   a. Structural drawings indicating type and character of structural systems, including sizes of typical members, size, overall dimensions, and floor elevations.
   b. Allowable soil bearing pressure and elevation of footings and slabs.
   c. Foundation drawings.
   d. Footing, beams, columns, and connection schedules.
   e. Certification by the A/E that the structural design has been coordinated with other disciplines and no interferences or dimensional conflicts are shown.
7. Division 06 22 00: Millwork
   a. Millwork must be fully presented with finishes, quality of construction, and details.
8. Division 07: Envelope
   a. All envelope materials and finishes must be fully discussed and presented.
   b. Submit calculations supporting the U values utilized for the walls, roof and U values and Shading Coefficients for windows and skylights
9. Division 07 10 00: Damp-proofing & Waterproofing
   a. Selected system must be fully presented.
10. Division 07 20 00: Thermal Protection
    a. Selected system must be fully presented.
11. Division 07 25 00: Weather barriers
    a. Selected system must be fully presented.
12. Division 07 71 00: Roof
    a. Identification of roof system, deck, membrane flashing and drainage
    b. Roof plan showing slopes, drains, parapets, major equipments and other features that might impact the roof system. Annotate all features.
    c. Roof section showing roof system, deck, membrane flashing and drainage.
    d. Materials and finished.
13. Division 07 77 00: Exterior Walls
    a. Elevations
       1) Develop detailed elevations of all sides to show the design intent, style, height, materials, colors, and other devices on the façades.
    b. Sections
       1) Building sections showing floor elevations, floor to floor heights, floor to ceiling heights, roof, day-lighting features, and wall construction.
       2) Wall sections showing wall construction, materials, water proofing, air barrier, water management system, flashing, and typical enlarged details at various locations including at roof parapet, floors, ground level floor, lowest floor, and foundation.
       3) Exterior wall cross sections and elevations indicating location and size and type of fenestration, and indicating overall thermal transfer value for the exterior wall envelope along with each type of proposed insulating material.
14. Division 08: Openings (Doors & Windows)
    a. All doors and windows must be annotated.
    b. Door schedule showing all types and quality levels coordinated with security plans.
15. Division 08 70 00: Hardware

a. Hardware schedule coordinated with doors and windows and security plan.

16. Division 09: Finishes
   a. Develop finish schedule identifying all finishes.
   b. A/E must present at least three schemes to the County for selection, review and approval.

17. Division 09 50 00: Ceiling
   a. Provide a ceiling plan showing major ceiling types, light fixtures, and ceiling height.

18. Division 09 60 00: Flooring
   a. Provide a flooring layout showing various possible finishes and materials.

19. Division 09 70 00: Wall Finishes
   a. Must be fully specified and scheduled.

20. Division 09 80 00: Acoustic Treatment
   a. Must be fully specified and scheduled.

21. Division 09 90 00: Painting
   a. Must be fully specified and scheduled.

22. Division 10: Specialties
   a. All sub items to this division must be fully specified and scheduled.

23. Division 11: Equipment
   a. All sub items to this division must be fully specified and scheduled.
      1) Division 11 26 00: Kitchen Equipment
      2) Division 11 28 00: Office Equipment (Computer, copier, etc.)
      3) Division 11 52 00: Audio- Visual Equipment

24. Division 12: Furnishings
   a. All sub items to this division must be fully specified and scheduled.
      1) Division 12 10 00: Artwork
      2) Division 12 20 00: Window Treatments
      3) Division 12 30 00; Casework
      4) Division 12 93 00: Site Furnishing
      5) Division 12 93 13: Bicycle Racks

25. Division 12 50 00: Furniture
   a. Furniture and loose equipment layout plans indicating size and location of all furniture and equipment. Existing furniture to be reused shall be distinguished from furniture to be purchased.
   b. Enlarged furniture plans and details/illustrations, including specially designed items or elements, to indicate finished appearance and functional operation if necessary.
   c. Updated Furniture Budget based on proposed layout that identifies new or reused/refurbished furniture (free-standing and systems) in all spaces; budget list prices; budget net prices; quantities; total cost; taxes; delivery and installation charges; and product that proposed budget is based on.
   d. Furniture selection options – provide: cut sheets, constructed samples (where possible), photographs, showroom tours (as deemed appropriate), finish and material options (samples of actual materials and colors), and pricing information for each item to be selected. Multiple options for selection required, and all options are to be coordinated with other furniture and architectural finish selections for the space(s).
   e. Furniture timetable identifying timeframes for design phase activities, preparation of specifications/bid documents, order placement/confirmation, manufacturing lead times, and delivery and installation in coordination with Project Schedule. Identify product selection options that present challenges to the schedule and/or anticipated pricing increases that may impact timing of procurement process.
   f. Binder shall include:
      1) Furniture plan;
      2) Furniture budget;
      3) Cut sheets / photographs;

4) Finish and material selections;
5) Furniture timetable.

26. Division 12 59 00: Systems Furniture

a. Provide complete layout of systems furniture (existing furniture to be reused shall be distinguished from furniture to be purchased).
   1) Panel plans
   2) Manufacturer
   3) Finishes
   4) Electrical, communication devices
   5) Accessories and components (including lighting and files)
   6) Electrical feed system (wall or poles)
   7) Dimensions
   8) Budget cost from vendor(s)

b. Systems Furniture selection options – provide: optional layouts/components, cut sheets, showroom tours, finish and material options (actual samples and colors), and pricing information for each configuration. Multiple options for selection required, including multiple manufacturers/vendors. All options are to be coordinated with other furniture and architectural finish selections for the space(s).

c. Furniture timetable identifying timeframes for design phase activities, preparation of specifications/bid documents, order placement/confirmation, manufacturing lead times, and delivery and installation in coordination with Project Schedule. Identify product selection options that present challenges to the schedule and/or anticipated pricing increases that may impact timing of procurement process.

d. Binder shall include:
   1) Systems Furniture plan;
   2) Systems Furniture budget;
   3) Cut sheets / photographs;
   4) Finish and material selections;
   5) Systems Furniture timetable.

27. Division 13: Special Construction

a. If any special construction system is designed it must be clearly outlined in this phase for closer attention in the next phases.

28. Division 14: Conveying Equipment

a. All vertical circulation elements must be clearly identified and dimensioned on the drawings.

29. Division 21; Fire Suppression

a. Provide floor plans analyzing exit routs and major life safety features.

b. Sprinkler plan with location of heads and stand pipe. Coordinated with joists and beams, lighting, duct work, and sprinkler riser diagrams.

c. Floor protection equipment room layout and description of wet or dry type systems, hose racks or cabinets and fire department tie-ins.

d. Design of a fully functional state of the art fire alarm system that meets Montgomery County code requirements for this type of facility fully coordinated with permitting authorities.

e. Location of fire pumps, booster pumps, hose connections and standpipes.

f. Provide fire hydrant flow tests.

g. Sprinkler Occupancy Hazard Classification:
   - Identify the Building spaces with the types of Hazard Areas as follows for Sprinkler Hydraulic Design Requirements per NFPA -13:
     a) Light Hazard,
     b) Ordinary Hazard
     c) Extra Hazard etc.

h. Show the incoming sprinkler system (Doubled Lined) with following details that include

but not limited to :
(a)Water Alarm Gong, (b) Fire Department Connection, 36 inches above the grade, (c) Normally Closed Bypass Valve for Testing Back Flow Preventer, (4) Pressure Switch, Connect to Fire Alarm System, (5) Pressure Gauge, (7) Wet Pipe Alarm Check Valve, (8) Retarding Chamber, (9) Drain Line with Valve, (10) Alarm Test Valve, (11)O.S. & Y Gate Valve with Tamper Switch, (12) Back Flow Preventer, etc.

30. Division 22: Plumbing

a. As indicated above a site utility master plan showing sanitary and storm sewer layout.
b. Drawings showing locations of sewage ejectors and grinders (if required), and storm manholes.
c. Green and LEED analysis of the plumbing system.
d. Floor plans indicating locations of all plumbing fixtures and special features, and approximate size of all piping systems, principal items of equipment and typical riser diagrams.

31. Division 22 40 00: Plumbing Fixtures

a. All plumbing fixtures must be fully specified and presented.

32. Division 23: HVAC

a. Submit all HVAC calculations for the building's heating, air conditioning and ventilation loads. The submitted calculations will be preformed with the Carrier Hap program or approved equal. The calculations will support the capacities of the equipment selected for each zone and capacities of all major equipment.
b. Technique indicating overall combined heat transfer coefficient for roof/ceiling composite and roof area including the proposed insulating materials.
c. Floor plans and sections of mechanical rooms showing the location of all major HVAC equipment.
d. The equipment layouts shall show the necessary clearances for maintenance accessibility and sections as required to convey to the County that adequate clearances have been provided. Include elevations detailing heights and locations of ductwork, piping, conduits, wiring, structural and other building elements.
e. Provide energy and life cycle cost analyses for at least three different systems and Recommend the best option.
f. Information on the heating and cooling systems should indicate in sufficient detail the source of heat and cooling and method and location of heating and cooling distribution and controls within the building.
g. Show locations and sizes of piping systems, air handling systems and principal items of equipment such as compressors. Also include necessary controls and riser diagrams.
h. Boiler Plant and/or incinerator designs shall comply with all requirements of the Department of Environmental Protection, as well as all applicable regulations and the building code.
i. Provide drawing sheet(s) that at a minimum indicate all spaces that will require detailed drawings for all major equipment and devices.
j. Provide control schematic for HVAC controls.
k. Provide drawing sheet(s) that at a minimum indicate all spaces that will require schedule of all equipment and devices to be incorporated.
l. Provide duct and pipe sizing calculations.
m. Provide block and zone heating and cooling load calculations using approved design assumptions and software.
n. Provide refined size and cost estimates of major equipment.
o. Equipment footprints and installation and maintenance clearances shown on drawings

for all heating and cooling plant equipment, plus air-handlers, pumps, fan coil units, convectors and other terminal equipment. Provide sections on typical mechanical equipment rooms to show elevation and mounting details.

p. Data sheets on all mechanical equipment to be used as basis of design.
q. Ductwork Layout: drawings will include combination of double line and single line ductwork to identify sizes, routing and distribution of air systems. All air type devices and thermostat locations proposed must be shown.
r. Single line schematic diagram of the HVAC piping system shall be included.
s. Single line control schematic diagram describing the proposed sequence of operation shall be included control point list for the Management and Control System.
t. Control schematics showing sensors and actuators with alphanumerical designations coordinated with sequence of operation.
u. Heating and cooling load calculations for each space and major duct or pipe runs sized to interface with structural members.
v. Location of devices in the ceilings.
w. An analysis of availability of components, construction sequence and scheduling, economic tradeoffs, acoustical and vibration control, safety and maintenance requirements.
x. Results of the energy analysis integrated in mechanical design.
y. Equipment schedule for all major HVAC components including energy efficiency ratings for each.
z. Certification by the A/E that the mechanical design has been coordinated with other disciplines and no interfaces or dimensional conflicts exist.
aa. Following divisions must be fully designed, specified, and presented.
    1) Division 23 08 00: Commissioning of HVAC
    2) Division 23 10 00: Facility Fuel System
    3) Division 23 20 00: HVAC Piping and Pumps
    4) Division 23 30 00; HVAC Air Distribution
    5) Division 23 40 01: HVAC Air Cleaning Devices
    6) Division 23 50 00: Central Heating Equipment
    7) Division 23 60 00: Central Cooling Equipment
    8) Division 23 70 00: Central HVAC Equipment
    9) Division 23 80 00; Decentralized HVAC Equipment

33. Division 25: Integrated Automation

a. Must be fully specified and scheduled.

34. Division 26; Electrical

a. Lighting on separate distribution, roughly sized.
b. Major electrical equipment roughly scheduled indicating size, capacity and total loads.
c. A colpete one-line diagram should be drawn in which a single line represents three phases of power system and it should be properly drawn, showing correct power distribution path from the normal power source and generators to *each* downstream load panels— including the ratings and sizing of each piece of electrical equipment, their circuit conductors, conduit size and their protective devices.
d. All service connections and electrical equipment (panels, transformers and switch gear) shall be located on centerline of tiles.
e. All services for special purposes shall be located and indicated.
f. All power consuming equipment and load characteristics.
g. Development of specific electrical power service and distribution systems, lighting, telephone, fire detection and alarm, security and electronic communications systems appropriate for the project, including computer network, cable TV and sound systems.
h. Equipment room layouts and clearances shown on drawings.
i. Electrical distribution riser diagram.
j. Wiring chases shown on drawings.

k. Total electric load calculation.
l. Major electrical equipment (switchgear, distribution panels, emergency generator, transfer switches, UPS system, etc.) dimensioned and drawn to scale into the space allocated.
m. Interior electrical loads estimate for systems furniture, receptacles, lighting, and any special use areas.
n. Analysis shall be made of availability of components, construction sequence and scheduling, economic tradeoffs, safety and maintenance requirements.
o. Draft specifications for each CSI section used.
p. Legend showing all symbols on drawings.
q. Certification by the A/E that the electrical design has been coordinated with other disciplines and County Department of Technology Services and no interferences or dimensional conflicts exist.
r. Low voltage systems
    1) Identify all low voltage systems and their requirements.
s. Following divisions must be fully designed, specified, and presented.
    1) Division 26 08 00: Commissioning of Electrical Systems
    2) Division 26 09 26: Lighting Control Devices
    3) Division 26 20 00: Low Voltage Electrical Distribution
    4) Division 26 31 00: Photovoltaic Collectors
    5) Division 26 40 00; Facility Lightening Protection

35. Division 26 50 00: Lighting

a. Development of lighting systems for the project following County technical guidelines for lighting and comments from Schematic Design.
b. The A/E is to provide Lighting Design strategy for the building to meet energy conservation goals set by the County.
c. Lighting Design to achieve a complete and acceptable design within wattage budget for project. Explicitly list specific lamp and ballast and diffuser by make and model on drawings and list same in specifications for all lighting equipment.
d. Specify lighting output (lumens) and efficiency (lumens/ watt) for any lamp and ballast.
e. Lighting shall be indicated as to type, location and intensities in foot candles for each space, room, or typical space.
f. Site lighting layout for the entire complex included data sheets for proposed fixtures and lamps and the proposed mounting height for each fixture pole.
g. Lighting, power, telecommunications and office automation devices and receptacles shown in plan.
h. Light fixture schedule with types and quantities proposed along with data sheets.
i. Development of lighting systems for the project following County technical guidelines for lighting and comments from Schematic Design.
j. Ceiling plans showing light fixture locations coordinated with room tasks, and multi-level switching arrangements.
k. Documentation that the design meets the ASHRAE 90.1P power budget established for the project.
l. Luminance calculations for the design by the zonal cavity method.
m. Day-lighting analysis as directed by the County Representative.
n. Documentation to be submitted at this stage will include:
    1) Statement of foot- candles to be maintained for each type of task surface in the building.
    2) Calculation based on the latest required ASHRE of lighting wattage budget and current established standards (IESNA Standard) of lighting quality and illumination level for the building interior and exterior. Including catalog cut sheets
    3) Strategy for meeting lighting budget.
    4) Day-lighting design and analysis.
    5) Implementation of lighting control requirements

6) Development of lighting systems for the project following County technical guidelines for lighting and comments from Schematic Design to include; (a) reflected ceiling plans with light fixture locations coordinated with room tasks, multi-level switching arrangements; and detailed schedule of lighting fixtures, lamps and ballasts; (b) documentation that the design meets the ASHRAE 90.1P power budget established for the project; (c) illuminance calculations for the design by the zonal cavity method for lighting below 20 fc; (d) point illuminance calculations where requested above 20 fc; (e) daylighting analysis as directed by the County Representative.

o. Photometrix Analysis: Provide drawing and analysis in graphic and text using light distribution software (photometrix) to show point to point light distribution in FC. The analysis should include the following:
1) Photometrix drawings indicating FC and height of point values
2) High lighting below and above standard (or requirement) points
3) Light level at building perimeter (exterior windows)
4) Light level at property lines
5) Strategies for light pollution control
6) Various type of light source
7) Blocking of lighting concern zones (areas that in the program require certain lighting level) both for interior of the building and site
8) Manufacturer light distribution cut sheets for each light fixture clearly correlated with light fixture types on the drawings
9) On large projects provide a rendering of site night lighting plan by using appropriate software.

36. Division 26 51 00; Interior Lighting
a. Must be fully designed, specified and scheduled.

37. Division 26 56 00: Exterior Lighting
a. Must be fully designed, specified and scheduled.

38. Division 27: Communications
a. Must be fully designed, specified and scheduled.

39. Division 27 20 00: Data Communication
a. Computer system must be identified. Possible entry point for the data line to the building must be identified.
b. Conduct a meeting with the County DTS to review the data system and where major related equipment should be located.
c. Verify all electrical needs for the computers and peripherals.

40. Division 27 30 00: Voice Communications
a. Telephone system must be identified. Possible entry point for the telephone line must be identified.
b. Conduct a meeting with the County DTS to review the telephone system and where major telephone equipment should be located.
c. Concept computer network and telephone system cable and conduit backbone design including all connections, drops, equipment racks, cable trays, electrical services, grounding systems and proposed equipment locations fully coordinated and in compliance with County Department of Technology Services (DTS).
d. Raceway systems for telephone, Local Area Network cabling, emergency communications etc. designed to County standards.

41. Division 27 40 00: Audio Video Communications
a. Complete audio video drawings, specifications, and schedules.

42. Division 28: Electronic Safety and Security
a. Outline of the security systems for the project including locking, control, observation, central control, and materials to be used.
b. Security and non security system logics.
c. Security and non security hardware and locking control systems.
d. Central control layout and control schemes.

e. Miscellaneous security equipment.

43. Division 31: Earthwork

a. Site plans: various site plans to show the followings:
   1) Existing and proposed contours. Plan must show a minimum of 2'- 0" contour lines showing cuts and fills,
   2) Locations of the proposed building or buildings. Building locations must be referenced from main survey baseline.
   3) Property lines, bench marks, set backs.
   4) Entrance driveway, parking and circulations including profiles, typical roadway cross-sections, and markings.
   5) All legal parameters of the property including all public, private, and utility right of ways.
   6) Storm water management and sediment control plans.
   7) File the site concept plan with the County Department of Permitting Services or the municipal code enforcing agency.
   8) All utilities existing and proposed (water, electricity, telephone, fiber optics, gas, etc), showing their location, elevation, size,, and entrance location to the site and the building s, and indicating whether over or under ground. Must coordinate the utility information with the local utility Co. requirements and records.
   9) Updated geotechnical report outlining findings resulting from soil borings, test pits, sonar analysis of the soil layers, soils analyses, soil bearing values, and other needed geotechnical studies.
   10) Natural Resource Inventory Forest Stand Delineation plan for approval by M-NCPPC, or Forest Conservation Plan for approval by municipal code enforcing agency.
   11) Pedestrian safety analysis and report.
   12) Landscaping plan.
   13) Sediment and erosion control plan.
   14) Construction staging plan.
   15) Fire department connections and fire hydrants. These documents shall be fully coordinated with all permitting authorities and utility companies.
   16) Following divisions must have already been completed, designed, specified and presented.
      a) Division 31 22 00: Grading
      b) Division 31 23 00: Excavating and Fill
      c) Division 31 25 00; Erosion and Sediment Controls
      d) Division 31 60 00: Special Foundations and Load Bearing Elements

44. Division 32: Exterior Improvements

a. Following divisions must have already been completed, designed, specified and presented.
   1) Division 32 10 00: Bases, Ballasts, and Paving
   2) Division 32 18 00: Athletic and recreational Surfacing
   3) Division 32 31 00: Fences and Gates
   4) Division 32 32 00; Retaining Walls
   5) Division 32 70 00: Wetlands
   6) Division 32 80 00: Irrigation
   7) Division 32 90 00: Planting

45. Division 33: Utilities

a. Utility Services for Construction
   1) It is essential that construction utility services availability be addressed in the construction documents.
      a) The consultant shall discuss with public utility companies to determine what sources and options are available for contractor's use.
      b) Describe what public utility companies will provide by way of connections, metering, transformers, etc.
      c) Payment responsibility for hookup charges and energy use prior to project completion shall be clearly identified.

b. Following divisions must have already been completed, designed, specified and presented.

1) Division 33 08 00: Commissioning of Utilities
2) Division 33 10 00; Water Utilities
3) Division 33 30 00: Sanitary Sewerage Utilities
4) Division 33 40 00: Storm Drain Utilities
5) Division 33 47 00: Ponds and Reservoirs
6) Division 33 50 00: Fuel Distribution Facilities
7) Division 33 70 00: Electrical Utilities
8) Division 33 73 00: Utility Transformers
9) Division 33 80 00: Communications Utilities

Phase 4: Construction Documents – CD

JJ. General

1. Division 01: General Requirements

a. Upon written notice to proceed from the County, the A/E shall start the Construction Documents phase.
b. The purpose of the Construction Documents Phase is to produce a complete set of drawings, specifications and other legal documents to be able to successfully obtain building permits, bid the project and engage in the construction phase of the project.
c. Upon County acceptance and approval of the design development documents, the building systems and exterior wall locations (building "footprint") may be changed only as approved by the County. No significant departure from the approved design development submittal will be allowed during the next phase, unless prior written approval is obtained from the County.
d. During this phase A/E must submit progress documents at the end of each stage. The intent of these submittals is for the County to monitor progress of and to provide comments on the work while the A/E is proceeding. These incremental in-phase submittals are not the same as the 100% submittal, which will be reviewed by a team of County professionals to assure compliance with all requirements and control the quality of design. The County's review of documents does not substitute for the A/E's responsibility for coordination and compliance with all requirements.
e. The A/E shall interface with all Agencies requiring permits and approvals for the Project as to the progress of the Design and incorporate comments as required.
f. Should the documents submitted not conform to the requirements outlined in this manual, the A/E must revise, correct and complete the documents and reprint at its own expense and with no additional cost to the County as required to obtain the County's approval.

KK. Stage 1: Documents Setup – CD

1. Drawings and CADD setup

a. AE must continue to work on all aspects of production during this stage, but for coordination and quality control focus will be on documents setup.
b. AE must present the drawing set organization. Compliance with the requirements of this manual must be verified. Refer to the Drawing Requirements at the beginning of this section.
c. Provide a set for review.

LL. Stage 2: Details Setup – CD

1. Details development

a. AE must continue to work on all aspects of production during this stage, but for coordination and quality control focus will be on details.
b. AE must develop a complete set of details cross referenced to related sheets.
c. Provide a set for review.
d.

MM. Stage 3: Integration Coordination – CD

1. Division 01: General Requirements

a. AE must continue to work on all aspects of production during this stage, but for coordination and quality control focus will be on details.

b. The A/E shall assist the County in conducting a public presentation meeting.

c. Provide updated phasing plan and analysis of the construction sequencing.

d. All drawings must be fully dimensioned, with legends, annotated and referenced to other documents.

e. A final integration sheet must be provide to coordinated, structure, ductwork, sprinkler, lighting, diffusers, speakers, and all other features that may interfere with each other and cause change of design during construction.

f. The A/E must submit a complete commissioning plan and schedule for approval by County in this phase, detailing how: all the project services and systems will be checked for compliance with the construction documents and tested for performance; the maintenance and operation manuals will be prepared and operations and maintenance training conducted; and the building placed in an operational steady state condition ready for turnover to County. Such plan is to be included in the construction contract documents for implementation of applicable portions by the Construction Contractor. The Commissioning Plan is to include the following information:

g. Equipment Maintenance Manuals

1) The Mechanical and Electrical contractors shall be required to prepare maintenance manuals for the servicing of all equipment installed as a part of their division. The general contractor shall prepare maintenance manuals for equipment in other divisions.

2) The information contained in the manuals shall be grouped in an orderly arrangement under basic categories; i.e., Primary Distribution Equipment, Secondary Systems Equipment, Special Raceways, Motors & Controls, Lighting Equipment, Clock & Program Equipment, Fire & Security Alarm Equipment, Central Supervisory Equipment, Special Communication Systems, etc.

3) The manuals shall have typewritten index and divider sheets between categories with identifying tabs.

4) Data incorporated into manuals shall be neat, clean copies, 8-1/2" x 11" size for binding.

5) The information included must be the exact equipment installed, not the complete "line" of the manufacturer. Where sheets show the equipment installed, as well as other equipment, the installed equipment shall be neatly and clearly identified on such sheets.

6) Manuals shall contain shop drawings, wiring diagrams, operating and maintenance instructions, replacement parts list, equipment nameplate data and performance curves or Tables for all equipment and systems installed under the project. All control systems shall be fully described along with operation descriptions and all system interfaces.

7) Wiring diagrams for each system shall be complete drawings for the specific system installed under the contract. "Typical" diagrams will not be acceptable unless properly marked to indicate the exact field installations.

8) The completed manuals shall be contained in slant ring view binders (3 "D" rings) with clear vinyl overlay on the front cover and spine. The binders shall have heavy-duty nylon reinforced hinges. The front cover "slip sheet" shall include: County, project name & number, building name, date, architect, appropriate engineer (mechanical, electrical, whatever), and reference to specific contents (e.g., Mechanical Operations and Maintenance Manual, Electrical Operations and Maintenance Manual, Warranties and Bonds, Furnishings, whatever). The spine "slip sheet", shall include: County, building name, and project name and number, and year.

9) The General Contractor shall coordinate volumes from all trades into a distinctive set; with complete uniformity of color, format, cover "slip sheets", indexing, tabbing, etc. The final volumes shall have a very professional quality and appearance.

10) One preliminary copy of all volumes, including covers and "slip sheets", shall be submitted to the Project Manager for review and approval.

11) Three complete copies of all volumes shall be delivered to the Owner upon approval of the preliminary copy, before systems turnover to the Owner and/or Owner training. The completed manuals shall be utilized during the training and commissioning process to verify the contents and assist with both processes.

h. AE must conduct a complete coordination workshop to include the owner and all major and critical disciplines.

i. Provide a set for review.

NN. Stage 4: Permit Documents – CD

1. Division 01: General Requirements

a. One (1) set of the drawings shall be of presentation size and quality in color and as necessary to brief the Architectural Review Committee (ARC).

b. The A/E shall provide the required number and type of documents to obtain permits and approval of governmental authorities having jurisdiction over the Project.

c. All drawings must be fully dimensioned, with legends, annotated and referenced to other documents.

d. Obtain all necessary approvals from all required permitting authorities to do the construction. This may include DGSDGS, M-NCPPC, DEP, MDOT, SHA, and other local, state, and federal permitting and regulating agencies.

e. The sets containing the original approvals will be retained by the County as the official approved sets.

f. The A/E shall participate in such reviews and meetings as are necessary to ensure that the project design conforms to all applicable codes and all requirements of responsible agencies and will make any changes to the Construction Documents which are required for issuance of all permits and legal authorizations needed to construct the Project.

g. The A/E shall obtain and deliver to the County all permits and approvals required of the work excluding trade permits that must be obtained by the general or subcontractors. In some jurisdictions it is required that permit fees and applications to be paid and filed with the permitting officials prior to the selection of the contractors. In those cases the A/E must file and obtain all such permits as necessary for progress of the project prior to bidding.

h. The A/E must provide as minimum number of sets of documents as identified in the ***Table of Deliverables During the Design Phases*** at the end of this document. Unless otherwise noted in the contract as an exception the following quantities must be delivered:

1) Minimum **6** sets of full size drawings
   a) 2 for Facilities Management
   b) 2 for Design Section review team
   c) 1 for Construction Section
   d) 1 for the user agency
2) Minimum **4** sets of half size drawings
   a) 1 for the file
   b) 1 for the user agency
   c) 1 for Design Section review team
   d) 1 for the Design Section Chief
3) Minimum **2** sets of small size drawings (8.5x11 or 11x17 for large scale projects)
   a) 1 for the file
   b) 1 for the Design Section Chief

OO. Stage 5: Bid Documents – CD

1. Division 01: General Requirements

a. The A/E shall review the County's General Conditions for Construction consisting generally of: (a) Bidding and Contract Requirements; (b) General Conditions; and (c) Supplementary Conditions, and make recommendations as to bidding procedures and other factors affecting budget and scheduling. The General and Supplemental Conditions can only be modified by the County Attorney's office.

b. Documents for the bid must be 100% finished and complete. A/E must be advised that especially after this phase incomplete documents or any changes will have additional cost impact to the County.

c. The A/E must certify in writing that the project can be constructed within the CCAP.

d. All drawings must be fully dimensioned, with legends, annotated and referenced to other documents.

e. The A/E shall prepare such clarifications and solicitation amendments to the bidding documents as may be required and submit to the County for review. The County will then direct the A/E to provide a reproducible copy of the approved amendment for reproduction and distribution by the County.

f. The resulting final construction document submittal is to be a complete, fully coordinated, integrated package, suitable for bidding distribution, without any need for amendments or further clarification.

g. The A/E and its consultants shall finalize the list of warranties and expected submittals, including test results and operating and maintenance information. The list should be organized by Construction Specification Institute (CSI) Division, Section and Paragraph numbers and submitted to the County prior to the bid opening. This listing shall be the basis of the A/E's, County's and Construction Contractor's submittal logs.

h. The A/E shall prepare a comprehensive listing of all construction submittals and all contractor required warranties for County's review and approval. This listing will be used by the A/E and the County to confirm submittal compliance and warranty provisions.

i. The A/E must certify in writing that the project can be constructed within the CCAP.

j. Single or multiple contracts may be required by the County, and the detailed drawings for each contract shall be prepared by the A/E with appropriate designation noted thereon.

k. Provide the final updated schedule for the construction sequence so that the Owner and the Contractor may reliably predict and schedule outages, space access and business interruptions. If there are long lead items that impact the construction schedule, they should be identified early for possible Owner purchase. Specific areas of coordination need to be identified to alert bidders to special work area problems.

l. Utility Services for Construction
   1) It is essential that construction utility services availability be addressed in the contract documents. For County construction, the consultant shall discuss with public utility company what sources and options are available to the contractor; describe what public utility company will provide in the way of connection, metering, transformers, etc. Payment responsibility for hookup charges and energy use prior to project completion shall be clearly identified.
   2) The Consultant shall show the layout for utilities connection on the drawings.

m. The A/E must deliver final and complete contract documents to the reproduction firm identified by the County. These documents will remain available for reproduction for as long as is necessary to complete bidding and contract award. The A/E is then responsible for retrieving the documents. The prime consultant is responsible for coordination, completeness, and accuracy of all printable documents at the print shop. Extra printing cost due to incompleteness, inaccuracy, lack of coordination, etc. must be paid by the consultant and not the owner.

n. The A/E must provide as minimum number of sets of documents as identified in the ***Table of Deliverables During the Design Phases*** at the end of this document. Unless otherwise noted in the contract as an exception the following quantities must be delivered:

1) Minimum **3** sets of full size drawings
   a) 1 for Construction Section
   b) 1 for Design Section review team
   c) 1 for Construction Section
2) Minimum **2** sets of half size drawings
   a) 1 for the file
   b) 1 for the user agency
3) Minimum **2** sets of small size drawings (8.5x11 or 11x17 for large scale projects)
   a) 1 for the file
   b) 1 for the Design Section Chief

PP. Submittal Requirements for the Construction Documents Phase

1. Division 01: General Requirements

a. Complete site plans: various site plans to show the followings:
   1) Existing and proposed grades and contours. Plan must show a minimum of 2'- 0" contour lines showing cuts and fills,
   2) Layout and location of all proposed work including buildings, structures, retaining walls and other site improvements with details.
   3) Locations of the proposed building or buildings. Building locations must be referenced from main survey baseline.
   4) Property lines, bench marks, set backs.
   5) Entrance driveway, parking and circulations including profiles, typical roadway cross-sections, and markings.
   6) All legal parameters of the property including all public, private, and utility right of ways.
   7) Storm water management and sediment control plans.
   8) This is the phase to file for the site concept plan with the County Department of Permitting Services or the municipal code enforcing agency.
   9) All utilities existing and proposed (water, electricity, telephone, fiber optics, gas, etc), showing their location, elevation, size,, and entrance location to the site and the building s, and indicating whether over or under ground. Must coordinate the utility information with the local utility Co. requirements and records. [Note to Designer: Use a separate site drawing to show utilities on projects with excessive layouts and details].
   10) Updated geotechnical report outlining findings resulting from soil borings, test pits, sonar analysis of the soil layers, soils analyses, soil bearing values, and other needed geotechnical studies.
   11) Natural Resource Inventory Forest Stand Delineation plan approved by M-NCPPC.
   12) Forest Conservation plan approved by municipal code enforcing agency.
   13) Pedestrian safety analysis and report.
   14) Landscaping plan.
   15) Sediment and erosion control plan.
   16) Construction staging plan.
   17) Fire department connections and fire hydrants. These documents shall be fully coordinated with all permitting authorities and utility companies.
   18) The Designer shall certify, in writing, to the County that all applicable local and state officials have been contacted regarding each utility connection and that the department responsible for permits or connection approval has agreed to the system's use.

b. Floor plans
   1) Floors plans layouts for all levels fully detailed, annotated, and dimensioned showing walls, major wall types, room name and number, room size, door swings, major mechanical equipment, other appliances and equipments that take floor space, bulkhead dash lines, etc.
   2) Gross and net area calculations for each space to show conformance with the Program of Requirements as amended. Sample charts to be used are at the end of this document.
   3) Complete code analysis consisting of all fire walls and partitions, building areas, egress paths and capacities, construction and use types, etc. – Fully coordinated with all permitting authorities.

c. Specification Requirements – CD
1) The Specifications shall be in final form and the Project Description that accompanied the Outline Specifications in the Schematic and Design Development Phases shall be updated.
2) The A/E must work with the County project manager to produce incremental completed specification as construction documents progress through this phase.
3) In order to prepare the project manual for bidding which includes complete specifications, the County will provide the General Conditions of the Contract, Advertisement for Bids, Instructions to Bidders, and Construction Proposal Forms and Agreement(s) which the A/E shall incorporate into the Construction Documents.
4) Specification must include design narrative as described in the commissioning program.
5) Specifications that are to accompany Construction Document shall consist of a comprehensive description of the project and the materials proposed for use in the work. The general scope shall be indicated by Sections as required for Construction Specifications. The "PROJECT DESCRIPTION" shall be a narrative description of the project and shall include all applicable architectural, civil, structural, mechanical and electrical programs and/or systems.
6) The A/E shall fully coordinate all aspects of the technical specifications with the General Conditions and additional documents provided by the County to produce a comprehensive construction contract manual.
7) Submittal requirements must be clearly identified in the specifications.
8) Operations and Maintenance Training
   a) The specifications shall include requirements for the contractor to provide detailed training and instruction for County personnel. It shall be a requirement that the contractor videotape all training sessions and a copy provided to the County prior to final completion.
   b) The instruction or training periods shall not commence until the systems involved are complete, tested, and operating, and O & M manuals and as-builts completed.
   c) The contractor shall be required to have qualified individuals conducting all training. As a minimum, training personnel shall be foremen or superintendents from the trade involved, or a factory representative for special equipment or systems.

d. Estimating Requirements – CD
1) Cost estimates shall include complete breakdowns of each CSI section indicating materials, labor, units, unit costs and total cost. The total cost shall include in the labor item all insurance, state and federal payroll taxes, and any payments to the unions. The total cost for each Section shall include all General Contractors' and Subcontractor's overhead and profits.

e. Renderings – CD
1) Variety of renderings can and must be presented at this phase suitable for public presentation including:
   a) Elevations
   b) Sections
   c) Floor plans with and without programmatic functional divisions delineated by colored shading with full legend
   d) Site plan with roof, shadow and landscaping
   e) Axonometric or perspective view of the building on the site
   f) Axonometric or perspective view of interior spaces

f. Model – CD
1) A final professional model must be prepared by the A/E to show site contour and building mass and location with enough details to be able to relay the site and building concepts. Major site elements such as roads, wetland, wooded areas, etc. must be clearly delineated. This model should be transportable to various meetings for presentation.

2. Division 01 81 13: Sustainable Design Requirements

a. The A/E shall prepare all the necessary documentation for LEED certification. A copy must be submitted to the County.
b. A separate LEED verification and green design control meeting must be conducted to verify all green goals.

c. The A/E shall prepare all the necessary documents for LEED certification.
d. The LEED binder must be completed to include:
   1) LEED score sheets for various phases.
   2) Details of strategies for LEED compliance.
   3) Cut sheets of equipments and materials.
   4) Copy of related correspondences.
   5) Copy of all minutes of meetings related to LEED.
   6) All other documents related to sustainable design as requested by the County.
e. Energy Conservation Design shall be in sufficient detail and with appropriate efficiency specifications to enforce construction contractor compliance with energy efficient construction. This includes, but is not limited to:
   1) Continuation of design strategies for energy conservation approved in the prior phase.
   2) Submit for review and approval an energy analysis reflecting the increased level of detail of the Construction Document Phase. Form and content of the report shall be as described in the County's Energy Program of Requirements.
   3) Actual lighting wattage from lighting design development plans.
   4) Actual efficiencies of all HVAC equipment selected as basis of design.
   5) Actual window area and glazing types from architectural design development plans.
   6) Realistic schedules and usage patterns on a zone-by-zone basis.
   7) Efficiency specifications shown with equipment schedule on drawings and specifications for all heating and cooling equipment, motors and major appliances.
   8) Detail of insulation and vapor barriers, including ceiling spaces and exterior wall.
   9) Details of sealing or gasketing of all joints and specifications for air-tightness of windows and doors.
   10) Specification of exterior glazing U-Value, shading coefficient and visible transmittance.

3. Division 01 91 00: Commissioning Requirements
   a. A completed Commissioning plan. See CD phases requirements.
   b. All checklists and testing forms must be included in the commissioning plan.
   c. A dedicated meeting must be coordinated among project team to review the commissioning plan and its requirements and a plan of action must be generated for the construction phase.

4. Division 02: Existing Conditions
   a. Must be fully documented.

5. Division 02 21 00: Site Survey
   a. Must be fully documented.

6. Division 02 22 19: Traffic Assessment
   a. Must be fully documented.

7. Division 02 24 00: Environmental Assessment
   a. Must be fully documented.

8. Division 02 30 00: Subsurface Investigation
   a. Must be fully documented.

9. Division 03: Structural System
   a. Structural drawings indicating type and character of structural systems, including sizes of typical members, size, overall dimensions, and floor elevations.
   b. Allowable soil bearing pressure and elevation of footings and slabs.
   c. Foundation drawings.
   d. Footing, beams, columns, and connection schedules.
   e. Certification by the A/E that the structural design has been coordinated with other disciplines and no interferences or dimensional conflicts are shown.
   f. Completed structural floor plans, specifications and schedules with detailing.
   g. Boring plans with dates, ground elevation water level, and bottom grades of footings and slabs plotted.
   h. Foundation plan with bottom grades showing layout of all footings, walls, slabs on grade including reinforcing, grade beams, and columns; include design soil bearing

pressures and live loads for each area.

i. Floor and roof plans of structural systems including framing, grades of finished floors and depressed areas, with locations and dimensions for all openings. Also indicate design floor loads.

j. Complete foundation wall elevation and typical sections, with reinforcing indicating location, dimensions and grades for all footings, steps and wall openings.

k. Complete details and section with dimensions for all construction joints, reinforcing and other embedded items.

l. Schedules (with dimensions) for all lintels, beams, joists and columns.

m. Unless detailed on the drawings, the following information shall appear in the general notes, Sheet S-1: class and 28 day strength of concrete for each portion, structural steel and concrete reinforcing design stresses for each type of structural member, concrete cover for each type of structural member, shrinkage and temperature steel requirements, reinforcing laps for main reinforcing and temperature steel, bend point, cutoff, and hook locations for all members, minimum beam and lintel bearing. Reinforcing steel fabrication shall be in accordance with most recent ACI, "Manual of Standard Practice for Detailing Reinforced Concrete." Structural steel fabrication shall be in accordance with the AAISC "Manual of Steel Construction."

n. Roof structural systems shall be designed for minimum of 1/2 inch per foot pitch to roof drains.

10. Division 06 22 00: Millwork

a. Must be fully documented.

11. Division 07: Envelope

a. All envelope materials and finishes must be fully discussed and presented.

b. Elevations

1) Develop detailed elevations of all sides to show the design intent, style, height, materials, colors, and other devices on the façades.

c. Sections

1) Building sections showing floor elevations, floor to floor heights, floor to ceiling heights, roof, day-lighting features, and wall construction.

2) Wall sections showing wall construction, materials, water proofing, air barrier, water management system, flashing, and typical enlarged details at various locations including at roof parapet, floors, ground level floor, lowest floor, and foundation.

12. Division 07 10 00: Damp-proofing & Waterproofing

a. Must be fully documented.

13. Division 07 20 00: Thermal Protection

a. Must be fully documented.

14. Division 07 25 00: Weather barriers

a. Must be fully documented.

15. Division 07 71 00: Roof

a. Roof plan showing slopes, drains, parapets, major equipments and other features that might impact the roof system. Annotate all features.

b. Roof section showing roof system, deck, membrane flashing and drainage.

16. Division 07 77 00: Exterior Walls

a. Exterior wall cross sections and elevations indicating location and size and type of fenestration, and indicating overall thermal transfer value for the exterior wall envelope along with each type of proposed insulating material.

17. Division 08: Openings (Doors & Windows)

a. All doors and windows must be annotated.

b. Door schedule showing all types and quality levels coordinated with security plans.

18. Division 08 70 00: Hardware

1) Hardware schedule coordinated with doors and windows and security plan.

19. Division 09: Finishes

a. Develop finish schedule identifying all finishes.
b. Finish plans for all levels with complete annotation, legend and schedule.

20. Division 09 50 00: Ceiling
a. Provide reflected ceiling plans for all levels showing ceiling types, light fixtures, and ceiling height.

21. Division 09 60 00: Flooring
a. Provide flooring plans for all levels showing various possible finishes and materials.

22. Division 09 70 00: Wall Finishes

23. Division 09 80 00: Acoustic Treatment
a. Must be fully documented.

24. Division 09 90 00: Painting
a. Must be fully documented.

25. Division 10: Specialties
a. Must be fully documented.

26. Division 10 06 10.13 Exterior Signage
a. Must be fully documented.

27. Division 10 06 10.16 Interior Signage
a. Complete Sign plan(s) and specifications with schedule fully referenced to the other documents.
b. Special graphics, directional signage and graphic system.

28. Division 10 21 00 Toilet Compartments
a. Must be fully documented.

29. Division 10 22 26 Operable Partitions
a. Must be fully documented.

30. Division 10 71 13 Exterior Sun Control Devices
a. Must be fully documented.

31. Division 10 73 00: Protective Covers (Canopies, etc.)
a. Must be fully documented.

32. Division 11: Equipment
a. Must be fully documented.
   1) Division 11 26 00: Kitchen Equipment
   2) Division 11 28 00: Office Equipment (Computer, copier, etc.)
   3) Division 11 52 00: Audio- Visual Equipment
   4) Division 11 65 00: Athletic and Recreational Equipment
   5) Division 11 82 00: Solid Waste Handling Equipment

33. Division 12: Furnishings
a. Must be fully documented.
   1) Division 12 10 00: Artwork
   2) Division 12 20 00: Window Treatments
   3) Division 12 30 00; Casework

34. Division 12 50 00: Furniture
a. Coded Furniture Plans and loose equipment layout indicating size and location of all furniture and equipment.
b. Enlarged furniture plans and details/illustrations, including specially designed items or elements, indicating finished appearance and functional operation if necessary.
c. Coded quantity/type schedule fully referenced to the plans.
d. Furniture specification for each item to be purchased and/or refurbished/reupholstered sufficient for bidding and/or quotation preparation. Note that procurement process may involve multiple bid/request for quotation packages and/or vendors/contracts.
e. Furniture budget (coded to coordinate with Coded Furniture Plan) that identifies new or reused/refurbished/reupholstered furniture (free-standing and systems) in all spaces; selected product; list prices; net prices; quantities; total cost; taxes; delivery and installation charges; vendor; and lead time.

f. Quotation(s) from the furniture vendor(s) to support the cost identified in the Furniture Budget. Quotation must include furniture delivery lead time..
g. Samples of actual finish and material selections.
h. Furniture timetable identifying timeframes for preparation of specifications/bid documents, order placement/confirmation, manufacturing lead times, and delivery and installation in coordination with Project Schedule. Identify challenges to the schedule and/or anticipated pricing increases that may impact timing of procurement process.
i. Binder shall include:
   1) Coded furniture plan with quantity/type schedule;
   2) Furniture budget;
   3) Furniture specifications;
   4) Cut sheets / photographs;
   5) Samples of finish and material selections;
   6) Furniture timetable.

35. Division 12 59 00: Systems Furniture
a. Must be fully documented.
b. Coded Furniture Plans identifying overall system layout; detailed system configuration(s) and components; critical dimensions; coordination with electrical and low-voltage services. Detailed layouts to include material and finish specifications for all components.
c. Coded quantity/type schedule fully referenced to the plans.
d. Documents/specifications must be sufficient for bidding and/or quotation preparation. Note that procurement process may involve multiple bid/request for quotation packages and/or vendors/contracts.
e. Furniture budget (coded to coordinate with Coded Furniture Plan) that identifies selected product; list prices; net prices; quantities; total cost; taxes; delivery and installation charges; vendor; and lead time.
f. Samples of actual finish and material selections.
g. Furniture timetable identifying timeframes for preparation of specifications/bid documents, order placement/confirmation, manufacturing lead times, and delivery and installation in coordination with Project Schedule. Identify challenges to the schedule and/or anticipated pricing increases that may impact timing of procurement process.
h. Binder shall include:
   1) Coded furniture plan with quantity/type schedule;
   2) Furniture budget;
   3) Furniture specifications;
   4) Cut sheets / photographs;
   5) Samples of finish and material selections;
   6) Furniture timetable.

36. Division 12 93 00: Site Furnishing
a. Must be fully documented.

37. Division 12 13 13: Bicycle Racks
a. Must be fully documented.

38. Division 13: Special Construction
a. If any special construction system is designed it must be fully detailed and specified.

39. Division 14: Conveying Equipment
a. Must be fully documented.

40. Division 21; Fire Suppression
a. Must be fully documented.

41. Division 22: Plumbing
a. As indicated above a site utility master plan showing sanitary and storm sewer layout.
b. Drawings showing locations of sewage ejectors and grinders (if required), and storm manholes.

c. Plumbing/sprinkler design diagrams showing service entry, etc.
d. Green and LEED analysis of the plumbing system.
e. Floor plans indicating locations of all plumbing fixtures and special features, and size of all piping systems, principal items of equipment and typical riser diagrams.
f. Plumbing and sprinkler riser diagrams.
g. All work done by the Plumbing Subcontractor, which includes, but not limited to all water, gas, air, vacuum, sanitary and storm wastes, and accessories. Foundation drain lines are the work of the General Contractor and shall not be indicated on the plumbing drawings. Site utilities shall be indicated on the utility drawings.
h. Plumbing work, other than site work, shall not be combined on the same sheets with the Fire Protection, HVAC, electrical, or other drawings except with the prior approval of the County.
i. Trapping primer and venting of all plumbing fixtures including floor drains.
j. Water and gas supply sources, storm and sanitary discharge mains.
k. All piping shall be carefully sized and all sizes shall be indicated on drawings and riser diagrams. Indicate all directions of flow and pitch on piping.
l. All accessories, valves, fixtures including all drinking fountains, grease traps for kitchen waste and all necessary panels, identified as to type and size.
m. Plumbing Legend and/or graphical symbols on the first sheet of the plumbing drawings in accordance with the American National Standards Institute (ANSI).
n. Domestic water booster pumps, boiler feed water, meter location, hose bibs.
o. Hot water; storage tanks, piping material, hanger details.
p. Complete sprinkler plumbing plans, risers and equipment.
q. Plumbing and sprinkler riser diagrams, sprinkler equipment layout, standpipe locations if applicable, and fire extinguisher locations.

42. Division 22 11 00; Facility Water Distribution
a. Must be fully documented.

43. Division 22 13 00: Facility Sanitary Sewerage
a. Must be fully documented.

44. Division 22 40 00: Plumbing Fixtures
a. Must be fully documented.

45. Division 23: HVAC
a. General
1) The first sheets of drawings in the mechanical set and the electrical set should be devoted to indexes, abbreviations, symbols, line nomenclature, and site plans; followed by one-eighth inch scale floor plans of the building and various systems which are, in turn, followed by one-quarter inch scale mechanical and electrical room drawings and details. Schematic diagrams and equipment schedules must be shown in full detail as separate drawings.
2) The heating and cooling systems indicating in sufficient detail the source of heat and cooling and method and location of heating and cooling distribution and controls within the building.
3) Heating and cooling load calculations for each space and major duct or pipe runs sized to interface with structural members.
4) Results of the energy analysis integrated in mechanical design.
5) Certification by the A/E that the mechanical design has been coordinated with other disciplines and no interfaces or dimensional conflicts exist.
6) Show locations and sizes of piping systems, air handling systems and principal items of equipment such as compressors. Also include necessary controls and riser diagrams.
7) Provide duct and pipe sizing calculations.
8) Block zone and room-by-room heating and cooling load calculations using approved design assumptions and software.
9) Data sheets on all mechanical equipment to be used as basis of design.
10) Double line layout of the air distribution system for the entire facility, showing location of

supply diffusers, return grills, outside air intake louvers, building exhaust louvers, etc.

11) Single line piping diagram for heating, cooling and condenser water flow, showing all major accessories.
12) Sequences of operation for the HVAC systems with control point list for the Management and Control System.
13) Control schematics showing sensors and actuators with alphanumerical designations coordinated with sequence of operation.
14) Location of fire pumps, booster pumps, hose connections and standpipes.
15) Location of devices in the ceilings.
16) An analysis of availability of components, construction sequence and scheduling, economic tradeoffs, acoustical and vibration control, safety and maintenance requirements.
17) Equipment schedule for all major HVAC components including energy efficiency ratings for each.
18) All piping, ductwork and equipment should be sized and shown.
19) All piping and ductwork in mechanical rooms and pipe spaces to be double lined at 1/4 scale.
20) All duct work to be double-lined on the floor plan.
21) Large scale mechanical details should be complete.
22) Details of HVAC controls.
23) All equipment schedules shown on the drawings.
24) Mechanical Commissioning Plan.
25) Master list of equipment submittals along with submission schedule.
26) Data sheets on all mechanical equipment specified, including diffusers and grilles.
27) Detailed coordination of air-distribution system with architectural elements, plumbing wiring and fire suppression systems.
28) Showing details of branch duct take-offs.
29) Single-line piping diagram for heating, cooling and condenser water flow, showing all major accessories.
30) Detailed sequence of operations for the HVAC systems using alphanumeric designations for sensors and actuators as shown on control schematics, with detailed control point list, specifications and operation strategies for the Management and Control System.
31) Complete control schematics showing sensors and actuators with alphanumerical designations coordinated with sequence of operation.
32) Detailed specifications covering energy efficiency, maintainability factors, and quality of each HVAC component.
33) County standard specification for Operation and Maintenance manual and training requirements appropriately modified for this project.
34) Site utilities shall be indicated on the utility drawings.
35) HVAC work, other than site work, shall not be combined on the same sheets with Fire Protection, Plumbing, Electrical, or other drawings except with the prior approval of the County.
36) All systems shall be sized at all reductions and riser diagrams of piping and duct systems shall be indicated.
37) All directions of flow and pitch on piping, and direction of flow, volumes for duct systems shall be indicated.
38) All equipment, accessories, valves and dampers with all necessary access panels, identified as to type and size.
39) Access panels, where required for access to valves and dampers, etc., shall be indicated on drawing.
40) All major equipment, including but not limited to, the boilers, chiller, air handlers pumps must be install on a 4’’ thick house keeping pad.
41) Cooling tower design shall be indicated on the drawings showing site location, elevations and floor plan of equipment layout and typical flow diagram as related to the total HVAC system.
42) Adequate ventilation shall be provided in utility tunnels. Ventilation for exterior utility tunnels shall be indicated on the utility drawings.
43) All fire and smoke dampers, access panels and doors shall be installed in accordance with

the latest edition of NFPA Code 90.a.

b. Mechanical Room:
   1) Plan and section of mechanical rooms.
   2) Boiler Plant and/or incinerator designs shall comply with all requirements of the Department of Environmental Protection, and all applicable regulations and the building code.
   3) Accessibility plans showing that mechanical and electrical equipment can be serviced and maintained. Show elevations detailing the differences in elevations of piping, conduits, wiring, structural and other building elements.
   4) Large scale mechanical room plans showing equipment locations, clearances and sections.
   5) Detailed equipment room layouts and clearances shown on drawings for all heating and cooling plant equipment, air-handlers, pumps, fan coil units, convectors and other terminal equipment. All ductwork and piping in the mechanical room to be double-lined. Provide elevations as required.
   6) In all designs of new and/or replacement boiler and chilled water plant, provide a flow diagram detailing steam or hot water distribution systems, return systems, including all existing equipment and their function, as well as any proposed expansions with all necessary instrumentation and controls.
   7) Maintenance accessibility analysis including sections of the HVAC equipment.
   8) Provide installation details for all major equipment
   9) Provide schedules for all equipment and devices.
   10) Indicate amount of air flow (both supply and return through the duct in CFM.
   11) Indicate positive and negative pressure zone.
   12) Avoid using sound liners. Should sound liner be used by County authorization, the liner be protected by perforated galvanized sheet.
   13) Do not specify flex duct more than 6'. Flex duct shall be insulated with Mylar lining from the factory.
   14) The air handlers and the duct system shall not be hanged from the lower chord of the joist.
   15) Indicate smoke detector locations per code.

c. Controls drawings shall include the followings:
   1) Provide HVAC control diagram
   2) Provide sequence of controls
   3) Address mechanical room ventilation requirements.

46. Division 23 08 00: Commissioning of HVAC

a. The A/E must use Commissioning Guide to develop the Commissioning Plan for approval by the County.

b. Equipment Maintenance Manuals
   1) See CD phases requirements.

47. Division 23 10 00: Facility Fuel System

a. Must be fully documented.

48. Division 23 20 00: HVAC Piping and Pumps

a. Must be fully documented.

49. Division 23 30 00; HVAC Air Distribution

a. Must be fully documented.

50. Division 23 40 00: HVAC Air Cleaning Devices

a. Must be fully documented.

51. Division 23 50 00: Central Heating Equipment

a. Must be fully documented.

52. Division 23 60 00: Central Cooling Equipment

a. Must be fully documented.

53. Division 23 70 00: Central HVAC Equipment

a. Must be fully documented.

54. Division 23 80 00; Decentralized HVAC Equipment

a. Must be fully documented.

55. Division 25: Integrated Automation

a. Must be fully documented.

56. Division 26; Electrical

a. Lighting on separate distribution, roughly sized.
b. Major electrical equipment roughly scheduled indicating size, capacity and total loads.
c. Major electrical equipment roughly scheduled indicating size, capacity and total loads.
d. A complete one-line diagram should be drawn in which a single line represents three phases of power system and it should be properly drawn, showing correct power distribution path from the normal power source and generators to each downstream load panels— including the ratings and sizing of each piece of electrical equipment, their circuit conductors, conduit size and their protective devices.
e. All service connections and electrical equipment (panels, transformers and switch gear) shall be located on centerline of tiles.
f. All services for special purposes shall be located and indicated.
g. All power consuming equipment and load characteristics.
h. Development of specific electrical power service and distribution systems, lighting, telephone, fire detection and alarm, security and electronic communications systems appropriate for the project, including computer network, cable TV and sound systems.
i. Equipment room layouts and clearances shown on drawings.
j. Electrical distribution riser diagram.
k. Wiring chases shown on drawings.
l. Total electric load calculation.
m. Major electrical equipment (switchgear, distribution panels, emergency generator, transfer switches, UPS system, etc.) dimensioned and drawn to scale into the space allocated.
n. Interior electrical loads estimate for systems furniture, receptacles, lighting, and any special use areas.
o. Analysis shall be made of availability of components, construction sequence and scheduling, economic tradeoffs, safety and maintenance requirements.
p. Completed specifications for each CSI section used.
q. Legend showing all symbols on drawings.
r. Certification by the A/E that the electrical design has been coordinated with other disciplines and County Department of Technology Services and no interferences or dimensional conflicts exist.
s. Electrical drawings shall indicate the following on utility drawings.
    1) Site utilities shall be indicated on utility drawings.
    2) Electrical work, other than site work, shall not be combined on the same sheets with Fire Protection, Plumbing, HVAC, or other drawings except with the prior written approval of the County.
    3) General arrangement: floor plan of each floor. Typical sections through the structure, floor and ceiling heights and elevations, and type of construction, including concrete pads shall be indicated.
    4) Interior lighting system; type of wiring, light fixture schedules, location and mounting heights of all fixtures, receptacle and switch outlets, sizes and types of all lamps and ballast, conduits, all other accessories and riser diagrams shall be indicated on the drawings. Indicate details and method of supporting electrical fixtures and conduits including empty conduits and outlets for telephone and communication equipment. Designer shall include on the drawing statement that all electrical lighting fixtures be supported from the building structure, and shall be independent of ducts, pipes, ceilings and their supporting members.
    5) Power system; locations, types, and method of control for all motors, heaters, appliances, controllers, starters, branch circuits, feeder conductors and conduits. Indicate riser diagrams. Show details and indicated method of supporting electrical conduit.
    6) Signal systems; locations and types of all outlets and equipment, service connections,

wiring diagrams, all other essential details.

7) Services; location and details of all services, whether overhead or underground, feeder sizes, plans and elevations of switchgear and transformers, metering and service switchboard arrangements, wiring and ground fault diagram and bus ducts. These items must be approved by local utility Company.
8) Generator; location, size, type of fuel, method of connection and protection of all generators, transformers, exciters, motor generators, switch gear, transfer switches and associated equipment, current characteristics and equipment capacities. Indicate equipment connections by means of one line and/on wiring diagrams and schedule all major items of equipment and all instruments.
9) Underground work; the sizes and locations of manholes and types of cables, number, size and location of ducts, locations, sizes and types of cable supports, fireproofing, duct line profile, and one line diagram of connections.
10) Pole line work; location, length, treatment and class of poles, guying , cross -arms, insulators, circuiting, transformers, protective and switching devices, lighting arresters, special structures, diagrams, current characteristics and grounding.
11) Exterior lighting; location, size, and types of transformers, luminaries, lamps and ballast, poles, cables, ducts, conduits and manholes, details of control equipment and connection diagrams.
12) Emergency system details including transfer switch, type of fuel.
13) One line diagram indicating load in KVA, and available short circuit amperes at each transformer, switchboard, distribution panel -board, branch circuit panel -board, and at major pieces of equipment.
14) Riser diagram for all systems.
15) Data outlets & conduits with pull wires.

t. Electrical construction documents shall be coordinated with all other construction documents eliminate conflicts and to locate electrical outlets, fixtures, panels, switchgear, equipment and accessories.
u. Lighting plan should show all switching and controls, fixture schedule should be complete and lighting details should be complete
v. Power distribution plans
w. Distribution information on all power consuming equipment except lighting and device branch wiring should be complete
x. All electrical equipment schedules should be complete
y. System components should be located on plans
z. Electrical Commissioning Plan
aa. Final specifications for all CSI sections used.
bb. Legend of all symbols shown on drawings
cc. Certification by the A/E that the electrical design has been coordinated with the other disciplines and County Department of Technology and no interferences or dimensional conflicts exist.
dd. Electrical construction documents include the preparation and submission of detailed engineering calculations and drawings for electrical work entailed by the approved architectural design and engineering analysis shall include all electrical requirements of the work including but not limited to power acquisition and emergency generation, power distribution, interior, exterior and parking lot lighting, telephone and communications systems, including sound systems, cable TV, fire detection and alarm, security systems, low voltage systems, direct current applications and emergency and special effects lighting.
ee. Electrical construction documents include, but are not limited to:
    1) Reflected ceiling plans showing light fixture locations coordinated with room tasks, multi-level switching arrangements, detailed fixture schedules listing make and model of all lamps, ballasts, diffusers and fixtures.
    2) Final size and cost of major components.
    3) Equipment room layouts and clearances shown on drawings.

4) Electrical riser diagram.
5) Wiring chases shown on plans.
6) Cross checks with security documents.

ff. Analysis shall be made of availability of components, construction sequence and scheduling, economic trade-offs, safety and maintenance requirements.

gg. Low voltage systems
1) Identify all low voltage systems and their requirements.

57. Division 26 08 00: Commissioning of Electrical Systems
a. Must be fully documented.

58. Division 26 09 26: Lighting Control Devices
a. Must be fully documented.

59. Division 26 20 01: Low Voltage Electrical Distribution
a. Must be fully documented.

60. Division 26 31 00: Photovoltaic Collectors
a. Must be fully documented.

61. Division 26 40 00; Facility Lightening Protection
a. Must be fully documented.

62. Division 26 50 00: Lighting
a. The A/E is to provide lighting design strategy for the building to meet energy conservation goals set by the County.
b. Lighting shall be indicated as to type, location and intensities in foot candles for each space, room, or typical space.
c. Site lighting layout for the entire complex including data sheets for proposed fixtures and lamps and the proposed mounting height for each fixture pole.
d. Lighting, power, telecommunications and office automation devices and receptacles shown in plan.
e. Light fixture schedule with types and quantities proposed along with data sheets.
f. Minimum of three manufactures must be specified for each specialty light fixture.
g. Ceiling plans showing light fixture locations coordinated with room tasks, and multi-level switching arrangements.
h. Documentation that the design meets the ASHRAE 90.1P power budget established for the project.
i. Luminance calculations for the design by the zonal cavity method.
j. Day-lighting analysis as directed by the County Representative.
1) Statement of foot- candles to be maintained for each type of task surface in the building.
2) Calculation based on the latest required ASHRE of lighting wattage budget and current established standards (IESNA Standard) of lighting quality and illumination level for the building interior and exterior. Including catalog cut sheets
3) Strategy for meeting lighting budget.
4) Day-lighting design and analysis.
5) Implementation of lighting control requirements
6) Development of lighting systems for the project following County technical guidelines for lighting and comments from Schematic Design to include; (a) reflected ceiling plans with light fixture locations coordinated with room tasks, multi-level switching arrangements; and detailed schedule of lighting fixtures, lamps and ballasts; (b) documentation that the design meets the ASHRAE 90.1P power budget established for the project; (c) illuminance calculations for the design by the zonal cavity method for lighting below 20 fc; (d) point illuminance calculations where requested above 20 fc; (e) daylighting analysis as directed by the County Representative.

k. Photometrix Analysis: Provide drawing and analysis in graphic and text using light distribution software (photometrix) to show point to point light distribution in FC. The analysis should include the following:
1) Photometrix drawings indicating FC and height of point values
2) High lighting below and above standard (or requirement) points

3) Light level at building perimeter (exterior windows)
4) Light level at property lines
5) Strategies for light pollution control
6) Various type of light source
7) Blocking of lighting concern zones (areas that in the program require certain lighting level) both for interior of the building and site
8) Manufacturer light distribution cut sheets for each light fixture clearly correlated with light fixture types on the drawings
9) On large projects provide a rendering of site night lighting plan by using appropriate software.

63. Division 26 51 00; Interior Lighting

a. Must be fully documented.

64. Division 26 56 00: Exterior Lighting

a. Must be fully documented.

65. Division 27: Communications

a. Must be fully documented.

66. Division 27 10 00: Structured Cabling

a. Must be fully documented.

67. Division 27 20 00: Data Communication

1) Computer system must be identified. Entry point for the data line to the building must be shown.
2) Verify all electrical needs for the computers and peripherals.
3) Raceway systems for telephone, Local area network cabling, emergency communications etc. designed to County standards.

68. Division 27 30 00: Voice Communications

1) Telephone system must be identified. Entry point for the telephone line must be shown.
2) Complete computer network and telephone system cable and conduit backbone design including all connections, drops, equipment racks, cable trays, electrical services, grounding systems and proposed equipment locations fully coordinated and in compliance with County Department of Technology Services (DTS).
3) Raceway systems for telephone, Local Area Network cabling, emergency communications etc. designed to County standards.

69. Division 27 40 00: Audio Video Communications

1) Complete audio video drawings, specifications, and schedules.
2) AV system must be coordinated with other building systems.
3) Commissioning Plan must explain AV coordination.

70. Division 28: Electronic Safety and Security

a. Provide floor plans analyzing exit routs and major life safety features.
b. Floor protection equipment room layout and description of wet or dry type systems, hose racks or cabinets and fire department tie-ins.
c. Fire protection drawings shall indicate standpipe location, sprinkler systems, access panels, fire pumps and accessories.
d. Fire Protection work, other than site work, shall not be combined on the same sheets with the plumbing, HVAC, electrical, or other drawings except with the prior approval of the County.
e. Completed specification of the security systems for the project including locking, control, observation, central control, and materials to be used.
f. Security and non security system logics.
g. Security and non security hardware and locking control systems.
h. Central control layout and control schemes.
i. Miscellaneous security equipment.
j. Security commissioning plan.

71. Division 31: Earthwork

a. Must be fully documented.

1) Division 31 22 00: Grading
2) Division 31 23 00: Excavating and Fill
3) Division 31 25 00; Erosion and Sediment Controls
4) Division 31 60 00: Special Foundations and Load Bearing Elements

72. Division 32: Exterior Improvement

a. Must be fully documented.

1) Division 32 10 00: Bases, Ballasts, and Paving
2) Division 32 18 00: Athletic and recreational Surfacing
3) Division 32 31 00: Fences and Gates
4) Division 32 32 00; Retaining Walls
5) Division 32 70 00: Wetlands
6) Division 32 80 00: Irrigation
7) Division 32 90 00: Planting

73. Division 33: Utilities

a. Must be fully documented.

1) Division 33 08 00: Commissioning of Utilities
2) Division 33 10 00; Water Utilities
3) Division 33 30 00: Sanitary Sewerage Utilities
4) Division 33 40 00: Storm Drain Utilities
5) Division 33 47 00: Ponds and Reservoirs
6) Division 33 50 00: Fuel Distribution Facilities
7) Division 33 70 00: Electrical Utilities
8) Division 33 73 00: Utility Transformers
9) Division 33 80 00: Communications Utilities

b.

Bidding and Negotiations Phase

QQ. General

1. After receiving written authorization from the County, the A/E shall proceed with the Construction Bid/Award Phase.

2. Prepare all addenda during the bid period.

3. County will conduct bidding, award, and negotiations but the A/E must be available to the County for assistance in performing these tasks.

4. The A/E shall compute, establish and itemize the added cost or deduction to the estimated contract price for all items to be included in the addendum in written form.

5. Addendum pages, including any drawings, shall be numbered consecutively with total attachments indicated on each page, i.e., page 1 of 8, page 2 of 8, -- page 8 of 8.

6. The A/E is to review requests for substitutions and submit recommendation(s) to County for approval.

7. If requested by the County A/E must review and evaluate bids and qualifications of the bidders.

8. The County will schedule and conduct a Pre-bid submission conference with prospective bidders to review the Project requirements. The A/E team must participate in the conference to explain and clarify bidding documents. If needed within three (3) calendar days after the pre bid conference the A/E shall deliver to the County an amendment required as a result of the pre-bid conference.

9. Should first bidding or negotiation produce prices in excess of the approved CCAP, the A/E shall participate with the County in as many follow up re-bid, renegotiation, and design revisions, at no additional cost to the County until a bid obtained with a price(s) within the approved CCAP or acceptable to the County. The County will assist in design revision decisions. All redesign must be approved by the County. The revised documents shall be submitted to all permitting authorities for approval if needed.

10. If the A/E revise the design or conduct re-bidding under its responsibilities set out in the preceding paragraph, its Construction Administration Phase and Post Construction Phase services shall be extended to take design revision/re-bid delays into account at no additional expense to the County.

11. The A/E shall assist the County in the preparation of the Contract(s) between County and Construction Contractor(s) for the County's execution. The A/E will assist the County in coordinating award(s) and Notice(s) to Proceed.
12. The A/E shall assist the County in Bidding and Negotiation Phase activities as defined in this section relative to Furniture Services (free-standing and systems).

Construction Administration Phase

RR. General

1. The Notice to Proceed from the Department Head or designee for the Construction Administration Phase of the Project will coincide with the notice to proceed to the Construction Contractor and the phase will terminate with the completion of all punch list items by the contractor and final payment to the construction contractor.
2. Construction Administration, unless stipulated otherwise by contract, is the responsibility of the prime consultant. This includes schedule, costs, conformance to drawings change orders, specifications, submittals, compliance with codes, tests, quality (workmanship), commissioning, final review and acceptance and warranty. Correction of shoddy workmanship cannot be deferred until the final punch list is prepared - it must be actively pursued throughout the construction period - starting at the pre-construction conferences. It is particularly important to review portions of the work that may be covered up or otherwise made difficult and costly to correct by subsequent work.
3. All consultants must take full responsibility for monitoring their portion of the contractor's work and assure that the completed project reflects favorably upon all trades and design disciplines
4. One of the most important early steps in the construction process is review of submittals. Consequently, submittal requirements must be clearly identified in the contract documents.
5. A/E must attend and prepare minutes for all progress meetings including as minimum two (2) pre-construction meetings.
6. A/E must use standard AIA forms where such forms are not provided by the County.
7. A/E must understand the role of A/E and its responsibilities as outlined in the General Condition of Contract Between the County and the Construction Contractor.
8. The A/E shall consult with the County and participate in all decisions as to the acceptability of subcontractors and other persons and organizations proposed by the Construction Contractor for various portions of the work.
9. The A/E must provide change order/quotation services consisting of:
    a. Preparation, reproduction and distribution of drawings and specifications to describe work to be added, deleted and/or modified.
    b. Review of proposals from contractor(s) for reasonableness of quantities and costs
    c. Review and recommendations relative to changes in time for Substantial Completion.
    d. If requested by the County, negotiations with contractor(s) on County's behalf relative to costs of Work proposed to be added, deleted or modified.
    e. Assisting the County in the preparation of appropriate construction contract modification documents.
    f. Coordination of communications, approvals, modifications and record-keeping relative to Changes in the Work.
10. The A/E shall render to the County, within five (5) calendar days unless otherwise authorized by the County, interpretations of requirements of the Contract Documents This response time is intentionally less than the General Conditions of Construction Contract to allow for review by the County. The A/E shall make all interpretations consistent with the intent of and reasonably inferable from the Contract Documents. These interpretations shall be subject to approval by the County. The A/E's decision in matters relating to artistic

effect shall be consistent with the intent of the Contract Documents and concurred with by the County.

11. Should errors, omissions or conflicts in the drawings, specifications or other Contract Documents by the A/E be discovered, the A/E will prepare and submit to the County, within ten (10) calendar days unless otherwise authorized by the County, such amendments or supplementary documents and provide consultation as may be required, for which the A/E shall make no additional charges to the County.
12. The A/E shall not be responsible for construction means, methods, techniques, sequences or procedures, or safety precautions and programs in connection with the Work, and shall not be responsible for the Construction Contractor's failure to carry out the Work in accordance with the Contract Documents.
13. Periodic visits of the A/E shall be not less than bi-weekly to coincide with the construction progress meetings with the Construction Contractor. Each engineering discipline shall make periodic visits not less than once a month during the course of work applicable to its discipline. During critical work phases, each of the disciplines may be required to make additional visits. On the basis of such on-site observations, the A/E and its consultants shall take the appropriate steps to protect the County against defects and deficiencies in the Work of the Construction Contractor. If the A/E observes any work that does not conform to the Contract Documents, the A/E shall immediately make an oral and preliminary written report of all such observations to the County and Construction Contractor. The A/E and its consultants shall not be required to make exhaustive or fulltime on site observations to check the quality or quantity of the Work, but shall make as many observations as may be reasonably required to fulfill their obligations to the County.
14. Field Reports must be done as a minimum on a bi-weekly basis. AIA Field Report form should be used. The A/E shall render final written field reports relating to the periodic visits and observations of the Project as required to the County within three (3) calendar days of the visit and in a format required by the County.
15. The A/E shall be responsible for assisting the Construction Contractor in obtaining governing agency occupancy approval. If any exceptions arise related to the design or specified materials the A/E will provide their services to correct the situation at no additional cost to County.
16. The AE must provide Project Closeout services upon notice from the contractor(s) that the Work, or a designated portion thereof which is acceptable to the County, is sufficiently complete, in accordance with the Contract Documents, to permit occupancy or utilization for the use for which it is intended, and consisting of:
    a. A detailed inspection with County representative(s) for the conformity of the work to the Contract Documents to verify the punch list of the items to be completed or corrected submitted by the contractor(s) is complete.
    b. Determination of the monetary amounts to be withheld until final completion.
    c. Securing consent of sureties, if any, to reduction in or partial release of retainage or the making of final payment.
    d. Issuance of Certificate(s) of Substantial Completion.
    e. Issuance of Certificate(s) of Final Completion.
17. The A/E shall participate in all required construction completion meetings.
18. The A/E shall prepare all the necessary documentation for LEED certification.
19. The A/E must maintain a complete set of submitted and contract documents at the print shop as required in previous phases.
20. The A/E shall assist the County in Construction Administration Phase activities as defined in this section relative to Furniture Services (free-standing and systems).

SS. Documents Review

1. The County will establish with the A/E procedures to be followed for review and processing of all shop drawings, catalog submissions, Project reports, test reports, maintenance

manuals, and other necessary documentation, as well as requests for changes and applications for extensions of time.

2. The A/E must review all RFI, submittals, shop drawings, substitution requests, invoices and contractors requests and respond in a timely fashion in accordance to the general condition of the contract.
3. The A/E shall review and approve shop drawings, samples, schedules, schedule of values, and other submissions of Construction Contractor(s) as well as the Work performed by the Construction Contractor(s) for conformance with the design concept of the Project and for compliance with the Contract Documents. The review and return of submittals shall be accomplished by the A/E within fourteen (14) calendar days from date of receipt or as identified in the General Condition of Contract, except when otherwise authorized by the County. This response time is intentionally less than the General Conditions of Construction Contract to allow for review by the County
4. Based on observations at the site and upon the Construction Contractor's applications for payment, the A/E shall determine the amount owed to the Construction Contractor(s), pursuant to the terms of the County/Construction Contractor Agreement, and shall within seven (7) calendar days after receipt of Application from Construction Contractor, issue Certificates for Payment to the County in such amounts. The County shall consult with the A/E in the determination of the amount due the Construction Contractor and the A/E shall sign the Certificate of Payment prior to the time it is transmitted to the County for payment. The A/E's signing of a Certificate of Payment shall constitute a representation by the A/E to the County, based upon the A/E's observations at the site and the data comprising the Application for Payment that the Work has progressed to the point indicated, that to the best of the A/E's knowledge, information and belief, the quality of the Work appears to be in accordance with the Contract Documents (subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion; the results of any subsequent tests required by the Contract Documents; minor deviations from the Contract Documents correctable prior to completion; and to any specific qualifications stated in the Certificate for Payment), and that the Construction Contractor is entitled to payment in the amount certified. However, if it should later be found that the Construction Contractor has failed to comply with its contract with the County in any way or detail, such failures and subsequent compliance shall be the sole responsibility of said Construction Contractor provided that A/E has complied with the terms and conditions of the contract.
5. By signing a Certificate for Payment to the County, the A/E shall not be deemed to represent that it has made any examination to ascertain how and for what purpose the Construction Contractor has used the monies paid on account of the Construction Contract Sum. If, in accordance with its duty, the A/E advises the County of nonconforming work, the A/E shall confirm the nonconformance in writing to the County within three (3) calendar days of observation.
6. When the Construction Contractor states that the Work or portions of the Work are substantially complete, the A/E and its consultants shall inspect the Work or portions of the Work, prepare and submit to the County with in three (3) calendar days, typed punch lists of the Work of the Construction Contractor(s) which is not in conformance with the Contract Documents. The A/E shall transmit such punch lists to the Construction Contractor(s) and County. The A/E will inspect and prepare a punch list on all portions of the Work.
7. The A/E will not issue revised construction documents without prior approval of the County, i.e. substitutions, drawing changes, and letters of correction.
8. The A/E and its consultant(s) shall conduct up to three (3) comprehensive Substantial Completion inspections per construction contract at the request of the County. If more than three (3) Substantial Completion inspections are required for the project through no fault of the A/E, the additional inspections shall be deemed additional services.
9. The A/E shall review facts and make a recommendation to the County for any claims or

disputes arising as a result of this phase.

10. The A/E must review and approve all Operation and Maintenance (O&M) manuals and warranties submitted by the construction contractor(s) and require the construction contractor to provide final and complete O&M manuals to the County prior to substantial completion.
11. The A/E shall assist the County in Construction Administration Phase activities as defined in this section relative to Furniture Services (free-standing and systems).

TT. Commissioning, Quality Control, Testing

1. The A/E shall assist the County in its management of the implementation of the Commissioning Plan and verification of compliance by the Construction Contractor to the Commissioning Plan. This assistance shall include coordination and verification of all maintenance and training manuals, and recommendations on training and scheduling. A commissioning schedule/plan shall be maintained and updated every other week by the construction contractor. The A/E shall maintain records of the commissioning process and document the bi-weekly progress of the Commissioning Plan. The A/E shall provide review and recommendations when required to keep this progress on schedule.
2. The County shall have authority to condemn or reject Work when in the County's or the A/E's opinion the Work does not conform to the Contract Documents. The A/E will verify non-conformance and the County will issue a formal notice to the construction contractor. Whenever in the County's or the A/E's reasonable opinion it is considered necessary or advisable to ensure the proper implementation of the intent of the Contract Documents, the County shall have the authority to require special inspection or testing of any Work in accordance with the provisions of the Contract Documents whether or not such Work is fabricated, installed or completed.
3. The A/E shall provide assistance in the original operation of any equipment or system such as initial start-up, testing, adjusting and balancing.
4.

Post Construction Phase

UU. General

1. The Notice to Proceed for the Post Construction Phase will coincide with the issuance of the substantial completion certificate and the phase shall be complete per the Master Schedule and Critical Contract Completion Period.
2. The A/E and its consultants shall conduct a warranty inspection with the County and using agency of the project nine months after substantial completion to identify items that need correction before contractors one year warranty period expires. A/E must provide a list of items to be corrected in coordination with the County.
3. The A/E and its consultants shall conduct an inspection with the County and using agency of the project, with the exception of furniture and equipment, ten (10) calendar days prior to warranty expiration and provide to the County a written report specifying any warranty deficiencies which may exist.
4. The A/E shall assist the County with any design issues identified during the warranty phase and verify that all equipment and systems are properly installed and functioning in accordance with the design and specifications.
5. A/E shall conduct inspections(s) upon notice by the contractor(s) that the work is ready for final inspection and acceptance and notify the County and contractor(s) of deficiencies discovered in follow-up inspections, if any. A/E shall receive and review transmittal of warranties, affidavits, receipts, releases and waivers of lien or bond indemnifying the County against liens and secure consent of surety or sureties, if any, to the making of final payment(s).
6. The A/E and/or its consultants shall observe and review test data of the original operation of any equipment or system such as initial start-up testing, adjusting and balancing to verify

that all equipment and systems are properly installed and functioning in accordance with the design and specifications.

7. The A/E and its consultants shall conduct up to three (3) comprehensive Final Completion inspections for the project at the request of the County. If more than three (3) Final Completion inspections are required for the project, through no fault of the A/E, the additional inspections shall be deemed additional services.

8. Upon correction of the deficiency reports (punch lists), and acceptance of all other close-out submittals and certificates of the Construction Contractor, the County and the A/E shall approve the Application for Final Payment.

9. The A/E will provide a review of the implementation of the Commissioning Plan and assist the County in obtaining a fully functional project that meets all requirements of the Contract Documents.

10. The A/E shall review facts and make a recommendation to the County for any claims or disputes arising as a result of this phase.

11. The A/E is responsible for integration of the construction contractor's provided as built drawings into a final "As Built" set in CADD format and two (2) hard copies deliverable to County. The A/E shall prepare a set of reproducible record drawings which show significant changes in the Work made during the construction process, based on neatly and clearly marked-up contract drawings, prints, and other data furnished by the Construction Contractor(s) and the applicable Amendments, Clarifications, and Change Orders which occurred during the Project. Two sets of full size drawings must be hard copies (one mylar and one bond); the other set must be in CADD format.

12. The A/E will assist the County with coordinating the loose furniture installations and delivery. The A/E shall provide up to three (3) comprehensive furniture installation inspections to verify all loose furniture has been delivered and installed correctly without damage as approved by the using agency.

The A/E shall assist the County in Post-Construction Administration Phase activities as defined in this section relative to Furniture Services (free-standing and systems).

Table of Phases and Deliverables

VV. Table of Deliverables During the Design Phases

	Design Phases													
PHASE	**CP**		**SD**		**DD**					**CD**				
Overall %	**5**		**15(5+10)**		**40(15+25)**					**70(40+30)**			**PERMIT**	**BID**
In Phase %	**50**	**100**	**50**	**100**	**20**	**40**	**60**	**80**	**100**	**10**	**30**	**50**	**80**	**100**
Stage	CP1	CP2	SD1	SD2	DD1	DD2	DD3	DD4	DD5	CD1	CD2	CD3	CD4	CD5
Progress Delivery (all materials presented to the county)	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
QC Review Process		Y		Y					Y				Y	
Report Booklets		12		12					12				12	4
Space Calculation Chart	Y	Y	Y	Y					Y			Y	Y	
Drawing Sets		12		12	2	2	4	2	12	2	4	4	12	7
LCCA According to LCCA plan or as required by PM	Y	Y	Y	Y	Y	Y	Y	Y	Y					
Specifications & cut sheets		CSI-O		CSI-O		CSI-S	CSI-S	CSI-S	CSI-S	CSI-S	CSI-S	CSI-S	CSI-S	CSI-S
		12		12	1	1	1	1	12	1	2	4	12	12
LEED binder		4		4				4	4			4	6	
Cost Estimate		CSI		CSI					CSI			CSI	CSI	Final check
Renderings		Y		Y	A/N	A/N	A/N	A/N	Y	A/N	A/N	A/N		
3D Animation		A/N	A/N	Y	A/N	A/N	A/N	A/N	Y	A/N	A/N	A/N	Y	
Slide Show	A/N	Y	A/N	Y	A/N	A/N	A/N	A/N	Y	A/N	A/N	Y	A/N	A/N
Material Boards and samples		A/N		1	A/N	A/N	1	A/N	1	A/N	A/N	1		
Furniture Binder	2	2		4			4		2			2	2	4
Model				WM					WM			FM		
Electronic Files	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

	Design Phases													
PHASE	**CP**		**SD**		**DD**					**CD**				
Overall %	**5**		**15(5+10)**		**40(15+25)**					**70(40+30)**				
													PERMIT	**BID**
In Phase %	**50**	**100**	**50**	**100**	**20**	**40**	**60**	**80**	**100**	**10**	**30**	**50**	**80**	**100**
Stage	CP1	CP2	SD1	SD2	DD1	DD2	DD3	DD4	DD5	CD1	CD2	CD3	CD4	CD5
Decisions Log	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M
Submittal Tracking plan and Logs	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M	P/M
PROJECT Schedule	P/I	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y
Schedule /Progress Log	P/I	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y	P/I, Y
Minutes of Meetings	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	P/I
Project Schedule	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I
Constr. Cost Change Log	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I	P/I

1. Legend

Y	Yes to be delivered
A/N	As needed to be delivered
P/I	Per invoice – Required for payment
P/M	Per meeting
CSI	Delivered in Construction Specification Institute system
CSI-O	Delivered in Outline format for all divisions of CSI
CSI-S	Delivered to include divisions and required sections of CSI
WM	Working Model
FM	Final professional model
LCCA	Life Cycle Cost Analysis

CP
Stage 1: Program and Data Verification-CP
Stage 2: Site and Building Concepts-CP
SD
Stage 1: Site Design & Building Layout-SD
Stage 2: Systems Selection-SD
DD
Stage 1: Floors Layout & Site Coordination-DD
Stage 2: Systems Coordination-DD
Stage 3: Interior Systems & Materials-DD

Stage 4: Design Coordination-DD
Stage 5: Design Presentation-DD
CD
Stage 1: Documents Setup – CD
Stage 2: Details Setup – CD
Stage 3: Integration Coordination – CD
Stage 4: Permit Documents – CD
Stage 5: Bid Documents – CD

WW. A/E Services Breakdown Per Phase

Phase	Design Phases				Bidding & Negotiations	Construction	Post Construction
	CP	SD	DD	CD		Construction Administration	Warranty Inspection
Phase %	5%	10%	25%	30%	5%	20%	5%
Cumulative %	5%	15%	40%	70%	75%	95%	100%

Please go to next page

Space Tabulation and Comparison Charts

XX. Space Tabulation Chart

1. This chart shows all spaces that are requested by the user/tenant and must show the inside area of each space. This chart must be already presented in the POR. At the end of each phase the A/E must verify and update the chart to indicate variations of what they have designed (actual measurements from the plans) from the original program.

Space Tabulation Chart - (SAMPLE)
Project Phase: Concept Planning (as an example)

Space	Type	Dimensions FT	Programmable Area SF	Quantity EA	Total Programmable Area SF
Administrative office	Closed	9.75'x12'	117	3	351
Office Service Coordinator	Systems	8'x10'	80	6	480
Subtotal Administration					831

YY. Space Tabulation Comparison Chart

1. This chart shows all spaces that are requested by the user/tenant and are shown in the Total Programmable Area column of Space tabulation Chart. At the end of each phase the A/E must verify and update the chart to indicate variations from the original program. Chart will be completed phase by phase and at the end of the Construction Documents phase all columns must be completed.

Space Tabulation Comparison Chart by phase - (SAMPLE)

Space	POR	CP	SD	DD	CD
Administrative office	360	351	400	400	400
Office Service Coordinator	480	480	480	480	480
Subtotal Administration	840	831	880	880	880

ZZ. Building Area Charts

1. At the end of each phase the A/e must complete and present the Building Area Chart in compliance with the Space Measurement Standards in this manual. If designed building is comprised of typical floors, then the calculation can be presented for a typical floor. If design building includes a ground level and then typical floors, then two charts must be presented; one for the ground level and one for each typical floor. All atypical floors must have their own floor chart. A summary or total building chart must follow at the end that represents the total building calculations. The following samples represents a building with a ground floor and 3 typical floors:

Building Area Chart - (SAMPLE)

Floor: Typical floor

No.	Space category	Area SF	Multiplier	Formula for area
A	**Programmable Area**	**10,983**	**1.00**	**Total from Space Tabulation Charts**
B	Internal walls	1,235	0.12	A x B%
C	Assignable Area	12,218	1.12	A+B
d1	Internal corridors	1,867	0.17	A x d1%
d2	Non-programmable areas	109	0.01	A x d2%
D	Internal circulation	1,976	0.18	d1+d2
E1	Net Usable Area	12,850	1.17	A+d1
E2	Usable Area	14,194	1.30	C+D
f1	Lobby	439		
f2	Mech. room			
f3	Equipment room			
f4	Mail room			
f5	Telephone/IT room			
F	Building Common area	439	0.04	Σf
g1	Janitor’s closet	20		
g2	Elect. & Tel. room	90		
g3	Mech. room	90		
g4	Rest room	493		
g5	Corridors	1,845		
G	Floor Common Area	2,538	.23	Σg
h1	Shafts	78		
h2	Elevator banks	267		
h3	Stairs	391		
H	Major Vertical Penetrations	736	0.07	Σh
I	Rentable Area	17,171	1.56	E2+F+G
J	Gross Measured Area	17,907	1.63	I+H
K	Exterior walls	439	0.04	A x K%
L	**Gross Building Area**	**18,346**	**1.67**	**J+K**

See next page to continue

Building Area Chart - (SAMPLE)

Floor: Ground Floor

No.	Space category	Area SF	Multiplier	Formula for area
A	**Programmable Area**	**10,351**	**1.00**	**Total from Space Tabulation Charts**
B	Internal walls	931	0.09	A x B%
C	Assignable Area	11,282	1.09	A+B
d1	Internal corridors	1,863	0.18	A x d1%
d2	Non-programmable areas	103	0.01	A x d2%
D	Internal circulation	1,966	0.19	d1+d2
E1	Net Usable Area	12,214	1.18	A+d1
E2	Usable Area	13,248	1.28	C+D
f1	Lobby	1,197		
f2	Mech. room	199		
f3	Equipment room	0		
f4	Mail room	0		
f5	Telephone/IT room	0		
F	Building Common area	1,396	0.135	Σf
g1	Janitor's closet	20		
g2	Elect. & Tel. room	90		
g3	Mech. room	90		
g4	Rest room	493		
g5	Corridors	1,845		
G	Floor Common Area	2,538	0.245	Σg
h1	Shafts	78		
h2	Elevator banks	267		
h3	Stairs	391		
H	Major Vertical Penetrations	736	0.07	Σh
I	Rentable Area	17,182	1.66	E2+F+G
J	Gross Measured Area	17,918	1.73	I+H
K	Exterior walls	414	0.04	A x K%
L	**Gross Building Area**	**18,332**	**1.77**	**J+K**

See next page to continue

Building Area Chart - (SAMPLE)

Floor: Total Building

No.	Space category	Area SF	Multiplier	Formula for area
A	**Programmable Area**	**43,300**	**1.00**	**Total from Space Tabulation Charts**
B	Internal walls	4,763	0.11	A x B%
C	Assignable Area	48,063	1.11	A+B
d1	Internal corridors	7,361	0.17	A x d1%
d2	Non-programmable areas	433	0.01	A x d2%
D	Internal circulation	7,794	0.19	d1+d2
E1	Net Usable Area	50,661	1.18	A+d1
E2	Usable Area	55,856	1.29	C+D
f1	Lobby			
f2	Mech. room			
f3	Equipment room			
f4	Mail room			
f5	Telephone/IT room			
F	Building Common area	2,598	0.06	Σf
g1	Janitor’s closet			
g2	Elect. & Tel. room			
g3	Mech. room			
g4	Rest room			
g5	Corridors			
G	Floor Common Area	9,959	.23	Σg
h1	Shafts			
h2	Elevator banks			
h3	Stairs			
H	Major Vertical Penetrations	3,031	0.07	Σh
I	Rentable Area	68,413	1.58	E2+F+G
J	Gross Measured Area	71,444	1.65	I+H
K	Exterior walls	1,732	0.04	A x K%
L	**Gross Building Area**	**73176**	**1.69**	**J+K**

See next page to continue

AAA. Building Area Comparison Chart by Phase

1. At the end of each phase the AE must also present the Gross Building Area Calculation Chart in compliance with the Space Measurement Standards in this manual. If designed building is comprised of typical floors, then the calculation can be presented for a typical floor. If design building includes a ground level and then typical floors, then two charts must be presented; one for the ground level and one for each typical floor. All atypical floors must have their own floor chart. A summary or total building chart must follow at the end that represents the total building calculations. The following is the format for such charts:

Building Area Comparison Chart by phase - (SAMPLE)

Space	**POR SF**	**CP SF**	**Delta w/POR**	**SD SF**	**Delta w/POR**	**DD SF**	**Delta w/POR**	**CD SF**	**Delta w/POR**
Programmable Area	10,983	10,983	0	11,983	1,000	11,983	1,000	11,983	1,000
Assignable Area	12,279	12,279	0	12,279	0	12,279	0	12,279	0
Internal Circulation	1,938	1,938	0	1,938	0	1,938	0	1,938	0
Net Usable Area	12,839	12,839	0	12,839	0	12,839	0	12,839	0
Usable Area	14,217	14,217	0	14,217	0	14,217	0	14,217	0
Building Common Area	399	399	0	399	0	399	0	399	0
Floor Common Area	2,538	2,538	0	2,538	0	2,538	0	2,538	0
Major Vertical Penetrations	736	736	0	736	0	736	0	736	0
Rentable Area	17,154	17,154	0	17,154	0	17,154	0	17,154	0
Gross Measured Area	17,890	17,890	0	17,890	0	17,890	0	17,890	0
Exterior walls	486	486	0	486	0	486	0	486	0
Gross Building Area	**18,595**	**18,595**	**0**	**19,595**	**1,000**	**19,595**	**1,000**	**19,595**	**1,000**

Sample of Diagrams and Logs

A. Project Submission Log for Utilities, Permits, Required Documents

1. Table: Project Submission Log for Permits

Submission Requirement	Description	Contact Name	Contact Information	Consultant	Date of Application	Date of Approval	Status	Review Time

B. Design Documents Progress Log

1. Table: Design Documents Progress Log

Drawing Number	**Last Submission 50% DD 7-12-09**	**Current Submission 80% DD 9-23-09**	**Notes**
	Description	**Progress Since Last Submission**	
	General		
G-001	Sheet Title		
	Architectural		
A-121			
	Civil		
C-03			
	Add for others		
X-05			

Selected CSI Divisions for Reference Only

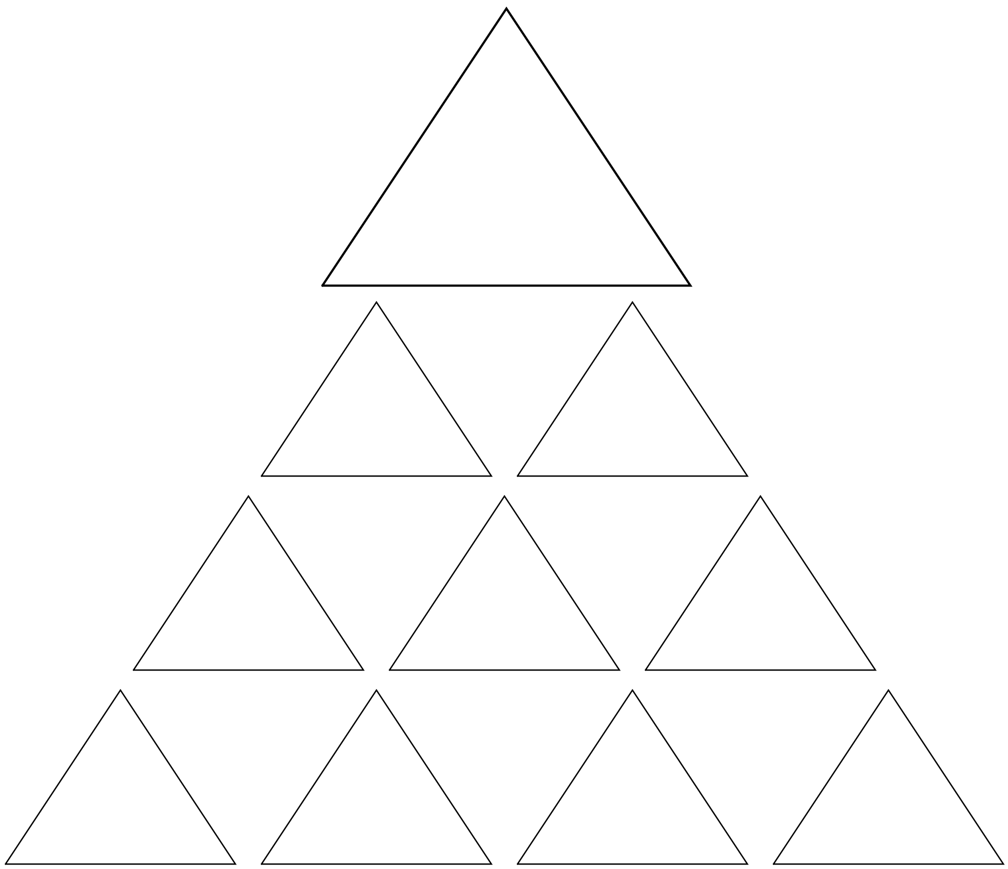
2. Division 01: General Requirements
   a. Division 01 81 13: Sustainable Design Requirements
   b. Division 01 91 00: Commissioning Requirements
3. Division 02: Existing Conditions
   a. Division 02 21 00: Site Survey
   b. Division 02 22 19: Traffic Assessment
   c. Division 02 24 00: Environmental Assessment
   d. Division 02 30 00: Subsurface Investigation
4. Division 03: Concrete - Structural System
5. Division 04: Masonry- Structural System
6. Division 05: Metals Structural System
7. Division 06 22 00: Wood, Plastics, and composites (Millwork)
8. Division 07: Thermal and Moisture Protection - Envelope
   a. Division 07 10 00: Damp-proofing & Waterproofing
   b. Division 07 20 00: Thermal Protection
   c. Division 07 25 00: Weather barriers
   d. Division 07 71 00: Roof
   e. Division 07 77 00: Exterior Walls
9. Division 08: Openings (Doors & Windows)
   a. Division 08 70 00: Hardware
10. Division 09: Finishes
    a. Division 09 50 00: Ceiling
    b. Division 09 60 00: Flooring
    c. Division 09 70 00: Wall Finishes
    d. Division 09 80 00: Acoustic Treatment
    e. Division 09 90 00: Painting
11. Division 10: Specialties
    a. Division 10 06 10.13 Exterior Signage

b. Division 10 06 10.16 Interior Signage
c. Division 10 21 00 Toilet Compartments
d. Division 10 22 26 Operable Partitions
e. Division 10 71 13 Exterior Sun Control Devices
f. Division 10 73 00: Protective Covers (Canopies, etc.)

12. Division 11: Equipment
    a. Division 11 26 00: Kitchen Equipment
    b. Division 11 28 00: Office Equipment (Computer, copier, etc.)
    c. Division 11 52 00: Audio- Visual Equipment
    d. Division 11 65 00: Athletic and Recreational Equipment
    e. Division 11 82 00: Solid Waste Handling Equipment
13. Division 12: Furnishings
    a. Division 12 10 00: Artwork
    b. Division 12 20 00: Window Treatments
    c. Division 12 30 00; Casework
    d. Division 12 50 00: Furniture
    e. Division 12 59 00: Systems Furniture
    f. Division 12 93 00: Site Furnishing
    g. Division 12 93 13: Bicycle Racks
14. Division 13: Special Construction
    a. Division 13 11 00: Swimming Pools
    b. Division 13 28 00: Athletic and Recreational Special Construction
15. Division 14: Conveying Equipment
16. Division 21; Fire Suppression
17. Division 22: Plumbing
    a. Division 22 11 00; Facility Water Distribution
    b. Division 22 13 00: Facility Sanitary Sewerage
    c. Division 22 40 00: Plumbing Fixtures
18. Division 23: HVAC
    a. Division 23 08 00: Commissioning of HVAC
    b. Division 23 10 00: Facility Fuel System
    c. Division 23 20 00: HVAC Piping and Pumps
    d. Division 23 30 00; HVAC Air Distribution
    e. Division 23 40 00: HVAC Air Cleaning Devices
    f. Division 23 50 00: Central Heating Equipment
    g. Division 23 60 00: Central Cooling Equipment
    h. Division 23 70 00: Central HVAC Equipment
    i. Division 23 80 00; Decentralized HVAC Equipment
19. Division 25: Integrated Automation
20. Division 26; Electrical
    a. Division 26 08 00: Commissioning of Electrical Systems
    b. Division 26 09 26: Lighting Control Devices
    c. Division 26 20 00: Low Voltage Electrical Distribution
    d. Division 26 31 00: Photovoltaic Collectors
    e. Division 26 40 00; Facility Lightening Protection
    f. Division 26 50 00: Lighting
    g. Division 26 51 00; Interior Lighting
    h. Division 26 56 00: Exterior Lighting
21. Division 27: Communications
    a. Division 27 10 00: Structured Cabling
    b. Division 27 20 00: Data Communication
    c. Division 27 30 00: Voice Communications

End of Section

ENERGY DESIGN GUIDELINES
MONTGOMERY COUNTY
MARYLAND



FOREWORD

The Montgomery County Maryland Energy Design Guidelines (EDG) has been designed to contain the latest Energy conservation recommendations that best match the needs of the county and its staff. These recommendations along with end user orientation programs, regular energy usage monitoring and reporting practices will be the basis for the conservation plans proposed.

These guides will parallel energy efficiency requirements highlighted in ASHRAE 90.1. Using this manual may require referencing the LEED version 2.2 and or the 2007 ASHRAE 90.1 guides. Also, the Energy Engineer of the Engineering and Management Services (EMS) will be ready to assist you with any specific questions regarding this manual or county energy conservation plans you may have. The County Energy Engineer can be reached at; Victor.Sousa@montgomerycountymd.gov or 240-777-6036.

DISCLAIMER

These guidelines were developed for use by Montgomery County, Maryland staff and projects. Others adopt or use these guidelines at their own risk. Neither Montgomery county, Maryland, or any of its employees make any warranty expressed or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed. Reference herein to any specific commercial product is to provide an example of such a product and does not constitute endorsement or recommendation for exclusive use. Outside standards and documents cited, used or excerpted in these guidelines are dated and are not warranted or be the latest or most applicable version of said material.

These guides shall not be used to circumvent any safety, health, or environmental requirements. For any exceptions or questions, please contact the County Energy Engineer at the office of EMS; Victor.Sousa@montgomerycountymd.gov or call 240-777-6036.

TABLE OF CONTENTS

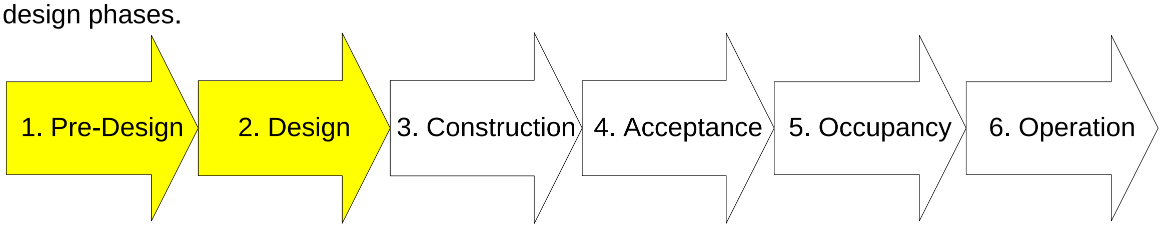
LIST OF TABLES

OVERVIEW

Montgomery County's concerns regarding the environment, energy consumption costs, balanced with the need to provide practical solutions for the end users have been considered in developing a standard approach and expected end results expected for each project. We expect "The whole building approach", where all building systems and team members work together and provide continuous feedback regarding these guides to become a powerful energy management tool , that will save Energy, construction Costs and the Environment.
Successful projects incorporate integrated design principles. This means that all of the building components must efficiently work together in order to maximize energy savings while ensuring occupant comfort and productivity.

PURPOSE

Montgomery County, Maryland Energy Design Guidelines serve to assist county; building owners, managers, designers, and contractors in building energy efficient buildings and managing their energy usage. These guidelines incorporate ANSI/ASHRAE/IESNA standard 90.1-2004 standards for buildings. These guidelines set minimum energy efficiency standards which designers and architects are encouraged to exceed. This document is intended to supplement the LEED requirements mandated by the County Council. These guidelines will specifically apply in the areas of HVAC, lighting Design, and Envelope. These guides will closely parallel energy efficiency requirements highlighted in ASHRAE 90.1, referencing the LEED efficiency rating system. The Energy engineer of EMS will be able to assist with any other references and or questions regarding this manual or the county energy efficiency requirements.
This Manual has been prepared to serve as a guide for providing professional services during all the design phases.



These guides collectively will be a stand-alone document that will compliment the LEED stated building rating requirements and the Montgomery county Design Guidelines. Given the current fluid environment for green building initiatives and recommendations at national and state levels, we will be updating these guides on a continuous basis, adjusting our processes and procedures to best match the needs of our end users. To ensure efficient availability of the up-to-date guides we will post the most recent updates on the county intranet web site.

Montgomery County recognizes that each building project is unique. Therefore, these Energy Design Guidelines are intended to provide general information regarding the characteristics that apply to all County buildings. However, there may be times when exceptions are necessary.

The County will consider exceptions on a case-by-case basis and will be considered depending upon the unique circumstances. Other information that must be included with the request for exceptions include:

- Physical description of the property and building,
- Life Cycle Costing analysis the options considered,
- Mechanical specifications with drawings accurately depicting the design and energy features, and
- Citation of the specific energy code or reference that the basis for requesting an exception.

All exceptions must be submitted to the Montgomery County Energy Engineer, Division of Operations. It is intended that the procedures outlined herein shall be followed to the fullest extent. When necessary exceptions will be allowed according to the procedures noted in these guides and in coordination with the office of EMS at Victor.Sousa@montgomerycountymd.gov or phone: 240-777-6036.

ROLES

Role of the Energy Analyst

The Architect must designate a qualified Energy Analyst to coordinate energy design requirements. The Energy Analyst on the design team needs to review and become familiar with all the material in these guidelines relevant to the project under design. It is the responsibility of the Energy Analyst to coordinate energy requirements within the design team, including the Architect, Mechanical designer and Electrical Designer. Specifically, the Energy Analyst is responsible for:

Understanding all energy guidelines and communicating them to the design team;

Making other team members aware of criteria which affect their design and redirecting design when necessary;

Attending all meetings where major Architectural decisions will be made, and advise the designer of impacts of such decisions on energy consumption, meeting prescriptive criteria and meeting the Energy Program of Requirements (EPOR);

Performing the required energy analysis and preparing detailed reports;

Reviewing plans and specifications for correct and complete implementation of energy features <u>prior</u> to each submission for review by the Owner. Overall, the Energy Analyst must ensure quality control for all energy design aspects of the project.

Rules

Energy ground rules are the guiding principles for making decisions that affect energy use of the building. The Architect and the design team must all be aware of these rules in order for the design to proceed smoothly to the Owner's acceptance. Some ground rules will be specific to a building. The general rules that apply to almost all our projects are as follows:

1) **<u>Energy features must be integrated into the building from pre-design phases</u>**, not added in during the last phases. For example, daylight buildings must include appropriate roof monitors and the building must be correctly oriented during Schematic Design. At a later phase it may be too late to achieve acceptable results.

2) **<u>Major decisions must be made as a team and based on energy analysis.</u>** Typically the Architect works alone during schematic design to configure the building shape and exterior elevation. This approach does not work well with advanced energy guidelines that limit glass area and promote climate-responsive design. The Architect needs to encourage participation of the energy Analyst in the early design stages to ensure prescriptive and program requirements are met and to help optimize design. Energy analysis must be used to make informed decisions regarding the design of the building.

3) **<u>The cost of the project must always be viewed as a whole.</u>** In new buildings, an energy improvement almost never exists in isolation and cost increases in one area will be balanced by cost decreases in another. For example, high-efficiency lighting fixtures with good optical control are "expensive" per fixture, but lower ***total*** project cost because fewer fixtures are needed, electrical distribution costs are smaller and total air conditioning first costs are often reduced by 20%.

4) **Both the energy budget and project cost budget (using ASHRAE 90.1) must be met**. Experience in our projects and around the nation shows that both energy and project costs can be controlled together. Conflicts emerge primarily when one or more of the energy ground rules have been overlooked.

RESPONSIBILITIES

A. Owner's (Montgomery County's) Project Manager
The Project Manager ensures that events occur in the proper order as shown on the charts. Design should not be allowed to proceed without required meetings and energy report approvals at Schematic and Design Development.

B. Design Architect
The Architect ensures that the design team has appropriate expertise to carry out all requirements indicated. The Architect ensures that all disciplines follow the energy ground rules and work together to achieve energy efficiency and cost control in the design.

C. Energy Analyst
The Analyst provides analysis and review internal to the design team on compliance with energy requirements and optimization of design. The analyst also compiles energy reports and provides the interface with Energy Engineer. The Analyst provides overall Quality Control of energy requirements in the design process.

D. County Energy Engineer
The County Energy Engineer (CEE) provides the Owner's Quality Assurance of energy efficient design. The CEE reviews credentials of the proposed Energy Analyst and approves or disapproves the appointment. The CEE reviews required energy reports, EPOR forms and checks implementation on the plans and specifications. When the designer's quality control is found to be inadequate, the CEE may require removal and replacement of the Energy Analyst.

E. Design Mechanical Engineer
The Mechanical Engineer provides implementation of energy efficiency requirements for mechanical systems, indoor air quality and ventilation requirements, energy management requirements, and mechanical commissioning requirements. The Mechanical Engineer participates in all meetings involving functional zoning of the building, HVAC system types, and location and size for mechanical rooms.

F. Lighting Designer
The Lighting Designer uses the Owner's requirements for design approach to create a functional lighting system tailored to the individual spaces of the building and meeting all wattage budgets. The Lighting Designer uses furniture layouts provided by the Architect in the process. The lighting designer calculates the wattage budget and actual lighting wattage for use by the Energy Analyst and Mechanical and Electrical Engineers at Schematic Design and Design Development. The lighting designer provides complete specification of all lighting equipment and controls following the Owner's Guide Specifications at Design Development.

G. Design Electrical Engineer
The Electrical Engineer provides implementation of all electrical system energy efficiency requirements and electrical commissioning requirements. The Electrical Engineer participates in all decisions involving distribution of electricity, and location and size of electrical rooms.

H. Owner's Maintenance Engineer

The Maintenance Engineer provides requirements on maintainability and accessibility of all mechanical and electrical systems at the Pre-Design briefing and all subsequent review meetings.

ENERGY DESIGN PROCESS

Pre-Design
Since all of the commercial building components must work together successfully long after project completion, it is essential that sufficient time be set aside in the beginning of a project for design team development, goal setting, and project planning. Everyone in a decision making position should be involved at the project's beginning. Ultimately, the building owner is responsible for setting the goals and their implementation. It is the design team's responsibility to translate goals and budget for the project into measurable benchmarks for design, construction, and operations so the project will be successful. Figure 1 illustrates this interrelationship.

Activities	Responsibilities
1. Select Team a. Design (Architect, Engineer, or Design Build Team) b. QA, Quality Assurance c. Construction Manager (CM)/General Contractor (GC)/ Estimator	Owner evaluates potential service providers and selects team.
2. Owner's Project Requirements (OPR) a. Document Functional and Spatial Requirements b. Document Energy Efficiency Goals	Owner, Designer analyze the project site, Owner's needs, and strategic sets presented in this Guide and document them defining the Owner's Project Requirements (OPR)1 and goals
3. Select Site a. Building Orientation Preference b. Consider Access to Public Transportation	Owner, Designer, CM
4. Define Budget (Benchmarks) a. Develop and Review Design Budget b. Develop and Review Construction Budget c. Develop and Review QA Budget	Owner, Designer, CM, Estimator Designer, Owner CM, Estimator, Owner QA
5. Design and Construction Schedule	Owner, Designer, CM, GC
6. Define Specific System Preferences	Owner, Designer, CM
7. Define Energy Costs/Efficiency Program Opportunities	Owner, Designer
8. Codes/Standards Requirements/Targets	Designer, Owner
9. Establish Prioritized List of Energy Goals	Owner, Designer, CM or GC

Design

In the Design Phase, the team develops the energy strategies into building plans, sections, details and specifications. The sequence many design designs as well as other identified strategies have a major impact on energy efficiency. The following steps, presented in sequence below, identify the appropriate time in the process to apply specific recommendations from the guidelines.

Activities	Responsibilities
1. Develop diagrammatic building plans that satisfy functional program requirements	Designer
2. Incorporate building envelope design strategies to reduce loads on energy-using systems	Designer
3. Develop site plan to make best use of building orientation and day lighting strategies	Designer
4. Select building systems and efficiency level	Designer, Owner, CM
5. Develop building plans, sections, and details incorporating above strategies	Designer
6. Continue to develop architectural and lighting details, including energy implications. For example: lighting, fenestration, and exterior sun control	Designer
7. Refine aesthetic details incorporating above details where applicable, for example: building elevations reflect appropriate location and size of windows	Designer
8. Design review—verify that project meets original goals	Owner, Designer, QA, CM
9. Calculate building HVAC loads. Use recommended loads for lighting power density from this Guide	Designer; often equipment manufacturer (EM) is involved
10. Match capacity of HVAC systems to design loads. Use efficiency of equipment as recommended by this Guide	Designer, EM
11. Perform final coordination and integration of architectural, mechanical, and electrical systems	Designer
12. Develop specifications for all systems	Designer
13. Integrate commissioning specifications into project manual	QA
14. Perform final cost estimates	CM, GC, Estimator
15. Review and provide revisions to final design documents	Owner, Designer, QA
11. Perform final coordination and integration of architectural, mechanical, and electrical systems	Designer

ENERGY EFFICIENCY BUDGET PROCESS

Currently some budgetary requests and approvals are completed without a design parameter review by general services group. General services can help all county building managers in properly planning and budgeting their future renovation and or new facility energy efficiency needs. Completing the new Energy Program of Requirements (EPOR) form shown below along with the original POR request will allow the County Energy engineer to help assist and proactively support the energy efficiency needs of all project owners. Eliminating the need for costly design changes later during the construction phase of the project.

1. ADMINISTRATION AND ENFORCEMENT

Administrative requirements relating to this guide and any exception from them shall be approved by the County Energy engineer (CEE) at the following electronic address ; Victor.Sousa@montgomerycountymd.gov or, 240-777-6036.

The following project categories will be monitored for compliance with the energy guidelines noted in this manual.

I. **New Buildings;** New buildings shall comply with the standard (standard is the latest ASHRAE90.1 standard) as described in this guide.

II. **Additions to Existing Buildings;** An extension or increase in the floor area or height of a building outside of the existing building envelope shall be considered additions to existing buildings and shall comply with these design guides.

III. **Alterations of Existing Buildings:** Alterations of existing buildings shall comply with the standard as described in these guides.

IV. **Replacement of Portions of Existing Buildings:** Portions of a building envelope, heating, ventilating, air-conditioning, service water heating, power, lighting, and other systems and equipment that are being replaced shall be considered as Alterations of Existing Buildings and shall comply with these guides.

V. **Changes in Space Conditioning;** Whenever unconditioned or semi heated spaces in a building are converted to conditioned spaces, such conditioned spaces shall be brought into compliance with all the applicable requirements of this standard that would apply to the building envelope, heating, ventilating, air-conditioning, service water heating, power, lighting, and other systems and equipment of the space as if the building were new.

A. Alternative Materials, Methods of Construction, or Design

The provisions of this guide are not intended to prevent the use of any material, method of construction design, equipment, or building system not specifically pre-scribed herein, as long as any exceptions have been approved by the office of the County Energy Engineer.

B. Validity

If any term, part, provision, section, paragraph, subdivision, table, chart, or reference of this guide shall be held unconstitutional, invalid, or ineffective, in whole or in part, such determination shall not be deemed to invalidate any remaining term, part, provision, section, paragraph, subdivision, table, chart, or referenced standard of this standard. Also the provisions of this guide shall not be deemed to nullify any provisions of local, state, or federal law. Where there is a conflict between a requirement of this guide and such other laws affecting construction of the building, precedence shall be determined by the controlling laws in Montgomery County Maryland.

C. Normative Appendices

The normative appendices to the ASHRAE 90.1 standards are considered to be integral parts of the man-datory requirements of this guide, which for reasons of convenience, are placed apart from all other normative elements.

D. Compliance Path

The County Division of Capital Development (DCD) has recently adopted the LEED system certification guides for building efficiency certification. The LEED system was conceived to improve the quality of buildings and their impact on the environment. As such the LEED system certification provides guidance for credits in both environmental and energy aspects of building design.

The LEED system offers 69 possible points overall. The Energy & Atmosphere section offers the most available points, (17 points or 24.6% See LEED Checklst). The EDG will focus its guidance and discussion mostly to achieve success in this area. Compliance in this area will have the largest impact for reducing operating costs and carbon emissions.

ASHRAE Standard 90.1 defines specific prescriptive requirements for each discipline (i.e., Envelope , HVAC, Lighting, Power , Service water heating) for building design.

E. Compliance and Optional Approaches

Projects including new buildings, additions to existing buildings; alterations of existing buildings shall comply (without exceptions) with the minimum requirements achieved by following the mandatory and prescriptive methods.

In addition, as of June 2007 (LEED–NC version 2.2), it is expected that all new construction will be required to meet or exceed the ASHRAE minimum performance requirements.

The County will use and apply the most practical energy efficiency (nationally adopted) standards, that best fit the need to reduce carbon producing energy consumption practices. The energy costs reductions will then be a by-product of this approach.The Montgomery County Energy Design Guidelines (EDG) were developed to better facilitate the county targeted use of energy efficiency certification requirements of the LEED document.

In order to comply with ASHRAE Standard 90.1, the project must meet all mandatory provisions plus show compliance with;

- Prescriptive Method,
- Building Envelope Trade off Method or
- Energy Cost budget Method.

These methods will be discussed in more detail in the following sections.

F. Mandatory and Prescriptive Paths

Since each discipline has its own set of specific rules within the Mandatory and Prescriptive requirements, individual provisions will be summarized separately.

G. ASHRAE 90.1 Mandatory Provisions

Each discipline must comply with the mandatory requirements which cannot be waived or traded. These rules require without exception, the observance of basic fundamental engineering principles. After that, the prescriptive provisions may be used.

- **Building Envelope Mandatory Provisions**: The standard requires that certain insulation and air leakage requirements be observed. Mandatory provisions must be satisfied in all cases.
- **Heating, Ventilating and Air Conditioning Mandatory Provisions**: The following provisions must be verified and implemented for all HVAC systems under consideration: 1)

Equipment efficiencies, 2)Load calculations for equipment sizing including diversity factors, 3)Controls, 4) System construction and insulation.

- **Service Water Heating Mandatory Provisions**: Addresses system sizing methodology, minimum allowable equipment efficiency, control types and methods to minimize distribution losses in circulating systems. Areas include: 1) capacity requirement calculations, 2) Equipment efficiency 3) Service hot water piping insulation. 4) Service water heating system controls. 5) Indoor swimming pools.
- **Power Mandatory Provisions**: Addresses maximum voltage drops in electrical distribution systems and requires single line drawings as well as operating and maintenance manuals.
- **Lighting Mandatory Provisions**: Prescribes methods for calculating interior and exterior lighting power. Prescribes automatic lighting shutoff space controls, tandem wiring for fluorescent fixtures, maximum luminaries wattages as well as exterior lighting systems efficiency.

H. ASHRAE 90.1 Prescriptive Provisions

These requirements along with the Mandatory provisions are the core of Standard 90.1. It is important to note that other methods described in the standard such as the Energy Cost Budget Method (ECB), Building Performance Rating Method, all require careful adoption of the prescriptive requirements that are outlined for each discipline. Because requirements are specific for each discipline, this document will outline separately highlights for each technology.

- **Building Envelope Prescriptive Path**: This method mandates specific requirements based on the type of building and the nature spaces within the building such as conditioned, heated, semi heated or unconditioned spaces. Prescriptive criteria for envelope components are available in special tables customized for specific climate zones. The tables represent minimum performance requirements to meet envelope performance requirements. There is some degree of flexibility within this discipline by utilizing the 'trade-off" option. The performance of one envelope component may be improved to make up for another component that may not meet the Standard. The trade off option must be used when vertical window area is more than the vertical wall area.

- **Heating, Ventilating and Air Conditioning Prescriptive Path:** : Applies primarily to complex systems in large buildings utilizing variable air volume systems and central chilled water cooling and hot water heating central plant systems. HVAC equipment efficiency must meet or exceed tabulated minimum performance as published in tables at the end of the section. The following are subject headings of areas that must be evaluated for all mechanical air and water systems: 1)Economizers, 2) Simultaneous Heating and Cooling Limitation. 3) Air System Design and Control including fan power limitations and control for VAV systems, 4) Hydronic system design and control 5) Heat rejection equipment, 6) Energy recovery 7) Exhaust Hoods, 8) Radiant Heating system, 9) hot gas bypass limitation.

- **Service Water Heating Prescriptive Path**: Distinctions are made for size limitations of space heating and water heating equipment and integrated equipment that satisfies both space and service water heating. Observe performance requirements for water heating system at the end of the section.

- **Power: Prescriptive path not used**.

- **Lighting Prescriptive Path:** The design of lighting systems involves light intensity measured in *lumens* and power density allowances (Watt/square foot). These sections addresses only power density allowances. The designer must use the Illuminating Engineers handbook for prescribed lighting intensities. For convenience, these tables are included in Appendix A. Building area and Space-by-space are two methods prescribed for calculating lighting power density for interior and exterior lighting. Note tables at the end of the lighting section in these guidelines.

2. ENERGY BUDGET

In order to quantify a building performance that meets the minimum ASHRAE 90.1 requirements it will be necessary as a first step, to assemble a baseline computer model of the prototype building to determine the baseline building energy consumption or ***energy budget*** that exactly satisfies the Standard's minimum performance requirements. The "baseline" building computer model will be created based on ASHRAE's Mandatory and Prescriptive minimum efficiency requirements for all disciplines. This benchmark reference or baseline performance will be measured against a second model representing the "actual" building. This energy budget represents LEED's minimum requirements for the Energy & Atmosphere project checklist and will serve as a reference to quantify the energy performance of the actual building and obtain additional credit points if desired.

A. Baseline and Actual Building Models

If the baseline building model is an exact replica of the actual building utilizing the actual Envelope, HVAC, and Lighting systems as intended for the actual design, no further work is necessary to meet minimum requirements. However, chances are that the actual building may incorporate envelope, mechanical or lighting systems with different performance characteristics than the "baseline" building model. Thus, a second model for the actual building will need to be assembled utilizing actual envelope, HVAC, Lighting, etc, components as intended in the design.

B. Notes on the Prescriptive Path and other Methods

With the exception of envelope trade-off within the Envelope portion of the ASHRAE prescriptive method, the prescriptive method does not offer much flexibility in the event that a certain discipline may not be able to meet Prescriptive requirements. For the actual building model, it may be necessary to use the Energy Cost Budget Method (ECB) method which allows trade offs within disciplines for added flexibility. It should also be noted that the ECB method is based on the implementation of Prescriptive provisions, with adjustments in each discipline as necessary that will ultimately simulate building performance to equal or exceed the established energy budget. Thus, the Prescriptive method becomes the method of choice for the baseline and actual building models regardless of what additional method may be chosen to implement thereafter. The designer may use the energy cost budget method (ECB method) in case tradeoffs between building systems is required to meet or exceed the baseline building performance.

C. Energy Cost Method (ECB) requirements

The energy cost budget method is a procedure that allows trade offs between building discipline design mandates as calculated by the prescriptive method. For example; where a designer can not achieve the mandated ASHRAE requirements in designing the HVAC system, it will redesign its Thermal envelope to compensate for the HVAC system and meet the overall building requirements from ASHRAE.

There are several methodologies that look like alternatives to the prescriptive method. Prescriptive method in fact has to be the method of choice in every case and used for all projects.

Meeting and or exceeding LEED's minimum requirements in areas of section 1.1through 1.5 of the LEED checklist (optimizing energy performance) by two points.

Generally a compliance path for designers will include:

1) Developing a baseline building model using ASHRAE's mandatory and prescriptive design guidelines.
2) The base line model will then be compared to the new building design. If it meets or uses lower amount of energy (or energy consumption points) the design is approved. Or,
3) If the consumption amount is larger than the base line model , the designer can use the energy budget costing method for trading off within disciplines. The specifics of trade off options to meet the final goals of the baseline design can be discussed with the County Energy Engineer.

To obtain additional LEED points, the general mandatory and prescriptive provisions described below can be used to model the baseline building. The proposed building shall exceed the performance of the baseline building as described in the sections below and shown in the LEED project checklist for energy and atmosphere section Appendix A.

D. Exception to existing building design

When an addition to an existing building cannot comply by itself, trade-offs will be allowed by modification to one or more of the existing components of the building. Modeling of the modified components of the building and additions shall use the procedures recommended by CEE. These additions should not result in a net increase in energy consumption.

- **Alterations of existing** buildings shall comply with the provisions of this section provided that such compliance results in a net increase of energy consumption of the building.

- **Building Renovations**; (new portions of buildings and their systems) All renovations are required to comply with these Energy Design Guidelines

  I. If industry standards cannot be achieved, the A/E shall provide a written explanation, using an exception request form to be provided by the County Energy Engineer as shown in Appendix A.

  II. Existing Building Walls are generally not required to meet new insulation requirements.

  III. Roof Replacements shall be upgraded to comply with these energy conservation guidelines.

  IV. Replacement windows shall comply with the requirements of these energy conservation guidelines.

  V. All New Building and Renovation construction shall utilize thermal integrity and air tightness principals and details from the National Institute of Standards and Technology (NIST) report NISTIR 4821

E. Compliance Documentation

Compliance documents shall show all the pertinent data and features of the building, equipment, and systems in sufficient detail to permit a determination of compliance by the building official and to indicate compliance with the requirements of this guide.

1. Supplemental Information. Supplemental information necessary to verify compliance with this guide , such as calculations, worksheets, compliance forms, vendor literature, or other data, shall be made available when required by the building official.

2. Manuals. Operating and maintenance information shall be provided to the building owner. This information shall include, but not be limited to, the following:

(a) Submittal data including equipment size and selected options
(b) Operations and maintenance manuals for each piece of equipment
(c) HVAC controls system maintenance and calibration information including wiring diagrams, schematics, and control sequence diagrams.

3. Labeling of Material and Equipment. Materials and equipment shall be labeled in a manner that will allow for a determination of their compliance with the applicable provisions of ASHRAE 90.1, 6.7.2.2 and 2.7.2.

4. Inspections. All building construction, additions, or alterations subject to the provisions of this guide shall be subject to inspection by the building official, and all such work shall remain accessible and exposed for inspection purposes until approved in accordance with the procedures specified by the building official. Items for inspection include at least the following:

(a) wall insulation after the insulation and vapor retarder are in place but before concealment,
(b) roof/ceiling insulation after roof/insulation is in place but before concealment,
(c) slab/foundation wall after slab/foundation insulation is in place but before concealment,
(d) fenestration after all glazing materials are in place,
(e) mechanical systems and equipment and insulation after installation but before concealment,
(f) electrical equipment and systems after installation but before concealment.

F. Other Exceptions

(a) A building that has been specifically designated as historically significant by the adopting authority or is listed in "The National Register of Historic Places" or has been determined to be eligible for listing by the U.S Secretary of the Interior need not comply with these requirements.

(b) Where one or more components of an existing building or portions thereof are being replaced, the annual energy consumption of the comprehensive design shall not be greater than the annual energy consumption of a substantially identical design, using the same energy types. Such compliance is verified by a design professional, by the use of any calculation methods acceptable to the authority having jurisdiction.

ENERGY DESIGN STRATEGY

Prioritize Goals	General Strategies	Detailed Strategies	Recommendations
Goal 1: Reduce loads on energy-using systems			
Reduce internal loads	Equipment and Appliances: Reduce both cooling loads and energy use	Use more efficient equipment and appliances	Use low energy computers and monitors; use Energy Star equipment
	Use controls to minimize usage and waste	Turn off or use 'sleep mode' on computers, monitors, copiers, and other equipment	
	Educate Occupants		
	Lighting: Reduce both cooling loads and energy use	Maximize the benefits of day lighting	Vertical glazing, skylights, interior lighting
		Use skylights and north facing clerestories to daylight interior zones	Skylights and vertical glazing
		Use efficient electric lighting system	Interior lighting
		Use separate controls for lighting in areas near windows	Interior lighting
		Use automatic controls to turn off lights when not in use	Interior lighting
Reduce heat gain/loss through building envelope	Control Solar gain to reduce cooling load through windows	Use beneficial building form at orientation	
		Minimize windows east and west, maximize north and south	Vertical glazing
		Use glazing with low solar heat gain coefficient	Vertical glazing, skylights
		External shade glazing to reduce solar heat gain and glare	Vertical glazing
		Use vegetation on S/E/W to control solar heat gain and glare	Vertical glazing
	Reduce solar gain through opaque surfaces to reduce cooling load	Increase insulation of opaque surfaces	Roofs, walls, floors, doors
		Increase roof surface reflectance and emittance	Roofs

		Shad building surfaces	
	Reduce conductive heat gain and loss through building envelope	Increase insulation on roof, walls, floor, slabs, and doors, and decrease window U-factor	Roofs, walls, floors, doors, vertical glazing
Reduce heat gain/loss through building envelope (cont'd)	Reduce infiltration	Provide continuous air barrier	
	Reduce heat gain or loss from ventilation exhaust air	Use energy recovery to precondition outdoor air	Energy Recovery
Reduce thermal loads	Reduce peak heating and cooling loads	Increase thermal mass	
	Utilize passive solar designs	Use thermal storage, walls, interior mass	
Reduce HVAC Loads	Reduce heat gain or loss in ductwork	Insulate ductwork	
		No ductwork outside the building envelope	
Refine building to suit local conditions	Consider natural ventilation, highest potential in marine climates, high potential in dry climates	Operable windows with screens so that air conditioning and heating are not necessary during transition periods	
		For buildings with operable windows, design building layout for cross ventilation	
Goal 2: Size HVAC System for reduced Loads			
Properly size equipment	Calculate Load		
	Size equipment		
Goal 3: Use more efficient systems			
Use more efficient HVAC Systems	Select efficient cooling equipment	Meet or exceed equipment efficiencies in 'Recommendations' chapter	HVAC
		Meet or exceed part load performances in 'Recommendations' chapter	HVAC
	Select efficient heating equipment	Meet or exceed equipment efficiencies in 'Recommendations' chapter	HVAC
	Select efficient energy recovery equipment	Meet or exceed equipment efficiencies in 'Recommendations' chapter	

Improve outdoor air ventilation	Control outdoor air dampers	Use air economizer	
		Use demand controlled ventilation	Ventilation
		Shut off outdoor air and exhaust air dampers during unoccupied periods	Ventilation
Improve fan power	Design efficient duct distribution system	Minimize duct and fitting losses	Ducts
	Reduce duct leakage	Seal all duct joints and seams	Ducts
	Select efficient motors	Use high-efficiency motors	
Improve HVAC Controls	Use control strategies that reduce energy use	Divide building into thermal zones	
		Use time-of-day scheduling, temperature setback and setup, pre-occupancy purge	
Ensure proper air distribution	Test, adjust, and balance the air distribution system	Use industry accepted procedures	
Use more efficient SWH systems	Select efficient service water heating equipment	Meet or exceed equipment efficiencies in 'Recommendations' chapter	SWH
	Minimize distribution losses	Use point of use units	
		Minimize pipe distribution	
		Insulate piping	
Use more efficient lighting	More efficient interior lighting	Do not use incandescent lighting, unless it will be used infrequently	
		Use more efficient electric lighting system	More efficient lamps, ballasts, ceiling fixtures, and task lights
	More efficient exterior lighting		
Goal 4: Refine Systems Integration			
Integrate building systems	Integrate systems - High-efficiency Adv. Case		
	Integrate systems - Daylight Adv. Case		Advanced day lighting Option

TECHNOLOGY MATRIX

A summary in the form of a "Technology Application Matrix" appears below. One enters the matrix by selecting the size of building from the categories to the left, and then reading across to review specific technologies for "HVAC and EMCS Systems" or "Lighting". To these technologies one must add the criteria shown across the top row for "ALL BUILDINGS".

The Technology Application Matrix represents decisions and selections made by the Owner in an organized and coordinated manner, based on life-cycle-cost analysis, advanced national standards, and research recommendations from a number of sources. Together, the matrix elements address the major energy problems in government and commercial buildings and form a firm basis for achieving desired energy performance levels. At the same time, the matrix provides for modern standards of good lighting, acceptable indoor air quality, and architectural creativity. The consultant should be familiar with the Matrix at this time with the intended direction of energy conservation desired by the Owner. The Energy Program of Requirements or at the Pre-Design meeting may change technologies for individual buildings

Table 1: Technology Application Matrix for Montgomery County

GUIDELINE SUMMARY			
	Thermal Envelope	**HVAC and Energy Management**	**Lighting and Energy Management**
		Energy Management Systems	
All Buildings	ASHRAE 90.1 Section 8.5: Envelope Component Packages NIST Envelope Guidelines: Thermal Integrity Details Comprehensive Air Barrier High-Performance Windows: NFRC U < 0.39 Btu/hr-ft2-F SC < 0.55 Day lighting Basics Light color Retractable Blinds Glare Control (Overhangs)	HVAC Equipment Efficiencies Table Baseline Air Systems Design Criteria ASHRAE 90.1 Sect. 9: HVAC Systems ASHRAE 62: Ventilation for Acceptable Indoor Air Quality Premium Efficiency Motors Condensing Boilers and Furnaces (where gas is available)	ASHRAE 90.1 Section 6.6: Wattage Budgets (x 65%) IES Light Levels with Localized or Task Lighting T8-Lamps/Electronic Ballasts CFL 13 for Task, Accent and Downlights HPS Exterior Cut-off Fixtures Convenient, Flexible Switching Occupancy Sensors (> 300 W) Switching zoned with Daylight

Complexes **> 90,000 sf**	Core Day lighting Analysis Perimeter Day lighting/Controls Tinted / Reflective Windows Air-lock Vestibules	DDC Plant and Distribution Controls DDC Terminal/Temperature Controls VFD's on System Pumps/Fans Draw-through Towers (Propeller) HVAC System Options: 1 Water-Cooled Centrifugal Chiller VAV Air-Handling/VFD 2 Water-Cooled Screw Chiller VAV Air-Handling/VFD 3 Hydronic Heat Pump	Automatic Daylight Controls: Photocell Control in Non-Task Areas Exterior Lighting Management through DDC system Interior Lighting Management through DDC [zone by floors]
Large Buildings **30,000 to 90,000 sf**	Core Day lighting Analysis Perimeter Day lighting/Controls Tinted / Reflective Windows Air-lock Vestibules	DDC Plant and Distribution Controls DDC Terminal/Temperature Controls HVAC System Options: 1 Central Screw Chiller VAV Air-Handling/VFDs 2 Central Reciprocating Chiller VAV Air-Handling/VFDs 3 Hydronic Heat Pump	Automatic Daylight Controls: Photocell Control in Non-Task Areas Exterior Lighting Management through DDC system Interior Lighting Management through DDC [zone by floors]
Medium Buildings **10,000 to 30,000 sf**	Perimeter Daylight / Windows Air-Lock Vestibules	DDC Plant and Distribution Controls DDC Terminal/Temperature Controls HVAC System Options: 1 Central Chiller VAV Air-Handling/VFDs 2 Split System Heat Pump 3 Split System A/C	Exterior Lighting Management through DDC system Interior Lighting Management through DDC [2 or 3 zones]
Small Buildings **2,000 to 10,000 sf**		DDC Package Control Interfaces DDC Unitary Controller HVAC System Options: 1 Packaged Terminal A/C 2 Packaged Heat Pump 3 Split System	Exterior Lighting Management through DDC Unitary Controller
Glossary	HVAC = Heating, Ventilating, and Air-conditioning CFL = Compact Fluorescent Lamp VAV = Variable Air Volume	VFD = Variable Frequency Drive DDC = Direct Digital Control A/C = Air Conditioning IES = Illuminating Engineers Society	NIST = National Institute of Standards and Technology ASHRAE = Am. Soc. of Heating, Refrigerating & Air-Conditioning Eng.

GUIDELINES BY SYSTEM

THERMAL ENVELOPE

This section summarizes the required specifications to use for County buildings regarding the thermal envelope.

Thermal Envelope Compliance Paths

For Climate Zone 4 per ASHRAE 90.1-2007, space-conditioning category, and class of construction, the building envelope shall comply with Section 5.1, General; Section 5.4, Mandatory Provisions; Section 5.7, Submittals; and Section 5.8, Product Information and Installation Requirements of ANSI / ASHRAE / IESNA Standard 90.1-2007 (I·P Edition); and either

1. Prescriptive Building Envelope Option

Prescriptive Building Envelope Option provided that

- the vertical fenestration area does not exceed 40% of the gross wall area for each space conditioning category and
- the skylight fenestration area does not exceed 5% of the gross roof area for each space-conditioning category, or

2. Building Envelope Trade-Off Option
3. Energy Cost Budget Method

Projects using the Energy Cost Budget Method per ASHRAE 90.1-2007 must comply with Section 5.4, the mandatory provisions of this section, as a portion of that compliance path.

Thermal Envelope Standards

Mandatory Provisions

Insulation:
Where required Insulation shall comply with the requirements of ANSI / ASHRAE / IESNA Standard 90.1-2007 (I·P Edition), Sections 5.8.1.1 through 5.8.1.9.

Fenestration and Doors:
Procedures for determining fenestration and door performance are described in of ANSI / ASHRAE / IESNA Standard 90.1-2007 (I·P Edition), Section 5.8.2

Air Leakage:
Building Envelope Sealing, The following areas of the building envelope shall be sealed, caulked, gasketed or weather-stripped to minimize air leakage:

a. joints around fenestration and door frames
b. junctions between walls and foundations, between walls at building comers between walls and structural floors or roofs and between walls and roof wall panels
c. openings at penetrations of utility services through roofs walls and floors
d. site-built fenestration and doors
e. building assemblies used as ducts or plenums

f. joints, seams, and penetrations of vapor retarders
g. all other openings in the building envelope

Air Leakage Fenestration and Doors:
Air leakage for fenestration and doors shall be determined in accordance with National Fenestration Rating Council, Procedure for Determining Fenestration Product Air Leakage (NFRC 400-2004).

Air Leakage Loading Dock Weatherseals:
Cargo doors and loading dock doors shall be equipped with weatherseals to restrict infiltration when vehicles are parked in the doorway.

Air Leakage Vestibules:
Building entrances that separate conditioned space from the exterior shall be protected with an enclosed vestibule, with all doors opening into and out or the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior doors to open at the same time. Interior and exterior doors shall have a minimum distance between them of not less than 7ft when in the closed position. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space.

<u>Prescriptive Building Envelope Options</u>

For a conditioned space, the exterior building envelope (roofs, walls, floors, slab on grade, opaque doors and fenestration) shall comply with either the nonresidential requirements of ANSI / ASHRAE / IESNA Standard 90.1-2007 (I·P Edition), Table 5.5-4, Building Envelope Requirements for Climate Zone 4 (A, B, C). If a building contains any semi-heated space or unconditioned space, then the semi-heated building space shall comply with the requirements for semi-heated space in Table 5.5-4.
Opaque Areas: For all opaque surfaces except doors, compliance shall be demonstrated by one of the following two methods:

Minimum rated R-values of insulation for the thermal resistance of the added insulation in framing cavities and continuous insulation only. Specifications listed in Normative Appendix A of ANSI / ASHRAE / IESNA Standard 90.1-2007 (I·P Edition) shall be used to determine compliance.

Maximum U-factor, C-factor or F-factor for the entire assembly. The values for typical construction assemblies listed in Normative Appendix A of ANSI / ASHRAE / IESNA Standard 90.1-2007 (I·P Edition) shall be used to determine compliance.

<u>Building Envelope Trade-Off Option</u>

The building envelope complies with the standard if

a. the proposed building satisfies the provisions of Sections 5.1,5.4,5.7, and 5.8, and
b. the envelope performance factor of the proposed building is less than or equal to the envelope performance factor of the budget building.

The envelope performance factor considers only the building envelope components. Schedules of operation, lighting power, equipment power, power, occupant density, and mechanical systems shall be the same for both the proposed building and the budget building.

Envelope performance factors shall be calculated using the procedures of Normative Appendix C, Methodology for Building Envelope Trade-Off Option.

Thermal Envelope References

ANSI / ASHRAE / IESNA Standard 90.1-2007. Energy Standard for Buildings Except Low-Rise Residential Buildings. I–P Edition.

IESNA. 1997. EPRI Daylight Design: Smart & Simple. New York: Illuminating Engineering Society of North America.

LBL. Daylight and Windows. LBL Tips for Day lighting with Windows. Berkeley, Calif.: Lawrence Berkeley National Laboratories. http://windows.lbl.gov/daylighting/designguide/designguide.html

Evans, Benjamin. 1997. Day lighting Design, Saver Standards for Architectural Design Data. New York: McGraw-Hill.

U.S. Department of Energy Office of Energy Efficiency and Renewable Energy Federal Energy Management Program. "GREENING FEDERAL FACILITIES: An Energy, Environmental, and Economic Resource Guide for Federal Facility Managers and Designers- SECOND EDITION,", Building Green, Inc., Brattleboro, VT, May 2001

DOE Building Technologies Toolbox,
http://www.eere.enCergy.gov/buildings/info/design/integratedbuilding/buildingenvelope.html

HEATING, VENTILATION AND AIR CONDITIONING SYSTEMS

If the thermal envelope is the building's skin, then the building's heating, ventilation, and air conditioning (HVAC) systems are its lungs and circulatory system. The HVAC system must be designed properly to ensure that the occupants are working in a safe and comfortable environment, free of unnecessary noise or distractions due to an improperly functioning HVAC System.

This section provides a summary of the essential elements to consider when designing, selecting, installing, and maintaining a heating or cooling system. This information is drawn from a variety of industry sources, including design guidelines prepared for building decision-makers at the state and national level, as well as technical guidance prepared by American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

Providing adequate ventilation is key component of indoor air quality. Strategies to provide adequate ventilation are often at odds with energy efficiency; however, designers and building owners and operators must meet ventilation code requirements first and then meet these requirements in the most energy-efficient manner possible. This section summarizes the ventilation requirements to achieve the proper levels of air quality, as required by Montgomery County.

Commercial projects typically have substantial internal heat gain due to lights, people, and equipment, so heat loss through the building envelope is a less important consideration than in residential projects. In addition to the cooling requirements to offset the internal heat gains (and external solar heat gains), Commercial buildings use substantial amounts of energy for heating, cooling, and moving large volumes of ventilation air.

Minimum ventilation rates are required for health and comfort. Ventilation air quantities should be no lower than those indicated in the American Society of Heating, Refrigeration, and Air-Conditioning Engineers' standard: ASHRAE 62-2001, Ventilation for Acceptable Indoor Air Quality.

HVAC Compliance Paths

Compliance with Section 6 ANSI / ASHRAE / IESNA Standard 90.1-2007 of shall be achieved by meeting all requirements for Section 6.1, General; Section 6.7, Submittals; Section 6.8, Minimum Equipment Efficiency; and either

1. Section 6.3, Simplified Approach Option for HVAC Systems; or
2. Section 6.4, Mandatory Provisions; and Section 6.5, Prescriptive Path.

Projects using the Energy Cost Budget Method must comply with Section 6.4, the mandatory provisions of this section, as a portion of that compliance path.

Simplified Approach Option for HVAC Systems: The simplified approach is an optional path for compliance when the following conditions are met:

a. building is two stories or fewer in height
b. gross floor area is less than 25,000 ft^2
c. each HVAC system in the building complies with the requirements listed in Section 6.3.2

HVAC Systems Standards

Simplified Approach

The HVAC system must meet all of the criteria of Section 6.3.2 Criteria, ANSI / ASHRAE / IESNA Standard 90.1-2007 (I·P Edition).

Mandatory Provisions

Minimum Equipment Efficiencies listed Equipment Standard Rating and Operating Conditions. Equipment shown in Tables 6.8.1 A through 6.8.1 G shall have a minimum performance at the specified rating conditions when tested in accordance with the specified test procedure.
Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements, unless otherwise exempted by footnotes in the table. Equipment covered under the Federal Energy Policy Act of 1992 (EPACT) shall have no minimum efficiency requirements for operation at minimum capacity or other than standard rating conditions. Equipment used to provide water heating functions as part of a combination system shall satisfy all stated requirements for the appropriate space heating or cooling category. Tables are as follows:

a. Table 6.8.IA Air Conditioners and Condensing Units
b. Table 6.8.1B Heat Pumps
c. Table 6.8.IC Water-Chilling Packages (see Section 6.4.1.2 for water-cooled centrifugal water-chilling packages that are designed to operate at nonstandard conditions)
d. Table 6.8.1D Packaged Terminal and Room Air Conditioners and Heat Pumps
e. Table 6.8.lE Furnaces, Duct Furnaces, and Unit Heaters
f. Table 6.8.1F Boilers
g. Table 6.8.1G Heat Rejection Equipment

All furnaces with input ratings of 225,000 Btu/h, including electric furnaces that are not located within the conditioned space shall have jacket losses not exceeding 0.75% of the input rating.

Minimum Equipment Efficiencies Listed Equipment Nonstandard Conditions.
Water-cooled centrifugal water-chilling packages that are not designed for operation at ARI Standard 550/590 test conditions (and, thus, cannot be tested to meet the requirements of Table 6.8.1C) of 440F

leaving chilled-water temperature and 85°F entering condenser-water temperature with 3 gpm/ton condenser water flow shall have a minimum full-load COP and a minimum NPLV rating as shown in the tables referenced below.

a. Centrifugal chillers <150 Ions shall meet the minimum full-load COP and IPLV/NPLV in Table 6.8.IH.
b. Centrifugal chillers 2: 150 tons and <300 tons shall meet the minimum full-load COP and IPLV/NPLV in Table 6.8.11.
c. Centrifugal chillers 2:300 tons shall meet the minimum full-load COP and IPLV/NPLV in Table 6.8.1J.

The table values are only applicable over the following full-load design ranges:

a. Leaving Chiller-Water Temperature: 40°F to 48°F
b. Entering Condenser-Water Temperature: 75°F to 85°F
c. Condenser - Water Temperature Rise: 5°F to 15°F

Chillers designed to operate outside of these ranges or applications utilizing fluids or solutions with secondary coolants (e.g., glycol solutions or brines) with a freeze point of 27°F or lower for freeze protection are not covered by this standard.

Labeling

Mechanical Equipment
Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of Standard 90.1.

Packaged Terminal Air Conditioners:
Packaged terminal air conditioners and heat pumps with sleeve sizes less than 16 in. high and 42 in. wide shall be factory labeled as follows: Manufactured for replacement applications only: not to be installed in new construction projects.

Load Calculations: Heating and cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with generally accepted engineering standards and handbooks acceptable to the adopting authority (for example, ASHRAE Handbook Fundamentals).

Controls

Zone Thermostatic Controls:
The supply of heating and cooling energy to each zone shall be individually controlled by thermostatic controls responding to temperature within the zone. For the purposes of Section 6.4.3.1, a dwelling unit shall be permitted to be considered a single zone.

Exceptions: Independent perimeter systems that are designed to offset only building envelope loads shall be permitted to serve one or more zones also served by an interior system provided
the perimeter system includes at least one thermostatic control zone for each building exposure having exterior walls facing only one orientation for 50 contiguous feet or more, and; the perimeter system heating and cooling supply is controlled by a thermostatic control(s) located within the zones(s) served by the system.

Exterior walls are considered to have different orientations if the directions they face differ by more than 45 degrees.

Dead Band:
Where used to control both heating and cooling, zone thermostatic controls shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

Exceptions:

a. Thermostats that require manual changeover between heating and cooling modes.
b. Special occupancy or special applications where wide temperature ranges are not acceptable (such as retirement homes, process applications, museums, some areas of hospitals) and are approved by the authority having jurisdiction.

Setpoint Overlap Restriction: Where heating and cooling to a zone are controlled by separate zone thermostatic controls located within the zone, means (such as limit switches, mechanical stops, or, for DOC systems, software programming) shall be provided to prevent the heating setpoint from exceeding the cooling setpoint minus any applicable promotional band.

Off-hour Controls:
HVAC systems shall have the off-hour controls required by Sections through
6.4.3.3.4.

Exceptions:

a. HVAC systems intended to operate continuously.
b. HVAC systems having a design heating capacity and cooling capacity less than 15,000 Btu/h that are equipped with readily accessible manual ON/OFF controls.

Automatic Shutdown:
HVAC systems shall be equipped with at least one of the following:

a. Controls that can start and stop the system under different time schedules for seven different day-types per week, are capable of retaining programming and time setting during loss of power for a period of at least ten hours, and include an accessible manual override, or equivalent function, that allows temporary operation of the system for up to two hours.
b. An occupant sensor that is capable of shutting the system off when no occupant is sensed for a period of up to 30 minutes.
c. A manually operated timer capable of being adjusted to operate the system for up to two hours.
d. An interlock 10 a security system that shuts the system off when the security system is activated.

Exception: Residential occupancies may use controls that can start and stop the system under two different time schedules per week.

Setback Controls:
Heating systems located in climate zone 4 shall be equipped with controls that have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures above a heating setpoint adjustable down to 55°F or lower. Cooling systems located in climate zones I b, 2b, and 3b shall be equipped with controls that have the capability to automatically restart and temporarily operate the system as required to maintain zone temperatures below a cooling setpoint adjustable up to 900F or higher or to prevent high space humidity levels.

Exception: Radiant floor and ceiling heating systems.

Optimum Start Controls:

Individual heating and cooling air distribution systems with a total design supply air capacity exceeding 10,000 cfm, served by one or more supply fans shall have optimum start controls.
The control algorithm shall, as a minimum, be a function of the difference between space temperature and occupied setpoint and the amount of time prior to scheduled occupancy.

Zone Isolation:
HVAC systems serving zones that are intended to operate or be occupied non-simultaneously shall be divided into isolation areas. Zones maybe grouped into a single isolation area provided it does not exceed 25,000 ft^2 of conditioned floor area nor include more than one floor. Each isolation area shall be equipped with isolation devices capable of automatically shutting off the supply of conditioned air and outdoor air to and exhaust air from the area. Each isolation area shall be controlled independently by a device meeting the requirements of Section, 6.4.3.3.1, Automatic Shutdown. For central systems and plants, controls and devices shall be provided to allow stable system and equipment operation for any length of time while serving only the smallest isolation area served by the system or plant.

Exceptions: Isolation devices and controls are not required for the following:

a. Exhaust air and outdoor air connections to isolation zones when the fan system to which they connect is 5000 cfm and smaller.
b. Exhaust airflow from a single isolation zone of less than 10% of the design airflow of the exhaust system to which it connects.
c. Zones intended 10 operate continuously or intended to be inoperative only when all other zones are inoperative.

<u>Ventilation System Controls</u>

Stair and Shaft Vents:
Stair and elevator shaft vents shall be equipped with motorized dampers that are capable of being automatically closed during normal building operation and are interlocked to open as required by fire and smoke detection systems.

Gravity Hoods, Vents, and Ventilators:
All outdoor air supply and exhaust hoods, vents, and ventilators shall be equipped with motorized dampers that will automatically shut when the spaces served are not in use.

Exceptions:

a. Gravity (nonmotorized) dampers are acceptable in buildings less than three stories in height above grade and for buildings of any height located in climate zones 1, 2, and 3.
b. Ventilation systems serving unconditioned spaces.

Shutoff Damper Controls:
Both air supply and exhaust systems shall be equipped with motorized dampers that will automatically shut when the systems or spaces served are not in use. Ventilation outdoor air dampers shall be capable of automatically Shutting off during preoccupancy building warm-up, cool down, and setback, except when ventilation reduces energy costs (e.g., night purge) or when ventilation must be supplied to meet code requirements.

Exceptions:

a. Gravity (nonmotorized) dampers are acceptable in buildings less than three stories in height and for buildings of any height located in climate zones 1, 2, and 3.
b. Gravity (nonmotorized) dampers are acceptable in systems with a design outdoor air intake or exhaust capacity of 300 cfm or less.

c. Dampers:

d. Where outdoor air supply and exhaust air dampers are required by Section 6.4.3.4, they shall have a maximum leakage rate when tested in accordance with AMCA Standard 500 as indicated in Table 6.4.3.4.4 of ASHRAE 90.1-2007, Maximum Damper Leakage.

Ventilation Fan Controls:
Fans with motors greater than 0.75 hp shall have automatic controls complying with Section 6.4.3.3.1 of ASHRAE 90.1 that are capable of shutting off fans when not required.

Exception: HVAC systems intended to operate continuously.

Heat Pump Auxiliary Heat Control:
Heat pumps equipped with internal electric resistance heaters shall have controls that prevent supplemental heater operation when the heating load can be met by the heat pump alone during both steady-state operation and setback recovery. Supplemental heater operation is permitted during outdoor coil defrost cycles.

Exceptions: Heat pumps whose minimum efficiency is regulated by NAECA and whose HSPF rating both meets the requirements shown in Table 6.8.18 and includes all usage of internal electric resistance heating.

Humidifier Preheat:
Humidifiers with preheating jackets mounted in the airstream shall be provided with an automatic valve to shut off preheat when humidification is not required.

Humidification and Dehumidification:
Where a zone is served by a system or systems with both humidification and dehumidification capability, means (such as limit switches, mechanical stops, or, for DDC systems, software programming) shall be provided capable of preventing simultaneous operation of humidification and dehumidification equipment.

Exceptions:

Zones served by desiccant systems, used with direct evaporative cooling in series.
Systems serving zones where specific humidity levels are required, such as museums and hospitals, and approved by the authority having jurisdiction.

Freeze Protection and Snow/Ice Melting Systems:
Freeze protection systems, such as heat tracing of outdoor piping and heat exchangers, including self-regulating heat tracing, shall include automatic controls capable of shutting off the systems when outdoor air temperatures are above 40°F or when the conditions on the protected fluid will prevent freezing.
Snow- and ice-melting systems shall include automatic controls capable of shutting off the systems when the pavement temperature is above 50°F and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40°F so that the potential for snow or ice accumulation is negligible.

Ventilation Controls for High-Occupancy Areas:
Demand control ventilation (DCV) is required for spaces larger than 500 ft^2 and with design occupancy for ventilation of greater than 40 people per 1000 ft^2 of floor area and served by systems with one or more of the following:

a. an air-side economizer,
b. automatic modulating control of the outdoor air damper, or
c. design outdoor airflow greater than 3000 cfm.

Exceptions:

a. Systems with energy recovery complying with Section 6.5.6.1,
b. Multiple-zone systems without DOC of individual zones communicating with a central control panel.
c. Systems with a design outdoor airflow less than 1200 cfm.
d. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1200 cfm.

<u>HVAC System Construction and Insulation</u>

Insulation:
Insulation required by this section shall be installed in accordance with industry-accepted standards (see Informative references below). These requirements do not apply to HVAC equipment. Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, but not limited to the following:

a. Insulation exposed to weather shall be suitable for outdoor service, e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.
b. Insulation covering chilled-water piping, refrigerant suction piping, or cooling ducts located outside the conditioned space shall include a vapor retardant located outside the insulation (unless the insulation is inherently vapor- retardant), all penetrations and joints of which shall be sealed.

Duct and Plenum Insulation:
All supply and return ducts and plenums installed as part of an HVAC air distribution system shall be thermally insulated in accordance with Tables 6.8.2A and 6.8.28.

Exceptions:

a. Factory-installed plenums, casings, or ductwork furnished as a part of HVAC equipment tested and rated in accordance with Section 6.4.1.
b. Ducts or plenums located in heated spaces, semi heated spaces, or cooled spaces.
c. For runouts less than 10 ft in length to air terminals or air outlets, the rated R-value of insulation need not exceed R-3.5.
d. Backs of air outlets and outlet plenums exposed to unconditioned or indirectly conditioned spaces with face areas exceeding 5 ft^2 need not exceed R-2; those 5 ft^2 or smaller need not be insulated.

Piping Insulation:
Piping shall be thermally insulated in accordance with Table 6.8.3.

Exceptions:

a. Factory-installed piping within HVAC equipment tested and rated in accordance with Section 6.4.1.
b. Piping that conveys fluids having a design operating temperature range between 60°F and 105°F, inclusive.
c. Piping that conveys fluids that have not been heated or cooled through the use of nonrenewable energy (such as roof and condensate drains, domestic: cold water supply, natural gas piping, or refrigerant liquid piping) or where heat gain or heat loss will not increase energy usage.
d. Hot-water piping between the shutoff valve and the coil, not exceeding 4 ft in length, when located in conditioned spaces.
e. Pipe unions in healing systems (steam, steam condensate, and hot water).

<u>Ducts and Plenum Leakage</u>

Duct Sealing:
Ductwork and plenums shall be sealed in accordance with Table 6.4.4.2A, Minimum Duct Sea Level provides definitions of seal levels), as required to meet the requirements of Section 6.4.4.2.2, Duct Leakage Tests and with standard industry practice.

Duct Leakage Tests:
Ductwork that is designed to operate at static pressures in access of 3 in. w.c. shall be leak-tested according to industry-accepted test procedures. Representative sections totaling no less than 25% of the total installed duct area for the designated pressure class shall be tested. Duct systems with pressure ratings in excess of 3 in. w.c. shall be identified on the drawings.

<u>Prescriptive Path</u>

Economizers:
Each cooling system that has a fan shall include either an air or water economizer meeting the requirements of Sections 6.5.1.l through 6.5.1.4.

Exceptions: Economizers are not required for the systems listed below.

a. Individual fan-cooling units with a supply capacity less than the minimum listed in Table 6.5.1, Minimum Size for Which an Economizer is required in ASHRAE 90.1-2007.
b. Systems that include nonparticulate air treatment as required by Section 6.2.1 in Standard 62.1.
c. Where more than 25% of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35F dew-point temperature to satisfy process needs.
d. Systems that include a condenser heat recovery system required by Section 6.5.6.2.
e. Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table 6.5.1, Minimum Size for Which an Economizer is required in ASHRAE 90.1-2007.
f. Systems that serve spaces whose sensible cooling load at design conditions, excluding transmission and infiltration loads, is less than or equal to transmission and infiltration losses at an outdoor temperature of 60°F.
g. Systems expected 10 operate less than 20 hours per week.
h. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.
i. Where the cooling efficiency meets or exceeds the efficiency requirements in Table 6.3.2.

<u>**Air Economizer:**</u>

Design Capacity:
Air economizer systems shall be capable of modulating outdoor air and return air dampers to provide up to 100% of the design supply air quantity as outdoor air for cooling.

Control Signal:
Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall not be controlled by only mixed air temperature.

Exception:
The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single-zone systems).

High-Limit Shutoff:
All air economizers shall be capable of automatically reducing outdoor air intake to the design minimum outdoor air quantity when au/door air intake will no longer reduce cooling energy usage. High-limit shutoff control types for specific climates shall be chosen from Table 6.5.I.I.3A, High-Limit Control Options for Air Economizers from ASHRAE 90.1-2007. High-limit shutoff control settings for these control types shall be those listed in Table 6.5.I.1.3B, High-Limit Control Settings for Air Economizers from ASHRAE-90.1-2007.

Dampers:
Both return air and outdoor air dampers shall meet the requirements of Section 6.4.3.3.4.

Systems shall provide a means to relieve excess outdoor air during air economizer operation to prevent over pressurizing the building. The relief air outlet shall be located to avoid recirculation into the building.

Water Economizers

Design Capacity:
Water economizer systems shall be capable of cooling supply air by indirect evaporation and providing up to 100% of the expected system cooling load at Oil/door air temperatures of 50°F dry bulb / 45°F wet bulb and below.

Exception: Systems in which a water economizer is used and where dehumidification requirements cannot be met using outdoor air temperatures of 50°F dry bulb 45°F wet bulb must satisfy 100% of the expected system cooling load at 45°F dry bulb / 40°F wet bulb.

Maximum Pressure Drop:
Precooling coils and water-to-water heat exchangers used as pan of a water economizer system shall either have a water-side pressure drop of less than 15 fl of water or a secondary loop shall be created so that the coil or heat exchanger pressure drop is not seen by the circulating pumps when the system is in the normal cooling (noneconomizer) mode.

Integrated Economizer Control:
Economizer systems shall be integrated with the mechanical cooling system and be capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

Exceptions:

a. Direct expansion systems that include controls that reduce the quantity of outdoor air required to prevent coil frosting at the lowest step of compressor unloading, provided this lowest step is no greater than 25% of the total system capacity.
b. Individual direct expansion units that have a rated cooling capacity less than 65,000 Btu/h and use nonintegrated economizer controls that preclude simultaneous operation of the economizer and mechanical cooling.
c. Systems in climate zones 1, 2, 3a, 4a, 5a, 5b, 6, 7, and 8.

Economizer Healing System Impact:
HVAC system design and economizer controls shall be such that economizer operation does not increase the building heating energy use during normal operation.

Exception: Economizers on VAV systems that cause zone level heating to increase due to a reduction in supply air temperature.

Simultaneous Heating and Cooling Limitation

Zone Controls:
Zone thermostatic controls shall be capable of operating in sequence the supply of heating and cooling energy to the zone. Such controls shall prevent

a. reheating,
b. recooling,
c. mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical cooling or by economizer systems, and
d. other simultaneous operation of heating and cooling systems to the same zone.

Exceptions:

1. Zones for which the volume of air that is reheated, recooled, or mixed is no greater than the larger of the following:
    a. the volume of outdoor air required to meet the ventilation requirements of Section 6.2 of Standard 62.1 for the zone,
    b. 0.4 cfm/ft^2 of the zone conditioned floor area,
    c. 30% of the zone design peak supply rate,
    d. 300 cfm, This exception is for zones whose peak flow rate totals no more than 10% of the total fan system flow rate, or
    e. any higher rate that can be demonstrated, to the satisfaction of the authority having jurisdiction, to reduce overall system annual energy usage by offsetting reheat/recool energy losses through a reduction in outdoor air intake for the system.
2. Zones where special pressurization relationships, cross-contamination requirements, or code-required minimum circulation rates are such that VAV systems are impractical.
3. Zones where at least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered (including condenser heat) or site-solar energy source.

Hydronic System Controls:
The heating of fluids in hydronic systems that have been previously mechanically cooled and the cooling of fluids that have been previously mechanically heated shall be limited in accordance with Sections 6.5.2.2.1 through 6.5.2.2.3.

Three-Pipe System:
Hydronic systems that use a common return system for both hot water and chilled water shall not be used.

Two-Pipe Changeover System:
Systems that use a common distribution system to supply both heated and chilled water are acceptable provided all of the following are met:

a. The system is designed to allow a dead band between changeover from one mode to the other of at least 15°F outdoor air temperature.
b. The system is designed to operate and is provided with controls that will allow operation in one mode for at least four hours before changing over to the other mode.
c. Reset controls are provided that allows heating and cooling supply temperatures at the changeover point to be no more than 30°F apart.

Hydronic (Water Loop) Heat Pump Systems:
Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection (e.g., cooling tower) and heat addition (e.g., boiler) shall have the following:

a. Controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F between initiation of heat rejection and heat addition by the central devices (e.g., tower and boiler).
b. For climate zones 3 through 8, if a closed-circuit tower (fluid cooler) is used either an automatic valve shall be installed to bypass all but a minimal flow of water around the tower (for freeze protection) or low-leakage positive closure dampers shall be provided. If an open-circuit tower is used directly in the heat pump loop, an automatic valve shall be installed to bypass all heat pump water flow around the tower. If an open-circuit tower is used in conjunction with a separate heat exchanger 10 isolate the tower from the heat pump loop, then heat loss shall be controlled by shutting down the circulation pump on the cooling tower loop.

Exception:

Where a system loop temperature optimization controller is used to determine the most efficient operating temperature based on real-time conditions of demand and capacity, dead bands of less than 20F shall be allowed.

Dehumidification:
Where humidistatic controls are provided, such controls shall prevent reheating, mixing of hot and cold airstreams, or other means of simultaneous heating and cooling of the same airstream.

Exceptions:

a. The system is capable of reducing supply air volume to 50% or less of the design airflow rate or the minimum rate specified in Section 6.2 of Standard 62.1, whichever is larger, before simultaneous heating and cooling takes place.
b. The individual fan cooling unit has a design cooling capacity of 80,000 Btu/h or less and is capable of unloading to 500 capacity before simultaneous healing and cooling takes place.
c. The individual mechanical cooling unit has a design cooling capacity of 40,000 Btu/h or less. An individual mechanical cooling unit is a single system composed of a fan or fans and a cooling coil capable of providing mechanical cooling.
d. Systems serving spaces where specific humidity levels are required to satisfy process needs, such as computer rooms, museums, surgical suites, and buildings with refrigerating systems, such as super· markets, refrigerated warehouses, and ice arenas. This exception also applies to other applications for which fan volume controls in accordance with Exception (a) are proven to be impractical to the enforcement agency.
e. At least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered (including condenser heat) or site-solar energy source.
f. Systems where the heat added to the airstream is the result of the use of airstream system and 75% of the heat added by the desiccant system is removed by a heat exchanger, either before or after the desiccant system with energy recovery.

Humidification:
Systems with hydronic cooling and humidification systems designed to maintain inside humidity at a dew-point temperature greater than 35F shall use a water economizer if an economizer is required by Section 6.5.1 of ASHRAE 90.1-2007.

Air System Design and Control:
Each HVAC system having a total fan system motor nameplate hp exceeding 5 hp shall meet the provisions below.

Fan System Power Limitation:
Each HVAC system al fan system design conditions shall not exceed the allowable fan system motor nameplate hp (Option I) or fan system bhp (Option 2) as shown in Table 6.5.3.J.IA, Fan Power Limitation

in of ASHRAE 90.1-2007. This includes supply fans, return relief fans, exhaust fans, and fan-powered terminal units associated with systems providing heating or cooling capability.

Exceptions:

a. Hospital and laboratory systems that utilize flow control devices on exhaust and/or return to maintain space pressure relationships necessary for occupant health and safety or environmental control may use variable-volume fan power limitation.
b. Individual exhaust fans with motor nameplate horsepower of 1 hp or less.
c. Fans exhausting air from fume hoods. Note: If this exception is taken, no related exhaust side credits shall be taken from Table 6.5.3.1.18 and the Fume Hood Exhaust Exception Deduction must be taken from Table 6.5.3.1.1 B, Fan Power Limitation Drop Adjustment.

Motor Nameplate Horsepower:
For each fan, the selected fan motor shall be no larger than the first available motor size greater than the bhp. The fan bhp must be indicated on the design documents to allow for compliance verification by the code official.

Exceptions:

a. For fans less than 6 bhp, where the first available motor larger than the bhp has a nameplate rating within 50% of the bhp, the next larger nameplate motor size may be selected.
b. For fans 6 bhp and larger, where the first available motor larger than the bhp has a nameplate rating with 30% of the bhp, the next larger nameplate motor size may be selected.

<u>VAV Fan Control (Including Systems Using Series fan Power Boxes)</u>

Part-Load fan Power Limitation:
Individual VAV fans with motors 10 hp and larger shall meet one of the following:

a. The fan shall be driven by a mechanical or electrical variable-speed drive.
b. The fan shall be a vane-axial fan with variable-pitch blades.
c. The fan shall have other controls and devices that will result in fan motor demand of no more than 30% of design wattage at 5 cfm of design air volume when static pressure setpoint equals one-third of the total design static pressure, based on manufacturers certified fan data.

Static Pressure Sensor Location:
Static pressure sensors used to control VAV fans shall be placed in a position such that the controller setpoint is no greater than one-third the total design fan static pressure, except for systems with zone reset control complying with Section 6.5.3.2.3. If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each major branch to ensure that static pressure can be maintained in each.

Setpoint Reset:
For systems with DDC of individual zone boxes reporting to the central control panel, static pressure setpoint shall be reset based on the zone requiring the most pressure; i.e., the setpoint is reset lower until one zone damper is nearly wide open.

Hydronic System Design and Control:
HVAC hydronic systems having a total pump system power exceeding 10 hp shall meet provisions of Sections 6.5.4.1 through 6.5.4.4.

Hydronic Variable Flow Systems:
HVAC pumping systems that include control valves designed to modulate or step open and close as a function of load shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to 50% or less of the design flow rate. Individual pumps serving variable flow systems having a pump

head exceeding 100 R and motor exceeding 50 hp shall have controls and/or devices (such as variable speed control) that will result in pump motor demand of no more than 30% of design wattage at 50% of design water flow. The controls or devices shall be controlled as a function of desired flow or to maintain a minimum required differential pressure. Differential pressure shall be measured at or near the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure.

Exceptions:

a. Systems where the minimum flow is less than the minimum flow required by the equipment manufacturer for the proper operation of equipment served by the system, such as chillers, and where total pump system power is 75 hp or less.
b. Systems that include no more than three control valves.

Pump Isolation:
When a chilled-water plant includes more than one chiller, provisions shall be made so that the flow in the chiller plant can be automatically reduced, correspondingly, when a chiller is shut down. Chillers referred to in this section, piped in series for the purpose of increased temperature differential, shall be considered as one chiller.

When a boiler plant includes more than one boiler, provisions shaII be made so that the flow in the boiler plant can be automatically reduced, correspondingly, when a boiler is shut down.

Chilled- and Hot-Water Temperature Reset Controls:
Chilled- and hot-water systems with a design capacity exceeding 300,000 Btu/h supplying chilled or heated water (or both) to comfort conditioning systems shall include controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outdoor air temperature.

Exceptions:

a. Where the supply temperature reset controls cannot be implemented without causing improper operation of hearing, cooling, humidifying, or dehumidifying systems.
b. Hydronic systems, such as those required by Section 6.5.4.1 that use variable flow to reduce pumping energy.

Hydronic (Water Loop) Heat Pump Systems:
Each hydronic heat pump shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off.

Heat Rejection Equipment:
This section applies to heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling lowers, closed-circuit cooling towers, and evaporative condensers.

Exception:
Heat rejection devices whose energy usage is included in the equipment efficiency ratings listed in Tables 6.8.IA through 6.8.ID.

Fan Speed Control:
Each fan powered by a motor of 7.5 hp or larger shall have the capability to operate that fan at two-thirds of full speed or less and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature / pressure of the heat rejection device.

Exceptions:

a. Condenser fans serving multiple refrigerant circuits.
b. Condenser fans serving flooded condensers.
c. Installations located in climate zones I and 2

d. Up 10 one-third of the fans on a condenser or tower with multiple fans where the lead fans comply with the speed control requirement.

Energy Recovery

Exhaust Air Energy Recovery:
Individual fan systems that have both a design supply air capacity of 5000 cfm or greater and have a minimum outdoor air supply of 70% or greater of the design supply air quantity shall have an energy recovery system with at least 50% recovery effectiveness. Fifty percent energy recovery effectiveness shall mean a change in the enthalpy of the outdoor air supply equal to 50% of the difference between the outdoor air and return air at design conditions. Provision shall be made to bypass or control the heat recovery system to permit air economizer operation as required by Section 6.5.1.1 of ASHRAE 90.1-2007.

Exceptions:

a. Laboratory systems meeting Section 6.5.7.2.
b. Systems serving spaces that are not cooled and that are heated to less than 60F.
c. Systems exhausting toxic, flammable, paint, or corrosive fumes or dust.
d. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.
e. Where more than 60% of the outdoor air heating energy is provided from site-recovered or site-solar energy.
f. Healing systems in climate zones I through 3.
g. Cooling systems in climate zones 3c, 4c, 5b, Sc, 6b, 7, and 8.
h. Where the largest exhaust source is less than 75% of the design outdoor airflow.
i. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.

Heat Recovery for Service Water Healing:
Condenser heat recovery systems shall be installed for heating or preheating of service hot water provided all of the following are true:

a. The facility operates 24 hours a day.
b. The total installed heat rejection capacity of the water-cooled systems exceeds 6.000,000 Btu/h of heat rejection.
c. The design service water heating load exceeds 1,000,000 Btu/h.

The required heat recovery system shall have the capacity to provide the smaller of

a. 60% of the peak heat rejection load at design conditions
b. preheat of the peak service hot water draw to 85°F.

Exceptions:

a. Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30% of the peak water-cooled condenser load at design conditions.
b. Facilities that provide 60'10 of their service water heating from site-solar or site-recovered energy or from other sources.

Exhaust Hoods

Kitchen Hoods:
Individual kitchen exhaust hoods larger than 5000 cfm shall be provided with makeup air sized for at least 50% of exhaust air volume that is

a. unheated or healed to no more than 60F and
b. uncooled or cooled without the use of mechanical cooling.

Exceptions:

a. Where hoods are used to exhaust ventilation air that would otherwise exfiltrate or be exhausted by other fan systems.
b. Certified grease extractor hoods that require a face velocity no greater than 60 fpm.

Fume Hoods:

Buildings with fume hood systems having a total exhaust rate greater than 15,000 cfm shall include at least one of the following features:

a. VAV hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50% or less of design values.
b. Direct makeup (auxiliary) air supply equal to at least 75% of the exhaust rate, heated no warmer than 2°F below room setpoint, cooled to no cooler than 3°F above room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
c. Heat recovery systems 10 precondition makeup air from fume hood exhaust in accordance with Exhaust Air Energy Recovery, without using any exception.

Radiant Heating Systems

Heating Unenclosed Spaces:
Radiant heating shall be used when heating is required for unenclosed spaces.

Exception:
Loading docks equipped with air curtains.

Heating Enclosed Spaces:
Radiant heating systems that are used as primary or supplemental enclosed space heating must be in conformance with the governing provisions of the standard, including, but not limited to, the following:

a. Radiant hydronic ceiling or floor panels (used for heating or cooling).
b. Combination or hybrid systems incorporating radiant heating (or cooling) panels
c. Radiant heating (or cooling) panels used in conjunction with other systems such as VAV or thermal storage systems.

Hot Gas Bypass Limitation
Cooling systems shall not use hot gas bypass or other evaporator pressure control systems unless the system is designed with multiple steps of unloading or continuous capacity modulation. The capacity of the hot gas bypass shall be limited as indicated in Table 6.5.9, Hot Gas Bypass Limitation in ASHRAE 90.1-2007.

Exception: Unitary packaged systems with cooling capacities not greater than 90,000 Btu/h.

Submittals
The County may require submittal of compliance documentation and supplemental information in accordance with this guideline.

Completion Requirements:
The following requirements are mandatory provisions and are necessary for compliance with the standard.

Drawings:
Construction documents shall require that, within 90 days after the date of system acceptance, record drawings of the actual installation be provided 10 the building owner or the designated representative of

the building owner. Record drawings shall include, as a minimum, the location and performance data on each piece of equipment, general configuration of duct and pipe distribution system including sizes, and the terminal air or water design flow rates.

Manuals:
Construction documents shall require that an operating manual and a maintenance manual be provided to the building owner or the designated representative of the building owner within 90 days after the date of system acceptance. These manuals shall be in accordance with industry-accepted standards and shall include, at a minimum, the following:

a. Submittal data stating equipment size and selected options for each piece of equipment requiring maintenance.
b. Operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
c. Names and addresses of at least one service agency.
d. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics. And control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.
e. A complete narrative of how each system is intended to operate, including suggested setpoints.

System Balancing
Construction documents shall require that all HVAC systems be balanced in accordance with generally accepted engineering standards. Construction documents shall require that a written balance report be provided to the building owner or the designated representative of the building owner for HVAC systems serving zones with a total conditioned area exceeding 5000 ft^2.

Air System Balancing:
Air systems shall be balanced in a manner to first minimize throttling losses. Then, for fans with fail system power greater than 1 hp, fan speed shall be adjusted to meet design flow conditions.

Hydronic System Balancing:
Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses; then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions.

Exceptions: Impellers need not be trimmed nor pump speed adjusted.

a. for pumps with pump motors of 10 hp or less or
b. when throttling results in no greater than 5% of the nameplate horsepower draw, or 3 hp, whichever is greater, above that required if the impeller was trimmed.

System Commissioning:
HVAC control systems shall be tested to ensure that control elements are calibrated, adjusted, and in proper working condition. For projects larger than 50,000 ft2 conditioned area, except warehouses and semi heated spaces, detailed instructions for commissioning HVAC systems shall be provided by the designer in plans and specifications.

HVAC References

Air Conditioning Contractors Association, www.acca.org

Air Conditioning and Refrigeration Technology Institute,
www.arti-21cr.org

Air Diffusion Council, www.flexibleduct.org

Consortium for Energy Efficiency, www.cee1.org

Energy Design Resources, www.energydesignresources.com
Environmental Protection Agency's ENERGY STAR Program, http://www.energystar.gov/ products/
Federal Energy Management Program, www.erere.energy.gov/femp
New Buildings Institute, www.newbuildings.org/pier

Northwest Energy Efficiency Alliance, www.nwalliance.org

ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction," for fabrication and installation of metal ductwork.

NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems."

Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), www.smacna.org

SMACNA Standards: Comply with HVAC Duct Construction Standards, Metal and Flexible fabrication and installation of metal ductwork and SMACNA HVAC Air Duct Leakage Test Manual.

SERVICE WATER HEATING

This section summarizes the required specifications to use for County buildings regarding the thermal envelope.

Service Water Heating Compliance Paths

Compliance shall be achieved by meeting the requirements of Section 7.1, General; Section 7.4, Mandatory Provisions; Section 7.5, Prescriptive Path; Section 7.7, Submittals; and Section 7.8, Product Information of ASHRAE 90.1-2007

Projects using the Energy Cost Budget Method for demonstrating compliance with the standard shall meet the requirements of Section 7.4, Mandatory Provisions, in conjunction with, Energy Cost Budget Method.

Service Water Heating Standards

Mandatory Provisions

Load Calculations:

Service water heating system design loads for the purpose of sizing systems and equipment shall be determined in accordance with manufacturers published sizing guidelines or generally accepted engineering standards and handbooks acceptable to the adopting authority (e.g., ASHRAE Handbook HVAC Applications).

Equipment Efficiency:

All water heating equipment, hot-water supply boilers used solely for heating potable water, pool heaters, and hot-water storage tanks shall meet the criteria listed in Table 7.8. Where multiple criteria are listed, all criteria shall be met. Omission of minimum performance requirements for certain classes of equipment does not preclude use of such equipment where appropriate. Equipment not listed in Table 7.8, Performance Requirements for Water heating Equipment of ASHRAE 90.1- 2007 has no minimum performance requirements.

Exceptions:

All water heaters and hot-water supply boilers having more than 140 gal of storage capacity are not required to meet the standby loss (SL) requirements of Table 7.8 when

a. the tank surface is thermally insulated to R-12.5,
b. a standing pilot light is not installed, and
c. gas- or oil-fired storage water heaters have a flue damper or fan-assisted combustion.
d. Service Hot-Water Piping Insulation:

The following piping shall be insulated to levels shown in Table 6.8.3, Minimum Pipe Insulation Thickness per ASHRAE 90.1-2007.

a. recirculating system piping, including the supply and return piping of a circulating tank type water heater
b. the first 8 ft of outlet piping for a constant temperature non-recirculating storage system
c. the inlet pipe between the storage tank and a heat trap in a non-recirculating storage system
d. pipes that are externally heated (such as heat trace or impedance heating)

<u>Service Water Heating System Controls:</u>

Temperature Controls:

Temperature controls shall be provided that allow for storage temperature adjustment from 120°F or lower to a maximum temperature compatible with the intended use.

Exception:

When the manufacturers installation instructions specify a higher minimum thermostat setting to minimize condensation and resulting corrosion.

Temperature Maintenance Controls:

Systems designed to maintain usage temperatures in hot-water pipes, such as recirculating hot-water systems or heat trace, shall be equipped with automatic time switches or other controls that can be set to switch off the usage temperature maintenance system during extended periods when hot water is not required.

Outlet Temperature Controls:

Temperature controlling means shall be provided to limit the maximum temperature of water delivered from lavatory faucets in public facility restrooms to 110°F.

Circulating Pump Controls:

When used to maintain storage lank water temperature, recirculating pumps shall be equipped with controls limiting operation to a period from the start of the heating cycle to a maximum of five minutes after the end of the heating cycle.

<u>Pools</u>

Pool Heaters:

Pool heaters shall be equipped with a readily accessible ON/Off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights.

Pool Covers:

Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90F shall have a pool cover with a minimum insulation value of R-12.

Exception:

Pools deriving over 60% of the energy for heating from site-recovered energy or solar energy source.

Time Switches:

Time switches shall be installed on swimming pool heaters and pumps.

Exceptions:

a. Where public health standards require 24-hour pump operation.
b. Where pumps are required to operate solar and waste heat recovery pool heating systems.

Heat Traps:

Vertical pipe risers serving storage water heaters and storage tanks not having integral heat traps and serving a non-recirculating system shall have heat traps on both the inlet and outlet piping as close as practical to the storage tank. A heat trap is a means to counteract the natural convection of heated water in a vertical pipe run. The means is either a device specifically designed for the purpose or an arrangement of tubing that forms a loop of 360 degrees or piping that from the point of connection to the water heater (inlet or outlet) includes a length of piping directed downward before connection to the vertical piping of the supply water or hot-water distribution system as applicable.

<u>Prescriptive Path</u>

Space Healing and Water Heating:

The use of a gas-fired or oil-fired space-heating boiler system otherwise complying with the HVAC Section of this Guideline to provide the total space heating and water heating for a building is allowed when one of the following conditions is met:

The single space-heating boiler or the component of a modular or multiple boiler system that is heating the service water has a standby loss determined in accordance with the procedures described in generally accepted engineering standards and handbooks, and n is the fraction of the year when the outdoor daily mean temperature is greater than 64F.

The standby loss is to be determined for a test period of 24 hours duration while maintaining a boiler water temperature of at least 90F above ambient, with an ambient temperature between 60F and 90F. For a boiler with a modulating burner, this test shall be conducted at the lowest input.

It is demonstrated to the satisfaction of the authority having jurisdiction that the use of a single heat source will consume less energy than separate units.

The energy input of the combined boiler and water heater system is less than 150,000 Btu/h.

Service Water Heating Equipment:

Service water heating equipment used to provide the additional function of space heating as part of a combination (integrated) system shall satisfy all stated requirements for the service water heating equipment.

Submittals:

The County may require submittal of compliance documentation and supplemental information.

POWER

This section summarizes the required specifications to use for County buildings regarding the Power Distribution System.

Power Compliance Path

Power distribution systems in all projects shall comply with the requirements of Section 8.1, General; Section 8.4, Mandatory Provisions; and Section 8.7, Submittals of ASHRAE 90.1-2007.

Power Standards

<u>Mandatory Provisions</u>

<u>Voltage Drop</u>

Feeders:

Feeder conductors shall be sized for a maximum voltage drop of 2% at design load.

Branch Circuits:

Branch circuit conductors shall be sized for a maximum voltage drop of 3% at design load.

Submittals:

Drawings and Construction documents shall require that within 30 days after the date of system acceptance, record drawings of the actual installation shall be provided to the building owner, including

a. a single-line diagram of the building electrical distribution system and
b. floor plans indicating location and area served for all distribution.

Manuals:

Construction documents shall require that an operating manual and maintenance manual be provided to the building owner. The manuals shall include, at a minimum, the following:

a. Submittal data staling equipment rating and selected options for each piece of equipment requiring maintenance.
b. Operation manuals and maintenance manuals for each piece of equipment/ requiring maintenance. Required routine maintenance actions shall be clearly identified.
c. Names and addresses of at least one qualified service agency.
d. A complete narrative of how each system is intended to operate. Enforcement agencies should only check to be sure that the construction documents require this information to be transmitted to the owner and should not expect copies of any of the materials.

LIGHTING

This section shall apply to the following:

a. interior spaces of buildings
b. exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies exterior building grounds lighting provided through the building's electrical service

Exceptions:

a. emergency lighting that is automatically off during normal building operation
b. lighting within dwelling units
c. lighting that is specifically designated as required by a health or life safety statute. ordinance, or regulation
d. decorative gas lighting systems

Lighting Alterations:

The replacement of lighting systems in any building space shall comply with the LPD requirements of Section 9, of ASHRAE 90.1-2007 applicable to that space. New lighting systems shall comply with the applicable LPD requirements of Section 9. Any new control devices as a direct replacement of existing control devices shall comply with the specific requirements of Mandatory Provisions.

Exception:

Alterations that replace less than 50% of the luminaries in a space need not comply with these requirements provided that such alterations do not increase the installed interior lighting power.

Installed Interior Lighting Power:

The installed interior lighting power shall include all power used by the luminaries, including lamps, ballasts, transformers, and control devices except as specifically exempted Prescriptive Requirements

Exceptions:

If two or more independently operating lighting systems in a space are capable of being controlled to prevent simultaneous user operation, the installed interior lighting power shall be based solely on the lighting system with the highest wattage.

Luminaire Wattage:
Luminaire wattage incorporated into the installed interior lighting power shall be determined in accordance with the following criteria:

The wattage of incandescent or tungsten-halogen luminaires with medium screw base sockets and not containing permanently installed ballasts shall be the maximum labeled wattage of the luminaire.

The wattage of luminaires with permanently installed or remote ballasts or transformers shall be the operating input wattage of the maximum lamp/auxiliary combination based on values from the auxiliary manufacturers literature or recognized testing laboratories or shall be the maximum labeled wattage of the luminaire.

For line-voltage lighting track and plug-in busway, designed to allow the addition and/or relocation of luminaires without altering the wiring of the system, the wattage shall be

a. the specified wattage of the luminaires included in the system with a minimum of 30 W/lin ft or

b. the wattage limit of the system s circuit breaker or

c. the wattage limit of other permanent current-limiting device(s) on the system.

The wattage of low-voltage lighting track, cable conductor, rail conductor, and other flexible lighting systems that allow the addition and/or relocation of luminaires without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.

The wattage of all other miscellaneous lighting equipment shall be the specified wattage of the lighting equipment.

Lighting Compliance Path

Lighting systems and equipment shall comply with Section 9.1, General; Section 9.4, Mandatory Provisions; and the prescriptive requirements of either

a. Section 9.5, Building Area Method; or
b. Section 9.6, Space-by-Space Method

General Lighting Standards

Prescriptive Requirements

The Building Area Method for determining the interior lighting power allowance a simplified approach for demonstrating compliance.

The Space-by-Space Method is an alternative approach that allows greater flexibility.

Interior Lighting Power:

The interior lighting power allowance for a building or a separately metered or permitted portion of a building shall be determined by either the Building Area Method or the Space by Space Method. Trade-offs of interior lighting power allowance among portions of the building for which a different method of calculation has been used are not permitted. The installed interior lighting power identified in accordance with Installed Interior Power Lighting shall not exceed the interior lighting power allowance.

Exceptions:

The following lighting equipment and applications shall not be considered when determining the interior lighting power allowance developed in accordance with either method, nor shall the wattage for such lighting be included in the installed interior lighting power identified in accordance with Installed Interior Lighting Power. However, any such lighting shall not be exempt unless it is an addition to general lighting and is controlled by an independent control device.

a. Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments.
b. Lighting that is integral to equipment or instrumentation and is installed by its manufacturer.
c. Lighting specifically designed for use only during medical or dental procedures and lighting integral to medical equipment.
d. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.
e. Lighting integral to food warming and food preparation equipment.
f. Lighting for plant growth or maintenance.
g. Lighting in spaces specifically designed for use by occupants with special lighting needs including visual impairment and other medical and age-related issues.
h. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.
i. Lighting in interior spaces that have been specifically designated as a registered interior historic landmark.
j. Lighting that is an integral part of advertising or directional signage.
k. Exit signs.
l. Lighting that is for sale or lighting educational demonstration systems.
m. Lighting for theatrical purposes, including performance, stage, and film and video production.
n. Lighting for television broadcasting in sporting activity areas.
o. Casino gaming areas.
p. Furniture-mounted supplemental task lighting that is controlled by automatic shutoff and complies with mandatory Provisions

Mandatory Provisions

Lighting Control

Automatic Lighting Shutoff:

Interior lighting in buildings larger than 5000 ft^2 shall be controlled with an automatic control device to shut off building lighting in all spaces. This automatic control device shall function on either

a scheduled basis using a time-of-day operated control device that turns lighting off at specific programmed times an independent program schedule shall be provided for areas of no more than 25,000 ft^2 but not more than one floor or

a. an occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space or

b. A signal from another control or alarm system that indicates the area is unoccupied.
c. Exceptions:
d. The following shall not require an automatic control device:
e. Lighting intended for 24-hour operation.
f. Lighting in spaces where patient care is rendered.
g. Lighting in spaces where an automatic shutoff would endanger the safety or security of the room or building occupant(s).

Space Control:

Each space enclosed by ceiling height partitions shall have at least one control device to independently control the general lighting within the space. Each manual device shall be readily accessible and located so the occupants can see the controlled lighting.

A control device shall be installed that automatically turns lighting off within 30 minutes of all occupants leaving a space, except spaces with multi-scene control, in

a. classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms),
b. conference/meeting rooms, and
c. employee lunch and break rooms.

These spaces are not required to be connected to other automatic lighting shutoff controls.

For all other spaces, each control device shall be activated either manually by an occupant or automatically by sensing an occupant. Each control device shall control a maximum of 2500 ft^2 area for a space 10,000 ft^2 or less and a maximum of 10,000 ft^2 area for a space greater than 10,000 ft^2 and be capable of overriding any time-of-day scheduled shutoff control for no more than four hours.

Exception:

Remote location shall be permitted for reasons of safety or security when the remote control device has an indicator pilot light as part of or next to the control device and the light is clearly labeled to identify the controlled lighting.

Exterior Lighting Control:

Lighting for all exterior applications not exempted in Section 9.1 shall have automatic controls capable of turning off exterior lighting when sufficient daylight is available or when the lighting is not required during nighttime hours. Lighting not designated for dusk-to-dawn operation shall be controlled by either

a. a combination of a photosensor and a time switch or
b. an astronomical time switch.

Lighting designated for dusk-to-dawn operation shall be controlled by an astronomical time switch or photosensor. All time switches shall be capable of retaining programming and the time setting during loss of power for a period of at least ten hours.

Exception:

Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security, or eye adaptation.

Additional Control:

a. Display /Accent Lighting display or accent lighting shall have a separate control device.
b. Case lighting lighting in cases used for display purposes shall have a separate control device.
c. Correctional Facility shall have a master control device at the main entry that controls all permanently installed luminaires and switched receptacles.
d. Task lighting supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided the control device is readily accessible and located so that the occupant can see the controlled lighting.
e. Nonvisual Lighting i.e. lighting for nonvisual applications, such as plant growth and food warming, shall have a separate control device.
f. Demonstration Lighting i.e. lighting equipment that is for sale or for demonstrations in lighting education shall have a separate control device.

Tandem Wiring:

Luminaires designed for use with one or three linear fluorescent lamps greater than 30 W each shall use two-lamp tandem-wired ballasts in place of single lamp ballasts when two or more luminaires are in the same space and on the same control device.

Exceptions:

a. Recessed luminaires more than 10 ft apart measured center to center.
b. Surface-mounted or pendant luminaires that are not continuous.
c. Luminaires using single-lamp high-frequency electronic ballasts.
d. Luminaires using three-lamp high-frequency electronic or three-lamp electromagnetic ballasts.
e. Luminaires on emergency circuits.
f. Luminaires with no available pair.

Exit Signs:

Internally illuminated exit signs shall not exceed 5 W per face.

Exterior Building Grounds Lighting:

All exterior building grounds luminaires that operate at greater than 100 W shall contain lamps having a minimum efficacy of 60 Im/W unless the luminaire is controlled by a motion sensor or qualifies for one of the exceptions above.

Exterior Building Lighting Power:

The total exterior lighting power allowance for all exterior building applications is the sum of the individual lighting power densities permitted in Table 9.4.5, Lighting Power Densities for Building Exteriors, of ASHRAE 90.1-2007, for these applications plus an additional unrestricted allowance of 5% of that sum. Trade-offs are allowed only among exterior lighting applications listed in the Table 9.4.5, Tradable Surfaces section.

Exceptions:

Lighting used for the following exterior applications is exempt when equipped with a control device independent of the control of the nonexempt lighting:

a. Specialized signal, directional, and marker lighting associated with transportation.
b. Advertising signage or directional signage.
c. Lighting integral to equipment or instrumentation and installed by its manufacturer.
d. Lighting for theatrical purposes, including performance, stage, film production, and video production.
e. Lighting for athletic playing areas.
f. Temporary lighting.
g. Lighting for industrial production, material handling, transportation sites, and associated storage areas.
h. Theme elements in theme/amusement parks.
i. Lighting used to highlight features of public monuments and registered historic landmark structures or buildings.

<u>Building Area Method Compliance Path</u>

<u>Building Area Method of Calculating Interior</u>

Lighting Power Allowance:

Use the following steps to determine the interior lighting power allowance by the Building Area Method:

a. Determine the appropriate building area type from Table 9.5.1, Lighting Power Densities Using the Building Area method of ASHRAE 90.1-2007 and the allowed LPD (watts per unit area) from the "Building Area Method" column. For building area types not listed, selection of a reasonably equivalent type shall be permitted.
b. Determine the gross lighted floor area (square feet) of the building area type.
c. Multiply the gross lighted floor areas of the building area type(s) times the LPD.
d. The interior lighting power allowance for the building is the sum of the lighting power allowances of all building area types. Trade-offs among building area types are permitted provided that the total installed interior lighting power does not exceed the interior lighting power allowance.

<u>Alternative Compliance Path: Space-by-Space Method</u>

Space-by-Space Method of Calculating Interior Lighting Power Allowance:

Use the following steps to determine the interior lighting power allowance by the Space by Space Method:

a. Determine the appropriate building type from Table 9.6.1, Lighting Power Densities Using the Space-by-Space Method, from ASHRAE 90.1-2007. For building types not listed, selection of a reasonably equivalent type shall be permitted.
b. For each space enclosed by partitions 80% or greater than ceiling height, determine the gross interior floor area by measuring to the center of the partition wall. Include the floor area of balconies or other projections. Retail spaces do not have to comply with the 80% partition height requirements.

c. Determine the interior lighting power allowance by using the columns designated Space-by-Space Method in Table 9.6,1, Lighting Power Densities Using the Space-by-Space Method, from ASHRAE 90.1-2007. Multiply the floor area(s) of the space(s) times the allowed LPD for the space type that most closely represents the proposed use of the space(s). The product is the lighting power allowance for the space(s). For space types not listed, selection of a reasonable equivalent category shall be permitted.
d. The interior lighting power allowance is the sum of lighting power allowances of all spaces. Trade-off's among spaces are permitted provided that the total installed interior lighting power does not exceed the interior lighting power allowance.

Additional Interior Lighting Power:

When using the Space-by-Space Method, an increase in the interior lighting power allowance is allowed for specific lighting functions. Additional power shall be allowed only if the specified lighting is installed and automatically controlled, separately from the general lighting, to be turned off during non-business hours. This additional power shall be used only for the specified luminaires and shall not be used for any other purpose.

An increase in the interior lighting power allowance is permitted in the following cases;

For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance, such as chandelier-type luminaries or sconces or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 1.0 W/ft^2 of such spaces.

For lighting equipment installed in sales areas and specifically designed and directed to highlight merchandise.

County Specific Lighting Standards

Lighting energy is directly proportional to the lighting level provided. Too often, designers apply high light levels uniformly to all areas of building. This approach results in a uniform "checkerboard" layout of fixtures with a high power density. Using moderate light levels and layouts tailored to each task results in dramatically lower lighting energy. In fact, of all energy guidelines, the single most important is simply to apply IES footcandle (fc) recommendations literally and completely. Total building energy consumption will typically be reduced 20 percent, and the first cost of constructing the building will be significantly reduced.

IES LIGHTING HANDBOOK *VISUAL COMFORT*

The target values of illuminance for Illuminance Categories A to C are *average maintained illuminance*, and the lumen method, using zonal-cavity calculated coefficients of utilization for luminaries, or for daylighting, predicts such average illuminance values. The target values of illuminance obtained for visual displays in the last six categories (D through I) are localized values, that is, *maintained illuminance on the task* and point calculations methods are appropriate. In either case the procedure for determining light loss factors should be used in calculating maintained average or point illuminance.

The Designer must provide Illuminance Categories and Illuminance Values for Generic Types of Activities in Interiors and Illuminance Levels for Various Areas in Commercial Buildings as per the IES Lighting Handbook 1987 Application Volume, pp. 2-5.

Below are the key recommendations per the standards above.

Table 2: Lighting Recommendations by Space Type

	Lighting Power Recommendations by Space Type	
	E-Benchmark Lighting Power Density	Additional Allowance for Chandelier
Portion of Building	W/SF	
Convention Center	1.2	Yes
Court House	1.2	Yes
Dining: Cafeteria	1.4	Yes
Dormitory	1	No
Exercise Center	1	No
Gymnasium	1.1	No
Hospital/Health Care	1.2	No
Library	1.3	No
Museum	1.1	No
Office	0.9	No
Parking Garage	0.3	No
Penitentiary	1	No
Performing Arts Theatre	1.6	Yes
Sports Arena	1.1	No
Town Hall	1.1	Yes
Source: Small HVAC System Design Guide, p 13, Table 1		

A. Linear Fluorescent Lighting

Fluorescent lighting is the best source for most lighting applications because it is efficient and can be switched and controlled easily. Modern linear fluorescent lamps have good color rendering and are available in many styles. Lamps are classified by length, form (straight or U-bend), and tube diameter (T folded configurations). Straight-tube fluorescent lamps are most often used in 1x4-, 2x4-, and 1x8-ft luminaries; folded lamps are used for smaller, square fixtures—1x1s or 2x2s. [1]

Table 3: Linear Fluorescent Lighting Comparison

Lamp Type	**T-12**	**T-12 ES**	**T-8**	**T-5**
Watts	40	34	32	54
Initial Lumens	3,200	2,850	2,850	5,000
Efficacy (lm/W)	80	84	89	93
Lumen depreciation	10%	10%	5%	5%

[1] GREENING FEDERAL FACILITIES, An Energy, Environmental, and Economic Resource Guide for Federal Facility Managers and Designers SECOND EDITION

Source: Phillips Lighting as cited in Efficient Lighting Strategies, Building Technologies Program, p. 82

B. High performance T-8's

a. The energy efficiency specifications are based on performance characteristics of 4 foot T-8 lamps with a not-to-exceed nominal wattage of 32W. The lamps and ballasts must be tested in accordance with the appropriate IESNA and ANSI reference standards, and must meet OSHA/NRTL and UL safety guidelines. These lamps should be applied in accordance with the national best practices in lighting designs such as 1) IESNA Recommended Practices and 2) Lighting power densities provided by County and state building codes.

Table 4: Efficiency Criteria for 4' Linear 32W T8 Lamps

Performance Characteristics for Lamps				
Mean System Efficacy	≥ 90 MLPW for Instant Start Ballasts ≥ 88 MLPW for Programmed Rapid Start Ballasts			
Performance Characteristics for Lamps				
Color Rendering Index (CRI)	≥ 81			
Minimum Initial Lamp Lumens	≥ 3100 Lumens			
Lamp Life	≥ 24,000 hrs at 3-hours per start.			
Lumen Maintenance -or- Minimum Mean Lumens	≥ 94% -or- ≥ 2900 Mean Lumens			
Performance Characteristics for Ballasts				
Ballast Efficacy Factor (BEF) BEF based on: (1) Type of ballast (2) No. of lamps driven by ballast (3) Ballast Factor	**Instant-Start Ballast (BEF)**			
	Lamps	Low BF ≤0.85	Norm 0.85< BF ≤1.0	High BF ≥1.01
	1	≥ 3.08	≥ 3.11	n/a
	2	≥ 1.60	≥ 1.58	≥ 1.55
	3	≥ 1.04	≥ 1.05	≥ 1.04
	4	≥ 0.79	≥ 0.80	≥ 0.77
	Programmed Rapid-Start Ballast (BEF)			
	1	≥ 2.84	≥ 2.84	n/a
	2	≥ 1.48	≥ 1.47	n/a
	3	≥ 0.97	≥ 1.00	n/a
	4	≥ 0.76	≥ 0.75	n/a
Ballast Frequency	≥ 40 kHz			
Power Factor	≥ 0.90			
Total Harmonic Distortion	≤ 20%			

Source: CEE High Performance T-8 Specification, revised 3/6/2006

C. Volumetric Lighting

RT5™ Volumetric Recessed Lighting from Lithonia Lighting uniformly illuminates the entire volume of space, eliminating harsh shadows, dark walls and the "cave effect" arising from the sharp cutoff of parabolic. This lighting system uses up to 33 percent less energy than the industry standard of an 18-cell, 3-lamp T8 parabolic fixture.

This design incorporates a unique lamp/ballast combination from OSRAM SYLVANIA, RT5 delivers high-quality lighting that fills a space with the right amount of light. To achieve the proper balance of light, RT5 features a two-piece refractor system that uses a combination of diffusing film and precisely extruded prisms to efficiently diffuse light. The result is a low-brightness refractor that illuminates and complements the highly-reflective barrel, provides outstanding lamp obscuration, and creates a smooth distribution at all angles and distances. [2]

D. Fluorescent Troffers

APPLICATIONS: Offices, conference rooms, corridors, general office lighting.

A. Number of Cells:

2x4, 3-lamp fixtures shall have 18-cell louver.
2x4, 2-lamp fixtures shall have 12-cell louver.
1x4, 1-lamp fixtures shall have 6-cell louver.

B. **Fixture efficiency**, as measured by an independent photometric testing lab, shall be greater than or equal to 70 percent. The Contractor shall submit fixture cut sheets showing section through fixture and photometric data from an independent testing laboratory using IES reporting format.

C. **Visual Comfort Probability (VCP**) shall not be less than 75 either lengthwise or crosswise at 100 fc in room 20 feet wide, 40 feet long and 8.5 feet ceiling height, with reflectances of 80/50/20.

a. *Diffuser*: Parabolic Louvers provide high fixture efficiencies with excellent light distribution that assists the "localized" lighting approach required by these Guidelines. Properly positioned, parabolic fixtures can provide high-quality light that is free of glare and veiling reflections. The high “spacing criterion” of parabolic louvers permits very wide fixture spacing yielding uniform illumination with a reduced number of fixtures.

b. *Specular vs. Semi-Specular.* Specular louvers offer better CRT glare protection than semi-specular louvers, but will appear to be darker in the ceiling plane. Either type is permissible.

c. The following louver types ***must not be accepted*** as alternatives: Specular "egg-crate" louvers with less than 3" cells, e.g., "paracube" diffusers (3/4 to 1" grid). These louvers provide unacceptably low fixture efficiency.

d. *Use of Acrylic Prismatic Lenses.* Acrylic prismatic lenses may be used in non-task areas where illumination of walls is specifically desired, e.g. in storage rooms or near bulletin boards.

e. *Ballasts*: Each 2- or 3-lamp fixture shall contain a single electronic ballast to fire the required number of lamps.1-lamp fixtures shall be tandem wired to avoid single lamp ballasts where indicated on drawings.

T 5- High Bay Lamps

[2] www.lithonia.com/RT5. June 28, 2005

Facility owners, managers, and architects specifying high-bay lighting applications should choose the most energy-efficient system with the lowest mercury content appropriate for their construction and remodeling projects.

Retrofit projects should be analyzed carefully for payback and benefits such as improved color rendering.

Before purchasing a lighting system, buyers should consult a lighting professional who can analyze the entire project for energy efficiency, lighting level, and appropriate color rendering. Tell your chosen professional that your organization would like to specify low-mercury alternatives wherever possible.

Facilities should recycle all mercury-containing products, including all HID lamps, T5s, and induction fluorescents.

Table 5: Characteristics of Three High-Bay Lamps and Lighting Systems

Attribute	**T5 HO Linear Fluorescent [9] (25°C/35°C)***	**Induction [10]**	**Metal Halide [11]**
Rated life (hours)	20,000	100,000	20,000
CRI	82	80	65
Lumen maintenance	93% @ 40% of life	70% @ 60% of life	65% @ 40% of life
Re-strike time	Instant on	Instant on	10 Minutes
Number of lamps per equivalent system	4	2	1
System watts	234	314	452
System initial lumens	17,800 / 20,000	24,000	37,600
System mean lumens	16,544 / 18,600	17,760	24,440
Mercury in the system [12]	5.6 - 20 mg	28 - 34 mg	40 - 65 mg
Initial system cost (fixture and ballast)	$200 [13]	$800 [14]	$150 [15]

Lumens produced by HO T5 lamps depend on operating temperature.

Source) INFORM: Strategies for a better environment

Table 6: Efficiency Criteria for High Bay Fixtures (HO T5)

Equipment	**General Specification**
High Bay Fixtures	T5 lamps are well suited for the low-profile, elegant fixtures that are especially popular for upscale retail, hospitality and commercial spaces like display cases or wall-washing. Its smaller scale allows for sleeker fluorescent direct/indirect surface mounted and pendant fixtures/ They are used to light surfaces more than 15 feet away. Common uses are industrial manufacturing, gymnasiums, and warehouses.

	Recommended: High-output linear fluorescent (T5 HO) Lamps
	.T5 lamps are designed to peak in their lumen ratings at 95°, compared to 77° for T12 and T8 lamps. This thermal characteristic provides higher light output in confined applications where there is little or no air circulation, and it provides more usable lumens per watt in indirect fixtures.

Table 7: Performance Characteristics for Lamps

Mean System Efficacy	Initial Lamp Efficacy	104 lpw	93 lpw
	Initial System Efficacy	89 lpw	85 lpw
Maintained System Efficacy	81 lumens per Watt		
Performance Characteristics for Lamps			
Color Rendering Index (CRI)	≥ 81		
Minimum Initial Lamp Lumens	≥ 3100 Lumens		
Lamp Life	≥ 20,000		
Ballast Factor	100%		
Lumen Maintenance –or- mean lumens	≥ 93% -or- 40% of life ≥ 16,544		
Re-strike Time	Instant On		
System Watts	234		
Mercury Content	5.6-20 m.g.		
Optimum Operating Temperature	95° F		

E. Wall Lighting Fixtures

APPLICATIONS: Lighting vertical surfaces along walls such as bulletin boards, marker boards, directories, merchandise, bookcase, and so on.

Use a recessed fluorescent wall-lighting fixture such as the Lightolier "Wal-Lyter" utilizing BIAX lamps. This fixture produces more uniform lighting of wall surfaces more efficiently than either fluorescent or incandescent round "wall-washer" fixtures or spots or floods. Significantly fewer fixtures are required, reducing first cost as well as energy costs.

The BIAX lamps also have a 20,000-hour rated life, greatly reducing maintenance over smaller compact fluorescent lamps (10,000 hours) or incandescent bulbs (1,000 to 3,000 hours). Also, far fewer total lamps are needed since each F40BX BIAX lamp produces as much light as three PL-13 Watt lamps or two 100 Watt incandescent lamps.

A. BIAX Lamp Type. Use a two-foot BIAX lamp with 3500K color temperature, equivalent to Phillips PL-L 40W/36.

B. BIAX Ballast Type. Use an electronic ballast designated for BIAX lamps. Tandem-wire fixtures using 2- or 3-lamp ballasts where feasible.

Fluorescent Wallwashers: High performance recessed wallwasher/accent light using one BIAX type lamp.

F. Exterior Lighting

Applications: All exterior areas such as signs, parking lots, walkways and site lighting.

A. **Use HPS Lamps.** High Pressure Sodium (HPS) lamps shall be used for all parking lots, walkways and site lighting. Metal Halide lamps may be used for lighting building entrances and facades.

B. **Exterior Fixtures**. Use fixtures with high-quality optics to maximize fixture spacing and minimize the number of fixtures. A spacing-to-mounting-height ratio of 5 to 1 should be possible.

C **Pole fixtures** shall be <u>vertical burn</u> for best optics, *Quality Lighting Design 123* or equal. Mounting height should be 20 to 40 feet.

D. **Wall Fixtures** shall be arm-mounted cut-off fixtures for maximum spacing with lowest total cost. “Wall packs” are not permitted.

E. **Glare Control**. All exterior fixtures shall have a cut off angle of 75 degrees or less to prevent disabling glare and light trespass to adjacent areas. This criterion <u>eliminates</u> the use of "Wall-pack", globe, ground-mounted and bollard fixtures.

"Tilt up" of any fixture head is <u>prohibited</u> due to glare and "light pollution" liabilities.

G. Exit Signs

Exit signs shall be of LED type direct-view and edge-lit models only. Unit shall be UL listed, Energy Star certified, and carry a minimum 25-year warranty. Use Guide specifications verbatim.

A. All EXIT signs for interior use shall be of the Light-Emitting-Diode (LED) type. Unit shall be UL listed and meet NFPA Life Safety Code 101. Unit shall be electronically protected from voltage surges, brown outs, and short circuits.

B. LED's shall be red on black background with white faceplate. Unit shall be enclosed in a white metal case. Sign faces shall be protected with minimum 1/8" clear Lexan shield.

C. Maximum line wattage draw with or without battery installed shall be 7 Watts for single-face signs and 11 Watts for double-face signs.

D. Battery Back-up units shall have a UL listed rechargeable battery with a 7-year full warranty. Electronics shall protect the battery against brown-out conditions, overcharge and deep-discharge hazards. Battery shall provide a minimum of 2-hours of sign operation in the event of a power failure. Derangement lights shall be located on the face of the unit with a battery test button on the bottom of the unit.

E. Unit shall carry a 20 year full warranty on the electronics, LED's, transformers, case, and all parts except the battery.

Table 8: High Efficient Lighting Fixture Recommendations

Type of Fluorescent Luminaire	Description	Benefits	Cautions	Applications
Indirect/Direct Linear Luminaire	Primarily indirect, pendant or wall mounted, T8, T5 or T5HO lamping	Soft, even illumination, good visual comfort, easily dimmed	Choose spacing for good ceiling brightness uniformity	*High and low bay areas and classrooms*
Indirect/Direct Decorative Luminaire	Typically compact fluorescent or induction lamping	Significant energy savings, performance comparable to incandescent	Select diffuser for good brightness uniformity on glowing elements	*Small offices, lobbies, waiting areas, atriums, and corridors*
Linear Strip Luminaire	Surface mounted or pendant mounted with or without side reflectors, typically T8 lamping	Energy-efficient, small size, low-cost, easily dimmed	Best when concealed	*In coves or wall slots, on top of cabinets, stacks or lockers, and mechanical rooms*
Task Luminaire	Linear wall mounted "under shelf" or "arm type"	Task lighting allows for lower ambient lighting levels	Provide appropriate task/ambient contrast ratios	*Any task surface (desks, counters, workbenches, etc.)*
Indirect Recessed Luminaire	Recessed (light is directed up toward top of housing and reflected back down), typically 2' x 2' or 2' x 4', T8 or CFL biax lamping	Optimized for fewer lamps than typical recessed lensed troffer luminaries, good visual comfort	Does not brighten ceiling, consider minor supplemental lighting (such as wall sconces)	*Corridors, open/private offices (can replace standard troffer in many applications)*
Recessed Wall Washer	Linear or round can-type, Linear or CFL lamping	Significant energy savings, performance better than incandescent	Best when paired or in groups, choose spacings carefully	*Select wall surfaces in many room types*
Recessed Downlight	Round can-type, CFL lamping	Significant energy savings, performance comparable to incandescent	Does not brighten the ceiling, can create light "scallop" on walls	*Localized infill lighting, often combined with other luminaire types*
Wall Sconces	*Wall mounted, decorative, CFL lamping*	*Significant energy savings, performance comparable to incandescent*	*Select diffuser for good brightness uniformity on glowing elements*	Lobbies, corridors, conference rooms, etc

Source: Energy Efficient Lighting by David Nelson, AIA, Clanton & Associates, Inc

These fixture specifications include fixtures that ensure a balance of performance, energy savings, comfort, lighting quality, quantity and maintenance, at a cost-effective price. Many standard products meet these generic specifications. Even small variations from these specifications may result in undesirable effects. For example, specular louvers or reflectors may increase light levels and reduce reflected glare, but will also increase overhead glare and decrease desirable room surface brightness. These recommendations are from the "*Office knowhow*" Design Guide, Northeast Energy Efficiency Partnerships, 2002.

Table 9: General Specification

Equipment	General Specification
Occupancy Sensor Applications	Coverage patterns shall be determined based on the height of the sensor, furniture, partition locations, and finish of interior surfaces. Sensors shall be able to detect typical motion (e.g. walking in corridors; writing and computer use in offices) throughout the accessible portions of the spaces lit by controlled luminaries.
Private Offices	Recommended: Wall-Mounted Ultrasonic Occupancy Sensors with a 10 minute delay
Open Offices	Recommended: Ultrasonic Ceiling Mounted Occupancy Sensors set to maximum sensitivity with a 15 minute time delay. Connect sensors to an automatic wall switch so lights must be manually turned on at the switch but are turned off by the sensor. In spaces with vertical partitions, files or other objects that create barriers higher than four feet, reduce the sensor coverage area.
Corridors	Recommended: Install ceiling mounted ultrasonic sensors designed for linear corridor distribution. Set to maximum sensitivity and 15 minute time delay.
Large Offices Spaces, Conference Rooms	Recommended: Install ceiling mount- corner-wide view with passive infrared high on the wall. Set to maximum sensitivity and a 15 minute time delay.

*Office lighting knowhow, p. 8, 2002.

Table 10: General Code Requirements

General Code Requirements
Be UL Listed Under Section
Conform to all applicable portions of the National Electrical Code
Be rated for operation in ambient air temperatures ranging from 50^0 F to 104^0 F when installed in conditioned spaces. When used in locations where ambient air temperatures may fall below 50^0 F, provide equipment rated for operation in ambient air temperatures ranging from -40^0 F to 95^0 F.

*Table 11: Occupancy Sensor Applications**

Applications	Sensor Type	Angle of Coverage	Typical	Optimum Mounting

			Effective Range	Height
Open Partitioned Areas; Small Open Offices: File Rooms: Reproduction Rooms: Conference Rooms: Restrooms: Garages:	Ceiling Mount-Ultrasonic	360°	500 to 2,000 sq.ft	8-12 ft.
Large Office Spaces; Conference Rooms	Ceiling Mount-Corner Wide View-Passive Infrared	170° -180°	300 to 1,000 sq.ft.	40-48 inches
Private Offices; Copy Rooms	Ceiling Corner Mount-Narrow View-Passive Infrared	110° -120°	To 40 ft.	3-10 inches
Hallways; corridors; aisle ways	Ceiling Mount Corner Mount-Narrow View-Ultrasonic	360°	To 100 ft.	8-12 feet

*CEC, PG&E Information Efficiency Information, “Occupancy Controls for Lighting”

Table 12: Specifications for Ceiling/Corner Mounted Occupancy Sensors

Ceiling-Mounted Occupancy Sensors	
Location	Sensors shall be mounted flat against the ceiling. Sensors should not be installed in locations where the air blows across them or where their view is obstructed by dropped beams, soffits, or other irregular ceiling conditions. Maintain a minimum 72 inch separation between sensors and HVAC supply diffusers.
	When sensors located in adjacent lighting control zones overlap, provide sensors which are designed so they do not interfere with each other.
Wattage	Sensors shall be entirely low-voltage (nominal 15V-24V), NEC Class 2 device which is powered by and sends switching signals back to power pack. Provide 72 inch slack in the cable connecting each sensor with its power pack to allow for sensor relocation.
Detection Capabilities	Occupancy sensors shall detect motion either:
Ultrasonic	By emitting a high frequency (nominal 25kWz-40kWz) audio signals and listening for a Doppler shift in the return signal. Sensor shall not emit audible sound. Sensor should be entirely solid-state, crystal controlled to within a +/- 0.005% frequency variation,

	By passively sensing changes in the infrared radiation received by the sensor from various zones in the room. Passive infrared sensors shall be entirely solid-state and shall have a fresnel lens with no less than two vertical levels to break up the room into different zones for IR detection. Passive infrared sensors shall have a full 180^o field of view in the horizontal plane when not "masked."
	Fresnel lenses shall be "masked" as required to prevent sensors from detecting motions outside the areas they are controlling. Manufacturer shall provide masking tape which matches the color of the sensor.
	Sensor shall have an LED, clearly visible throughout the coverage area, which flashes each time motion is detected.
	Time delay (after motion is no longer detected before the light is turned off) shall be adjustable through a range from 15 seconds to 20 minutes. Adjustment mechanism shall be located in the sensor. Default time delay shall be 15 minutes.
	Sensitivity to motion shall be adjustable. Adjustment mechanism shall be located in the sensor.
	The sensor shall be protected from false triggering due to radio frequency interference or poor grounding.
	Failed circuitry should default to the "On" position so failure will avoid a hazardous condition and provide light while the failed sensor is being removed.
	There shall be no way to override the motion sensor to "on" without a special key or tool.
	Sensor shall be compatible with electronic ballasts and shall have 100% off switch with no leakage to the current load.

*Federal Energy Management Program (FEMP) Master Specification: Occupancy Controls, May 1998; 16500-pp. 42-45

Table 13: Specifications for Wall-Mounted Occupancy Sensors

Wall-Mounted Occupancy Sensors	
Location	Wall-mounted occupancy sensors are intended for use in small rooms with no interior obstructions.
	Sensors shall be wall-mounted at standard switch height in compliance with the Americans with Disabilities Act guidelines.
	Sensor shall be designed to fit in standard single-gang switch box. Mount in multigang box when adjacent to other switches.
	Faceplate shall have no visible hardware.
	Sensor shall incorporate a motion detector and a manual tap switch to operate lights in manual on, automatic-off mode.
Detection Capabilities	Occupancy Sensor shall detect motion by either:
Ultrasonic	Emitting high frequency (nominal 25kWz-40kWz) audio signals and listening for a Doppler shift in the return signal. Sensor shall not emit audible sound. Sensor should be entirely solid-sate, crystal controlled to within a +/-0.005% frequency variation,

Passive Infrared	By passively sensing changes in the infrared radiation received by the sensor from various zones in the room. Passive infrared sensors shall be entirely solid-state and shall have a fresnel lens with no less than two vertical levels to break up the room into different zones for IR detection. Passive infrared sensors shall have a full 180^{o} field of view in the horizontal plane when not "masked."
	Fresnel lenses shall be "masked" as required to prevent sensors from detecting motions outside the areas they are controlling. Manufacturer shall provide masking tape which matches the color of the sensor.
LED	Sensor shall have an LED, clearly visible throughout the coverage area, which flashes each time motion is detected.
Time Delay	Ultrasonic: 10 to 15 minute time delay
Compatibility with Electronic Ballasts	Sensor shall be compatible with electronic ballasts and shall have 100% off switch with no leakage to the current load.
Maintenance Requirements	Sensor shall have a concealed override switch or other provision which allows maintenance personnel to easily bypass the sensor in the case of malfunction. Bypassing the motion sensor shall cause the device to operate like a standard wall switch. All adjustment mechanisms shall be concealed from view, but shall be readily accessible to maintenance personnel using common hand tools.
Time-Delay	Time delay (after motion is no longer detected before the light is turned off) shall be adjustable through a range from 15 seconds to 20 minutes. Adjustment mechanism shall be located in the sensor.
False "Ons"	The sensor shall be protected from false triggering due to radio frequency interference or poor grounding.
	Failed circuitry should default to the "On" position so failure will avoid a hazardous condition and provide light while the failed sensor is being removed.
	There shall be no way to override the motion sensor to "on" without a special key or tool.

*Federal Energy Management Program (FEMP) Master Specification: Occupancy Controls, May 1998; 16500-pp. 45-47

Lighting References

IESNA. 1997. EPRI Day lighting Design: Smart and Simple. New York: Illuminating

Engineering Society of North America.

NBI. Advanced Lighting Guidelines. White Salmon, Wash.: New Buildings Institute.

ENERGY MANAGEMENT SYSTEMS

Facility managers should consider automatic controls and sensing technology when equipment can be turned on, shut off, or modulated based on schedules, temperatures, pressures, light levels, or the presence or absence of personnel. HVAC and lighting are prime candidates for automatic controls. It is easiest to add (or change) control systems when the HVAC or lighting systems are being replaced or modified in other ways, though controls can often be retrofit fairly easily.

Sophisticated electronic controls, such as programmable thermostats and Energy Management Control Systems (EMCS), can be prone to problems with electrical power quality: surges, spikes, brownouts, and outages, particularly in locations distant from utility substations. Putting this equipment on circuits with surge suppression or uninterruptible power supply (UPS) may be advisable.

To avoid injury, it is important to post signs indicating the control mechanism and to install disconnect switches near equipment operated by automatic controls.

Table 14: Energy Management and Controls Tips

WHEN PURCHASING PROGRAMMABLE THERMOSTATS MADE FOR USE WITH HEAT PUMPS, ENSURE THAT THEY HAVE "RAMPED RECOVERY" FEATURES FOR HEATING. RAMPED RECOVERY SLOWLY BRINGS THE BUILDING UP TO THE TARGET TEMPERATURE WITHOUT ENGAGING THE SUPPLEMENTARY ELECTRIC STRIP HEATING.
Facility managers should document all the automatic controls in their facilities by recording the locations of controls, the equipment being controlled, and any requirements for resetting the time or program as seasons change, as time changes for Daylight Savings, or after power outages.
Electrically combining time clocks and photocells may provide a good way to program the needed exterior lighting logic—for example, "on at sunset, off at 10:00 p.m." Facilities with EMCS equipment should have no trouble implementing this type of control logic.

Many scheduling, optimizing, and reporting functions are available with an EMCS:

- **Start/stop controls** will limit operating hours of equipment according to predetermined schedules.
- **Optimum start/stop** controls delay bringing equipment online until the latest possible time. This is particularly useful in limiting HVAC operation.
- **Temperature setback/setup** saves energy by allowing building conditions to drift (within predefined limits) during unoccupied periods.
- **Economizer controls** turn off chillers during mild weather and allow outside air to provide space conditioning.
- **Enthalpy control** provides more sophisticated economizer control that is based on both temperature and humidity.

Energy Management Controls Guidelines

Buildings will be equipped with Direct Digital Controls (DDC) to perform both energy management and automatic temperature control. The DDC system shall perform all start/stop of HVAC equipment, control distribution system valves and dampers, and control all terminal devices for temperature regulation. All new buildings and renovations shall include these controls along with communications equipment for dial-up from remote operator PC's.

The individual DDC controllers shall be capable of stand-alone operation but shall share information through a network. The network in turn can be accessed by a PC either locally through direct communications ports or over phone lines by operator PC's communicating through modems.

The DDC controllers shall perform all HVAC control algorithms, control dampers, temperature settings, economizer operation and equipment on/off schedules for HVAC plant equipment, air-handlers and hydronic systems. Pneumatic controls shall not be used. Actuators for valves and dampers shall be DDC. Terminal devices, including VAV boxes and thermostats, shall be operated by DDC Terminal Equipment Controllers.

The designer shall provide a complete "point list" and sequence of operation in verbal form and a corresponding logic diagram for review by the Owner. These three items shall be submitted at Design Development and located on the mechanical drawings.

The DDC system shall also interface with other building automation systems on the project, including at least security, lighting, fire and life-safety through an open protocol processor. The direct digital control system shall also interface to microprocessor controls of HVAC equipment including chillers and VSD's. A lighting management system shall be used to turn off all <u>interior</u> and <u>exterior</u> lights as described under *Lighting Design Guidelines* - ON/OFF controls. It is <u>not</u> permissible to use mechanical or electronic time clocks outside of the Energy Management System for this or any other application.

The programming and variable naming conventions used by the DDC system shall be compatible with existing software and point names used by the Owner.

Thermostats and Controls

A. Two-Stage Commercial Grade Thermostats

The primary function of the thermostat is to control the heating and cooling output of the unit, but most thermostats also control the operation of the supply fan. Fans are required to run continuously during operating hours, and cycle on and off with a call for heating or cooling during unoccupied hours. Commercial thermostats should be used to provide continuous fan operation/ ventilation during occupancy. The thermostat should be programmed for intermittent fan operation during unoccupied hours, and provide a one hour “purge” of the building prior to occupancy.

Designers should specify controls with “default” settings that are appropriate for commercial applications**.** Gas/electric systems with economizers should use thermostats with two stages of cooling to allow integrated operation of the economizer and mechanical cooling system. When differential temperature or enthalpy economizer control is used, the first stage of cooling is used to initiate economizer operation, and the second stage of cooling is used to start the compressor to maintain space temperature control.

Location of the thermostat can dramatically affect system loads and occupant comfort. Locating several thermostats in the same general area with conflicting heating and cooling set-points can invite problems with simultaneous heating and cooling, where adjacent units “fight” each other to maintain selected settings.

B. Controller Options and Interfaces

A. Modern HVAC units can be configured with a variety of controller options, including standard electromechanical controls, microprocessor controls, and controllers with EMS interface capability. Standard controls may be used with thermostats from a variety of vendors. In some units with microprocessor control, the thermostat control logic is contained within the unit controller and the zone thermostat is merely a temperature sensor.

B. Interfaces allow the units to be controlled by one of several energy management systems, including both manufacturer-supplied systems and third-party systems. These interfaces allow the EMS to take over most of the unit control function, including calls for heating and cooling, fan operation and scheduling, and economizer control. Additional digital I/O channels are included to provide alarm capability for fan failure, dirty filters, compressor high- or low-pressure lockout, and economizer status. Supply and return air temperature information can also be transmitted to the EMS console (Heschong Mahone, 2003). [3]

C. System-wide Controls

A. Multi-zone time clocks provide simple on/off scheduling for multiple zones. They are useful for facilities with frequent unoccupied periods.

B. Direct digital control (DDC) energy management systems (EMS) provide a universal, centralized, expandable and networkable system of programmable, automatic controls for scheduling, optimizing, monitoring and operating all aspects of building systems, including HVAC. A major advantage of an EMS is the ability to optimize and integrate system controls and functions into a more efficient package. Multiple facilities can be controlled through network or modem lines.

C. DDC systems are usually designed by the distributor or installing contractor to the owner's performance specifications. To ensure correct equipment and programming, provide detailed specifications for scheduling, operation sequencing, user software, user accessibility, intersystem compatibility, future expansion needs and any other desired features.

D. Initial hardware and software programming should be performed by a manufacturer's representative to the County's specifications.

D. Controls

Controls should be installed for energy-efficient HVAC system operation in accordance with ASHRAE 90.1. These include:

1. Programmable Thermostatic Controls
2. Off-Hour Controls
3. Heat Pump Auxiliary Heat
4. Humidification and Dehumidification
5. Freeze Protection
6. Ventilation Controls for High-Occupancy Areas
7. Economizers
8. Simultaneous Heating and Cooling Limitation
9. Fan Power Limitation
10. Variable Air Volume (VAV) Fan Control
11. Condenser Fan Speed Control

Table 15: Controls Guidelines

All controls should be commissioned per the manufacturer's instructions.
Control components should be well labeled with designation, function and associated zone(s).
Thermostats and temperature sensors should be located away from sources of heat, cold, direct sun, and drafts. Thermostats should be mounted on insulated backing and located on interior walls.
Dual compressor units should be installed with two-stage cooling controls. Controlling a dual compressor unit with single-stage controls can result in increased energy use and unit wear.

[3] Small HVAC System Design Guide, CEC, 2003, p. 65.

E. Energy Management Lighting Controls

General Guidance

A. Provide, install, and test Energy Management Lighting Controls as specified herein for the areas indicated on the drawings and load schedule(s).

B. Electrical contractor shall coordinate all work described in this section with all other applicable plans and specifications.

System shall consist of Lighting Controllers photo sensors, occupant sensors, manual controls. The lighting controller shall also interface to Building Automation Systems (BAS) and/or time clocks. In addition system will include appropriate number of electronic dimming ballasts installed in fluorescent fixtures.

Manufacturer: Company continuously manufacturing lighting control systems for a minimum of 10 years.

Each lighting controller shall be listed by U.L. as Energy Management Equipment. Additionally, each input control device shall be listed by U.L., where required. C. Manufacturer shall maintain ISO 9001 certification. Provide a copy of the certificate as part of the submittal.

Lighting Controllers-General

Lighting controllers shall be mounted to standard 4X4 metal junction boxes. Enclosure shall be capable of withstanding a 10 ft. drop to a concrete floor without impairing electrical operation or sustaining physical damage.

Lighting controllers shall be completely assembled by the manufacturer. Controller shall have color coded pigtails for connections made within the junction box for input and output line-voltage connections. The contractor shall provide line and load wiring. Input control device wiring shall terminate to a set of clearly marked low voltage Class 2 terminals. These terminals must be completely contained within the enclosure and have a removable cover. A barrier shall isolate class 2 wiring from line-voltage wiring. No other wiring or assembly by the contractor shall be required.

Lighting controllers must operate within an ambient temperature range of 0C (32^{o}F) to 40^{o}C (104^{o}F).

Lighting Controller-Operation

A positive air-gap relay shall be employed within each lighting controller to ensure that the load circuits are open when the "off" function is selected. These relay must be integral to the controller and be capable of operating 16 Amps of electronic ballast load. Lighting control manufacturer shall provide and warrant the relays for 10 year life (30,000 cycles) at full load.
Each lighting controller shall be designed and tested to withstand surges, without impairment to performance, of 6000V, 200A as specified by ANSI/IEEE std. C62.41.

The lighting controller output shall provide dimming from 100% light output down to 1% light with Lutron Hi-lume electronic ballasts and 100% light output down to 10% light with Lutron Eco-10 ballasts or similar manufacturers.

Control system manufacturer and Fixture Manufacturer are responsible for coordination of proper ballast and lamp in fixture.

Lighting controller shall be microprocessor based to provide the logic necessary to combine the inputs from photo sensors, occupant sensors, manual controls, fire/security systems, demand controllers, BAS and/or time clocks.

Lighting controller output shall be based on Lowest Light Level Requested Formula to maximize energy savings.

Minimal time shall be required for initial calibration of the Lighting controller. Adjustments shall be limited to: Maximum Light Level; Minimum Light Level; and Photo sensor Level. All adjustments made using trimmers that require a screwdriver for setting levels. Adjustments, while being performed, will automatically override any normal operation time delays or fade rates to facilitate easy adjustment and automatically return to normal operation at the completion of adjustments. Adjustments can only be made with low voltage cover removed.

Input Controls

Input controls shall be low voltage type. Input controls shall use low voltage Class 2 wiring and be electrically isolated from power wiring by means of a U.L. listed Class 2 power supply. A separate set of terminals shall be provided for control termination at the lighting controller.

Lighting controller shall incorporate a Full Power red LED indicator light. The light will go on to provide a visual signal that the output of the lighting controller is at 100%, indicating power is not being reduced.

Photo sensor Control

Where indicated on the drawings, provide MW-PS-WH photo sensors to work in conjunction with the lighting controllers. Photo sensor(s) shall be color and spatially corrected to provide a true representation of changes in lighting levels which a person perceives. Phototransistor technology shall be utilized so that the photo sensor output does not change as a function of time or temperature. Cadmium sulfide photo sensors (photo-resistors) shall not be acceptable. The photo sensor(s) shall have a directional response for accurate detection of available daylight. Once installed properly, photo sensor(s) shall be of a design that minimizes the chance that it could be moved and therefore change the sensor calibration. All calibration adjustment shall be done at the lighting controller.

Photo sensor shall be manufactured by the lighting control system manufacturer, and shall incorporate a built-in time delay in order to ignore rapidly changing sky conditions. Photo sensor shall be capable of operating in the following compensation mode:

Daylight Compensation-The photo sensor shall continuously monitor daylight illumination. As daylight illumination increases, the photo sensor and lighting controller combination reduces output of the fixtures over a continuous range to the minimum set power level and, if sufficient daylight is available to off. Changes in light output will be gradual with a 30 second fade rate. The photo sensor/lighting controller shall incorporate digital signal processing techniques to provide long-term control stability. The digital processing shall provide automatic adjustment of the turn-off delay time in response to the variations and fluctuations of daylight.

Manual controls

Provide manual control stations of the Vareo or NovaT* style as indicated on plans and schedules. Manual controls shall provide on/off control of the controller. In addition manual control allows adjustment of light level from minimum to level set by photo sensor. Manual control shall not be able to raise controller output above Lowest Requested Light Level.

F. Lighting Occupancy Controls

Occupant sensors

Provide ceiling mounted occupant sensors as shown on plans and as scheduled. Controller shall supply 15 and 24VDC for sensor operation. Sensors requiring additional power supply or relay control units are not acceptable. Sensor output shall be a low voltage/normally open switch (or electronic) closure. The lighting controller shall provide the following occupant sensor operation:

Area occupied-Lighting controller adjusts lighting to photo sensor/manual control level.

Area unoccupied-Lighting controller adjusts lighting to level set by unoccupied level preset adjustment.

Area unoccupied/auto shut-off mode-when auto shut-off mode is activated lighting controller turns lighting off.

Energy Management References

Santos, J. "*All Controllers Are Not Created Equal - Knowledge Of The Differences Is Key To Specification,* Heating, Piping and Air Conditioning, May 2001, HPAC website at www.hpac.com.

The Iowa Energy Center *DDC On Line* web site at www.DDC-online.org

ASHRAE BACnet website: http://www.bacnet.org/

Echelon website (LonWorks networks): http://www.echelon.com/

ADDITIONAL CONSIDERATIONS

SOURCES OF ADDITIONAL INFORMATION

ASTM International—Publishes standards that support LCCA.
R. S. Means Company—Offers construction cost databases.
Sustainable Buildings Industry Council (SBIC)—Offers workshops on Designing Low-Energy Buildings that include instruction in using Energy-10 software.
U.S. Army Corps of Engineers Life-Cycle Cost Module
U.S. Cost—Conducts training workshops for Success Estimator and Tri-Services Parametric Estimating System (TPES) models several times each year.
U.S. Department of Energy (DOE) Office of Federal Energy Management Programs (FEMP)—Conducts workshops on a variety of topics related to energy and water conservation. A streaming video on life-cycle costing may be accessed from www.energyworkshops.org/femp/ which includes an introduction to BLCC5.
U.S. Life-Cycle Inventory (LCI) Database—Created by NREL and partners, this publicly available database allows users to objectively review and compare analysis results that are based on similar data collection and analysis methods.

REFERENCES

Building Economics: Theory and Practice by Rosalie T. Ruegg and Harold E. Marshall. New York: Van Nostrand Reinhold, 1990.

Building Maintenance and Repair Cost Reference by Whitestone Research. 2004.

Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis, Annual Supplement to Handbook 135 by Sieglinde K. Fuller, Amy S. Rushing, and Laura I. Schultz. NISTIR 85-3273-19. Gaithersburg, MD: National Institute of Standards and Technology, April 2005. Also available from the DOE/FEMP Help Desk at 1-877-EERE-INF (1-877-337-3463).

Engineering Economy by G. J. Thuesen and W. J. Fabrycky. Prentice Hall, 1993. ISBN 0-13-277491-7.

GSA LEED® Cost Study GSA, 2004.

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Life-Cycle Costing Manual for the Federal Energy Management Program by Sieglinde Fuller and S.R. Petersen. NIST Handbook 135. National Institute of Standards and Technology, 1995.

Simplified Energy Design Economics by Harold E. Marshall and Rosalie T. Ruegg. NBS SP 544. Washington, DC: National Bureau of Standards, January 1980.

Building Economics: Theory and Practice by Rosalie T. Ruegg and Harold E. Marshall. New York: Van Nostrand Reinhold, 1990.

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APPENDIX A

SPACE MEASUREMENT STANDARDS

The following standard describes the requirements to be followed when undertaking space measurements. In reconciling design to program, all areas as defined as “Gross Measured Area”, shall be accounted for. This includes occupy-able and non-occupy-able areas that encompasses, but are not necessarily limited to; mechanical rooms, duct chases, electrical closets, etc.

Recognized Standards

The only acceptable method for measuring floor areas is the method described in the American National Standards Institute, Inc. (ANSI) standard Z76.1-1996, created by the Building Owners and Managers Association International (BOMA) and available in their publication <u>Standard Method for Measuring Floor Area in Office Buildings;</u> Hereinafter referred to as the BOMA Standard.

For architectural programming purposes, measurement of floor areas shall adhere to the BOMA standard and shall also be subject to the supplementary definitions and qualifications, which follow.

General Guidelines

No terms shall be used in place of those defined in either this document or in the BOMA standard When necessary, additional terms may be used, but these must be explicitly defined in relation to the BOMA standard. Under no circumstances shall such additional terms be employed if such use has the potential to adversely affect the accuracy or reliability of the BOMA standard. For example, the term "square footage" shall not be used in place of more specific terms such as "rentable square footage" or "usable square footage" as defined in the BOMA standard.

Wherever suitable, floor area figures related to leasing shall be provided in the Global Summary of Areas format, described in the BOMA standard.

Where it is necessary to employ conversion factors (such as grossing factors) in the calculation of areas, the source or derivation of said conversion factors shall be provided along with the figures calculated.

Definitions

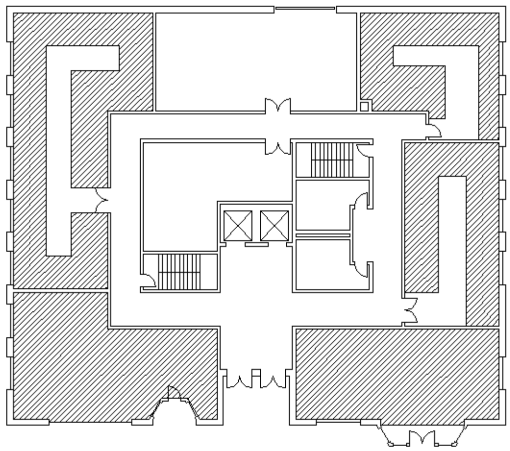
In order to employ the BOMA standard for architectural programming purposes, it has been necessary to provide additional clarification of the BOMA definitions as well as provide supplementary definitions. This additional material is <u>underlined</u> in the following section.

All other material in the following section consists of summaries based on Capital Development interpretation of the BOMA standard. These are meant to supply a context for the supplementary material and are provided for general reference only; these summaries should not be considered a replacement for the BOMA standard.

1. Programmable Area

Programmable area consists of the portion of usable area, excluding permanent structural or architectural elements and internal circulation, which may be programmed for typical office uses - i.e. occupied by people or specific functions in the performance of department job duties.

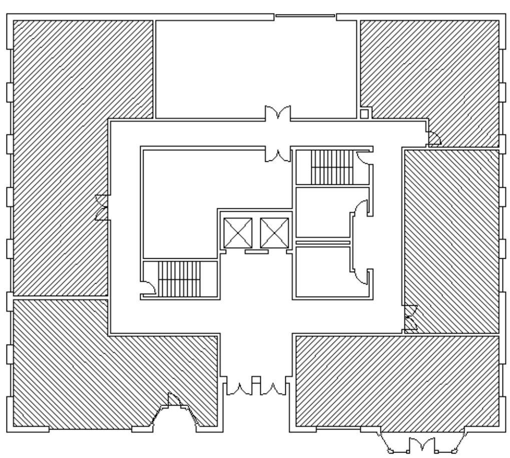
Programmable Area



2. Net Usable Area

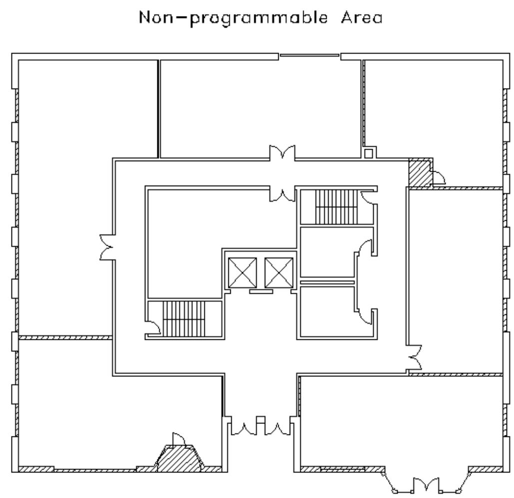
Net Usable Area consists of the portion of usable area, excluding areas occupied by permanent structural or architectural elements or areas otherwise not occupiable by standard uses (i.e. window ledges), which is occupied by people or specific functions and which includes internal circulation

Net Usable Area



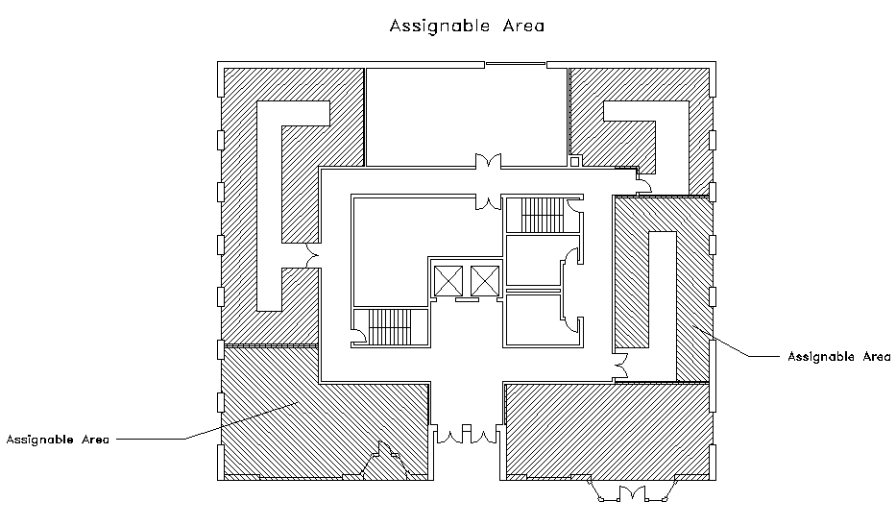
3. Non-Programmable Area

Non-programmable area consists of the portion of usable area which cannot be programmed for typical office uses, such as areas occupied by permanent structural or architectural elements or areas otherwise not occupiable by standard uses (i.e. window ledges).



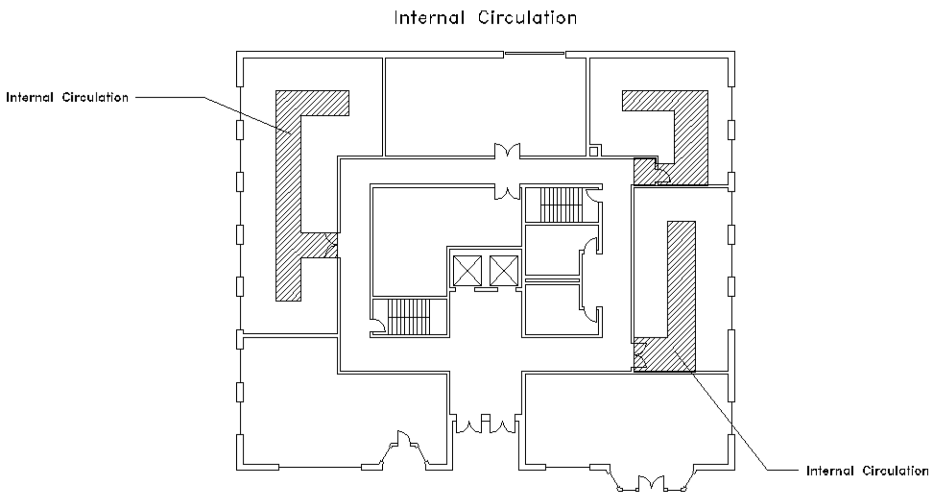
4. Assignable Area

Assignable Area is the portion of Usable Area, excluding Internal Circulation, which can be assigned to a particular tenant.



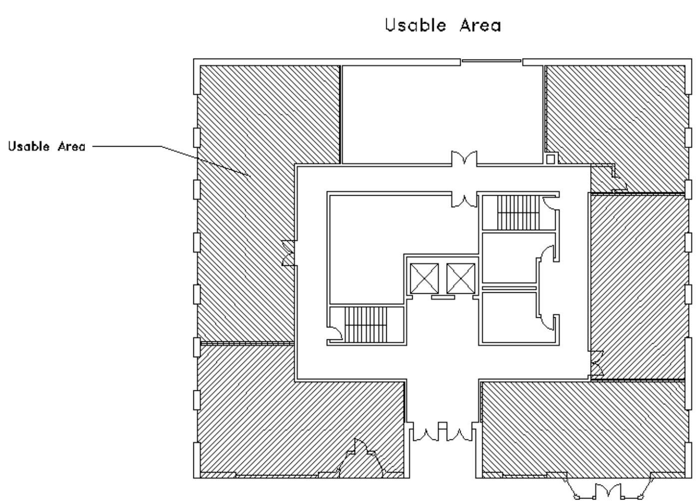
5. Internal Circulation

Internal Circulation is the portion of an Assignable Area necessary for circulation through the space.



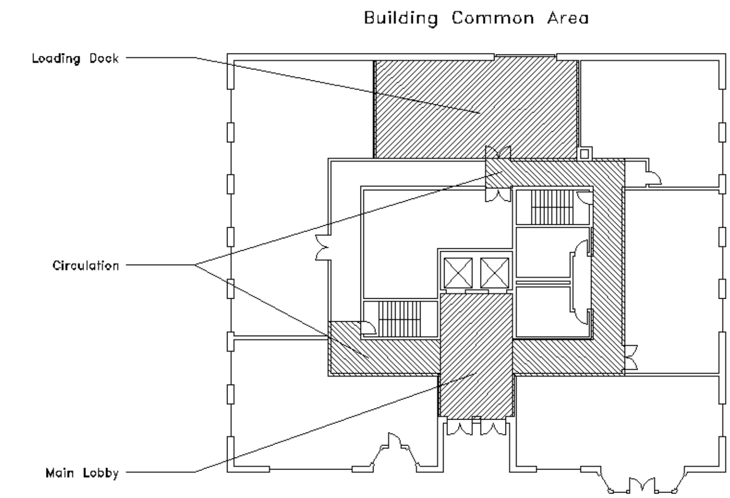
6. Usable Area

Usable Area is equal to Rentable Area minus Floor Common area and Building Common area.



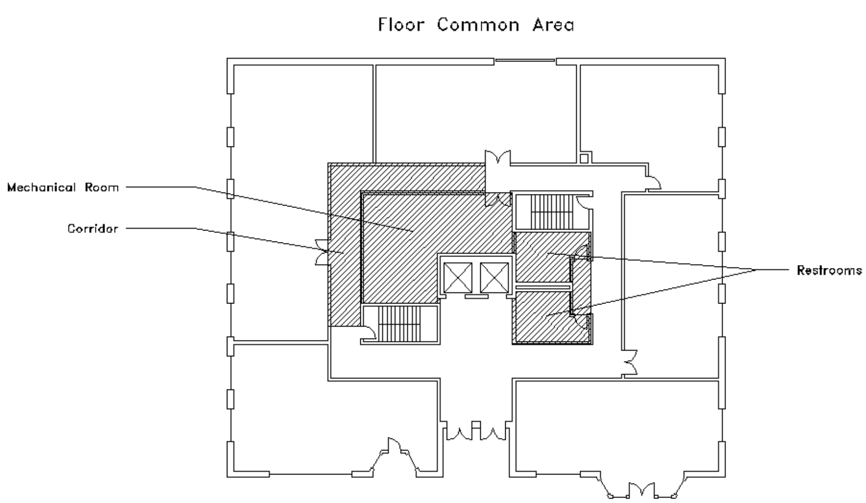
7. Building Common Area

Building Common Areas are those areas in the building which provide services to all building tenants. These areas may include, but are not limited to, lobbies, conference rooms, mechanical rooms, equipment rooms, and mail rooms.



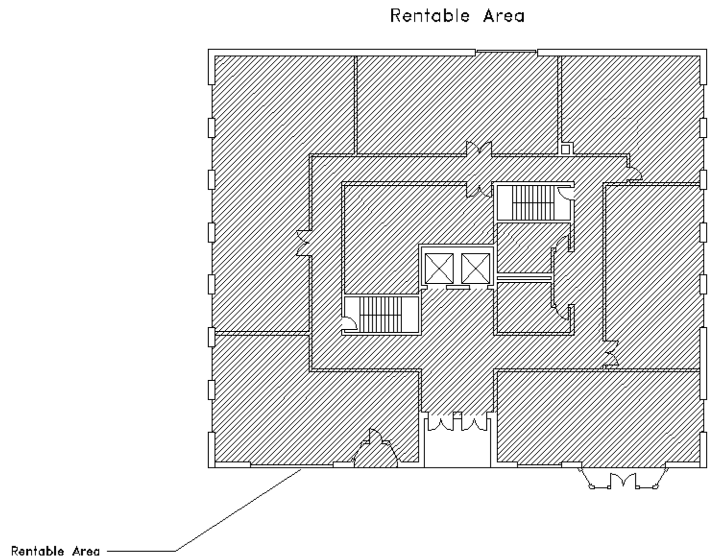
8. Floor Common Area

Floor Common Areas are those areas such as restrooms, janitorial closets, corridors, and mechanical spaces, which serve only the tenants of a particular floor.



9. Rentable Area

Rentable Area is equal to Gross Measured Area minus Major Vertical Penetrations. No deductions are made for columns or projections necessary to the building.

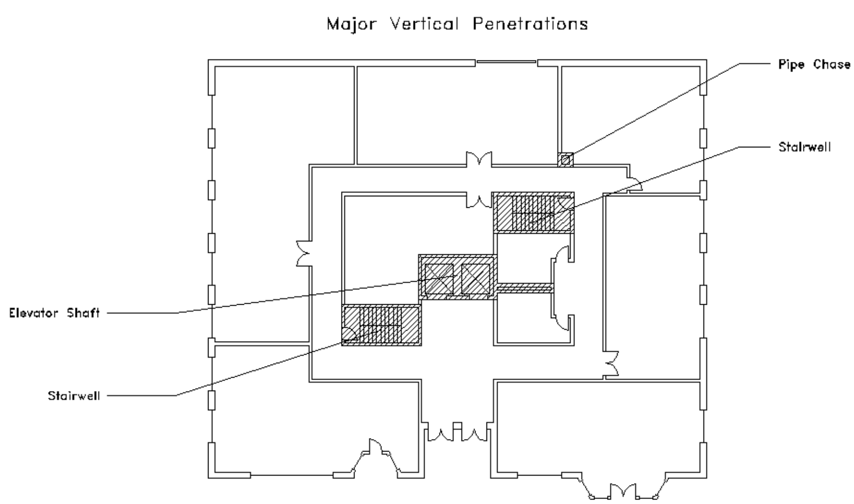


10. Rentable/Usable Ratio

A conversion factor that, when applied to the Usable Area of a building, gives the Rentable Area. This factor calculates the space required for Floor and Building Common Areas.

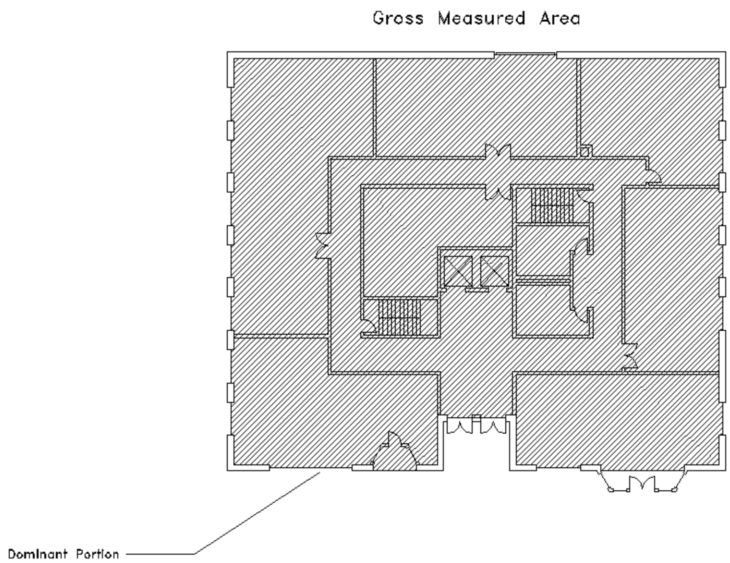
11. Major Vertical Penetrations

Major Vertical Penetrations include stairs, elevator shafts, flues, pipe shafts, ducts and the like, as well as their enclosing walls. Atria, lightwells, and other penetrations above the finished floor are included. Vertical penetrations built for the private use of a tenant shall not be included, <u>nor shall be penetrations smaller than one square foot in area.</u>



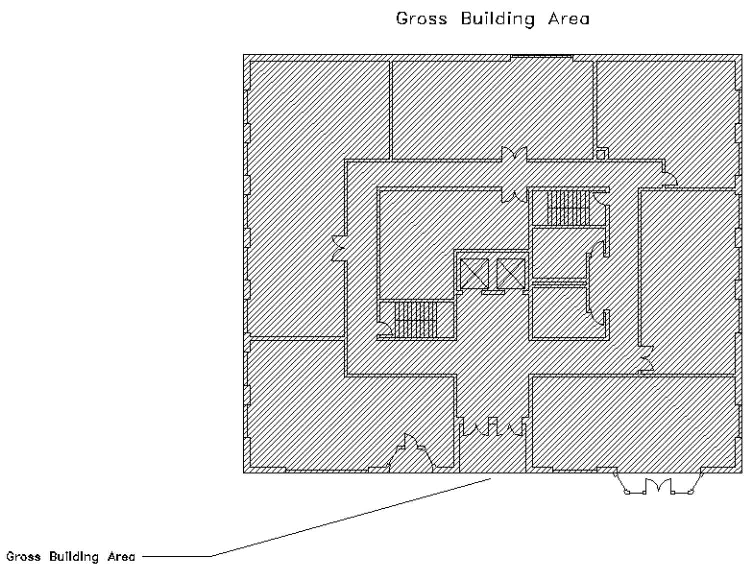
12. Gross Measured Area

Gross Measured Area is that area enclosed by the Dominant Portion, which is measured to the interior finished surfaces of exterior walls.



13. Gross Building Area

Gross Building Area is the total constructed area of a building, measured to the exterior surface of permanent outer building walls, and includes all enclosed areas. This figure is used for leasing purposes when an entire building is leased to a single tenant. While this area is also commonly referred to as Construction Gross Area, this terminology shall not be employed.



14. Gross/Rentable Ratio

A conversion factor that, when applied to the Rentable Area of a building, gives the Gross Building Area. This factor calculates the space required for vertical penetrations and exterior walls.

- The following chart represents a typical ratio of various space measurement categories for a four story office building with all floors above ground level to have a typical layout.
- Please be advised that this chart does not show the possible range and represents approximate values.
- We have found that these ratios are very close for most building types and large variations from these ratios must be closely examined.

Floor: Total Building

No.	Space category	% of Programmable Area	Multiplier to Programmable Area	Formula for area
A	**Programmable Area**	100%	1.00	Total from Space Tabulation Charts
B	Internal walls	11%	0.11	
C	**Assignable Area**	111%	1.11	A+B
d1	*Internal corridors*	17%	0.17	
d2	*Non-programmable areas*	1%	0.01	
D	**Internal circulation**	19%	0.19	d1+d2
E1	**Net Usable Area**	118%	1.18	A+d1
E2	**Usable Area**	130%	1.30	C+D
f1	*Lobby*			
f2	*Mech. room*			
f3	*Equipment room*			
f4	*Mail room*			
f5	*Telephone/IT room*			
F	**Building Common area**	6%	0.06	Σf
g1	*Janitor's closet*			
g2	*Elect. & Tel. room*			
g3	*Mech. room*			
g4	*Rest room*			
g5	*Corridors*			
G	**Floor Common Area**	23%	.23	Σg
h1	*Shafts*			
h2	*Elevator banks*			
h3	*Stairs*			
H	Major Vertical Penetrations	7%	0.07	Σh
I	**Rentable Area**	159%	1.59	E2+F+G
J	**Gross Measured Area**	166%	1.66	I+H
K	Exterior walls	4%	0.04	
L	**Gross Building Area**	179%	1.79	J+K

End of Section

GENERAL BUILDING STANDARDS

Table of contents

1. General (01 00 00)

1.1. This document provides a general and broad scope of requirements for various building components. No details or performance specifications are included in this section. Program of Requirements (POR) should not repeat theses requirements for every space. In specifying these requirements in the POR, use of the phrase "Building Standard" will be adequate. Variations from the General Building Standards must be included in the POR. Other sections of this manual ("*Montgomery County Manual for Planning, Design, and Construction of Sustainable Buildings"* [Design Manual]) explains County's design requirements in detail.

1.2. When approved by the County is requested, County means Building Design Section, Division of Capital Development, DPWT.

1.3. Design

1.3.1. Building image should reflect a public facility, a place for people, a civic landmark, durability, strength, openness, accessibility, high standards, Green, sustainability, etc.

1.3.2. The space offered or designed must project a professional and aesthetically pleasing appearance including an attractive front and entrance.

1.3.3. The design of the space must be conducive to efficient layout and good utilization

1.4. Code and other compliances

1.4.1. Building and site must be designed in compliance with all applicable codes and regulations including Federal, State, County, Local jurisdictions, regulating agencies, utility companies, etc.

1.4.2. Facilities must be design in strict adherence with the latest "Montgomery County Manual for Planning, Design, and Construction of Sustainable Buildings" (Design manual). (Green)

1.4.3. If not part of the scope of work, a POR will have been prepared by the County, perhaps with the involvement of a consultant. The POR is intended to identify the types of spaces required, the activities and number of people to be accommodated, space sizes and proximity relationships, services requirements, etc. The program must be well prepared to provide a good starting point for the design process. All programming for County facilities shall be based on the criteria contained in this manual.

1.4.4. For detail information about components of Building Standards see the Design Manual.

1.4.5. Site and buildings must be designed for LEED certification.(Green)

1.5. Standard Contract Forms

1.5.1. Department of procurement updates these documents regularly. These documents shall be used as boilerplate for all contracts and published with the RFP and other advertisements for consultant services.

2. Accessibility Provisions (01 00 01)

2.1. It is County policy to provide a barrier free environment that will benefit all people: the disabled, infants, seniors, and the temporarily injured, etc. Such an environment should not be perceived as unusual or burdensome, but rather simply another aspect of our cultural fabric needing positive integration. The design teams shall design County projects so that all, including the disabled, can experience community activity.

2.2. Full compliance with ADA is required.

2.3. All conference rooms must be designed for wheelchair access and use. The table must be accessible by wheel chair and room must be maneuverable in accordance to codes.

2.4. All County facilities larger than 10,000 SF must have a single-user, assisted use or unisex toilet room for family use.

3. Safety and Security (01 00 02)

3.1. Safety and security provisions are becoming more complex as concerns for personal safety increase, equipment becomes more sophisticated and costly, and security systems of all types become more readily available at reasonable cost. More often than not, security requirements conflict directly with convenient access for maintenance, custodial care, and response to emergencies.

3.2. Early security planning may directly influence the design and location of many strategic mechanical and electrical components to the benefit of all concerned. Standardized access and CCTV systems as required by Electrical Requirements shall be provided.

3.3. The consultant shall consider crime prevention (anticipation, recognition and appraisal of crime risk and the initiation of some action to remove or reduce it) in the development of the overall design of facilities. The CPTED (Crime Prevention Through Environmental Design) shall be used in the design of County facilities.

3.4. In planning and designing building areas that are 80 inches or greater above surrounding floor/ground level, the designer shall make provisions for fall protection/fall restraint as required by OSHA 1910.132.

3.5. Building areas that are defined by OSHA 29 CRF 1910-146 as “Permit Required Confined Spaces” shall be minimized in the design of new or renovated County facilities.

4. Structural Considerations (01 00 03)

4.1. General

4.1.1. It has been common practice to design to International Building Code (IBC) minimum structural requirements for floor loading, seismic zone, etc. Operational experience indicates that designing to code minimums is not in the owner's long-term best interests. One example is floor load capacity. The other major consideration is vibration. A great deal of instrumentation is extremely sensitive to vibration, which leads to more rigid structures or inclusion of vibration isolation pads, etc. Designers shall address in the Schematic Design Phase; floor loading and vibration isolation provisions and advantages provided by the proposed structural system.

4.2. Column distances

4.2.1. To provide a flexible work environment, narrow structural bays will not be accepted. A span of 30’x30’ or larger shall be designed

4.3. Floor to floor height

4.3.1. Floor to floor heights are an area of major concern. Although there would be some variation based on the intended use of the space, anything less than fourteen feet will not be considered adequate. Further, the depth of the structure for each floor should be carefully controlled to be as uniform as possible throughout and not broken up by major beams. Floor to ceiling distance must be minimum of 8’ (9’ is recommended for providing 2’ clerestory to be able to transfer the daylighting into the interior spaces. (Green)

4.3.2. The space between the ceiling and under side of the structure above shall be minimum 3’ to provide adequate space for all mechanical, sprinkler and lighting devices.

4.3.3. Although not mandatory, concrete waffle slab construction offers several advantages over most other forms of construction; e.g., no deep beams; a uniform/modular surface to work under; opportunity for patterns for hangers, sleeves, etc.; rigidity; etc., and should be given adequate consideration.

4.4. Floor load

4.4.1. Floor live loads must be 100 lb/sf or more to comply with codes. On each floor a designated area must have 200 lb/sf live load for filing area

4.5. Seismic Resistance Considerations

4.5.1. It is reasonable to expect that the science and art of seismic design will continue to change rapidly as new information and faults are discovered and consultants are encouraged to anticipate and account for possible future practices and requirements as much as practicable. The structural design for all new County facilities shall meet the current codes.

5. Internal Accessibility (01 00 04)

5.1. One of the most important requirements in facilities is accessibility to services distribution systems. Pipe and duct shafts should be provided floor landings or platforms with lighting, electric outlet and doors -- not access panels. Suspended ceilings should only be provided where highly desirable in offices, conference rooms, etc. Where suspended ceilings are appropriate, they must be lift-out exposed T-bar type systems. Hidden spline type ceilings are unacceptable. Suspended ceiling material must be able to withstand a lot of handling and be easily cleaned. Where hard finish ceilings are required, extensive access panel provisions must be included, carefully sized and located to provide effective access to the equipment above.

6. Concrete (03 00 00)

6.1. General

6.1.1. All DCD projects that include concrete shall conform to the requirements of the latest edition of American Concrete Institute ACI 301 "Specifications for Structural Concrete for Buildings". These specifications shall be used essentially in their entirety by referral in the project Specifications.

6.1.2. The Designer shall review the mandatory and supplemental requirements listed in ACI 301. Items not listed in these Specifications will be assumed to be inapplicable to the project or shall be subject to the option of the General Contractor.

6.1.3. As a requirement of the Specifications, two (2) copies of the latest revision of ACI 301 shall be furnished by the General Contractor for use in the field by the General Contractor and the Construction Representative.

6.1.4. Floors, walls and decks of swimming pools and the roof above shall have reinforcement steel galvanized as in subparagraph f, below.

6.1.5. No insulating concrete fill shall be used on roof decks.

6.1.6. All exposed embedded items in exterior concrete or parking garage floors or ramps shall be galvanized if fabricated from ferrous metal as in subparagraph f), above.

6.1.7. The specifications shall include a provision requiring that the General Contractor shall submit his proposed methods for curing of concrete to the Designer for approval prior to placement of any concrete.

6.1.8. The Specifications shall direct the General Contractor to maintain an accurate daily record of the locations in which concrete is placed and shall furnish a certified copy of this record to the Designer.

6.1.9. The Contract Specifications shall also include the Specification Standard paragraph entitled "Additional Concrete due to Unanticipated Soil conditions".

6.1.10. All underground chambers for exterior electrical work shall be constructed of cast-in-place concrete or one-piece precast concrete chambers.

7. Metals (05 00 00)

7.1.1. All miscellaneous and ornamental iron to be exposed to the weather or high humidity areas and fabricated of corrosive iron or steel shall be hot-dip galvanized after fabrication whenever possible in accordance with ASTM A386 or A123 as applicable. All hot-dip galvanized steel shall be inspected for compliance with ASTM requirements and shall be stamped to indicate the ASTM number and the ounces of zinc per square of surface.

7.1.2. Galvanized items to receive additional finishes shall be additionally treated by applying a passivating process equal to Bonderizing, Granodizing or Duncanizing.

7.1.3. All iron and steel, not to be galvanized, shall require a shop coat of metal primer prior to shipping.

8. Wood and Plastics (06 00 00)

8.1.1. All lumber used for blocking, nailing cleats and other wood set in exterior walls or roofs or in contact with damp concrete, shall be impregnated, under pressure with a wood preservative. All treated wood shall be dried before installation and all field cuts shall be brush treated with the preservative materials.

9. Envelope (07 00 00)

9.1. Exterior walls

9.1.1. Exterior walls to be brick, cast stone, concrete masonry units (high quality and decorative types), or other long lasting high quality materials. Materials and finishes must be suitable for the function of the building.

9.1.2. Exterior walls must be calculated such that the dew point is on the outside surface of the vapor barrier. Air and vapor barrier must be provided. Cavity between the inside sandwich and outside must be 2” and weep holes must be provided.(Green)

9.1.3. Envelope must be air tight. All openings, windows, doors, joints, etc. must be sealed. Wrappings must fold into the rough opening to cover the entire thickness of the wall before installation of doors or windows and opening. (Green)

9.2. Glazing

9.2.1. Glazing units and windows must be High-Performance, U factor smaller than 0.39 Btu/hr-ft2-deg F, Shading Coefficient (SC) smaller than 0.55, double pane, low E (0.34 or better), with tinted and reflective glass with frames that are equipped with thermal breaks all around. Architectural shading devices for control of sun light are highly recommended. (Green)

9.2.2. Windows must be extended as minimum from 2’-6” above finished floor to 7’-6” (5’ high). Maximum view to outside must be provided. (Green)

9.2.3. All windows must be weather-tight. Opening windows must be equipped with locks. Off street, ground level windows and those accessible from fire escapes, adjacent roofs, and other structures that can be opened must be fitted with a sturdy locking device.

9.2.4. Provide light control reflective blinds for all windows. (Green)

9.3. Roof

9.3.1. Roofs must be design to comply with NRCA Roofing and Waterproofing Manual latest edition. (Green)

9.3.2. Roofing color must be light color to comply with LEED certification requirements. (Green)

10. Doors and windows (08 00 00)

10.1. Exterior doors must be heavy duty full flush, hollow steel construction, solid core wood, or insulated tempered glass. Wood doors must be at least 1.75 inches thick. Exterior doors must be weather-tight, equipped with automatic door closers and open outward. Hinges, pivots, and pins shall be installed in a manner which prevents removal when the door is closed and locked.

10.2. Interior doors must have a minimum opening of 36 by 80 inches. Hollow wood doors are not acceptable. They must be flush, solid core natural wood, veneer faced or equivalent finish as approved by the County. They must be operable by a single effort.

10.3. Doors must have heavy duty hardware with hardware stops. Door closers must be concealed. Corridors and outside doors must be equipped with 5-pin, thumbler cylinder locks and door checks. All locks must be master keyed. The County must be furnished at least two (2) master keys and two(2) keys for each lock.

11. Interior Finishes (09 00 00)

11.1. The County's goal in the selection of interior finishes is to select materials that are appropriate to the type of space served; are free of hazardous materials; give maximum value for their initial costs; are cost-effective to clean, maintain, and repair; provide quality indoor air; and support the sustainability policies of the County. The specifics for the selection of interior finishes are detailed in this manual. The consultant shall review and become familiar with these requirements which shall not be violated without specific notice and approval.

11.2. All flooring materials must be provided with 5 to 10% attic stocks as required by the County during the design.

11.3. County must be provided with at least three different color schemes for the entire interior finishes not later than the middle of design development phase. The selected scheme must be presented in a booklet/binder format as well as enveloped packages to include all samples of finishes, marked to show the complete major specification and locations used.

11.4. All exterior windows must be equipped with window blinds. The blinds may be aluminum or plastic vertical or horizontal blinds with aluminum slats of one inch width. Blind must have non-corroding mechanism.

11.5. Paint

11.5.1. Product must not contain formaldehyde, aqueous ammonia, crystalline silica, or ethylene glycol. Total VOC must be below 2.9 pounds/gallon.

11.5.2. Specifications shall include storage and protection of equipment, materials, and surfaces, preparation of surfaces, quality assurance and method of application of paints and finishes.

11.5.3. Include a painting schedule in the Specifications for describing coating systems for all surfaces.

11.5.4. Provide for field painting of all non-galvanized or corrosive type metals with two coats of a rust inhibitive paint. Concealed surfaces shall be painted prior to installation.

11.5.5. Specify back painting or treatment for all interior and exterior wood surfaces that will be concealed after installation.

11.6. Wallboard

11.6.1. All gypsum wall board to be minimum 5/8” thickness, fire-rated where required and water-resistant at areas subject to moisture.

11.6.2. All finish surfaces to receive one coat primer/sealer and two coats of latex semi-gloss enamel paint.

11.7. <u>The Lathing and Plastering</u>

11.7.1. Waterproof Portland Cement plaster shall be used for walls and ceilings wherever plastered areas occur in kitchens, bath, showers, utility, toilet and service sink rooms and other spaces subject to higher humidity. Metal lath and accessories shall be galvanized when used in such areas.

11.7.2. Acoustical plaster will not be permitted, except with the written approval

11.8. <u>Woodwork</u>

11.8.1. Constructed from formaldehyde-free, low VOC (Volatile Organic Compound) materials or permanently sealed to prevent out-gassing. Non-toxic glues and low VOC products should be used in fabrication. Where feasible, previously used materials in good and usable condition should be used first, followed by products with a high percentage of recycled content. Veneer should be from species harvested and procured in the US or Canada from providers certified as practicing sustainable forest management as recognized by independent forest management certification agency.

11.8.2. All finished woodwork, where painted, to have one coat wood primer, one coat alklyd enamel primer and two coats semi-gloss alklyd enamel.

11.8.3. All finished woodwork, where stained, to have one coat stain and two coats satin finish lacquer.

11.9. <u>Laminate</u>

11.9.1. All adhesives are to be those with the lowest possible VOC content below 150g/L, contain no formaldehyde

11.9.2. Suspended Ceiling System

11.9.3. Acoustical Tile

11.9.4. NRC 50 or greater

11.9.5. STC 35 or greater

11.9.6. Light reflective 0.75 or greater

11.9.7. Designer shall provide reflected ceiling plans on Construction Drawings indicating layout and pattern of acoustical units and cut tiles. Details shall also be provided at changes of levels, at ceiling penetrations, access doors, special edge treatment and all necessary accessories of other trades.

11.9.8. Extra tile units shall be provided at the rate of two percent of each type of tile units installed.

11.9.9. Moisture-resistant tiles shall be specified for high-moisture areas.

11.10. <u>Carpeting</u>

11.10.1. Installation to be direct glue down. All adhesives are to be those with the lowest possible VOC content below 150g/L, contain no formaldehyde and which meet requirements of the manufacturer of the carpet involved or adhered.

11.10.2. Recycled content for both backing and synthetic fibers are to be the highest possible to achieve credit towards the LEED certification.

11.10.3. Carpet, backing and adhesive to have an Indoor Air Quality Certification issued by the Carpet and Rug Institute (CRI).

11.10.4. Carpet manufacturer to provide a ten year fiber wear warranty on all broadloom and tiles. Carpet manufacturer to provide a pattern match warranty for carpet tiles.

11.10.5. Store materials for 3 days prior to installation in area of installation to achieve temperature stability.

11.11. Marble

11.11.1. Specify non-staining caulking. All ties shall be brass.

11.11.2. Specify the sealing of backs of exterior wall stone.

11.12. Tile

11.12.1. Specify full mortar bed system for floors and walls in wet areas.

Continue on next page

11.13. Table of standard room finishes:

No.	Space	Wall	Floor	Ceiling
1	Building main lobby	Multi color Polymer paint	Ceramic tile	2x2 suspended ceiling or gypsum board
2	Elevator lobby	Multi color Polymer paint	Ceramic tile	2x2 white suspended grid with white acoustical tiles or gypsum board
3	Elevators	Stainless steel raised stiles and laminated plastic or other durable decorative material for recessed surfaces.	Ceramic tile, granite, or 32 Oz. 100% Nylon carpet	Perforated Steel or other durable decorative materials.
4	Service elevators	Stainless steel	Rubber	Perforated Steel
5	Corridors leading to the main lobby	Multi color Polymer paint	32 Oz. 100% Nylon carpet	2x4 white suspended grid with white acoustical tiles
6	Restroom	ceramic tile	ceramic tiles	gypsum board painted minimum of 2 coats of gloss paint
7	na	na	na	na
8	Electrical room	2 coats of white gloss paint	Sealed concrete	gypsum board painted minimum of 2 coats of gloss paint
9	Telephone room	2 coats of white gloss paint	Sealed concrete	gypsum board painted minimum of 2 coats of gloss paint
10	Janitor's closet	ceramic tile	ceramic tiles	gypsum board painted minimum of 2 coats of gloss paint
11	Building storage room	2 coats of white gloss paint	Sealed concrete	2x4 white suspended grid with white acoustical tiles
12	Supply room	2 coats of white gloss paint	Sealed concrete	2x4 white suspended grid with white acoustical tiles
13	CPU room	2 coats of white gloss paint	Sealed concrete	2x4 white suspended grid with white acoustical tiles
14	Kitchen	2 coats of white gloss paint	Vinyl Composite Tile, 1/8" thick.	2x4 white suspended grid with waterproof white acoustical tiles
15	Lounge with tables	2 coats of white gloss paint	Vinyl Composite Tile, 1/8" thick.	2x4 white suspended grid with waterproof white acoustical tiles
16	Standard office	2 coats of off white flat paint	32 Oz. 100% Nylon carpet	2x4 white suspended grid with white acoustical tiles
17	Executive office	2 coats of off white flat paint	32 Oz. 100% Nylon carpet	2x4 white suspended grid with white acoustical tiles
18	Conference room	2 coats of off white flat paint	32 Oz. 100% Nylon carpet	2x4 white suspended grid with white acoustical tiles
19	Executive conference room	26 OZ. vinyl wall covering	32 Oz. 100% Nylon carpet	2x4 white suspended grid with white acoustical tiles
20	Computer room	2 coats of off white flat paint	Vinyl Composite Tile, 1/8" thick.	2x4 white suspended grid with white acoustical tiles
21	Stairs	2 coats of off white flat paint	Sealed concrete with anti-skid tread ledges	Concrete

12. Specialties (10 00 01)

12.1. Toilet partitions shall be solid polymer resin, floor supported, overhead braced.

12.2. Each facility shall have at least a single flagpole capable of flying three flags, with a spotlight provided to illuminate the flags.

12.3. All signs must be approved by the County.

12.4. Interior signs must be designed as a uniform package. The sign style must be approved by the County.

12.5. Signs must be mounted on the latch side of doors at 54 inches above finished floor and/or comply with codes.

12.6. One building exterior sign must be provided at each major entrance and in accordance with the County sign standards.

12.7. One accessible chilled drinking fountain must be provided within 150 feet of travel distance on each floor of office space.

13. Restrooms and accessories (10 21 01)

13.1. Provide a mirror above each lavatory. If multiple lavatory counter is provided, provide a large full width and height mirror above the counter.

13.2. Provide A coat hook on inside face of door to each water closet stall and on several wall locations by lavatories.

13.3. Provide at least one paper towel dispenser, soap dispenser and waste receptacle for every two lavatories.

13.4. Provide a disposable toilet seat cover dispenser in every toilet room.

13.5. Provide a coin operated sanitary napkin dispenser in women's toilet rooms with waste receptacle for each water closet stall.

13.6. Provide ceramic tile from floor to minimum height of 4'-6" above finished floor.

13.7. Provide toilet paper dispenser having an unrestricted paper flow in every stall.

13.8. Flush controls must be automatic, or preferred dual up and down two volume control green flush system or comparable water saving flush systems approved by the County. (Green)

13.9. Urinals must be water saving type with no lips for sanitary and health reasons. Water less urinals are preferred. (Green)

13.10. Design of rest rooms must be fully in compliance with ANSI or ADAAG.

13.11. All county buildings must be designed to provide with family (otherwise known as single user, assisted-use or unisex) toilet and bathing rooms. This is intended for large assembly and mercantile facilities for people who use opposite sex personal care assistants.

14. Vertical Transportation (14 00 00)

14.1. General

14.1.1. Elevators and stairways are required in every facility more than one story high to handle people, material, equipment movement among floors. Early consideration must be given to the scale and potential conflict of equipment, material and waste movement versus passenger movement.

14.1.2. All steps on a single fight of stairs shall have uniform riser heights and uniform tread widths. Open risers are not permitted. Stair treads shall not have abrupt nosing and must be no less than 11 inches wide, measuring from riser to riser. The radius of curvature at the leading edge of tread must not be greater than ½ inch. The maximum nosing projection must not be greater than 1 ½ inch. Stairs must have non-skid treads.

14.1.3. A number of elements are available to the designer to fashion efficient vertical transportation systems. Well-designed and properly located stairways and dual-purpose freight-passenger elevators can be important elements in vertical movement of people. Dedicated freight elevators are normally required near loading docks, supply rooms, and other marshaling points for material traffic. Dumbwaiters and dual-purpose freight-passenger machines are useful complements to freight elevators and can substitute for freight elevators in special situations. However, the error of not providing adequate elevator systems is usually considered to be a huge operational penalty by the end users and is one of the most costly deficiencies to correct in later years.

14.1.4. Consultants shall identify the basic performance parameters of number, size, and speed of cars as part of the Basic Technical Program. Size and speed requirements will generally dictate the type, whether hydraulic, geared traction, or gearless traction. In some instances, combinations such as double-roped gearless should be considered. In general, hydraulic machines should be specified only for elevators with relatively infrequent use. Any elevator serving 4 or more floors shall be sized for use by emergency stretcher as required by codes.

14.1.5. For building in which elevators and/or escalators are the primary means of vertical access, the design criteria shall be as follows:

14.1.6. Maximum projected wait to load, up-bound peak = 30 seconds.

14.1.7. Maximum projected wait to load, down-bound peak = 30 seconds.

14.1.8. Maximum projected wait to load, daytime base = 30 seconds.

14.2. Elevators

14.2.1. For two stories and above buildings provide elevator(s)

14.2.2. A separate service elevator adjacent to the loading dock must be provided.

14.2.3. Interior of service elevator must be stainless steel with hooks for the protection blankets.

14.2.4. Interior of the passenger elevators must be elegant and durable.

15. Plumbing System (22 00 00)

15.1. Cross contamination control in facilities is a critical concern. Consequently, two water distribution systems shall be provided within each facility; i.e., potable and non-potable/industrial water. The non-potable/industrial system shall serve make-up water requirements for cooling systems, etc. Distribution systems must be isolated from each other and the utility service to the building by backflow prevention devices. Dual back-flow prevention devices (or equivalent piping connections) must be provided since shutdowns are impossible to arrange for routine testing and maintenance of the devices. Generous space provisions must be allowed in such areas for proper testing and maintenance.

15.2. When incoming water pressure exceeds eighty (80) psig, provide a pressure reducing station with two PRV's (each sized at 2/3 of total flow) in parallel, each valved to operate independently. A minimum pressure of twenty five (25) psig should be provided at the highest point of the building. The assembly shall include appropriate valves, strainers, gauges, drains, etc. and include a bypass. All this should be in accordance with WSSC requirements and codes.

15.3. Each building service shall include a water meter. Each building tenant unrelated to the County (e.g. retail business tenant) will be submetered for water use. It is also recommended to submeter any large single uses of water within a building or facility.

15.4. The building non-potable water headers shall have reduced pressure back flow preventers.

15.5. The plumbing system should be divided into smaller systems with isolation valves separating them. This will allow a section of the building to be worked on without affecting the remainder of the building.

15.6. Provide booster heaters for dishwashers and other equipment requiring higher hot water temperatures. Do not raise the temperature of the building system.

15.7. Provide dielectric unions whenever dissimilar piping materials are used.

15.8. Provide access doors for all plumbing system components that require maintenance. The access doors should be located on both the architectural and mechanical plans and coordinated.

15.9. Seismic bracing must be provided and coordinated with the structural engineer.

15.10. Water piping shall not be installed below slabs on grade except for trap priming lines.

15.11. The building water header shall be constructed type L copper pipe.

15.12. All building distribution piping shall be type L copper tubing.

15.13. Fittings on copper tubing shall be wrought copper or cast brass, solder pattern. All connectors 2-1/2" in diameter shall be Victaulic or equivalent.

15.14. Solder shall be 95-5 tin antimony or approved equal. No lead type solders shall be allowed on the job site.

15.15. Plumbing fixture partition stop connections, through the wall, shall be brass pipe.

16. Waste and Drains (22 13 02)

16.1. The minimum size of side sewers shall be six (6) inches.

16.2. All waste drains shall be gravity systems. Sump pumps and sewage pumps shall not be used without specific approval.

16.3. Waste piping and drainage systems under slabs on grade shall be extra heavy cast iron soil pipe.

16.4. Roof drains shall be cast iron or brass, with cast iron or brass high dome strainers. The first section of pipe below the drain must be cast iron or brass.

16.5. No PVC, CPVC, ABS or galvanized piping shall be used within the building envelope.

16.6. All pipes, valves, clean-outs, and particularly waste piping, must be accessible for maintenance. Those recessed in wall cavities must have access doors, removable panels, or other approved methods for access.

16.7. Food preparation and service areas require extensive piping. Access is extremely important. Such areas shall not be located on a slab on grade. Where located above a suspended ceiling, the ceiling must be 100% accessible.

16.8. Wastes and clean water drains shall be collected independently in each building and carried separately to the city sanitary sewer and storm drains respectively. If no storm drain exists within 200 feet of the building, connect clean water drains to sanitary sewers and provide for future connection to storm drains.

16.9. All footings shall have footing drains connected to the storm drain system. Footing drains shall not be connected to an interior sump pump.

16.10. All area drains, yard drains, window well drains, and the like shall be connected to the storm drain system.

16.11. Invert elevations of sanitary sewer lines leaving the buildings shall be of sufficient depth to permit future connection of a waste line from any point in the basement area.

16.12. Drains from transformer vaults having oil-filled transformers and shop areas where oil is present shall connect to sanitary sewers through a City of Seattle approved oil interceptor.

16.13. Crosses shall not be used in waste piping.

16.14. Connections in waste piping for food service areas shall turn down with a 1/8 bend at the connection to the next branch.

16.15. Waste piping from garbage disposals shall be carried separately to a major waste pipe, with as few bends as possible and completely accessible clean outs.

16.16. Floor drains shall be connected to the sanitary sewer. Drains for fire sprinkler system shall be six (6) inches minimum and shall be connected to storm drains.

16.17. Mechanical rooms, pipe trenches, tunnels and other areas with piping shall be equipped with floor drains. Provide primed floor drains.

16.18. Avoid installing drain lines in complicated architectural work; if installed, use brass pipe with bronze fittings.

16.19. Provide trap primers for floor drains and funnel drains in mechanical rooms; and other places where traps may dry out. (Use timer type).

16.20. Waste and drainage piping crossing excavated areas shall be supported on precast concrete beams supported by the building structure and undisturbed earth.

16.21. Clean outs shall be the full size of the piping served.

16.22. Drainage from flammable or hazardous chemical/liquid storage rooms must not be connected to the sewer systems. Coordinate a special drainage system with the Fire Marshal.

16.23. P-traps for all fixtures other than lavatories and similar usage sinks shall have integral clean outs. Drum traps shall not be used.

16.24. Pipe bedding under floor slabs shall be Type IV.

17. Mechanical System (23 00 00)

17.1. The County's goal in the design of mechanical and electrical systems serving their facilities is to select systems and equipment that; are appropriate to the type of space served; give maximum value for their initial costs; are cost-effective to operate, maintain, and repair; provide quality indoor air; and support the sustainability policies of the County. The specifics for the selection and design of these systems are elaborated in this document. The consultant shall review and become familiar with these requirements which shall not be violated without specific notice and approval.

17.2. If room data sheets for support spaces, e.g., mechanical and electrical rooms and closets, custodial spaces, loading docks, etc., have not been completed prior to award of the design contract, the selected consultant must begin by developing room data sheets for all support spaces of this type, involving representatives of the Department(s) effected and the Project Manager. This work must be completed during the schematic design phase.

17.3. Baseline HVAC Air System requirements (from Energy Design Guideline)

SYSTEM	COMPONENT	CRITERIA
AIR HANDLER	FAN	blow through configuration backward-curved airfoil (unless cfm < 3,000)
	DRIVE	Variable frequency drive on all VAV AHU's. Soft start on all constant volume AHU's.
	DISCHARGE	Minimum length of four equivalent diameters before any obstructions or take offs at discharge of fan.
	HOUSING	Double-wall construction IAQ .double slopped drain pan design.
	MOTOR	Premium High efficiency.
	OUTSIDE AIR INTAKE	outside air must mix in the return air duct to eliminate temperature stratification prior to entering the AHU.
	FILTER AND COIL FACE VELOCITY	300 fpm or less maximum design velocity.
	FILTRATION	65% dust spot efficiency minimum. Provide filter module with pre-filters.
DUCT WORK	TYPE	main ducts to be round spiral (preferred) or oval spiral. do not use rectangular. branch ducts to be round spiral. do not use rectangular duct in the gymnasiums.
	VAV BOXES	full DDC boxes. do not use fan-powered boxes.
	DIFFUSERS	louvered cone diffusers, stamped one-piece construction with Coanda pockets-no mitered pieces. do not use perforated diffusers.
	TAKEOFFS	Minimum straight, unobstructed duct run of 4 to 6 (preferred) duct diameters before any takeoffs bends or transitions. Takeoffs require 45 degree boots.
	TRANSITIONS	Expansions in duct diameter must include a transition not exceeding 20 degrees divergence angle.
	LINING	No interior lining may be use unless contained in double-wall construction.
	FLEX DUCT	Maximum run of 6 feet on flex duct connections. show hard duct up to 6 feet of any diffuser. Show a segmented elbow detail for connection between flex duct and diffusers.
OUTDOOR AIR ENERGY CONTROL		on air handlers with greater than 3000 cfm outside air relief requirements, one of the following options must be used:

SYSTEM	COMPONENT	CRITERIA
1)	ENERGY RECOVERY	Desiccant wheel energy recovery system. (Resize heating and cooling capacity to include effect of energy recovery and reduce first cost.)
2)	CO2 SENSING	Modulate AHU outdoor and return air dampers with pid loop to maintain 1000 ppm co2 in the return air.
COMPLETE AIR SYSTEM	OVERALL AIRFLOW EFFICIENCY	VAV less than 1.0 hp per 1000 cfm constant volume-less than 0.6 hp per 1000 cfm
	CONTROLS	Complete DDC for automatic temperature control, valves and actuators, and energy management functions. Provide complete point list on drawings. Specify Siemens control EMS.
	SEQUENCE OF OPERATION	Use owner's standard sequence of operation for vav systems (see EMS section). Provide logic diagram on drawings supporting the verbal sequence of operation.

17.4. Design temperature

INDOOR COOLING	**78 F**
INDOOR HEATING	**68 F**
OUTDOOR SUMMER	**1% OR PER LATEST ASHRAE**
OUTDOOR WINTER	**99% OR PER LATEST ASHRAE**

17.5. Hot and Chilled water circulation system must be designed with at least two pumps one main and one stand-by. The pump control shall have capability of cycling on and off between the main and stand-by pumps.

17.6. Chiller water system shall be designed to be drained for winter freeze protection. Glycol shall not be used for freeze protection unless it is absolutely needed for operation of the building to run specific program.

17.7. Electric Resistance Heating Is not permitted

17.8. Do not design the heating system with one boiler. The heating system must be equipped with at least two boilers with a minimum of 20% redundancy.

17.9. Boilers must be equipped with boiler management system (BMS per manufacturer recommendation and with all safety devices. For each boiler power cut-off switch must be installed outside the boiler room and adjacent to the boiler room door. Boiler plant shall be design with reverse return piping unless it conflicts manufacturer recommendation.

17.10. Table: Minimum Performance of Heating and Cooling Equipment

COOLING EQUIPMENT TYPE	CONDENSING METHOD	COOLING CAPACITY (BTU/HR)	SIZE (TONS)	MINIMUM COOLING EFFICIENCY	MINIMUM HEATING EFFICIENCY
AIR-CONDITIONERS	AIR COOLED	<65,000	0 TO 5	11.0 EER	2.2 COP
HEAT PUMP	AIR COOLED	<65,000	0 TO 5	12.5 SEER	2.2 COP
SPLIT SYSTEMS	AIR COOLED	>65,000	>5	9.5 EER	2.2 COP
HYDRONIC HEAT PUMPS	WATER SOURCE	ALL CAPACITIES	ALL SIZES	11.5 EER	4.0 COP
CHILLERS	AIR-COOLED		<150	<1.25 W/TON	
	WATER-COOLED		>150	<0.63 W/TON	

HEATING EQUIPMENT TYPE	FUEL	HEATING CAPACITY (BTU/HR)	MINIMUM THERMAL EFFICIENCY	MINIMUM ANNUAL EFFICIENCY
BOILERS	GAS	<300,000	93%	90% A.F.U.E.
BOILERS	GAS	>300,000	93%	
FURNACES	GAS	<300,000		90% A.F.U.E.
SERVICE WATER HEATING	GAS	ALL	0.90	

17.11. Air Distribution System (23 30 00)

17.11.1. All return air must be in the duct system

17.11.2. Duct construction details shall conform to the recommendations of the ASHRAE 55 guide and data book and SMACNA (Require Class III leakage rate

17.11.3. Drawings shall show the specific location of fire dampers.

17.11.4. Supply outlets shall be suitably located to avoid drafts caused by colliding air patterns or disruption of air flow caused by vertical obstructions in the ceiling such as drop light fixtures, ceiling beams, or proximity to the wall.

17.11.5. Rectangular ductwork shall not be used in high velocity air systems.

17.11.6. The duct system shall not be internally sound-lined. If sound-lined is absolutely necessary to reduce noise level, the designer shall specify perforated galvanized sheet metal lined top of the internal sound-line. High velocity ductwork leakage shall not exceed eight (8) cfm per 100 square feet of duct surface under a pressure of five (5) inches wg.

17.11.7. Rectangular duct shall not be used in the gymnasium.

17.11.8. High velocity ductwork leakage shall not exceed eight (8) cfm per 100 square feet of duct surface under a pressure of five (5) inches wg.

17.11.9. Length of the flex duct shall not exceed 6 feet.

17.11.10. Flex duct shall be factory insulated with Mylar lining.

17.11.11. The duct connection from main to branch and from branch to sub-branch shall be equipped with 45 degree boot.

17.11.12. Each plenum area shall be provided with a light. All lights in a single fan system shall be switched as a group. Switch shall include an "ON" pilot light.

17.11.13. The construction document shall notify the contractor not to hung duct system from the lower chord of the joist.

17.11.14. Perforated plate ceiling diffusers and grills should not be used without approval from The County . The diffusers and grills shall be louver type.

17.11.15. Air deflection must be adjustable for all types of ceiling supply diffusers.

17.11.16. The supply, return and exhaust in the natatorium and high humidity areas such as shower rooms shall be aluminum sheet metal with welded and flanged waterlight joints.

17.11.17. Plenums shall be rigidly constructed of eighteen (18) gauge (minimum) galvanized sheet metal.

17.11.18. Angle iron bracing inside plenums shall be galvanized.

17.11.19. Access doors to ducts (hinged, latched, with sponge plastic seals) shall be provided upstream and downstream from all coils and elsewhere where frequent access is required.

17.11.20. Access doors shall be provided for all plenum areas with latches operative from both inside and outside the plenum.

17.11.21. All access doors shall be self-closing due to the direction of air flow and by pressure differential.

17.11.22. Access panels shall be provided at all fire dampers and elsewhere where occasional access is required. These access panels may be held in place with sheet metal screws with sponge plastic seal for sizes less than 12" x 12". For large size access panel use hinges and/or latches.

17.12. Occupancy sensors

17.12.1. Carbon Dioxide (CO_2) sensors must be used in the conference room and other highly concentrated occupied spaces.

17.13. Ventilation

17.13.1. Mechanical ventilation shall be provided for all spaces. Even though the exterior rooms may be provided with code-complying ventilation capacity in the fenestration (window/door design), a minimum six air change per hour ventilation rate shall be mechanically maintained to alleviate the problems of the "air-tight" building and preclude opening windows during the heating season for ventilation purposes, which becomes an uncontrolled heat loss and causes undesirable drafts. However, mixed systems utilizing temperature controlled exhaust fans with operable windows for ventilation during hot days is recommended where feasible.

17.13.2. All interior ventilation shall meet occupancy-driven building code ventilation requirements, maximum internal heat-gain cooling requirements, and fume exhaust make-up air requirements. Supply air ventilation systems shall be variable volume type to assure that minimum amounts of supply air are processed at all times to assure minimum operating costs throughout the entire system. Heating and cooling energy costs are second only to custodial costs in regard to the annual cost of operating facilities, as such ASHRAE standard 90.1 must be observed to ensure energy efficient mechanical design. Every energy cost reduction resulting from improved design techniques is an investment in the life-long economic value of the building and should be pursued to the maximum extent within the given program and budget.

17.13.3. Supply air intakes and exhaust fan discharges are critical issues for the building being planned and for the buildings surrounding the site selected for the new building. Outdoor air intakes must be carefully located to avoid ingesting contaminated air from exhaust air discharges from this or other buildings, vehicles in roadways or at loading docks, etc. Similarly, exhaust air discharges from this building must be carefully located to avoid recirculation into the building and to avoid contaminating the air intakes of adjoining buildings. Experience indicates that mistakes are virtually irreversible or, at best, are exceedingly costly to correct. Air intake and discharge requirements must be resolved before almost all other design considerations due to the influence such decisions will have on all of the rest of the design.

17.14. Temperature/Humidity Control and Energy Management

17.14.1. The building control system must allow for maximum operational efficiency and flexibility as well as competitive pricing on future expansion and upgrades. Building temperature, humidity and energy management controls shall be direct digital control (DDC) technology utilizing distributed microprocessor based apparatus. Each building shall be designed to operate in a "stand alone" mode but shall include the necessary features for communication and control with a remote operator's station. Connection to a remote operator's station must be included at the time of bid and construction. The inclusion of such shall have no bearing on the environment control system to be provided.

17.14.2. The variable volume requirements are the most sensitive and stringent requirements for the system. Fume exhaust air quantities will vary based on current use; supply air quantities will vary to match and to accommodate cooling requirements; yet pre-determined differential air conditions must be maintained between adjoining occupancies. These requirements must be automatically sustained.

17.14.3. Use Siemens system (proprietary)

17.15. Mechanical Rooms and Pipe/Duct Shafts

17.15.1. Consultants shall identify an adequate amount of mechanical room space which makes allowance for efficient operation, servicing, repair, and removal of mechanical equipment as part of the Basic Technical Program. Mechanical rooms shall not be planned for any other use, specifically, they may not to be used as janitorial materials storage or rest break areas.

17.15.2. In addition to rooms required for HVAC equipment and distribution, a working room for mechanical equipment, having clear and easy access to the exterior, shall be provided in the basement, adjacent to the utility tunnel connection, to provide for proper management of all central mechanical utilities and their distribution within the building. Distribution within the building shall be via readily accessible pipe and duct shafts.

17.15.3. To the maximum extent possible, mechanical equipment shall be located in interior space. Interior mechanical rooms also must be planned with adequate sound insulation to mitigate the noise generated by mechanical equipment. It is preferred, that when rooftop equipment is necessary, that the equipment area be completely enclosed with a louvered wall and covered with a roof structure. Penetrations of the outer roof are discouraged. Use of open air "wells" should be considered at strategic locations so that exhaust ducts and plumbing vents can move horizontally under the roof, enter the wells through vertical surfaces and then turn vertically to discharge to atmosphere without penetrating the horizontal waterproof roof membrane.

17.16. Magnetic Bearing Chillers

17.16.1. Magnetic bearing chillers should be considered for every project. Available technology include centrifugal compressors as small as 75 tons.

17.16.2. Unit shall contain multi- stage, oil free magnetic bearing, hermetical centrifugal compressor. Each compressor shall operate inlet guide vanes in concert with variable frequency drive to optimize part load efficiency.

17.16.3. Performance: The chiller shall be capable of operation down to 10 percent of full load rating with standard ARI entering condenser water relief without hot has bypass.

17.16.4. Chiller Components:

A. Compressors:
   i. The unit shall have two stage magnetic bearing, oil free hermetic centrifugal compressors. The compressor drive rain shall be capable of coming to a complete safe stop in the event of a power failure.

B. Motor:
   i. Permanent magnet, synchronous motor of the hermetic type, sized appropriately to fulfill compressor horsepower requirements. Motor shall be liquid refrigerant cooled with internal thermal overload protection devices embedded in the winding of each phase. Motor shall be compatible with variable frequency drive operation.

C. Chiller Control
   i. Microprocessor based control architecture to include a controller for each compressor and a unit controller. The following parameters shall be displayed:
      1. Entering and Leaving chilled water temps
      2. Entering and Leaving condenser water temps
      3. Evaporator saturated refrigerant pressure
      4. condenser saturated refrigerant pressure
      5. Percent of 100% speed per compressor
      6. % rated load amps for entire unit
   ii. In addition, a complete fault history shall be displayed and downloadable via a USB port drive.
   iii. Chiller plant architecture software shall be used to display the chiller, piping, pumps and cooling tower
   iv. The control module shall interface with the County's EMS panel.

18. Acoustic Control (23 00 02)

18.1. All County facilities must be designed with the comfort of users and occupants in mind. Most often noise pollution inside and outside of the facilities are forgotten during the design and construction. It is the responsibilities of the design team to identify all noise generating sources, and noise sensitive areas and then create a chart to identify how design will resolve those issues.

18.2. The following considerations must be adhered to as minimum:

18.2.1. Facilities with "heavy" ventilation and air conditioning requirements are becoming too noisy for sustained occupancy. Thus, it is mandatory that careful attention be given to thorough acoustic management of all noise sources. Because of the complexity and the problems (e.g., structural transmission) it is recommended that computerized analyses be employed when there is reason to be apprehensive about acoustic control.

18.2.2. Mechanical rooms shall be designed to avoid transfer of sound and vibrations to the adjacent rooms.

18.2.3. Vibration isolators must be used for all noise generating mechanical equipment.

18.2.4. Floor isolators and vibration absorbing support shall be design for all floor mounted vibrating or noise making equipment.

18.2.5. Air handling units inside the building must have acoustical and sound dampening chambers.

18.2.6. Since use of fiberglass liners are not permitted in the duct works, perforated liners must be considered to reduce the transfer of sound into the facilities.

18.2.7. Location of chillers, cooling tower, emergency genetor, air handlers and other noise generating equipment must be carefully studied to minimize sound transfer to adjacent properties.The db level at the property line must comply with county requirement.

18.2.8. If the heating system design calls for pulse boiler(s), mufflers must be provided on the air intake and boiler exhaust to attenuate the noise.

18.2.9. Conference rooms must be well sound isolated.

18.2.10. Elevator shafts must be sound isolated and not located adjacent to work spaces.

18.2.11. All windows must be double paned.

18.2.12. All doors must have noise silencer.

18.2.13. Close attention to design of duct work must be given to reduce the air noise. A/E must present design ideas in this respect to the county.

18.2.14. Design of interior walls must be such to minimize sound transfer to adjacent rooms.

18.2.15. Ceilings in carpeted space shall have a Noise Reduction Coefficient (NRC) of not less than 0.55. Ceiling in offices, conference rooms, and corridors having resilient flooring shall have an NRC of not less than 0.65.

18.2.16. Ambient Noise from mechanical equipment shall not exceed Noise Criteria Curve (NC) 35 in accordance with ASHRAE in offices and NC 40 in corridors, cafeterias, lobbies, and toilets, and NC 50 in all other areas.

18.2.17. Rooms separated from the adjacent spaces by ceiling-high partitions (not including doors) shall not be less than the following Noise Isolation Class (NIC) standards in accordance with ASTM: Conference Rooms NIC-40 and Offices NIC-35.

19. Compressed Air (23 00 03)

19.1. Compressed air should be reduced to 30 psig or the minimum pressure needed as required by pneumatic equipment requiring compressed air before distribution within buildings. Occasionally there is a requirement for higher pressure air, which should be separately served. (The pressure requirement should be carefully determined, the operating cost increases by 1% for every 2 psi pressure increase).

20. Insulation (23 00 04)

20.1. A vapor barrier jacket is required for chilled water piping, equipment, refrigerant suction piping, domestic cold water piping, rainleader piping, air handling ducts and equipment with air temperatures of 55oF. or less.

20.2. Pipe insulation in utility tunnels, up to the building service header main valve, shall have a uniformly ribbed, 0.01 inch minimum thickness metallic casing with a vapor barrier lining.

20.3. Fittings, valves, and flanges shall have an insulation thickness no less than the adjacent piping but must be removable without damage for easy reapplication.

20.4. Demolition (removal) of carcinogenic insulation containing asbestos shall follow procedures outlined in the Asbestos Abatement chapters of OSHA/WISHA.

20.5. Pipe insulation in maintenance areas (mechanical rooms, accessible shafts, etc.) is subject to mechanical damage (crushing, abrasion and laceration) resulting from maintenance activities. Rigid insulation materials protected with appropriate casings and vapor barrier linings are required in these spaces.

20.6. Oversize Pipe Rings, Inserts, and Shields: Install the pipe insulation and jacket extending through the pipe hanger ring. Provide an extra high density insulation insert and metal shield within each hanger, except where pipe covering protection saddles are welded to the pipe.

20.6.1. Insulating Inserts: Extra high density insulating inserts shall be the same thickness as pipe insulation, and shall be Pittsburgh-Corning "Foamglas" or Pipe Shields "Thermal Hanger Shield" and shall cover not less than the lower 40 percent of the circumference of the insulation; sizes of section, 6 inches minimum length up to 6 inch outside diameter, 8 inches minimum length for larger sizes. "Foamglas" shall not be used for high pressure steam. Install the insulating insert section to replace a cutout section of insulating material within the insulation jacket, with tightly fitted butt type joints. For pipe on trapeze channel hangers, provide Pipe Shield Model A3000 insulated pipe support which covers 100 percent of the circumference of the pipe.

20.6.2. Metal Shields: Except where pipe covering protection saddles are specified, provide outside of the jacket and inside of each hanger, a metal shield of 18 gage sheetmetal, minimum, covering lower 40 percent of the circumference of the insulation, length not less than that specified for cut-in section of high density insulating insert. On 6 inch and larger pipe, shields shall be 14 gage minimum, two pipe diameters in length.

20.7. All insulation, facings, coatings, adhesives and other accessories shall have a fire hazard rating not to exceed 25 for Flame Spread and 50 for Fuel Contributed and Smoke Developed; ratings determined by UL Standard No. 723, NFPA Standard No. 255, test results from the approved testing laboratory shall be available to indicate that fire hazard ratings for materials do not exceed the above amounts.

21. Electrical Requirements General (26 00 00)

21.1. All electrical systems must be designed for an anticipated 30 to 40 year life span before requiring major repairs or replacements.

21.2. Primary switch cubicles can exceed the height of standard doorways. Allowances should be made for installation, and changes or additions to switchgear sections during the life of the building.

21.3. Weights of transformers could not exceed floor loadings. Make sure that lifting eye and floor loading are accommodated in the design. Seismic supports and restraints are necessary.

21.4. In remodel projects, shutdowns of existing feeders and services may be necessary. These shutdowns may have to occur after normal working hours to prevent interruption of critical operations. The cost of such premium working hours can have a major impact on the construction estimate. Also, temporary power may be necessary to maintain service to critical loads.

21.5. Operation of power tools may have to be scheduled with the owner to reduce the noise impact on day to day operations of the facilities.

21.6. There are several existing control systems on the site from energy management to fire alarm systems. Interfacing new systems into the existing systems needs to be carefully coordinated, both from the installation standpoint of the contractor and the interface with existing systems operated by the County.

21.7. Abandonment of equipment and raceways in place is not acceptable.

21.8. AE must include the following requirement in the specifications:

"Contractor and manufacturer supplying equipment such as UPS must agree and make available directly to the County, all warranties, parts, documentations, training manual and training, special tools and software to fully service the equipment under the same terms. County may choose a Service Agent for this purpose and the contractor and manufacturer must agree to provided above mentioned services and provisions to the County Service Agent."

22. Power Distribution (26 00 01)

22.1. Anticipating future loads or special needs is difficult, however providing flexibility of power distribution within County facilities is imperative. Local distribution must be planned with generous conduit sizing, sleeving, and extra space in principal electrical cabinets or closets. Sleeving and conduit up-sizing is a modest-cost investment toward serving unknown future requirements, which can then be accommodated by the relatively inexpensive installation of increased size wiring.

22.2. Comply with latest IES light levels, with localized or task lighting.

22.3. Fluorescent light fixtures to generally 2'x4' four T-8 lamps. In special areas 2'x2' may be authorized by the County.

22.4. Down lights to have fluorescent high efficiency lamps

22.5. Use of incandescent lamps may be authorized by special permission from the County for specialty areas.

22.6. Lighting control systems shall accommodate use by other than the normal building occupants; e.g., custodial staff, maintenance mechanics, etc., who may not be familiar with unique provisions. Hence, a convenient means for on/off control must be provided for service support staff otherwise frustrated staffs who don't understand normal operation may abort sophisticated control systems.

22.7. Use of energy saving switching such as dual switching, daylight zoning, and occupancy sensors is required.

22.8. Light output shall not vary in response to an input voltage variance of less than 10% of rated voltage.

22.9. Total Harmonic Distortion shall be less than 10%.

22.10. Ballast shall be full Rapid Start.

22.11. Ballast shall have a sound rating of A or better.

22.12. All lighting fixtures shall be of high quality construction, designed for long life and easy maintenance. The use of high efficiency metallized reflectors is encouraged for energy conservation and maintenance.

22.13. Replacement parts should be readily available and easily secured from the manufacturer/supplier.

22.14. In fire rated ceilings, the fixture installation must also comply with the U.L. construction requirements of the ceiling listing.

22.15. In the interest of energy conservation, the lowest reasonable ambient illumination level will be encouraged with the balance of the volt-amp allowance used for task lighting. Multiple switching and split circuiting will be preferred to constant higher light levels. Task lighting should be maximized.

22.16. Provide ground fault protection on exterior lighting circuits.

22.17. Convenient means must be provided for relamping, cleaning, repairing, or replacing lighting fixtures. Special consideration must be given to fixtures mounted in high or other inaccessible or hazardous locations by providing chain or cable-operated disconnecting hangers, winches, catwalks, overhead access, etc.

22.18. Emergency lighting shall also be provided in mechanical and electrical rooms. Position fixtures over equipment control stations and pathways.

22.19. All street and walkway lighting fixtures shall be individually protected by an in-line waterproof fuse holder located in the pole base. The fuse shall be on the line side of the ballast.

23. Emergency Power (26 00 02)

23.1. Emergency power generating equipment should be designed only when specifically is requested in the POR or during the schematic design by the County. Such system should be located in or around the facility with noise and access considerations.

24. Electrical Sub Metering System (26 00 03)

24.1. The county desire is to segregate the electrical power usage, particularly for HVAC, Lighting, and general Power systems on all new county facilities.

24.2. The sub metering system will allow the county a better knowledge of how energy is used within a facility; it allows management to identify a collection of prospects to improve efficiency, minimize waste, and reduce energy consumption, it reveals existing or imminent problems that can negatively affect a facility's operation; it provides accurate evaluation of spare electrical system capacity, determines each system cost portion and allows facility managers to more effectively target and address equipment that is operating below a predetermined energy efficiency threshold. The system must be capable of inter link with county energy management system.

24.3. At a minimum, power monitoring and metering equipment must record the minimum and maximum of each power usage, keep an event log, and trend voltage, current, kW, kWh, kVA, kVAR, power factor, and current total harmonic distortion and report it to the county energy management system (EMS) located at the seven locks facility.

25. Electrical Short Circuit Coordination and Voltage Drop Study (26 00 04)

25.1. The Short Circuit Coordination and Voltage Drop Study are critical part for the safe, efficient, & economical operation of the electrical distribution system in county facilities. An engineering analysis & coordination study must be performed for all new county facilities. The analysis must include a short-circuit analysis with protective device evaluation, a protective device coordination study, a motor starting study (for larger motors project specific), and voltage drop study analysis. The engineering analysis & coordination study must be coordinated as follows:

25.2. Provide short-circuit and protective device coordination study for the county facilities electrical distribution design system. The intent of these studies are to verify that the specified and supplied equipment are properly rated, correctly applied, and within industry and manufacturer's tolerances. The study must include all portions of the electrical distribution system from the normal and alternate sources of power throughout the distribution system down to the electrical panel or disconnect device. The short circuit study must be coordinated for normal, standbys, and emergency power conditions. The study must be in accordance with applicable ANSI and IEEE Standards & must be calculated by means of the SKM Power Tools or equal. Documentation study submittals must include a summarized final report including the following.

1. Executive summary including introduction and scope of work.
2. Short-circuit methodology analysis results and recommendations
3. Short-circuit device evaluation table
4. Protective device coordination methodology analysis results & recommendations
5. Protective device settings table
6. Time-current coordination graphs and recommendations.

25.2.1. The study must include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.

25.2.2. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.

25.2.3. One-line riser diagram computer generated clearly identifying individual equipment buses, bus numbers, equipment and breaker rating in kw and Kva, the ohmic impedance, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, device numbers used in the time-current coordination analysis, voltage drop at each bus and other necessary information's pertinent to the computer analysis.

25.2.4. Interactive alarms for warnings and limit violations.

25.2.5. Detailed customizable output reports

25.3. Provide voltage drop calculation study. The voltage drop study must be performed to determine the steady-state loading profile of the each county facility electrical system. The load-flow study must calculate the voltage drop on each feeder, the voltage at each bus, and the power flow in all branch and feeder circuits. Losses in each branch and total system power losses are also calculated. The recommended sizing both feeders and branch circuits to prevent a voltage drop exceed 3 percent at the farthest outlet, where the maximum total voltage drop of the feeders and branch circuits does not exceed 5 percent.

26. Electrical Rooms and Closets (26 20 00)

26.1. Provide separate rooms or closets for communications equipment.

26.2. Adequate space for electrical equipment shall be provided in the basement utility connection to provide for proper management of all central electrical utilities and their distribution within the building. Distribution within the building shall be via readily accessible electric rooms or closets. Electric rooms or closets must be independent from all other types of closets, e.g., communications, telephone, custodial, etc. Adequate ventilation for heat producing and/or heat sensitive electrical equipment must be provided. Piping is absolutely not allowed in transformer vaults and main switchgear areas. The County must not be exposed to the risks that can result from lack of proper design attention to this requirement.

26.3. Separate rooms shall be designated to accommodate the immediate and / or future installation of on-site co-generation of power (i.e., micro-turbine engines or fuel cells).

26.4. Provide concrete bases and housekeeping pads for all transformers and equipment, seismically designed with structural connections to floor slab, and channel or angle iron frames for welded equipment fastening.

26.5. Design for future removal or replacement of transformers and provide ventilation for removal of heat generated by the transformers.

26.6. Install all medium voltage services for buildings in rooms or spaces with concrete or solid masonry walls and ceilings.

26.7. In general, allocate floor space for future switchgear.

26.8. The room design shall take into consideration the possibility of flooding when below grade.

26.9. Adequate doors, hatchways, etc., to permit ready installation or removal of major equipment.

26.10. Provide ventilation completely separate from the building ventilating systems.

26.11. Mechanical piping and ductwork must not be installed in electrical equipment and transformer rooms except where required for operation of the electrical equipment.

26.12. Piping and ductwork must never be installed directly over any transformer or switchgear. Sprinklers are the only exception, if installed to protect electrical equipment.

26.13. Adequate lighting, ventilation, and sound control must be provided, including emergency lighting and receptacles, if emergency system is available.

26.14. In shops or similar areas, branch panels may be mounted on or in walls.

26.15. Special attention must be given to the design of the floor structure to permit future openings in the slab without weakening the structure. Provide capped sleeves, knockouts and floor space for future conduit.

27. Teleconferencing and Video Facilities (27 00 00)

27.1. All major County facilities will have at least one conference room with interactive video equipment. This will be used for videoconferences, training and long-distance interviews. Besides security on the room, it will also need storage and wiring provision for the equipment.

27.2. A dedicated cable TV room shall be provided in each building required to be wired for cable TV access.

28. Communications (27 00 01)

28.1. General Considerations.

28.1.1. The Consultant shall include a Communications engineer – in the design of any new building to insure telecommunications requirements are considered.

28.1.2. The sizes and configurations of communications rooms in a building will depend upon several factors, chiefly:

28.1.3. The number of people (workstations) in the building;

28.1.4. The number of people (workstations) on each floor;

28.1.5. The nature of technology in use in the building, e.g., number of personal computers, number and kind of mid- and mainframe computers, printers, interactive-voice-response systems, applications servers and so forth.

28.1.6. Security. In general access to all telecommunications rooms should be controlled by proximity cards rather than keys. This method allows a log of everyone who entered such rooms and allows quick and simple shutdown of access when a card is lost or an employee (County, contractor, US West or other) leaves service.

28.2. Communications Rooms

28.2.1. Main Distribution Frames – usually a large room in the basement or on a lower level where fiber optic and copper cables from outside the building enter and can be cross-connected to the internal wiring plant. Considerations:

28.2.2. Space, power and HVAC for main telephone switch.

28.2.3. Vented battery plant in a separate room from the communications room. See also OSHA requirements for such rooms.

28.2.4. Space and power and HVAC for main building County data communications devices (switches, routers).

28.2.5. UPS (uninterruptible power supplies) for most telephone and data com equipment.

28.2.6. Backup generator. Such a generator may be required based upon the importance of the building and the communications requirements of the building tenants. Such a generator could be located in a separate room near the MDF or in another part of the building.

28.2.7. Wall board – punch down block field.

28.2.8. Intermediate Distribution Frames – a room on each floor where fiber optic and copper cables that run vertically inside the building from the MDF can be cross-connected to the floor distribution cabling.

28.2.9. IDF's could be located on every floor, or, if properly designed, perhaps every third floor;

28.2.10. Wall board – punch down block field

28.2.11. Space and power and HVAC for each floors data communications switches

28.3. Wiring Infrastructure Considerations (including Workstations):

28.3.1. Wiring from outside the building:

28.3.2. County Communications requirements

28.3.3. Dual entrances to the building (from two separate directions)

28.3.4. Fiber optic cable will need to enter the building as CCTV requires fiber optic cable for real time monitoring.

28.3.5. Copper cable

28.3.6. Telecommunications companies requirements

28.3.7. Provision for multiple companies

28.3.8. Cable television. Connect to CATV vendors probably via fiber optic cable to the MDF, with CATV distributed to certain floors and rooms via coaxial cable.

28.3.9. Vertical wiring from MDF to IDFs on each floor:

28.3.10. Provide 4 empty conduits with pull line, 4" in diameter, from the MDF to each floor IDF

28.3.11. Later fiber optic or copper cable will be pulled inside the conduits

28.3.12. Floor distribution wiring:

28.3.13. Four pair (eight wire) twisted pair cables to each jack

28.3.14. Category 6 wire

28.3.15. Workstation requirements:

28.3.16. Four jacks in a quad-plex wall plate at each workstation

28.3.17. RJ45 jacks

28.3.18. One telephone and one data jack at each workstation, plus considerations for other devices – fax, second phone, second computer, modems, etc.

28.3.19. General requirements

28.3.20. Plan an additional 15% quad-plexes per floor to cover fax machines, printers etc. in common work areas

28.3.21. Plan at least one power-fail phone per 10 workstations, including one power-fail phone in each conference room

28.3.22. Conference rooms

28.3.23. Plan one quad-plex every six linear feet – a minimum of two per room

28.3.24. Plan one telephone instrument per room

28.4. Consolidated Server and Computer Room considerations

28.4.1. Plan one major computer/server room for the building, located adjacent, but separate from the MDF. The separate room is for security and fire suppression.

28.4.2. Additional rooms may be required on other floors depending upon user requirements.

28.4.3. See considerations for UPS, battery and generator backup under item #2 above.

28.5. Radio requirements

28.5.1. Some facilities may require an inside antenna (e.g., “leaky coax”) to insure proper 800 MHz public safety radio coverage inside the building.

28.5.2. Some facilities may require BDA’s to amplify or repeat outside radio signals (800 MHx or other) and rebroadcast them inside the building.

28.5.3. The roofs of some facilities may be appropriate for supporting antennas for 800 MHz public safety or other radio broadcast.

29. Access Control Systems (27 00 04)

29.1. An integrated access control and alarm monitoring system with the capability of alarm graphics, integrated badging, and CCTV monitoring, using County’s MS Windows Operating System (as approved by DTS) for multiple workstations is required. The system must be compatible with the existing County security system and must be configured for multiple site codes and multi-company configuration to allow segregated management at various locations including remote site support via Dial-up chains. Efficient alarm management with status and command from maps and comprehensive reporting capabilities including scheduled reports is required.

30. Closed Circuit Television (CCTV) Systems (27 00 05)

30.1. Where programmed, an integrated CCTV system with digital recording, fiber optic capability, internet viewing capability, fixed color cameras, color pan tilt cameras, motion detection, and ability to interface with the existing County system. Panic alarms and intrusion detection alarms shall be provided. The system must have the ability to print out clear, color CCTV photos of on-screen images. Systems will also include 21" color monitors, Internet viewing, fixed color cameras, and digital recording. The CCTV system must be designed to handle further expansion.

31. Site (32 00 00)

31.1. Site disturbance

31.1.1. Building location must be coordinated with the topography so that minimum area of the site is disturbed (minimum cut and fill). (Green)

31.1.2. In design of site, natural topography of the land must be respected to the maximum level possible. (Green)

31.1.3. Valuable natural resources must be protected. (Green)

31.2. Building location

31.2.1. Orientation of the building must be in relation to the sun movement and energy calculations. (Green)

31.3. Accessibility

31.3.1. All site functions must be accessible.

31.3.2. Site circulations must be efficient.

31.4. Vehicular Access

31.4.1. A comprehensive analysis of the vehicular circulation and its interaction with pedestrian movement must be provided.

31.4.2. In order to service any facility it is imperative that service vehicles have direct access to the facility. Early in the design process, the amount of service vehicle traffic to be generated by the facility must be identified and accounted for in the plan. A dedicated vehicular access for delivery and service vehicles is mandatory and should be thoughtfully integrated into the overall design philosophy for the building and the site. It is not unusual for service, delivery or construction vehicles to access buildings in ways different than planned, therefore pedestrian pathways, plazas, etc., shall be designed for vehicular loads just the same as all streets.

31.5. Serviceability

31.5.1. Every building built in the County is intended to serve its purpose over a long period of years. The initial design and construction is only a brief moment in time and cost for the facility. The true value and quality of a building is measured over the years by its ability to adjust to the needs of the end-users and the cost of servicing the components and systems within the building. A building cannot function if it cannot be serviced. Although it is important to get the "front door" right, it is the "back door" that determines how well the building will work. When building services can be provided to meet all requirements and be virtually transparent to the end users, then the building is most likely a success.

31.6. Safety and security

31.6.1. Site must be pedestrian friendly and safe.

31.6.2. Provisions of Crime Prevention Through Design must be considered.

31.6.3. Separation of vehicular and pedestrian access must be maintained and their relationship must be analyzed for maximum safety.

32. Side walk (32 00 01)

32.1. Sidewalks to be 5 feet wide minimum. Finishes shall be as bright as possible. (Green)

32.2. Use of pervious materials for on site sidewalks is promoted. (Green)

33. Natural Gas (33 00 02)

33.1. Natural gas if available and shall be utilized where appropriate in mechanical spaces. For remodel projects, verify adequacy of service.

33.2. Connections to existing and activation of all new lines will be under the supervision of the utility provider company.

33.3. All welds must be inspected.

34. Water Service (33 10 00)

34.1. Water service to the facility shall be provided from the adjacent central water distribution mains in accordance with the utilities drawing provided for the project. Separate services shall be provided for fire protection where utilized. For remodel projects, verify adequacy of service.

34.2. Gate valves eight (8) inch size and larger shall be fitted with an auxiliary bypass line and valve; four (4) inch size.

34.3. All water mains will be installed per WSSC requirements , except that connections to existing water mains owned and maintained by the municipatl jurisdictions outside of the WSSC region.

34.4. At the entry to buildings and at other locations where a water main crosses backfill, provide a concrete grade beam to support the pipe. Support off the building and/or firm soil.

34.5. Provide flexibility in piping on unstable earth and provide a flex joint at building entry.

34.6. Test pressure shall not be less than 50 psi above static, but no less than 200 psi or more than 200% of the working pressure for the class and size of pipe tested.

34.7. The line shall be filled between valves with all air expelled at high points. Test pressure shall then be applied and maintained, for at least 2 hours. Test pressure must be maintained without pumping for 15 minutes with a pressure drop of less than 15 psi.

35. Sanitary Sewer and Storm Drainage (33 40 00)

35.1. Sanitary sewer and storm drainage systems shall be separated. Corrosive waste may require a dilution/neutralizing tank. Hazardous wastes are disposed of by a collection service. Roof drains, footing drains, and area drains shall be connected to the storm drainage system. All active and/or inactive sanitary or storm piping within the footprint of the facility shall be removed and relocated as appropriate. All systems shall be designed for gravity conveyance. Pumping of sewage or storm drainage is not permitted without specific approval of the County. For remodel projects, verify adequacy of service.

35.1.1. All lateral and trunk sanitary sewers shall be sized to flow full under maximum anticipated flow while maintaining minimum velocities under average flow conditions. In general, design flow velocities shall be kept within the range of 3-8 feet per second.

35.1.2. No pipe smaller than 6 inch size shall be used.

36. Parking (34 00 01)

36.1. General

36.1.1. Provide number of parking spaces designated for hybrid cars (Green)

36.1.2. If possible investigate use of pervious parking surface (Green)

36.1.3. Provide number of bike racks. (Green)

36.1.4. Provide number of lockers for bikers. (Green)

36.1.5. Provide shower facility for bikers. (Green)

36.2. Open Parking area

36.2.1. Parking must be asphalt with 6 inches of gravel base, 4” of base course and 2” of top course.

36.2.2. Parking spaces must be striped with white color

36.2.3. Parking lighting must be with fixtures that have cut off glare angle of not more than 60 degree from the center line of the light fixture. (Green)

36.2.4. Lamps to be High Pressure Sodium (HPS) with maximum of 3 foot candle at the bottom of the fixture and not less than 1 foot candle at the border with other fixtures. (Green)

36.3. Parking garage

36.3.1. Parking must be concrete coated with special epoxy non skid texture, color to be medium warm gray.

36.3.2. Parking spaces must be striped with white color

36.3.3. Parking lighting that are at the edge of the garage and visible from outside, must be with fixtures that have cut off glare angle of not more than 45 degree from the center line of the light fixture. (Green)

36.3.4. Lamps to be Metal Halide with maximum of 10 foot candle at the bottom of the fixture and 5 foot candle at the border with other fixtures. (Green)

36.3.5. Top level if open must be off white color concrete. (Green)

36.4. Bike Rack

36.4.1. Bike racks must be provided for all facilities

36.4.2. Bikes need two point of contact to hold them stable and to enable locking of frame and wheel.

36.4.3. Use U form bike racks.

36.4.4. Bikes are expensive. Racks need to be located in place of high visibility to provide security by making them well lighted and located near the entrances.

36.4.5. Preferably bike racks should be placed under covered areas for weather protection.

36.4.6. Bike lockers provide both security and protection from weather.

36.4.7. A general role of thumb is 1 rack per 25 vehicle parking spaces of a facility.

36.4.8. Spacing requirements are about 7’L x 4’ W per rack and a stable concrete or asphalt surface is needed. A specialized security bolt should be utilized.

36.4.9. Pedestrian and ADA thoroughfare should be considered in rack placement.

37. Service areas (34 00 00)

37.1. Loading dock

37.1.1. Where necessary to provide for the safe and efficient transfer of large quantities or sizes of material in and out of County facilities, a loading dock should be provided. It is the consultant's responsibility to identify the extent of requirements during the schematic and design development phases of each project and then incorporate all associated provisions into the contract documents. In general, the program will dictate whether a separate service entrance with loading dock is required. If required, it is for custodial service deliveries; mail delivery and pick-up; waste collection and removal; recycling; facility maintenance; delivery services (U.P.S., Federal Express, etc.); general contractors and subcontractors; movers; etc. In some cases, there is a possibility of mail and package screening. Considerable care must be exercised in regard to minimizing conflicts with provisions for disabled persons.

37.1.2. Loading dock must be provided for all buildings unless otherwise noted. Loading platform must be 4' high with levelers for 55' foot trucks or as identified in the POR.

37.2. Vehicle & Loading Access Doors

37.2.1. Building interior vehicle access, some loading areas, "Sally Ports", and other building interior areas are generally accessed through large door systems. In all cases possible, such doors are to be "Overhead Panel", or "Horizontal Sliding", rather than "Overhead Coiling" door systems. In new buildings, early design consideration is to be paid to providing sufficient overhead clearance at sufficient horizontal clearance from the door and inside the space, to allow for "Overhead Panel" doors. The doors are to have oversize, or the heaviest possible operating hardware, to provide for both operational reliability and durability.

37.3. Service Areas

37.3.1. Service areas and loading docks must be carefully located in consideration of other design features of the building and adjoining existing buildings. This area must accommodate various functions such as waste management, recycling, chemical waste, pickup and delivery. All-weather, access must be provided. Verify sizes of waste and recycling containers with the Project Manager.

37.4. Waste Handling

37.4.1. Effective waste management must be carefully considered at the very beginning stages of design. Some facilities may have waste that is considered to be hazardous or waste that requires special handling by designated regulatory agencies. Waste handling provisions must be carefully developed and in such a way as to not negatively affect or diminish the aesthetics or functional provisions required for site standard presentation. (Green)

37.4.2. Effective recycle management provisions consisting of work space for waste management staff and retention space for segregated waste awaiting routine pickup must be included in the waste handling area of all facilities. If Green Chutes are installed in all new buildings greater than one story in height (in consultation with the Division of Operations), the chutes should be installed in pairs with one chute as a two cubic yard dumpster for commingled recycling and another dumpster for glass. (Green)

37.5. Trash area

37.5.1. An area must be provided to accommodate trash bins one for each of general, glass, plastics, paper, and metal. (Green)

37.6. Custodial Provisions

37.6.1. Designers must make adequate provisions for the receipt, storage and redistribution of custodial supplies for the building and for the efficient operational servicing of the building. Custodial closets for local storage and control of supplies and equipment, in close proximity to the freight elevator, should be included on every floor.

END OF SECTION

1. Crime Prevention Through Environmental Design

Only in the last 20 years have designers and architects begun to see the need to plan and build with more than just the traditional threats of nature --- fire, earthquakes and hurricanes --- in mind. They must now consider the threat of crime.

2. Strategies

There are four overlapping CPTED strategies:

1. **Natural Surveillance**
   A design concept directed primarily at keeping intruders easily observable. Promoted by features that maximize visibility of people, parking areas and building entrances: doors and windows that look out on to streets and parking areas; pedestrian-friendly sidewalks and streets; front porches; adequate nighttime lighting.

2. **Territorial Reinforcement**
   Physical design can create or extend a sphere of influence. Users then develop a sense of territorial control while potential offenders, perceiving this control, are discouraged. Promoted by features that define property lines and distinguish private spaces from public spaces using landscape plantings, pavement designs, gateway treatments, and fences.

3. **Natural Access Control**
   A design concept directed primarily at decreasing crime opportunity by denying access to crime targets and creating in offenders a perception of risk. Gained by designing streets, sidewalks, building entrances and neighborhood gateways to clearly indicate public routes and discouraging access to private areas with structural elements.

4. **Target Hardening**
   Accomplished by features that prohibit entry or access: window locks, dead bolts for doors, interior door hinges.

3. Guidelines

The following guidelines are offered by CPTED for office facilities:

1. Natural Access Control

   - Public entrances should be clearly defined by walkways and signage
   - Building entrances should be accentuated through architectural elements, lighting, landscaping and/or paving stones

2. Natural Surveillance

   - restrooms should be observable from nearby offices
   - all exterior doors should be well lit
   - hallways should be well lit
   - dumpsters should not create blind spots or hiding areas
   - windows and exterior doors should be visible from the street or by neighbors

- all four facades should have windows
- parking areas should be visible from windows, side parking areas should be visible from the street
- parking and entrances should be observable by as many people as possible
- parking area and walkways should be well lit
- dumpster should be clearly visible
- shrubbery should be kept under two feet in height for visibility
- the lower branches of existing trees should be kept at least six feet off the ground
- windows should not be obstructed with signs
- windows and doors should have views into hallways

3. Territorial Reinforcement
    - perimeters should be defined by landscaping or fencing
    - fences should be designed to maintain visibility from street
    - exterior private areas should be easily distinguishable from public areas
    - security and/or reception area should be positioned to screen all entrances

4. Target Hardening
    - exterior door knobs should be a minimum of 40 inches from adjacent windows
    - case hardened dead bolt locks should be installed on all exterior doors with a minimum of one-inch throw
    - door hinges should be installed on the interior side of the door or tamper proof hinges used

V. Strategies for the built environment

CPTED strategies rely upon the ability to influence offender decisions that precede criminal acts. Research into criminal behavior shows that the decision to offend or not to offend is more influenced by cues to the perceived risk of being caught than by cues to reward or ease of entry. Consistent with this research, CPTED based strategies emphasize enhancing the perceived risk of detection and apprehension.

Consistent with the widespread implementation of defensible space guidelines in the 1970s, most implementations of CPTED as of 2004 are based solely upon the theory that the proper design and effective use of the built environment can reduce crime, reduce the fear of crime, and improve the quality of life. Built environment implementations of CPTED seek to dissuade offenders from committing crimes by manipulating the built environment in which those crimes proceed from or occur. The three most common built environment strategies are natural surveillance, natural access control and natural territorial reinforcement.

Natural surveillance and access control strategies limit the opportunity for crime. Territorial reinforcement promotes social control through a variety of measures.

A. Natural surveillance

Natural surveillance increases the threat of apprehension by taking steps to increase the perception that people can be seen. Natural surveillance occurs by designing the placement of physical features, activities and people in such a way as to maximize visibility and foster positive social interaction among legitimate users of private and public space. Potential offenders feel increased scrutiny and limitations on their escape routes.

- Place windows overlooking sidewalks and parking lots.
- Leave window shades open.
- Use passing vehicular traffic as a surveillance asset.
- Create landscape designs that provide surveillance, especially in proximity to designated points of entry and opportunistic points of entry.
- Use the shortest, least sight limiting fence appropriate for the situation.
- Use transparent weather vestibules at building entrances.
- When creating lighting design, avoid poorly placed lights that create blind-spots for potential observers and miss critical areas. Ensure potential problem areas are well-lit: pathways, stairs, entrances/exits, parking areas, ATMs, phone kiosks, mailboxes, bus stops, children's play areas, recreation areas, pools, laundry rooms, storage areas, dumpster and recycling areas, etc.
- Avoid too-bright security lighting that creates blinding glare and/or deep shadows, hindering the view for potential observers. Eyes adapt to night lighting and have trouble adjusting to severe lighting disparities. Using lower intensity lights often requires more fixtures.
- Use shielded or cut-off luminaries to control glare.
- Place lighting along pathways and other pedestrian-use areas at proper heights for lighting the faces of the people in the space (and to identify the faces of potential attackers).

Natural surveillance measures can be complemented by mechanical and organizational measures. For example, closed-circuit television (CCTV) cameras can be added in areas where window surveillance is unavailable.

B. Natural access control

Natural access control limits the opportunity for crime by taking steps to clearly differentiate between public space and private space. By selectively placing entrances and exits, fencing, lighting and landscape to limit access or control flow, natural access control occurs.

- Use a single, clearly identifiable, point of entry
- Use structures to divert persons to reception areas
- Incorporate maze entrances in public restrooms. This avoids the isolation that is produced by an anteroom or double door entry system

- Use low, thorny bushes beneath ground level windows.
- Eliminate design features that provide access to roofs or upper levels
- In front yard, use waist-level, picket-type fencing along residential property lines to control access, encourage surveillance.
- Use a locking gate between front and backyards.
- Use shoulder-level, open-type fencing along lateral residential property lines between side yards and extending to between back yards. They should be sufficiently unencumbered with landscaping to promote social interaction between neighbors.
- Use substantial, high, closed fencing (for example, masonry) between a backyard and a public alley.

Natural access control is used to complement mechanical and operational access control measures, such as target hardening.

C. Natural territorial reinforcement

Territorial reinforcement promotes social control through increased definition of space and improved proprietary concern. An environment designed to clearly delineate private space does two things. First, it creates a sense of ownership. Owners have a vested interest and are more likely to challenge intruders or report them to the police. Second, the sense of owned space creates an environment where "strangers" or "intruders" stand out and are more easily identified. By using buildings, fences, pavement, signs, lighting and landscape to express ownership and define public, semi-public and private space, natural territorial reinforcement occurs. Additionally, these objectives can be achieved by assignment of space to designated users in previously unassigned locations.

- Maintained premises and landscaping such that it communicates an alert and active presence occupying the space.
- Provide trees in residential areas. Research results indicate that, contrary to traditional views within the law enforcement community, outdoor residential spaces with more trees are seen as significantly more attractive, more safe, and more likely to be used than similar spaces without trees.
- Restrict private activities to defined private areas. For example, have your neighborhood BBQ in your back yard, not your front yard.
- Display security system signage at access points.
- Avoid cyclone fencing and razor-wire fence topping, as it communicates the absence of a physical presence. and cues a reduced risk of being detected.
- Placing amenities such as seating or refreshments in common areas in a commercial or institutional setting helps to attract larger numbers of desired users.
- Scheduling activities in common areas increases proper use, attracts more people and increases the perception that these areas are controlled.

Territorial reinforcement measures make the normal user feel safe and make the potential offender aware of a substantial risk of apprehension or scrutiny.

D. Other CPTED Elements

Maintenance and activity support aspects of CPTED were touched upon in the preceding, but are often treated separately because they are not physical design elements within the built environment.

- [Maintenance

Maintenance is an expression of ownership of property. Deterioration indicates less control by the intended users of a site and indicate a greater tolerance of disorder. The Broken Windows Theory is a valuable tool in understanding the importance of maintenance in deterring crime. Broken Windows theory proponents support a zero tolerance approach to property maintenance, observing that the presence of a broken window will entice vandals to break more windows in the vicinity. The sooner broken windows are fixed, the less likely it is that such vandalism will occur in the future.

- Activity Support

Activity support increases the use of a built environment for safe activities with the intent of increasing the risk of detection of criminal and undesirable activities. Natural surveillance by the intended users is casual and there is no specific plan for people to watch out for criminal activity.

VI. Effectiveness and criticism

CPTED strategies are most successful when they inconvenience the end user the least and when the CPTED design process relies upon the combined efforts of environmental designers, land managers, community activists, and law enforcement professionals.

In terms of effectiveness, a more accurate title for the strategy would be crime **deterrence** through environmental design. Research demonstrates that offenders cannot be literally prevented from committing crimes by using CPTED. CPTED relies upon changes to the physical environment that will cause an offender to make certain behavioral decisions. Those changes are crafted so as to encourage behavior, and thus they deter rather than conclusively "prevent" behavior. It has only been since the introduction of 2nd Generation CPTED that CPTED has finally made constructive attempts to enhance social cohesion and build a strong sense of community to impact the motives that cause crime in the first place.

Beyond the attraction of being cost effective in lowering the incidence of crime, CPTED typically reduces the overall costs of preventing crime. Retrofitting an existing environment to meet CPTED can sometimes be costly, but when incorporated in the original design phase of facility planning, cost of designing to CPTED principles are often lower than with traditional approaches. Operational costs are often lower also, as CPTED lighting designs can significantly lower energy use. Adding to the attraction of CPTED is that it lowers liability.

The area of liability has led to the questioning of how much crime prevention is really necessary for a given place. It has been mooted that a risk management approach might be superior to a fear-driven one.[1] The question is, "does a community give up too much freedom, usually in terms of movement and assembly, to be free from fear of crime?" This was a question that was not widely asked in the 1990's; note the rise around the world of gated communities and the use of CCTV in public spaces.

VII. Four obstacles to adopting CPTED

There are four primary obstacles to the adoption of CPTED.

First is a lack of knowledge of CPTED by environmental designers, land managers, and individual community members. For this reason, allocating substantial resources to community educational programs are often required.

The second major obstacle is resistance to change. Many specifically resist the type of cooperative planning that is required to use CPTED. Beyond that, skeptics reject the research and historic precedents that support the validity of CPTED concepts.

The third obstacle is the perception that CPTED claims to be a panacea for crime that will be used to displace other more traditional approaches rather than a small, but important, complementary tool in deterring offender behavior.

The fourth obstacle is that many existing built areas were not designed with CPTED in mind, and modification would be expensive, politically difficult, or require significant changes in some areas of the existing built environment.

Natural Surveillance
A design concept directed primarily at keeping intruders easily observable. Promoted by features that maximize visibility of people, parking areas and building entrances: doors and windows that look out on to streets and parking areas; pedestrian-friendly sidewalks and streets; front porches; adequate nighttime lighting

Territorial Reinforcement
Physical design can create or extend a sphere of influence. Users then develop a sense of territorial control while potential offenders, perceiving this control, are discouraged. Promoted by features that define property lines and distinguish private spaces from public spaces using landscape plantings, pavement designs, gateway treatments, and 'CPTED" fences.

Natural Access Control
A design concept directed primarily at decreasing crime opportunity by denying access to crime targets and creating in offenders a perception of risk. Gained by designing streets, sidewalks, building entrances and neighborhood gateways to clearly indicate public routes and discouraging access to private areas with structural elements.

Activity Support
Activity support is the presence of activity planned for the space. Activity support involves placing activity where the individuals engaged in an activity will become part of the natural surveillance system. Examples include:

- Place safe activities in areas that will discourage would be offenders, to increase the natural surveillance of these activities and the perception of safety for normal users, and the perception of risk for offenders.

- Place high risk activities in safer locations to overcome the vulnerability of these activities by using natural surveillance and access control of the safe area.

- Locate gathering areas in locations that provide for natural surveillance and access control or in locations away from the view of would-be offenders.

- Improve the scheduling of space to allow for effective use and appropriate intensity of accepted behaviors.

Maintenance
Proper maintenance of landscaping, lighting treatment and other features can facilitate the principles of CPTED, territorial reinforcement, natural surveillance and natural access control. Functions include:

- Proper maintenance of lighting fixtures to prescribed standards.

- Landscaping which is maintained at prescribed standards.
- Minimizing the conflicts between surveillance and landscaping as the ground cover, shrubs and trees mature.

sources: http://www.cptedontario.ca/ and http://www.tempe.gov/tdsi/Planning/CPTED/cpted1.htm

A. [edit] 2

Target Hardening
Accomplished by features that prohibit entry or access: window locks, dead bolts for doors, interior door hinges.
Presented along with each of these CPTED strategies are guidelines which, as a homeowner, builder or remodeler, you can apply to reduce the fear and incidence of crime and improve the quality of life.
source: http://www.cpted-watch.com/introduction.htm#Strategies

B. [edit] 3

The 3-Ds
For CPTED to be successful, it must be understandable and practicable for the normal users of the space. The normal users know more about what is going on in the environment and they have a vested interest (their own well-being) in ensuring that their immediate environment operates properly. The "Three-D" approach to space assessment provides a simple guide for the normal users in determining the appropriateness of how their space is designed and used. The Three-D concept is based on the three functions or dimensions of human space:

1. All human space has some **designated** purpose.
2. All human space has social, cultural, legal or physical **definitions** that prescribe the desired and acceptable behaviors.
3. All human space is **designed** to support and encourage the desired behaviors.

source: http://www.tempe.gov/tdsi/Planning/CPTED/cpted1.htm

C. [edit] 4

Crime Prevention Through Environmental design (CPTED) is a design methodology proposing that through proper design and use of the built environment, the architect can reduce opportunities for and fear of predatory crime and improve the quality of life. It is taught by the National Crime Prevention Institute, the American Society of Industrial Security, the American Institute of Architects, and the Florida Atlantic University School of Architecture and is based on three functions of human space:

- Designation: What is the purpose or intention of the space?
- Definition: What are the social, cultural, legal, and psychological ways the space is defined?
- Design: Is the space defined to support prescribed or intended behaviors?

Design professionals can use three basic strategies for CPTED: natural access control, natural surveillance, and territorial reinforcement. ~~Each~~ Access control can be implemented through three types of methods:

- Mechanical (electronic security needs, access control, surveillance devices, and technological solutions).
- Organizational (staff policies and procedures, information flow, movement of people, and the types, numbers, and deployment of security personnel, police, or designated observers).
- Natural (physical barriers, circulation patterns of people, information, products, and basic design decisions on circulation, access building materials, fenestration, and other design features that support overall security goals).

The most used CPTED strategies are:
Provide clear border definition of controlled space. Common law requires that space be defined to preserve property rights. Boundaries may be defined physically or symbolically. Fences, shrubbery, and signs are acceptable border definition. The intent is for a "reasonable individual" to recognize that he or she is transitioning from public to private space. Methods for enhancing the territorial response to create a sense of ownership or defensible space should be encouraged. The arrangement of furniture and color is a means of identifying interior spaces. Pictures, plants, and decorations help to define ownership and serve as environmental cues that may affect behavior of legitimate and illegitimate users of the space.
Provide clearly marked transitional zones. It is critical to identify public, semi-public, semi-private, and private spaces. As transitional definition increases, the range of excuses for improper behavior is reduced. Users must be made to acknowledge movement into controlled space.

Relocation of gathering areas. Formally designate gathering or congregating areas in locations with good natural surveillance and access control. Gathering areas in housing complexes may be placed in positions that are out of view of undesired users to decrease the magnetic effect or attraction.
Place safe activities in unsafe locations. Safe activities serve as magnets for normal users who exhibit challenging or controlling behaviors, such as staring, that tell other normal users that they are safe and abnormal users that they are at greater risk of scrutiny or intervention. Some caution must be used to ensure that a safe activity is not being placed in an unreasonable position.
Place unsafe activities in safe locations. Positioning vulnerable activities near windows of occupied space or within tightly controlled areas will help overcome risk and make users of these areas feel safer.
Redesignate the use of space to provide natural barriers. Conflicting activities may be separated by distance, natural terrain, or other functions to avoid fear-producing conflict. Noise from a basketball game by teenagers or screaming children on monkey bars may be disruptive and frightening to senior citizens. The threat does not have to be real to create the perception of risk for the normal or desired user.
Improve scheduling of space. Generally, effective and productive use of spaces reduces risk and perception of risk for normal users. Likewise, abnormal users feel greater risk of surveillance and intervention in their activities. Well thought out temporal and spacial relationships improve profit and productivity while increasing the control of behavior.
Redesign or revamp space to increase the perception of natural surveillance. The perception of surveillance is more powerful than its reality. Hidden cameras do little to make normal users feel safer and therefore act safer when they are unaware of the presence of these devices. Likewise, abnormal users do not feel at greater risk of detection when they are oblivious to surveillance potential. Windows, clear lines-of-sight, and other natural techniques are often effective as the use of mechanical or organized (e.g., guards, police) methods.
Overcome distance and isolation. Improved communication and design efficiencies increase the perception of natural surveillance and control. It is desirable to create the perception of immediate access to get help if necessary. For example, restroom locations and entry designs may be planned to increase convenience and surveillance, yet reduce the cost of construction and maintenance.
source: http://www.cpted-security.com/cpted11.htm

D. [edit] 5

NATURAL SURVEILLANCE

Surveillance strategies are a design concept directed at keeping intruders under observation. Organized surveillance strategies include police and guard patrols. Lighting and CCTV are mechanical strategies for surveillance, and natural strategies include windows, low landscaping, and raised entrances. Surveillance strategies are those directed at primarily keeping intruders under observation. Surveillance strategies are a design concept directed at keeping intruders under observation. Organized surveillance strategies include police and guard patrols. Lighting and CCTV are mechanical strategies for surveillance, and natural strategies include windows, low landscaping, and raised entrances.

Surveillance is the first principle of CPTED. Surveillance is the ability to look into an area, and the ability to look back out. It can be formal or informal. Things that inhibit surveillance are overgrown trees and shrubs, block walls and poor lighting. Surveillance strategies are aimed primarily at keeping intruders under observation and undesirable behavior under control. To improve surveillance, trim trees and shrubs, use fencing appropriately and utilize proper lighting techniques.

Placing eyes on the street was an idea that Jane Jacob's discovered during her work in New York's Greenwich Village. Placing legitimate eyes on the street, or capable guardians, can help to make a place unattractive to offenders, thus, preventing it from becoming a preference for them to commit crime. This can be accomplished by the proper placement of windows, adequate lighting, and removing obstructions to enhance sightlines.

Any architectural design that enhances the chance that a potential offender will be, or might be, seen is a form of natural surveillance. Often, it is not just the fact that the offender might be seen that matters. It is that the offender "thinks" they will be seen that can help deter the opportunity for crime.

Natural surveillance is naturally occurring. As people are moving around an area, they will be able to observe what is going on around them, provided the area is open and well lit. Natural surveillance is typically free of cost, but observers may choose not to get involved in any situation that may pose a potential threat to themselves or others. Other ways to achieve natural surveillance include landscaping, street design, and placing high risk targets in plain view of nearby residents, such as expensive cameras or display items near a sales clerk.

When surveillance cannot be achieved through natural means, sometimes mechanical means, such as using close circuit television, can be used. Mechanical surveillance employs the use of cameras, mirrors, and other equipment that allows an individual to monitor a remote or common area. Mechanical surveillance usually involves the purchase of moderately priced mirrors to the more expensive CCTV technology. Once the equipment is purchased , maintenance of these devices is a long term renewed cost as well as the organized cost of supervision. Who is watching the cameras and how are they responding when there is an incident. CCTV is best utilized for extraordinary behavior, not ordinary behavior. New technology is allowing critical incidents to be observed, recorded digitally, and activate and appropriate response.

Organized surveillance includes security patrols and other people or capable guardians who are organized to watch a targeted area. While this is the most effective deterrent to crime, it is also the least cost effective. While it may be necessary to employ security patrols or off-duty police, once the patrols are discontinued there is generally nothing left to show for your investment. But by far the most preferable method of surveillance is natural surveillance through good design.

ACCESS CONTROL

Natural access control strategies are intended to deny access to crime targets and to create a perception of risks to offenders. Access control is a design concept directed at reducing the opportunity and accessibility for crime. Organized methods of access control include security guards forces. Mechanical strategies include target hardening such as locks and card key systems. Windows may have protective glazing that withstands blows without breaking. Doors and window hardware may have special material and mountings which make them hard to remove or tamper with. Walls , floors, or doors may be specially reinforced in high security areas with materials that are difficult to penetrate. Natural methods of access control make use of spatial definition and circulation patterns. An example of natural design is the use of security zoning. By dividing space into zones of differing security levels, such as unrestricted, controlled, and restricted, sensitive areas can be more effectively protected. The focus of access control strategies is to deny access to a crime target and create in offenders, a perception of risk and detection, delay and response.

Effective access control is often the key to many security threats. Access control might be strongly considered in these areas:

- all entrances and exits to the site and building
- internal access points in restricted or controlled areas
- environmental and building features used to gain access

(trees, ledges, skylights, balconies, windows, tunnels)

- security screening devices (guard stations, surveillance,

identification equipment)

Access control is the second principle of CPTED. Because many criminals look for an easy escape, limiting access into an area and back out again is an effective way to deter criminal activity. Access control can be demonstrated by having one way into and out of a location, with devices such as a security post or the use of mechanical gates. Others who use "alternative methods" to enter an area look suspicious, stand out and risk detection and identification and increased risk of apprehension. It is important to assess how the intended users are entering the property. It is equally important to assess how others are entering the property as well. Look at perimeter fencing for damage and cut-through's. Look for footprints in the dirt and gravel, and wear patterns in the grassy areas. Determining the weak points will be the first step in correcting the problem.

There are three (3) types of access control to consider: Natural (or Environmental), Mechanical, and Organized. Natural/Environmental Access Control involves the use of the design features and circulation patterns.To keep trespassers from climbing over walls for instance, you could plant a hearty cactus in the area where it will be highly visible. The use of dirt berms or large rocks can also keep unwanted visitors from entering with a vehicle onto private property.

Mechanical Access Control includes the use of security gates, which have proven very effective at reducing auto thefts, burglaries, and drive-by shootings. Most perpetrators of these crimes to not want to exit the way they entered, as it gives witnesses the opportunity to record license plates and get better suspect information.

Organized Access Control entails the use of patrol or courtesy personnel to control who enters the property. Distribution of parking permits affixed to registered vehicles, will identify which vehicles belong to the residents. Enforcement of visitor parking and towing abandoned vehicles from lots and streets improves the image and milieu of being an environment supporting criminal activity.

Defining who uses a territory, or a place, is a major aspect of reducing crime opportunities. Access control includes creating a sense of turf, but it focuses on entry and exit points into buildings, parks, parking lots, and neighborhoods. Closing some entrance ways, and opening others in strategic locations, is one way of doing this.

Good security fencing and gates can accomplish access control. Sometimes simply locking one door, opening another, and notifying residents of the change can accomplish access control. In libraries and shopping mall stores, patrons are channeled past an attendant who can observe all those who enter and exit. Sometimes these places are equipped with electronic point of sales screening devices, but often merely having the access point controlled can be enough. Oscar Newman felt that apartments should channel residents through one or two common entrance ways, so that they get to know each other and so that access is controlled. That way intruders can more easily be identified. The same concept applies to who residential neighborhoods where gates and street closing can similar access control goals.

TERRITORIALITY

Defining who uses a territory, or a place, is a major aspect of reducing opportunities for crime. The concept is to turn a particular area over to a legitimate users of that place so that they will be more likely to adopt ownership over that defined place. This will make it less likely that persons who do not belong in place at risk will use it to commit criminal or nuisance behavior at high risk location. These adaptive behaviors is the concept of territoriality, or what Oscar Newman called "Defensible Space" ; reassigning physical areas so local people can be responsible for, and control, their own public environment. This does not automatically oust criminals, but it can render them more ineffective.

Territoriality can be accomplished by using a hierarchy of space, such as subdividing public spaces into semi-public and semi-private spaces. For example, a Starbuck's Coffee Shop which places chairs and tables onto the sidewalk directly in front of their store tends to reassign this public as part of Starbuck's territory. This can help deter loiterers from hanging in front of the store.

Similarly, symbolic property markers in the front yard of residential homes or apartment buildings, such as short fences, hedges and plantings, pavement stones, and front yard lighting, can demarcate the front area as belonging to residents in the building. This can make residents feel safer when entering or exiting their building; it can contribute to fewer burglaries, and it can reduce the opportunity for other crimes there.

Good territoriality demonstrates a sense of "ownership", alerting potential offenders that they don't belong there and they will be seen and reported., because undesirable behavior will not be tolerated. It has two (2) principle components: Defensible Space and Maintenance.

Defensible space is divided into four (4) categories: Public, Semi-public, Semi-private, and Private. Public areas are typically the least defensible. A car driving on a public street would not automatically arouse suspicion. If the street were a cul-de-sac, however this is a semipublic area. If there are only five homes in the circle, the driver would be expected to stop at one of the five homes or leave. Semi-private areas might include sidewalks or common areas around residential areas. While most people may not confront a stranger in a common area, they are likely to call the police it the person does not appear to belong there. Private areas are different in rental communities than in single-family home neighborhoods. In a typical apartment the private area may not begin until you actually enter into the unit. This is especially true if several units share a common balcony or stairways. In a single-family home neighborhood, may owners consider their front yard to be private, or defensible space.

There are many ways to establish defensible space. By planting low growing hedges or bushes, you will show a defined property line. By posting signs and stating groundrules such as "No Trespassing" or "No Soliciting," you have established the area is defensible space and removed the excuse for non-compliance or criminal behavior.

MANAGEMENT AND MAINTENANCE

One CPTED strategy that can be helpful from the small scale to the large scales is the concept of management and maintenance. At smaller scales this means that how property management maintains a property is instrumental in creating a sense of place, or territory, for legitimate users of that space. If a rental property is well maintained, it shows that management, or the owner, cares for and will defend the property against crime and incivilities. A property that is not maintained may indicate that the management is not concerned about the property, and might overlook or ignore criminal activity.

Property management can be the building owners or assigned to property managers. Some residential multi-family housing have live-in resident managers. By having a manager live on the property they get to know intimately the problems both inside and outside of their properties. Management policy and procedures create the impetus to hire security patrols, have electricity bills paid so the light will turn on, hire the trash removal company to pickup garbage from dumpsters, pay a gardener to mow the grass and trim the overgrown landscaping. Management is the first step in property crime prevention with the screening of tenants, the wording and enforcement of lease agreements stating a zero tolerance drug and crime policy, the hiring of staff, the repair of broken items.

Crime often congregates in areas where there are dilapidated and abandoned buildings, in places where liter and graffiti are rampant, and where the area looks as though no one cares. Further, If the property has several city code infractions, a property manager may lose the ability to deal effectively with criminal activity. A person facing eviction may threaten to report infractions to the city if the manager proceeds. For example, a manager attempting to evict a troublesome tenant, might find that person who is facing eviction may threaten to report the infractions to the city if the manager proceeds with the eviction process. In this case the manager may be forced to look the other way. If the property had been maintained in a clean fashion there would be nothing to hold against management. More importantly the property would be more likely to attract legitimate users in the first place.

Management and maintenance go hand in hand. A property can be an award winning design, but it no one is there to make sure that the property is maintained, and bills get paid, and residents/tenants get screened, illegally parked cars get towed, and bad tenants get evicted, and the lights get turned on, then the property will quickly fall into disrepair and start attracting criminal behavior.

ACTIVITY SUPPORT AND GENERATORS

Activity support is a small and medium scale CPTED principle. It involves the appropriate use of building functional spaces such as recreational facilities and common areas. The objective with activity support is to fill the area with legitimate users so that any abusers will leave. It may be difficult to believe that filling an areas with legitimate users will cause the deviant users or abusers to leave. But the opposite is also true, for if you fill an area with deviant users, the legitimate users will withdraw.

To promote activity support utilize the common areas effectively. By incorporating seating areas, picnic areas, porches and other amenities in open areas, the legitimate users will participate in the normal day to day functions and maintain ownership of the property.

Ask yourself, is that land feature or physical structure being used as it was intended? Does the intended design fit the designated use, and if not, what is that causing the problem? Who are the intended users? Why are the legitimate users not using an area? Why are the criminals frequenting an area? Why is it inviting? What will discourage them?

For example, in recreational areas and parks, the City might use proper lighting and establish community rules to encourage the proper and safe use of facilities. For laundry facilities, exercise rooms, and game rooms, maintaining clear visibility and supervision by capable guardians can make sure the activities there support the intended uses and users.

Activity support means that in urban parks you might schedule community barbecues and sports activities to reinforce legitimate uses of the park. This can be the case with gazebo's in the neighborhood parks, which can be placed where drugs are sold. Scheduling legitimate activities in the gazebo can prevent this unwanted drug or gang behavior from happening.

Activity generators are land uses or urban features that generate plenty of local activity. They are neither positive nor negative, but they can generate opportunities for crime if they are poorly planned or operated. For example, they include telephone booths or automated bank machines in strip malls. Depending on where they are placed, and when they are used, these activity generators can cause problems. Drug dealers might use the phones for drug sales; the ATM may be the site of robberies.

Activity generators are considered large scale since they do not operate in isolation of the surrounding land uses. It is insufficient to place housing to encourage activities in a commercial area, if the housing is isolated into small pockets, without local amenities , and lacks sufficient services. People will not place their eyes on the commercial street if they have no reason to look outside.

On the other hand, some kids of activities, such as hot dog or flower vendors, can provide legitimate uses and surveillance in certain areas, such as, parking lots of football stadiums, thereby placing more eyes into the parking lot to deter theft from cars.

source: http://www.cpted-security.com/cpted17.htm

E. [edit] 6

1) NATURAL SURVEILLANCE

Surveillance strategies are a design concept directed at keeping intruders under observation. Organized surveillance strategies include police and guard patrols. Lighting and CCTV are mechanical strategies for surveillance, and natural strategies include windows, low landscaping, and raised entrances. Surveillance strategies are those directed at primarily keeping intruders under observation. Surveillance strategies are a design concept directed at keeping intruders under observation. Organized surveillance strategies include police and guard patrols. Lighting and CCTV are mechanical strategies for surveillance, and natural strategies include windows, low landscaping, and raised entrances.

Surveillance is the first principle of CPTED. Surveillance is the ability to look into an area, and the ability to look back out. It can be formal or informal. Things that inhibit surveillance are overgrown trees and shrubs, block walls and poor lighting. Surveillance strategies are aimed primarily at keeping intruders under observation and undesirable behavior under control. To improve surveillance, trim trees and shrubs, use fencing appropriately and utilize proper lighting techniques.

Placing eyes on the street was an idea that Jane JacobÕs discovered during her work in New York's Greenwich Village. Placing legitimate eyes on the street, or capable guardians, can help to make a place unattractive to offenders, thus, preventing it from becoming a preference for them to commit crime. This can be accomplished by the proper placement of windows, adequate lighting, and removing obstructions to enhance sightlines.

Any architectural design that enhances the chance that a potential offender will be, or might be, seen is a form of natural surveillance. Often, it is not just the fact that the offender might be seen that matters. It is that the offender ÒthinksÓ they will be seen that can help deter the opportunity for crime.

Natural surveillance is naturally occurring. As people are moving around an area, they will be able to observe what is going on around them, provided the area is open and well lit. Natural surveillance is typically free of cost, but observers may choose not to get involved in any situation that may pose a potential threat to themselves or others. Other ways to achieve natural surveillance include landscaping, street design, and placing high risk targets in plain view of nearby residents, such as expensive cameras or display items near a sales clerk.

When surveillance cannot be achieved through natural means, sometimes mechanical means, such as using close circuit television, can be used. Mechanical surveillance employs the use of cameras, mirrors, and other equipment that allows an individual to monitor a remote or common area. Mechanical surveillance usually involves the purchase of moderately priced mirrors to the more expensive CCTV technology. Once the equipment is purchased , maintenance of these devices is a long term renewed cost as well as the organized cost of supervision. Who is watching the cameras and how are they responding when there is an incident. CCTV is best utilized for extraordinary behavior, not ordinary behavior. New technology is allowing critical incidents to be observed, recorded digitally, and activate and appropriate response.

Organized surveillance includes security patrols and other people or capable guardians who are organized to watch a targeted area. While this is the most effective deterrent to crime, it is also the least cost effective. While it may be necessary to employ security patrols or off-duty police, once the patrols are discontinued there is generally nothing left to show for your investment. But by far the most preferable method of surveillance is natural surveillance through good design.

2) ACCESS CONTROL

Natural access control strategies are intended to deny access to crime targets and to create a perception of risks to offenders. Access control is a design concept directed at reducing the opportunity and accessibility for crime. Organized methods of access control include security guards forces. Mechanical strategies include target hardening such as locks and card key systems. Windows may have protective glazing that withstands blows without breaking. Doors and window hardware may have special material and mountings which make them hard to remove or tamper with. Walls , floors, or doors may be specially reinforced in high security areas with materials that are difficult to penetrate. Natural methods of access control make use of spatial definition and circulation patterns. An example of natural design is the use of security zoning. By dividing space into zones of differing security levels, such as unrestricted, controlled, and restricted, sensitive areas can be more effectively protected. The focus of access control strategies is to deny access to a crime target and create in offenders, a perception of risk and detection, delay and response.

Effective access control is often the key to many security threats. Access control might be strongly considered in these areas:

* all entrances and exits to the site and building
* internal access points in restricted or controlled areas
* environmental and building features used to gain access (trees, ledges, skylights, balconies, windows, tunnels)
* security screening devices (guard stations, surveillance, identification equipment)

Access control is the second principle of CPTED. Because many criminals look for an easy escape, limiting access into an area and back out again is an effective way to deter criminal activity. Access control can be demonstrated by having one way into and out of a location, with devices such as a security post or the use of mechanical gates. Others who use Òalternative methodsÓ to enter an area look suspicious, stand out and risk detection and identification and increased risk of apprehension. It is important to assess how the intended users are entering the property. It is equally important to assess how others are entering the property as well. Look at perimeter fencing for damage and cut-through's. Look for footprints in the dirt and gravel, and wear patterns in the grassy areas. Determining the weak points will be the first step in correcting the problem.

There are three (3) types of access control to consider: Natural (or Environmental), Mechanical, and Organized. Natural/Environmental Access Control involves the use of the design features and circulation patterns.To keep trespassers from climbing over walls for instance, you could plant a hearty cactus in the area where it will be highly visible. The use of dirt berms or large rocks can also keep unwanted visitors from entering with a vehicle onto private property.

Mechanical Access Control includes the use of security gates, which have proven very effective at reducing auto thefts, burglaries, and drive-by shootings. Most perpetrators of these crimes to not want to exit the way they entered, as it gives witnesses the opportunity to record license plates and get better suspect information.

Organized Access Control entails the use of patrol or courtesy personnel to control who enters the property. Distribution of parking permits affixed to registered vehicles, will identify which vehicles belong to the residents. Enforcement of visitor parking and towing abandoned vehicles from lots and streets improves the image and milieu of being an environment supporting criminal activity.

Defining who uses a territory, or a place, is a major aspect of reducing crime opportunities. Access control includes creating a sense of turf, but it focuses on entry and exit points into buildings, parks, parking lots, and neighborhoods. Closing some entrance ways, and opening others in strategic locations, is one way of doing this.

Good security fencing and gates can accomplish access control. Sometimes simply locking one door, opening another, and notifying residents of the change can accomplish access control. In libraries and shopping mall stores, patrons are channeled past an attendant who can observe all those who enter and exit. Sometimes these places are equipped with electronic point of sales screening devices, but often merely having the access point controlled can be enough. Oscar Newman felt that apartments should channel residents through one or two common entrance ways, so that they get to know each other and so that access is controlled. That way intruders can more easily be identified. The same concept applies to who residential neighborhoods where gates and street closing can similar access control goals.

3) TERRITORIALITY

Defining who uses a territory, or a place, is a major aspect of reducing opportunities for crime. The concept is to turn a particular area over to a legitimate users of that place so that they will be more likely to adopt ownership over that defined place. This will make it less likely that persons who do not belong in place at risk will use it to commit criminal or nuisance behavior at high risk location. These adaptive behaviors is the concept of territoriality, or what Oscar Newman called ÒDefensible SpaceÓ ; reassigning physical areas so local people can be responsible for, and control, their own public environment. This does not automatically oust criminals, but it can render them more ineffective.

Territoriality can be accomplished by using a hierarchy of space, such as subdividing public spaces into semi-public and semi-private spaces. For example, a Starbuck's Coffee Shop which places chairs and tables onto the sidewalk directly in front of their store tends to reassign this public as part of Starbuck's territory. This can help deter loiterers from hanging in front of the store.

Similarly, symbolic property markers in the front yard of residential homes or apartment buildings, such as short fences, hedges and plantings, pavement stones, and front yard lighting, can demarcate the front area as belonging to residents in the building. This can make residents feel safer when entering or exiting their building; it can contribute to fewer burglaries, and it can reduce the opportunity for other crimes there.

Good territoriality demonstrates a sense of ÒownershipÓ, alerting potential offenders that they donÕt belong there and they will be seen and reported., because undesirable behavior will not be tolerated. It has two (2) principle components: Defensible Space and Maintenance.

Defensible space is divided into four (4) categories: Public, Semi-public, Semi-private, and Private. Public areas are typically the least defensible. A car driving on a public street would not automatically arouse suspicion. If the street were a cul-de-sac, however this is a semipublic area. If there are only five homes in the circle, the driver would be expected to stop at one of the five homes or leave. Semi-private areas might include sidewalks or common areas around residential areas. While most people may not confront a stranger in a common area, they are likely to call the police it the person does not appear to belong there. Private areas are different in rental communities than in single-family home neighborhoods. In a typical apartment the private area may not begin until you actually enter into the unit. This is especially true if several units share a common balcony or stairways. In a single-family home neighborhood, may owners consider their front yard to be private, or defensible space.

There are many ways to establish defensible space. By planting low growing hedges or bushes, you will show a defined property line. By posting signs and stating groundrules such as ÒNo TrespassingÓ or ÒNo Soliciting,Ó you have established the area is defensible space and removed the excuse for non-compliance or criminal behavior.

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source: http://www.cpted-security.com/cpted20.htm

F. [edit] 7

Crime Prevention Through Environmental Design (CPTED) is based on the premise that "proper design and effective use of the physical environment can produce behavioural effects that will reduce the incidence and fear of crime, thereby improving the quality of life. These behavioural effects can be accomplished by reducing the propensity of the physical environment to support criminal behaviour" (Crowe, T. (1991) Crime Prevention Through Environmental Design: Applications of Architectural Design and Space Management Concepts. Stoneham, MA: Butterworth-Heinnemann).

G. [edit] 8

Greg Saville and Gerry Cleveland discuss this holistic theory, or the ‘marriage of CPTED and Community Oriented Policing,’ in their article entitled Second Generation CPTED (1997). Second generation CPTED recognizes the most valuable aspects of a safe community lie not in structures of the brick and mortar type, but rather in structures of family, of thought and, most importantly of behavior. We may benefit from starting with an examination of the physical aspects of place, but we must end up looking at the social aspects of home and neighborhood — the affective environment. Second generation CPTED offers the promise of greatly enhanced, and more realistic, preventive strategies, equally important, it offers the possibility of a new approach for community building."

source: http://www.calea.org/newweb/newsletter/No79/crimeprevention.htm

End of Section

1. Indoor Air Quality Guidelines

A. General

The following guidelines are intended to outline processes and methods to minimize adverse Indoor Air Quality (IAQ) conditions on the occupants of buildings. These guidelines shall be met by both the Architect/Engineer (A/E) consultant and the contractor to assure acceptable IAQ conditions are provided to the initial occupants of the building and over the life of the building. Compliance with this guideline is considered to be a basic service.

B. IAQ Considerations

The A/E shall incorporate the following IAQ considerations into the design and construction documents:

1) Maintain strict pollutant source control by specifying materials and substances which are designed, manufactured, handled and installed in such a manner that they will produce the least harmful or annoying effect on the occupants of the building.

2) Provide an adequate outdoor air supply to the building which is protected from exterior pollutant sources, including the building's own exhaust and venting systems, cooling tower mist, parking areas, loading docks and smoking areas. Consider 3-stage intake air filtration consisting of pleated pre-filters, charcoal, and bag/box filters to take out a high proportion of the 1 um + aerosols.

3) Provide floor coverings appropriate for areas of use based on potential exposure to water, foot traffic, food spills and other contaminants.

4) Provide adequate and effective fresh air delivery to occupants and including special purpose areas.

5) Provide properly designed exhaust systems to remove pollutants generated within the building before they are redistributed through the occupied space. The exhaust systems shall be designed for compatibility not only with the building's air intake system(s), but also for compatibility with adjacent buildings and with future development in accordance with the site master plan.

6) Provide building design which will protect building occupants from infiltration, both natural and stack effect, of carbon monoxide, particulates and other pollutants from external sources, and radon from ground sources.

7) The design of the internal Heating, Ventilating, and Air Conditioning (HVAC) delivery systems shall incorporate the ability to redirect, without great expense, the internal air flows as occupancy and activity patterns change over the life of the building.

8) Acoustical insulation on the interior wall of the ventilation ducts shall not be used to achieve noise level of the ventilation system at or below 45 dBA in all work areas.

9) Provide documentation describing:

    a) The amount and type of chemical vapors or particles which may be emitted from materials introduced into the workspace; and

    b) The building design with the mechanical HVAC systems design including zoning.

10) Provide training to the building maintenance and operations personnel to ensure a thorough understanding of the IAQ goals, their role in meeting the goals, and how the HVAC systems should be operated to meet the goals

C. Indoor Pollutant Source Control Plan

The A/E shall develop and implement an Indoor Pollutant Source Control Plan indicating how the Emission Rate Standards that follow will be implemented. The Plan shall apply to all interior construction materials, finishes and furnishings including partitions, wall coverings, flooring, floor coverings, ceiling tiles, adhesives, paints, sealants, glazes, insulation, duct work, wiring and other materials which may have chemical content.

1) Design documents shall require that all appropriate suppliers be made aware of the IAQ goals and the requirements to comply with the Emission Rate Standards.

2) Where possible, materials used shall emit the lowest, yet technologically achievable, emissions of chemical vapors and particles.

3) Emission Rate Standards: The following are performance based, after the fact with the ventilation system operating:

   a. Formaldehyde Emission Rate Standard: The product emission rate shall not result in an indoor air concentration level of formaldehyde greater than the NIOSH Recommended Exposure Limit of 0.016 parts per million.

   b. Total Volatile Organic Compound (VOC) Emission Rate Standard: The product emission rate shall not result in an indoor air concentration level greater than 0.5 mg/m^3 of total volatile organic compounds.

   c. 4 Phenyl Cyclohexene (4-PC) Emission Rate Standard**:** The carpet emission rate shall not result in an indoor air concentration level greater than 1 part per billion.

   d. Total Particulates Emission Rate Standard: The product emission rate shall not result in an indoor air concentration of greater then 50 ug/m^3 total particulates in non-office and 10 ug/m3 for 8 hour TWA in office areas.

   e. Regulated Pollutant Standard: Any pollutant regulated as a primary or secondary air pollutant shall meet an emission rate standard that will not generate an air concentration greater than that promulgated by the National Ambient Air Quality Standard (USEPA, Code of Federal Regulations, Title 40, Part 50).

   f. Other Pollutant Standard: Any pollutant not specifically mentioned in subparagraphs 3.3.1 through 3.3.4 shall meet an emission rate standard that will not produce an air concentration level greater than 1/10 the Threshold Limit Value - Time Weighted Average (TLV-TWA) industrial workplace standard or 0.5 mg/m3 of total VOCs whichever is less.

4) As part of the Shop Drawing process, the A/E shall include a requirement that the contractor provide compliance information and Material Safety Data Sheets (MSDS) on all indoor construction material. Additionally, that the contractors disclose, in writing and prior to installation, information on those VOCs found to be emitted by the products and known to be carcinogens, mutagens, reproductive toxins, or compounds emitted to cause an air concentration of not greater than 0.1 ppm or 1/10 the TLV whichever is less.

5) All emission rate testing pertinent to air quality shall be done in accordance with ASTM D5116-90, Small Scale Environmental Determination of Organic Emissions from Indoor Materials/Products. All test data shall be made available to the County at its request.

6) The least amount feasible of "wet" materials (such as adhesives, sealants, glazes, caulks, paints, etc.) shall be used during construction and product applications. The Plan shall include control strategies for achieving this minimal use requirement.

7) "Dry" furnishing materials (such as carpet, acoustical panels, textiles, etc.) shall not be installed until "wet" materials have been applied and allowed to dry to the extent feasible and in accordance with other good building practices. Drying times should be chosen so that pollutant emission rates as set forth above are achieved prior to installation of the "dry" furnishings. Dry furnishings such as carpeting and floor tile shall not be applied to the cement floors until the moisture content of the cement is below 16%.

   a) All dry furnishing and materials (such as carpet, floor tile, acoustical tile, textiles, office furniture, wood shelving, etc.) shall be allowed to "air-out" in clean environments prior to installation in a building.

   b) All indoor construction material shall be protected from contamination by construction dust, debris, and fumes during all phases of construction, both before and after installation.

D. Ventilation Control Plan (ensure full compliance with ASHRAE Standard 62, 1999)

The A/E shall develop a Ventilation Control Plan, which includes an analysis of the adequacy and effectiveness of the proposed mechanical HVAC system covering the following factors:

1) Location of building outdoor air intakes to ensure an acceptable quality of outdoor air.

2) Location of building exhausts, plumbing vents and other pollutant sources to prevent reentrainment of exhausted or polluted air back into the building.

3) Integration of building air intake and exhaust locations with the overall site master plan to optimize the quality of outdoor air intake for all buildings on adjacent sites.

4) The ability of the building exhaust system to ensure external exhaust of pollutants and odors created in laboratories, building support areas, cafeteria, break rooms, printing areas photocopy areas, and other special purpose areas; and treatment of those exhausts, if appropriate, to eliminate particles and toxic pollutants from the air before exhausting it.

5) The ability of the HVAC system to provide: 1) an adequate ventilation rate of outdoor air to the ultimate expected building population and usage, and 2) adequate make-up air, as appropriate, for special purpose areas.

6) The ability to achieve acceptable ventilation effectiveness in the occupied zones with a maximum CO_2 level of less than 600-700 ppm under maximum normal loading.

7) The ability to effectively integrate the air delivery system with the occupied space activities and space design.

8) The ability of the building to provide protection of its occupants against infiltration, both natural and stack effect, of the following:

a) Carbon monoxide, aerosols, and other pollutants from the parking areas, loading dock areas, smoking areas, and other pollutant sources external to the building.

b) Radon from ground sources.

E. Additional Environmental Controls

1.) To prevent and/or inhibit the degradation of IAQ in adjacent occupied buildings during construction, the following shall be observed:

a) Minimize the amount of construction dust, vapors and fumes generated at the construction site;

b) Provide temporary source of outdoor air, if required, to prevent construction dust and fumes from infiltrating into the adjacent building's mechanical system; and,

c) Recondition the air systems of adjacent buildings, affected by the construction project, to at least the pre-construction cleanliness conditions.

d) During construction the site should be maintained so that there no moisture infiltration that could all cause future problems (e.g. wet insulation, wet flooring material, wet sheet rock, etc).

e) Before any material is placed on concrete surface the moisture content shall be measured to insure that it is within specification.

2) To prevent and/or inhibit the degradation of indoor air quality in occupied portions of buildings during renovation projects, the following shall be observed:

a) If possible, schedule renovation projects to occur during favorable weather seasons and/or conditions;

b) Separate and section off the area where renovation is to be performed from the remaining space or perform work during non-operating hours. Space shall be thoroughly cleaned and flushed with outdoor air prior to occupancy; and,

c) Prevent construction dust and fumes from infiltrating into the building's mechanical system.

F. Indoor Air Quality Operations Plan -ensure full compliance with ASHRAE Standard 62, 1999

The A/E shall provide a building indoor air quality operations plan, which includes, but is not limited to, the following:

1) HVAC design and operating documentation as recommended by the equipment manufacturers and the design engineer;

a) Information on the daily operation and management of the building systems, a description of normal operating procedures, special procedures such as seasonal start-ups and shutdowns, and a list of operating performance criteria including, but not limited to minimum outside air ventilation rates, special space relative humidity and pressurization requirements;

b) A general description of the building and its function including but not limited to, work activity, number of employees and visitors, hours of operation, weekend use, and potential air contaminants which could be released into the space.

2) The scope of work for the initial balancing of the HVAC system at the occupied zone before Substantial Completion and before final Acceptance;

3) A recommended program for re-balancing of the HVAC system at seasonal changes;

4) A recommended building flush out period of high ventilation at ambient temperatures (100% outside air) which shall take place after completion of all interior construction and prior to placing any furniture in the ventilated space, and another flush out period after all furniture has been unpacked and placed in the ventilated space, all of which shall be scheduled and occur prior to Substantial Completion (Balancing and Commissioning may take place during this flush out period);

5) The requirements for an extended ventilation flush period after Substantial Completion and occupancy at the normal ventilation rate (Include length of time for 24 hour per day operation and length of time and duration for early start up of HVAC systems); and,

6) The scope and content of a training program for the County's maintenance staff to properly operate and maintain the HVAC systems under all operating conditions to meet IAQ goals and ventilation standards.

End of Appendix

1. INTERNATIONAL PERFORMANCE MEASUREMENT & VERIFICATION PROTOCOL (IPMVP)

The IPMVP is a document which discusses procedures that, when implemented, allow building owners, energy service companies (ESCOs), and financiers of building energy efficiency projects to quantify energy conservation measure (ECM) performance and energy savings. The procedures also provide for measurement and verification of ECM performance over time to ensure predicted savings are maintained. The IPMVP provides an overview of current best practice techniques available for verifying savings from both traditionally- and third-party-financed energy and water efficiency projects.

A. Purpose:

The purpose of the IPMVP is to:
- Increase certainty, reliability, and level of savings;
- Reduce transaction costs by providing an international, industry consensus approach and methodologies;
- Reduce financing costs by providing project measurement and verification (M&V) standardization, thereby allowing project bundling and pooled project financing;
- Provide a basis for demonstrating emission reduction and delivering enhanced environmental quality;
- Provide a basis for negotiating the contractual terms to ensure that an energy efficiency project achieves or exceeds its goals of saving money and improving energy efficiency.

B. Measurement and Verification Options:

Each of the four M&V options defined in the IPMVP is applicable to different types of performance contracts, project values, and risk sharing between the energy service company (ESCO) and the owner. The purpose of defining several M&V options is to allow for variations in the cost and methods for assessing savings. Consequently, the M&V options described within the IPMVP vary in accuracy, cost of implementation, strengths, and limitations.

M&V Option	How Savings Are Calculated	Cost
Option A: Focuses on physical assessment of equipment changes to ensure the installation is to specification. Key performance factors (e.g., lighting wattage or chiller efficiency) are determined with spot or short-term measurements and operational factors (e.g. lighting operating hours or cooling ton-hours) are stipulated based on analysis of historical data or spot/short-term measurements. Performance factors and proper operation are measured or checked annually	Engineering calculations using spot or short-term measurements, computer simulations, and/or historical data	Dependent on number of measurement points. Approximately 1-5% of project construction cost of items subject to M&V.
Option B: Savings determined after project completion by short-term or continuous measurements taken throughout the term of the contract at the device or system level. Performance and operations factors are monitored.	Engineering calculations using metered data	Dependent on number and type of systems measured and the term of analysis/ metering. Typically 3-10% of project construction cost of items subject to M&V.
Option C: After project completion, savings determined at the "whole-building" or facility level using current year and historical utility meter (gas or electricity) or sub-meter data.	Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multivariate (hourly or monthly) regression analysis.	Dependent on number and complexity of parameters in analysis. Typically 1-10% of project construction cost of items subject to M&V.
Option D: Savings determined through simulation of facility components and/or the whole facility	Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering	Dependent on number and complexity of systems evaluated. Typically 3-10% of project construction cost of items subject to M&V.

C. Generic Monitoring and Verification Steps

M&V Basic Steps – All Methods. M&V of new buildings differs fundamentally from retrofit projects in that performance baselines are hypothetical rather than actual, and are therefore generally not physically measurable or verifiable. The implications of this increase with the complexity of measures and strategies to be monitored and verified. Yet the basic steps in new building M&V do not vary significantly in concept from retrofit M&V. These steps are as follows:

1. Define Baseline. Definition of baseline is actually a two-part process. First, a design baseline must be developed and defined. This can range from the stipulation of specific baseline equipment to specifying whole-building compliance with energy codes or standards. Once the design baseline has been established, computer-aided analytical tools are used to estimate the associated energy performance baseline.

2. Define Energy Efficient Design and Projected Savings. The energy efficient design is defined through the building design process, and is the natural outcome of that process. Computer-aided tools (such as DOE-2) are then used to estimate performance of the energy efficient design, which is subtracted from the baseline energy performance to generate projected savings. The estimation process should also include the identification and, if possible, quantification of factors that could affect the performance of both the baseline and energy efficient design.

3. Define General M&V Approach. Section 6.2.2 of the IPMVP presents new building M&V methods that are roughly analogous to the M&V retrofit Options A, B, and C presented in Section 3.10 of the IPMVP and reproduced above. The A and B analogs are directed at end-use measures, and C addresses whole-building M&V methods. The relative suitability of each approach is a function of the following:

   - The M&V objectives and the requirements of nay related performance contracts.
   - The number of ECMs and the degree of interaction with each other as well as with other systems.
   - The technical practicality and issues associated with M&V of particular ECMs or broader whole-building ECMs and strategies.
   - Current trends toward more integrated and holistic new building design that are moving M&V requirements more to the Option C end of the Option A-B-C spectrum.

4. Prepare Project-Specific M&V Plan. Development of an effective and efficient M&V plan for new buildings tends to be more involved than retrofit projects since performance strategies are usually more complex and the technical issues more challenging. Development of an M&V plan should begin during the early design phases of the project for the following reasons:
   - Technical analyses that are performed in support of design decisions concerning energy performance during the building design process provide a starting point in defining the M&V objectives and approach. The key elements of energy analysis are also usually key factors in M&V. Therefore, the energy analyses and projections should be well documented and organized with this in mind.
   - M&V considerations can, and should affect certain design decisions such as instrumentation, building system organization, etc.

5. Verify Installation and Commissioning of ECMs or Energy Efficient Strategies. Installation and proper operation is verified through site inspections as necessary combined with review of commissioning reports, fluid balancing reports, etc. Any deviations should be noted and addressed through adjustment of the affected performance projections.

6. Determine Savings Under Actual Post-Installation Conditions. Virtually all energy performance projections are predicated upon certain assumptions regarding operational conditions, e.g.,

   occupancy, weather, etc. This affects both the baseline and energy efficient design estimations. Deviations from the operational assumptions must be tracked by an appropriate mechanism (site survey, short and/or long term metering, etc.) and the baseline and energy efficient projections modified accordingly to determine actual savings.

7. Re-evaluate at Appropriate Intervals. Ongoing performance of ECMs or energy efficient strategies and the associated energy savings must be re-evaluated and verified at intervals and over a time frame appropriate to M&V and related performance contract requirements. This also allows ongoing management and correction of significant deviations form projected performance.

D. Summary of IPMVP Option B for New Buildings:

To use IPMVP Option B for new buildings, parties typically stipulate baseline energy consumption using a computer software energy simulation tool such as DOE-2.1. Projected energy savings are then developed based on proposed energy conservation measures and design strategies incorporated into the simulation tool analysis. After the building is built and occupied for a specified period of time, energy savings projections are adjusted by calibrating the simulation tool analysis to actual operating conditions using data from metered energy conservation measures.

Energy efficiency measures chosen to be metered can be any factor that materially affects the generation of savings. Operating hours and power draw over a period are typical examples of measured variables. Increased metering complexity produces higher verification accuracy at the expense of measurement and verification (M & V) cost. Using statistical sampling of similar multiple end-use points (such as motors or lamps) may be more appropriate for simple systems. Use of short- or long-term metering data typically depends on the constancy and/or predictability of the load. Another valuable aspect of metering to consider is that that metering provides long-term persistence operation data that can be used to improve or optimize the operation of equipment on a real-time basis.[*] (see note below)

E. Basic Steps to Implementing the IPMVP Option B:

In addition to the information provided above under the generic monitoring steps, the following apply specifically to IPMVP Option B:

1. Define baseline and estimate energy performance. For LEED purposes, this is a building complying with ASHRAE/IESNA Standard 90.1-1999 or the local code, whichever is stricter.
2. Define energy efficient design (energy conservation measures (ECMs)) and calculate initial savings estimate. This is a comparison of energy performance of baseline building and energy efficient building using the estimating tool/software.
3. Define general measurement and verification approach (data collection plan) during early project design phases. LEED specifies use of Option B for new buildings. (See IPMVP Chapter 6).
4. Verify installation and commissioning of ECMs.
5. Determine savings under actual post-installation conditions. Initial savings estimates are modified to account for as-built verified conditions and calibrated with monitoring data of operating conditions.
6. Re-evaluate at appropriate intervals. Typically performed annually after the first year of operation.

F. Additional Notes on Successful Specification and Use of the IPMVP:

Successful use of the IPMVP and the specification of a M & V method (e.g. IPMVP Option B) requires at least the following:

- State the document to be referenced, e.g. the IPMVP.
- State which option and method from the document will be used, e.g., Option B with post-installation metering of operating hours.
- Indicate who will conduct the M & V.
- Define the details of how calculations will be made.
- Specify metering to be conducted including information on the equipment, calibration, location of measurements, metering period, etc.
- Define key assumptions to be made about significant variables or unknowns.

[*] By using metering data to commission and optimize the performance of building systems, the City of San Diego's 73,000 square foot Ridgehaven office building has been able to reduce its kWh per square foot load from an already phenomenal 9 kWh at initial occupancy in 1996 to an amazing 6.5 kWh in 1999, saving the City over $80,000 per year in energy costs.

- Define the level of accuracy to be achieved, if not for the entire analysis, at least for key components;
- Indicate how quality assurance will be maintained and repeatability confirmed.
- Indicate reports to be prepared, their contents, and when they are to be provided.

G. Note on Energy Estimating/Simulation Tools:

It is expected that mutually agreed upon, widely accepted, and validated computer-based estimating tools will be used. Typically, more complex or demanding analysis will produce more precise analyses upon which to measure energy conservation measure and design strategy performance.

H. Read the IPMVP

At a minimum, project participants should read IPMVP Sections 3.0, 6.0, and Appendix II in order to become familiar with M&V concepts and approaches to implementing M&V.

M&V is analogous to building commissioning, but is intended to help preserve energy and water usage efficiency gains are over the long term. The IPMVP suggests parties enter into performance contracts, where the M&V contractor is paid based on the amount of energy and/or water saved, rather than typical fee-for-service contracts where a contractor's payments are not related to the performance of the installed systems. The IPMVP not only provides guidance on how to implement M&V, but it also provides guidance on establishing and carrying out contractual relationships related to M&V.

The latest version of the IPMVP and drafts of new section to be added may be downloaded from the following website: www.ipmvp.org

End of Section

SECTION 01 10 00 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

A. Project Identification: Project consists of the construction of a new [ ] ± sq ft [ ] facility.
   1. Project Location: [Street & City Address], Montgomery County, Maryland.
   2. Owner: Montgomery County, Maryland.

B. Design Team Identification:
   1. Architect: [Name, Address, Phone No, Fax No., E-mail address.]
   2. Civil Engineer: [Name, Address, Phone No.].
   3. Structural Engineer: [Name, Address, Phone No.].
   4. Mechanical & Plumbing Engineer: [Name, Address, Phone No.].
   5. Electrical Engineer: [Name, Address, Phone No.]

C. The Work includes, but is not limited to, [ ].

D. The Project has been designated as one requiring “Special Inspections” by the Montgomery County Department of Permitting Services. The Contractor is required to abide by all requirements of the Special Inspections program including but not limited to: Reading and signing the Statement of Special Inspections in order to get the Building Permit, performance of its responsibilities concerning special inspections, testing and certifications per the Statement, and preparation and submittal of required documentation in order to obtain the Use and Occupancy Permit.

E. The Contract Documents showing the existing construction of the facility were developed from historic documents and from limited field observations by the Architect and its consultants. Actual conditions may vary from those shown. Hidden conditions may be discovered over the course of the work. Further investigations may uncover conditions which may require remedial attention prior to proceeding with demolition or construction. Contractor shall be aware of the need to proceed with diligence and care and shall notify Architect of conditions which do not reflect those indicated or which require further testing and repair prior to proceeding. Contractor shall correct conditions that are detrimental to timely and proper execution of the Work. Contractor shall not proceed until unsatisfactory conditions have been corrected. Commencement or continuation of work constitutes acceptance of conditions and responsibility for satisfactory performance.

1.3 CONTRACT

A. Work will be performed under a general construction contract.

1.4 USE OF PREMISES

A. Use of Site: Limit use of premises to work in areas indicated on the Contract Documents and as permitted by law, ordinances and permits. Do not disturb portions of site beyond areas in which the Work is indicated.
   1. Limits: Confine construction operations to designated areas indicated on Drawings. Use of the existing [ ] site is prohibited. Vehicle access from [ ] Avenue and contractor parking on the

existing parking lot at [ ] is strictly prohibited.

2. Owner Occupancy: Allow for Owner occupancy of the existing building and use by the public.
3. Access: At all times, provide Architect/Engineer and Owner easy and safe access to the Work.
3. Driveways and Entrances: Keep driveways and entrances serving the premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

. Construction Parking: [On-site parking for construction personnel outside the limits of disturbance will not be available.] [Contractor permitted to park in any legal location.] [Refer to Drawings for allowable parking locations within the limits of disturbance. Arrangements for additional off-site parking and transportation to the site for construction personnel will be required by the Contractor.]

C. Site Access and Staging Area: Contractor may access site from [ ], and may use [ ] for temporary staging construction activities, as indicated on the drawings and approved by the Owner. The Contractor will be required to coordinate its activities with the Owner and [ ]. If needed, Contractor shall obtain and pay for additional storage or work areas needed for operations.

D. Crane Use and Storage: Contractor will be allowed [ ] to house the crane operations. Contractor shall provide a temporary green screen chain link fence around the crane at all times. Obtain Owner and regulatory approval for any crane swing outside work area.

E. Contractor shall provide barriers, protections, warning lines, signs, lighting and personnel to segregate work areas from pedestrian or vehicular traffic and to prevent damage to the building, adjacent buildings, paved areas and surrounding landscaping. Contractor shall repair any damage incurred to existing facility elements resulting from construction activities as soon as possible after occurrence of damage. All applicable O.S.H.A., M.O.S.H. and Montgomery County Government (MCG) requirements shall be observed by Contractor.

F. Working Hours including Noise Restrictions: The standard permitted Working Hours shall be between 7:00 a.m. and 4:00 p.m. Monday through Friday exclusive of County holidays. See General Conditions for additional information. In addition to standard work hour restrictions, the Contractor shall comply with the Montgomery County Department of Environmental Protection’s permissible noise levels for construction activities during the hours of 7:00 am to 9:00 pm, Monday through Friday, and 9:00 am to 3:00 pm on Saturday. Noise generated by construction activities beyond these hours is strictly prohibited.

G. Phasing: Phase 1: All Contract Work designated as Phase 1 on the drawings shall be Substantially Completed within the first 120 calendar days of construction activity (120 calendar days following Notice to Proceed). The boundary of this area shall include the limits of disturbance outside the lease line boundary. The Contractor is required to complete all Work, receive all required approvals and inspections, remove all sediment control measures and temporary construction material and barriers, reinstall all required security/visual barriers at the lease line perimeter and provide a fully stabilized Phase 1 site area prior to the 120 calendar day end. Upon completion of Phase 1, the Contractor will not be permitted to occupy or utilize the Phase 1 area. The warranty period for Phase 1 shall not begin until both Phase 1 and Phase 2 are Substantially Completed. Phase 2 Work: All remaining Contract Work shall be Phase 2 Work and shall be completed within the total Contract Time.

H. Security: Refer to Section 01 50 00 for required construction fence and other security requirements.

I. Signage: Refer to Section 01 50 00 for Construction and Project Signs.

J. Utility Shutdowns: Obtain written approval from the Owner for any required shutdown or outage of any utility. Schedule any outages to minimize impact on existing operations. Comply with all applicable codes and ordinances.

K. Keep project site clean. Remove trash daily.

1.5 WORK UNDER OTHER CONTRACTS

A. Owner plans to award separate contracts for other construction work at Project site to be conducted simultaneously with work under this Contract. These contracts include, but are not limited to, the following:
   1. Food Service Equipment: A separate contract will be awarded to furnish and install food service equipment. Specifications for food service equipment are included in the Project Manual for mechanical and electrical rough-in requirements by Contractor.
   2. Telephone and Data: A separate contract will be awarded to provide telephone, data and/or other telecommunication wiring and equipment. Contractor shall provide empty conduits and junction boxes, as shown on the Contract Documents..
   3. A separate contract will be awarded to provide inspection and testing not included in the Contract Documents.
   4. A separate contract will be awarded to manage commissioning. See Contractor commissioning requirements elsewhere in the Contract Documents.
   5. A separate contract will be awarded to provide loose furniture and equipment not included in the Contract Documents.
   6. Owner may also award separate contracts for miscellaneous construction items at Project site including, but are not limited to, [ ].

B. Cooperate fully with these separate Owner-hired contractors so work on those contracts can be carried out smoothly, without interfering with or delaying work under this Contract. Refer to Article 7 of the General Conditions of Contract for specific information concerning this issue.

1.6 OWNER-FURNISHED PRODUCTS

A. The following shall apply to Owner-furnished products:
   1. Products noted as “Owner furnished” shall be furnished by the Owner and installed by the Contractor.
   2. Products noted as “Owner furnished and Owner installed” shall be furnished and installed by the Owner.

B. For Owner-furnished products installed by the Contractor:
   1. Owner will provide Contractor with any shop drawings and/or product data as required for the installation of the Owner-furnished items. The Contractor shall review shop drawings and/or product data and shall promptly notify the Architect/Engineer and the Owner of any concerns or anticipated problems with installation and/or use of each item.
   2. Owner will coordinate with Contractor to furnish Contractor the anticipated delivery date for Owner-furnished products. Using Owner-furnished delivery dates, Contractor shall designate delivery and installation dates of Owner-furnished items in the Contractor's Construction Schedule.
   3. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule as approved by the Owner. The Work includes the Contractor providing support to receive and handle Owner's products at project site. Contractor shall arrange for the disposal of any packing material, boxes, etc. associated with Owner-furnished items.
   4. After delivery, Owner and Contractor will jointly inspect delivered items for completeness and any damage.
   5. If Owner-furnished items are damaged, defective, or missing, Owner will, at its option, arrange for replacement or direct to install product as received.
   6. Contractor is responsible for protecting Owner-furnished items from damage during site storage, handling including damage from exposure to the elements, and installation. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall replace them or repair them to Owner satisfaction.
   7. Owner is responsible for manufacturer’s warranties, inspections and service.

B. For Owner-furnished products installed by the Owner:
   1. Site Access: Provide access to Project site for Owner's construction forces.
   2. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
      a. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
      b. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

C. Furniture and Loose Equipment: The Owner will provide and install furniture and loose equipment denoted as “NIC” on the Contract Documents.

D. Reports of Subsurface Explorations and Geotechnical Engineering Analyses: Copies of the Owner’s Geotechnical borings, reports and analyses will be provided upon request to the Bidder/Contractor provided the Bidder/Contractor signs a Release Form per the Contract Documents.

1.7 PERMITS

A. Refer to General Conditions for Owner-obtained and for Contractor-obtained permits.

1.8 TAXES

A. Refer to General Conditions

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

SECTION 01 22 00 - UNIT PRICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for unit prices.

B. Related Sections include the following:
   1. Division 1 Section "Contract Modification Procedures" for procedures for processing changes.

1.3 DEFINITIONS

A. A Unit price is an Owner-established amount stated on the following Schedule of Unit Prices to be used as a price per unit of measurement for referenced materials or services added to or deducted from the Contract by appropriate Contract Modification. <u>Unit prices are applicable for change work only</u> and are not utilized in the Base Bid work.

B. By submitting a bid, the Contractor acknowledges acceptance of the established Unit Prices for their use in determining the value of change work. Prices as stated will remain in effect until final completion of the Contract.

C. Performance of Work not authorized by a Change Order or Field Order, whether or not such work is set forth hereunder as a Unit Price item, shall not be considered cause for extra payment beyond the Contract Sum. The Schedule of Unit prices has no impact, effect, or role on Base Contract Work

1.4 PROCEDURES

A. Unit prices include all Contractor cost/credit for indicated unit of work including, but not limited to costs for: material, labor, tools, equipment, delivery, handling, protection, supervision, installation, testing, insurance, bond, taxes, overhead, and profit.

B. Measurement and Payment: Contractor shall be responsible for measurement of Change work performed utilizing unit prices; however, the Contractor must notify the Architect/Engineer and Owner in sufficient time prior to commencing this work to allow proper Owner monitoring of any measurements. Only quantities which have been approved in writing by the Owner will be considered in any Contract Modification. Payment for change work will be per Division 1 Section "Contract Modification Procedures".

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor.

D. All change work performed utilizing unit prices shall be done per Contract Documents. Unit prices are for work in place, unless noted otherwise.

E. Schedule of Unit Prices: A Schedule of unit prices is included below.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES [*edit for project; use current costs*]

No.	Description	Unit	Unit Cost
1	Earth Excavation – Machine	Cu. Yd.	$2.00
2	Earth Excavation - Hand	Cu. Yd.	$10.00
3	Excavate and remove unsuitable material from site	Cu. Yd.	$12.00
4	Furnish, deliver, spread & compact imported fill material	Cu. Yd.	$12.00

END OF SECTION

SECTION 01 23 00 - ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for provision of additive and/or deductive Alternates. The Owner may elect to add and/or deduct the specified Alternates to the work in consideration for a change to the Contract Sum without a change in the Contract Time. The Owner may elect to accept any combination of alternates.

B. Bidders must submit, with their bids, prices for all Alternates listed in the Schedule of Alternates and the Proposal Form. If Alternates are accepted by the Owner, they will be indicated in the Contract and the Contract Sum will be adjusted by the amount provided on the Proposal Form.

1.3 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Alternate prices shall include <u>all</u> costs to implement the Alternate work including but not limited to costs for: material, equipment, labor, delivery, installation, insurance, overhead, profit and taxes.

C. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

B. Execute accepted alternates under the same conditions as other work of the Contract.

C. Schedule: A Schedule of Alternates is included at the end of this Section. The Contract Documents, whether referenced in the Schedule or not, specify requirements to perform the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. ALTERNATE NO. 1 - TITLE
1. Base Bid: EXPLAIN.
2. Alternate No. 1: EXPLAIN.

B. ALTERNATE NO. 2 - TITLE
1. Base Bid: EXPLAIN.
2. Alternate No. 2: EXPLAIN.

C. ALTERNATE NO. 3 - TITLE
1. Base Bid: EXPLAIN.
2. Alternate No. 3: EXPLAIN.

END OF SECTION

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications. Articles 11 and 12 of the General Condition of Contract contain detailed contractual requirements for Contract Modifications which must be followed in addition to requirements in this Section.

B. Related Sections include the following:
   1. Division 1 Section "Product Requirements" for administrative procedures for handling requests for substitutions made after Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect/Engineer may issue Supplemental Instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time. If the Contractor contends that any Supplemental Instructions constitute a Change, it shall notify the Architect/Engineer and Owner of such within the time limit specified in the General Conditions of the Contract and shall prepare a Contractor-Initiated Proposal as indicated in 1.4.B below.

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: For any Owner-initiated proposal requests, the Architect/Engineer or the Owner will issue a detailed description of any proposed change in the Work that may require adjustment to the Contract Sum and/or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Proposal Requests issued by Architect/Engineer or Owner are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
   2. Within the time specified in Proposal Request after receipt of Proposal Request, submit a quotation indicating the adjustments to the Contract Sum and/or the Contract Time necessary to execute the change.
      a. For any requested change to the Contract Sum, the Contract must provide a detailed cost breakdown of all costs/credits required to perform the change. Cost breakdown shall include but not be limited to: defined material and equipment costs including quantities and unit costs with trade discounts, defined labor costs including man-hours and hourly rates, applicable taxes, delivery charges, profit, overhead, bond, and insurance costs. If requested, furnish survey data to substantiate quantities.
      b. For any requested extension to the Contract Time, the Contractor must provide the information specified in Article 11 of the General Conditions of Contract including an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Proposals: If latent, unforeseen, or other conditions (including Contract Document deficiencies) require a Contract modification, the Contractor shall submit a request for a change.

1. If the Contractor discovers a condition, requiring a Contract Modification, that requires technical direction from the Architect/Engineer and/or the Owner, the Contractor shall immediately notify the Architect/Engineer and the Owner of such. If the Owner concurs, an Owner-initiated Proposal Request will be generated and the procedure outlined in 1.4.A above will be followed.
2. If the Contractor discovers a condition requiring a Contract Modification but not requiring technical direction, the Contractor shall issue a statement to the Owner and Architect/Engineer outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
3. For any requested change to the Contract Sum, the Contract must provide a detailed cost breakdown of all costs/credits required to perform the change. Cost breakdown shall include but not be limited to: defined material and equipment costs including quantities and unit costs with trade discounts, defined labor costs including man-hours and hourly rates, applicable taxes, delivery charges, profit, overhead, bond, and insurance costs. If requested, furnish survey data to substantiate quantities.
4. For any requested extension to the Contract Time, the Contractor must provide the information specified in Article 11 of the General Conditions of Contract including an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
5. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.

1.5 CHANGE INSTRUMENTS

A. Changes in the scope of the Contract may be effected only by a written Amendment signed by the Owner and Contractor. Changes in the Work which are within the general scope of the Contract may be effected by a written and executed Change Order or Field Order.

B. Change Order: A Change Order is a written order signed by the Owner (Director, Office of Procurement) directing the Contractor to perform a Change in the Work. If time or circumstances do not allow issuance of a Bilateral Change Order (i.e. signed by Owner and Contractor), the Owner will issue a Unilateral Change Order (i.e. signed by Owner only) directing a Change. The Contractor must proceed diligently with the Change work upon receipt of any executed Change Order. A Change Order may be used to adjust the Contract Sum and/or the Contract Time.

C. Field Order: A Field Order is a written instruction issued by the Owner (Contract Administrator) to the Contractor directing a change in the Work when unforeseen and unanticipated conditions arise which require immediate action to mitigate costs or avoid delays. It may provide for additional compensation to be paid to the Contractor (outside of the Contract), but does not change the Contract Time or Contract Sum. If time or circumstances do not allow issuance of a Bilateral Field Order (i.e. signed by Owner and Contractor), the Owner will issue a Unilateral Field Order (i.e. signed by Owner only) directing a Change. The Contractor must proceed diligently with the Change work upon receipt of any executed Field Order.

1.6 COORDINATION

A. Promptly, and before the next Application for Payment submission, revise the Schedule of Values and

Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum as shown in the Change Order. Record and invoice Field Order amounts separately.

B. Promptly, and before the next Progress Schedule submission. revise the project Progress Schedule to reflect any change in Contract Time authorized by Change Order; revise schedule to adjust times for other items of work affected by the change.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:
   1. Division 1 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   2. Division 1 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.
   3. Division 1 Section “Contractor Quality Control” for additional requirements for payments.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor, and approved by the Architect/Engineer and the Owner, allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing and processing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with Continuation Sheets.
      b. Submittals Schedule.
   2. Submit the Schedule of Values to Architect/Engineer and Owner for approval within 15 days after issuance of Notice to Proceed and at least seven (7) days before initial requisition for payment. The Schedule of Values must be approved prior to approval of contractor’s initial requisition for payment.
   3. Subschedules: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values correlated with each phase of payment.

B. Format and Content: The breakdown values in the Schedule of Values must be true and accurate and consistent with actual project costs incurred. Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location.
      b. Name of Architect/Engineer.

c. Architect/Engineer's project number.
d. Contractor's name and address.
e. Date of submittal.

2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.
    f. Change Orders (numbers) that affect value.
    g. Dollar value; and percentage of the Contract Sum to nearest one-hundredth percent adjusted to total 100 percent.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site; see 1.4.C below.
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
    a. Major temporary facilities and other overhead cost items that are not a direct cost of actual work-in-place shall be shown as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update the Schedule of Values before each Application for Payment when Change Orders and/or Contract Amendments result in a change in the Contract Sum. Field Orders do not change the Contract Sum and should not be listed in the Schedule of Values.

C. Off-Site Storage: Payment will not be made for materials and equipment stored off the site, except at Owner's sole discretion and prior approval. In general, material stored out of the County will <u>not</u> be approved for payment. If the Owner allows off-site storage, the corresponding Application shall be accompanied by:
1. Statement describing and quantifying the item(s) being stored,
2. Statement certifying location of the bonded warehouse(s) where materials or equipment is being stored,
3. Signed Affidavit of Storage,
4. Certificate of Insurance,
5. Bill of Sale <u>made to Owner</u> and
6. Statement certifying that item, or any part thereof, will not be installed in any construction other than work under this Contract.

Any approved material stored offsite shall be made available for inspection by the Architect/Engineer or Owner prior to payment.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect/Engineer and paid for by Owner. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

B. Payment Application Times: Unless noted otherwise, applications for payment shall be made monthly, near the end of each month. The period of construction work covered by each Application for Payment will usually be the preceding month. In order to expedite the review and approval of each application for payment, submit to and review with the Architect/Engineer and the Owner a draft (pencil copy) of each application for payment prior to submitting a formal copy.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as the forms for Applications for Payment. Equivalent forms will be considered at Contractor's request.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect/Engineer will return incomplete applications without action.
   1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions have been made.
   2. Include amounts of Change Orders issued before the last day of construction period covered by application.

E. Transmittal: Submit five (5) signed and notarized original copies of each Application for Payment to Architect/Engineer by a method ensuring receipt within 24 hours. Upon Owner request, each application shall include Subcontractors' and Material Suppliers' waivers of liens. Provide required quality-control documentation and similar required documentation such as an updated Progress Schedule. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Waivers of Mechanic's Lien: Upon Owner request, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors and suppliers.
   2. Approved Schedule of Values [Schedule of Values to be submitted to and approved by Architect/Engineer and Owner prior to submission of first application for payment.]
   3. Contractor's CPM Construction Schedule.
   4. Products list.
   5. Submittals Schedule (preliminary if not final).
   6. List of Contractor's staff assignments and principal consultants.
   7. Copies of trade permits, authorizations and licenses from authorities having jurisdiction for performance of the Work.
   8. Initial progress report.
   9. Data needed to acquire Owner's insurance.
   10. Contractor's Quality Control Plan.

H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the

Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
3. Contractor's request for partial release of retainage at Substantial Completion should be made separately from progress application for payment.

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of all Project closeout requirements including completion of all punchlist items.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. All required warranties
5. Updated final statement, accounting for final changes to the Contract Sum.
6. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
7. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
8. AIA Document G707, "Consent of Surety to Final Payment."
9. Evidence that claims have been settled.
10. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
11. Final liquidated damages settlement statement.
12. Certificate of Final Completion
13. Certification of satisfaction/release of all Permits including the Storm Water Management Permit.
14. Removal of all temporary facilities, utility service connections, surplus materials, rubbish and similar materials.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. General project coordination procedures.
   2. Coordination Drawings
   3. Coordination of Space.
   4 Administrative and supervisory personnel.
   5 Project meetings.
   6. Requests for Information.
   7. Field Survey and Layout

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Division 1 Section "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
   2. Division 1 Section "Submittal Procedures" for submitting shop drawings.
   3. Division 1 Section "Closeout Procedures" for coordinating Contract closeout.
   4. Division 1 Section "Contractor Quality Control" for meetings to satisfy CQC Program.

1.3 GENERAL COORDINATION

A. Coordinate procurement and construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.

B. Coordinate construction operations by each subcontractor with those of other subcontractors and entities to ensure efficient and orderly installation of each part of the Work. The Contractor and each subcontractor shall coordinate its operations with operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

C. If necessary, prepare documentation for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Preparation of Quality Control Program
4. Installation and removal of temporary facilities and controls.
5. Delivery and processing of submittals.
6. Progress meetings.
7. Pre-installation conferences.
8. Project closeout activities.

E. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate location of fixtures and outlets with finish elements. Bring unconcealed conditions indicated to the attention of the AE for confirmation of intent.

F. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.4 COORDINATION DRAWINGS [*Edit for Project requirements*].

A. General:

1. Submit required coordination drawings to Architect/Engineer and Owner for record only within 60 days of Notice-to-Proceed. Coordination drawings are not shop drawings and will not be accepted or approved by the Architect/Engineer or Owner.
2. Coordination drawings shall show the relationship and integration of different construction elements that require careful coordination during fabrication or installation to fit in space provided and/or to function as intended.
3. Except as otherwise specified, prepare composite coordination drawings to scale of 1/4"=1’-0" or larger; detailing major elements, components, and systems of utilities, architectural, structural, mechanical, and electrical elements, equipment and materials in relationship with each other. Include dimensions.
4. Provide coordination drawings utilizing different colors to illustrate work of separate trades or systems.
5. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to efficient flow of Work affecting one or more trades.
6. Indicate scheduling, sequencing, movement, and positioning of large equipment into building during construction.
7. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
8. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communications systems components, sprinklers, and other ceiling-mounted devices.
9. Show interrelationship of components to be shown on separate Shop Drawings.

10. Indicate required installation sequences.

B. Site Utilities: The coordination drawings shall include, but not be limited to, the following site utilities:

1. Water Distribution: Indicate pipe sizes, valve and meter locations, underground structures, connections, anchors, and reaction backing. Indicate spatial relationship between piping and other piping in same trench, and proximate structures.
2. Sanitary Sewerage: Indicate pipe sizes, manholes, locations and elevations, underground structures, and connections. Indicate spatial relationship between piping and other piping in same trench, and proximate structures.
3. Natural Gas Distribution: Indicate pipe sizes, valves, gas meters, and specialties. Include details of underground structures and piping. Show other piping in same trench and clearances from natural gas piping. Indicate interface and spatial relationship between piping and proximate structures.
4. Electrical and Communications: Indicate manholes and other structures, conduit and ductbank sizes, locations, and elevations. Include details of underground structures and connections. Indicate spatial relationship between conduit and other piping in same trench, and proximate structures.
5. Storm Drainage: Indicate pipe sizes, manholes and catch basins locations and elevations. Include details of underground structures and connections. Show other piping in the same trench and clearances from storm sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.

a. Profile Drawings: Show system piping and conduits in elevation. Draw profiles at a horizontal scale of not less than 1 inch equals 50 feet and a vertical scale of not less than 1 inch equals 5 feet. Indicate pipe, conduit and underground structures. Show types, sizes, materials, and elevations of all crossing utilities on profile

C. Structural Systems: Include, but do not necessarily limit to following:

1. Structural frame showing interface with exterior elements.
2. Location of openings in relation to structure.
3. Show attachments to decking, structural elements, and other systems.

D. Above Ceiling Coordination:

1. Work by all above ceiling trades, especially work located by the Contractor (i.e. sprinkler pipes, conduit runs, etc.) must be carefully coordinated by the Contractor, prior to shop drawings submissions to assure that all work will fit in the space available.
2. The Contractor shall prepare above ceiling coordination drawings for all ceilings and all other ceiling space within 60 days of notice to proceed. The drawings should show all above ceiling work, and structure, with required clearances and dimensions shown. The drawing should also show exposed ceiling work. Drawings must locate all ductwork, pipes, and conduit. In preparing these drawings, verify structural conditions, and requirements of all above ceiling trades. All above ceiling work and exposed ceiling work must be fully coordinated by the Contractor, prior to submitting shop drawings for affected items.
3. Submit the coordination drawings to the Architect/Engineer and Owner for record but not review. No additional compensation will be paid to correct work that does not fit in the space available, due to inadequate coordination by the Contractor, or that could have been resolved in the coordination drawing. Bring any discrepancies to the Architect/Engineer’s attention for resolution at the time of submitting the coordination drawings.
4. The Contractor should hold a pre-installation meeting with all subcontractors involved in the above ceiling and exposed ceiling work. Review the coordination drawing requirements,

plans, specifications, and proposed work sequencing and schedule. Resolve any problems or discrepancies prior to proceeding with the work.

E. Mechanical Systems: Include, but do not necessarily limit to, following:
   1. Proposed locations of piping, ductwork, equipment, and materials.
   2. Proposed locations for access panels and doors.
   3. Clearances for installing and maintaining insulation.
   4. Clearances for servicing and maintaining equipment, including coil removal, filter removal, and space for equipment disassembly required for periodic maintenance. Show access locations.
   5. Equipment connections and support details.
   6. Exterior wall and foundation penetrations.
   7. Fire-rated wall and floor penetrations.
   8. Sizes and location of required concrete pads and bases.
   9. Valve stem movement.

F. Electrical Systems: Include, but do not necessarily limit to, following:
   1. Proposed locations of major raceway systems, equipment, and materials.
   2. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance. Show access locations.
   3. Exterior wall and foundation penetrations.
   4. Fire-rated wall and floor penetrations.
   5. Equipment connections and support details.
   6. Sizes and location of required concrete pads and bases.

G. Notify Architect of conflicts and other coordination issues requiring resolution prior to commencing construction in each affected area. Respond to Architect/Engineer’s requests for information concerning the coordination drawings

H. Transmit copies of final coordination to all interested parties including all concerned subcontractors. Keep a copy of all final coordination documents in the contractor’s field office; make available for review and use by Architect/Engineer and Owner during construction.

1.5 COORDINATION OF SPACE

A. Coordinate use of ceiling space in accordance with the submitted ceiling coordination drawings.

B. Coordinate use of Project space and sequence of installation of plumbing, fire protection, mechanical and electrical Work. Follow routings shown for pipes, ducts, and conduits as closely as practicable, with due allowance for available physical space; place runs parallel with building lines. Utilize space efficiency to maximize accessibility for other installations, maintenance, and repairs.

C. Layouts of plumbing, fire protection, mechanical, and electrical systems, equipment, fixtures, piping, ductwork, conduit, specialty items, and accessories indicated on Drawings are diagrammatic. Contractor shall make minor variations in alignment, elevation, and details required to avoid interference and to satisfy architectural and structural limitations.

D. Prior to installation of material and equipment, review and coordinate Work with Architectural and Structural Drawings to establish exact space conditions. Where available space is inadequate or where reasonable modifications are not possible, request information from Architect/Engineer before proceeding.

E. Coordinate installation to prevent conflicts and cooperate in making, without extra charge, reasonable modifications in layout as needed.

F. Provide clear access to control points, valves, strainers, control devices, and specialty items of every nature related to such systems and equipment to obtain maximum head room. Provide adequate clearances as necessary for operation and maintenance.

1.6 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

A. General: In addition to project manager, project superintendent and Quality Control manager, provide other administrative and supervisory personnel as required for proper performance of the Work. Within 15 days of Notice-to-Proceed, submit to Architect/Engineer and Owner a list of principal Contractor staff assignments, including superintendent, project manager, Quality Control manager and other supervisory personnel in attendance at Project site. Identify individuals and their duties and responsibilities; mailing addresses, office telephone numbers, cell telephone numbers, fax numbers, and email addresses. Provide names, addresses, telephone numbers, fax numbers, and email addresses of individuals assigned as standbys in the absence of individuals assigned to Project.

B. Post a copy of the list in the Contractor’s Field Office.

1.7 PROJECT MEETINGS

A. Pre-construction Conference: The Owner will schedule a pre-construction conference before starting construction, at a time convenient to Contractor, but no later than 10 days after Notice-to-Proceed. The Architect/Engineer will preside at the meeting, record minutes of significant proceedings and decisions, and distribute minutes to participants within 7 days after the meeting. The conference will be held at the Owner’s office, the Project Site, or other convenient location. The meeting will be conducted to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Architect/Engineer, and their consultants; Contractor and its project manager, superintendent, and Quality Control Manager; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

   a. Designation of responsible personnel.
   b. Procedures for Project correspondence and communications
   c. Procedures for processing Requests for Information
   d. Procedures for processing Changes to the Work.
   e. Procedures for processing Applications for Payment.
   f. Submittal procedures.
   g. Initial construction schedule; procedures for processing CPM Schedules and Updates
   h. Critical work sequencing; long lead time items.
   i. Contractor’s Quality Control Plan
   j. Commissioning requirements
   k. Use of the premises by Contractor and others.
   l. Parking availability.

m. Working hours.
n. Project Phasing (as applicable).
o. Temporary construction facilities and controls.
p. Temporary utilities
q. Schedule for progress meetings
r. Office, work, and storage areas.
s. Equipment deliveries and priorities.
t. Security.
u. Safety (including first aid)
v. Coordination with Testing and Inspection Agencies
w. Housekeeping (cleaning) procedures.
x. List of Subcontractors
y. Contract Completion and Closeout Requirements
z. Procedures for Record Documents.

B. Special Inspections Pre-construction Conference

1. In accordance with the, Building Permit, and the requirements of the County's Department of Permitting Services, a pre-construction conference(s) will be conducted by the County to review the procedures and work required under the Special Inspections Program.

2. Suggested Agenda:
   a. Discuss the County's requirements for Special Inspections.
   b. Review proposed Inspection Plan.
   c. Examine credentials of proposed inspection professionals and testing laboratories.
   d. Reach an agreement on the Statement and the Schedule of Special Inspections.
   e. Discuss detection and reporting of critical problems.
   f. Discuss notification to the County of changes in critical services.
   g. Review requirements for testing, inspection, observation, reports and certification by the different entities involved.

3. Attendance: The following shall attend the pre-construction conference:
   a. Architect.
   b. Owner's Representative.
   c. Structural Engineer of Record.
   d. General Contractor.
   e. Special Inspector
   f. Professional in charge of Architectural Inspections.
   g. Geotechnical Inspector; Professional in charge of Geotechnical Services.
   h. Professional in charge of Structural Inspections (if different from Special Inspector)
   i Professional in charge of Materials Testing Laboratory (if different from Special Inspector).
   j. County DPS Representative for Special Inspections

C. Pre-installation Conferences: Schedule and conduct pre-installation conferences at the Project site before start of each construction activity that requires coordination with other construction.
1. Attendees: Following shall attend the meeting:
   a. Contractor's Superintendent,
   b. Contractor's Quality Control Manager (presides over meeting and is responsible for meeting minutes),
   c. Owner's Construction Representative,

d. Installer (subcontractor),
e. Representatives from Testing Agencies
f. Representatives of manufacturers and fabricators involved in or affected by the activity,
g. Representatives of subcontractors that have preceded or will follow the activity or are otherwise affected by the activity, and
h. Others as appropriate to activity

Provide 48-hour (2 work days) written notice to the Architect/Engineer and the Owner Project Manager of all pre-installation conferences. They may attend as appropriate.

2. Agenda: Review the progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. Contract Documents; requirements for proper installation.
   b. Related Change Orders.
   c. Purchases and deliveries
   d. Approved Submittals including shop drawings, product data and quality-control samples
   e. Review of mockups.
   f. Possible conflicts and material compatibility problems.
   g. Time schedules for activity, project schedule
   h. Weather limitations.
   i. Manufacturer's written recommendations.
   j. Warranty requirements.
   k. Acceptability of substrates.
   l. Temporary facilities and controls.
   m. Space and access limitations.
   n. Regulations of authorities having jurisdiction.
   o. Testing and inspecting requirements including coordination with testing/inspection agencies.
   p. Required performance results.
   r. Documentation requirements.
   s. Protection of construction, adjacent work, and personnel.
   t. Required Environmental Conditions for work
   u. Safety.
3. Record significant conference discussions, agreements, and disagreements of each conference. Provide copy of record to everyone involved and Owner and Architect/Engineer
4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Architect/Engineer will be conduct progress meetings at the Project Site bi-weekly, unless otherwise directed. Days and times for meetings will be mutually agreed upon. Contractor shall provide site facilities for meetings.
   1. Architect/Engineer will preside at progress meetings, record significant proceedings and decisions, and will distribute copies of meeting minutes to the Owner, Architect/Engineer, Design Consultants, and Contractor within 5 days after meeting. Contractor shall copy and distribute minutes to subcontractors, suppliers, and others as appropriate.
   2. Attendees: In addition to representatives of the Owner, the Architect/Engineer, and the Contractor (including the Job Superintendent, Quality Control Manager and Project Manager), each subcontractor, supplier, or other entity concerned with current progress or involved in planning, coordination, or performance of near-future activities shall be represented at these meetings. When requested by the Owner, the Contractor's CPM Scheduler shall attend

progress meetings. All participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

3. Agenda will generally include the following:
   a. Review, edit and approve minutes of the previous progress meeting.
   b. Review items of significance that could affect progress including any issues needing Owner and/or Architect/Engineer action to prevent delays.
   c. Include topics for discussion as appropriate to the status of the Project.
   d. Review Work progress, since the last meeting, compared against the latest approved Construction Schedule. Determine status of each current and near-future activity on the schedule to determine whether it is on time, ahead of schedule, or behind schedule. Pay especial attention to Critical Path items. Include Procurement activities (including fabrication and delivery dates) in the review.
   e. Corrective measures and procedures required to maintain Construction Schedule, if activities are behind schedule.
   f. Work scheduled for succeeding construction period (usually two weeks)
   g. Field observations and problems with proposed solutions. Review Contract deficiencies with regards to quality, safety, manpower, supervision, etc. Include report by Quality Control Manager.
   h. Status of Submittals (current log to be provided by Contractor).
   i. Status of Proposed Changes to the Work (current log to be provided by Contractor)
   j. Status of Requests for Information (current log to be proved by Contractor)
   k. Review of preliminary payment requests (as appropriate).
   l. Site Walk-through of the in-progress Work including site review of issues discussed during progress meeting. Walk-throughs shall be attended by, at a minimum: Contractor Superintendent, Contractor Project Manager, Architect/Engineer and Owner.

E. Coordination Meetings: Conduct Project coordination meetings for all parties (subcontractors, suppliers, etc.) involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.
   1. Attendees: Representation at each meeting by every party (Contractor, subcontractor, supplier, etc.) currently involved in construction activities. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work
   2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

F. Construction Quality Control Meetings: Conduct and attend meetings required by Section 01 45 00, Construction Quality Control.

G. Commissioning Meetings: Conduct and/or attend meetings required by the Commissioning Plan and/or Commissioning Specification Sections.

H. Special Meetings: Attend special meetings when requested by the Owner at Project Site or Owner's office to discuss specific project concerns. Attendees shall include Contractor project manager or Principal (as requested by the Owner) and any requested Subcontractor project manager or Principal (as requested by the Owner). All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

1.8 REQUESTS FOR INFORMATION

A. In the event that some portion of the Contract Documents requires clarification or interpretation by the Architect/Engineer, submit a written "Request for Information (RFI)" on a form approved by the Architect/Engineer. Requests for Information may only be submitted by the Contractor, not subcontractors, and shall be submitted to the Architect/Engineer and the Owner simultaneously. Clearly and concisely set forth the issue for which clarification or interpretation is sought and why a response by the Architect/Engineer and/or Owner is needed; completely provide all required information on the RFI form. Indicate an interpretation or understanding of the Contract requirement and reasons why such an understanding has been reached.

B. The Architect/Engineer will review all Requests for Information to determine whether they are requests for information within the meaning of the term. If Architect/Engineer determines that the document is not a Request for Information, the request will be returned to Contractor, unreviewed as to content. Any Request for Information to which the Architect/Engineer's response is a readily available Contract Document reference must be noted as such in the RFI Log. A pattern of submitting such unnecessary RFIs may result in a claim by the Owner against the Contractor for delay of the Project.

C. Responses from Architect/Engineer and/or Owner to RFIs do not change the requirements of the Contract Documents. If the Contractor believes that a response to a Request for Information represents a change in the requirements of the Contract Documents, the Contractor shall immediately indicate this by submitting written notice to Architect/Engineer and Owner per the requirements of the General Conditions. Failure to submit written notice immediately shall waive Contractor's right to seek additional time or cost under the General Conditions of the Contract.

D. All submitted RFIs shall bear the signature of the Contractor. For expediency, a RFI may be e-mailed as a Word attachment simultaneously to the Architect/Engineer and Owner; in that case, a "formal" signed RFI shall be forwarded at a later date.

E. Contractor shall maintain a current log of all RFI requests and answers at the Contractor's Field Office; this log shall be made available to the Architect/Engineer or Owner upon request.

1.9 FIELD SURVEY AND LAYOUT

A. Provide all field engineering services required to lay out the Work.

B. Employ a land surveyor registered in the State of Maryland and experienced in providing the specified services, to establish elevations, lines and levels utilizing recognized engineering survey practices.

C. Engage the surveyor to verify existing survey information shown on the Contract Documents including the location and verification of structures, dimensions, elevations, property lines, and indicated permanent benchmarks, control points and reference points. If discrepancies are discovered, notify Architect/Engineer and Owner promptly and before proceeding with affected work.

D. The surveyor shall also establish benchmarks, control points and reference points from which the facility elevations and lines can be determined for each element of the Work. Inform installers of lines and levels to which they must comply.

E. Protect and maintain all benchmarks, control points and reference points established by the surveyor. If survey control points are damaged, moved, or destroyed, engage surveyor to re-establish the control points.

F. The existence and location of utilities and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence, location and elevations of all utilities and other existing construction. Notify Architect/Engineer and Owner immediately in writing of any discovered discrepancies before proceeding with affected work.

G. During the progress of the Work, establish bench marks, reference lines, reference points and levels as necessary for each trade's work (including sitework) and for field verification of construction within specified tolerances. Check the location, level and plumb of every major element as the Work progresses; notify the Architect/Engineer when deviations from required lines and levels exceed allowable tolerances.

H. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect/Engineer or Owner.

I. Upon completion of work, submit two copies of a final survey, each copy certified by the land surveyor, that the location, elevation and dimensions of the buildings and site improvements are accurately constructed in accordance with the Contract Documents. Certified surveys shall be submitted to the Owner and Architect/Engineer for record only, not for review and approval.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

End of Section

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Contractor's Construction Schedule.
   2. Submittals Schedule.
   3. Daily construction reports.
   4. Material location reports.
   5. Field condition reports.
   6. Special reports.
   7. Construction photographs.

1.3 SUBMITTALS

A. Submittals Schedule: Within fifteen (15) days of Notice-to-Proceed, submit four copies of Submittals Schedule; two copies to be retained by the Architect/Engineer, one copy to be retained by the Owner; and one copy that will be returned by the Architect/Engineer for the Contractor's administrative use. Arrange the following information in a tabular format:
   1. Scheduled date for first submittal.
   2. Specification Section number and title.
   3. Submittal category (action or informational).
   4. Name of subcontractor.
   5. Description of the Work covered.
   6. Scheduled date for Architect's final release or approval.

B. Construction Schedule: Refer to Article 11 of the General Conditions of Contract (GCC).
   1. Submit, for Owner approval, Qualification Data for scheduling consultant specified in GCC Article 11 to demonstrate capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other specified information.
   2. Contractor's Initial CPM Construction Schedule: Submit two printed copies and two electronic copies (one each to Owner and Architect/Engineer) of initial CPM construction schedule. Printed copies shall be large enough to show entire schedule for entire construction period. Submit additional sets of initial construction schedule as necessary to obtain Owner and Architect/Engineer approval of initial schedule.

3. CPM Construction Schedule Updates: As required by project conditions, but at least monthly, submit two printed copies and two electronic copies (one each to Owner and Architect/Engineer) of CPM construction schedule update. Printed copies shall be large enough to show entire schedule for entire construction period. Submit additional sets of construction schedule updates as necessary to obtain Owner and Architect/Engineer approval of update. Each update shall include changes to the last approved Schedule Update. Updates are required to be submitted with each contractor's requisition for payments; requisitions will not be processed without corresponding schedule update. Schedule updates shall be submitted at least monthly even if requisitions for payments are not submitted.
4. Written narrative: Concurrent with each CPM schedule submission, submit two printed copies (one each to Owner and Architect/Engineer) of the CPM Written Narrative. The Narrative shall include a summary of changes to logic, duration, etc. since the preceding approved schedule. The Narrative shall also include copies of each computer-generated tabular report specified in GCC Article 11.

C. Daily Construction Reports: Superintendent's and Quality Control Manager's daily reports shall be submitted to the Owner's Construction Representative contemporaneously (within a maximum of two working days). Submit two copies at monthly intervals, to be retained by the Architect/Engineer.

D. Material Location Reports: Submit three copies at monthly intervals, to be retained by the Architect.

E. Field Condition Reports: Submit copies to the Architect and Owner, at time of discovery of differing conditions.

F. Special Reports: Submit copies to the Architect and Owner, at time of unusual event.

1.4 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Refer to Article 11 of the General Conditions of Contract and Paragraph 1.3.

B. *The Schedule for this project shall be man-loaded. [edit for the project]*

C. *The Schedule for this project shall be cost-loaded. [edit for the project]*

2.2 SUBMITTALS SCHEDULE

A. Article 11 of the General Conditions of Contract requires that all Procurement activities, including the Submittals Schedule, be incorporated into the Construction CPM Schedule. The following Submittals Schedule shall be provided consistent with the information in the overall project schedule.

B. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
   1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
   2. Initial Submittal: Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
   3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.3 REPORTS

A. Daily Construction Reports: Contractor Superintendent shall prepare a daily construction report recording the following information concerning events at Project site:
   1. List of subcontractors at Project site. Provide the count of each subcontractor's personnel and the work (identified by Construction Schedule Activity Numbers as appropriate) being done by each subcontractor.
   2. List and count of General Contractor personnel at Project site. Identify the work (identified by Construction Schedule Activity Numbers as appropriate) being done by Contractor's forces.
   3. List of separate contractors at Project site. Include the count of each separate contractor's personnel and the work (identified by Construction Schedule Activity Numbers) being done by each subcontractor.
   4. Total Count of personnel at Project site.
   5. Visits by third parties including utilities, third-party inspectors, etc.
   6. Equipment at Project site (including hours equipment was utilized, idle and down for maintenance)
   7. Material deliveries.
   8. High and low temperatures and general weather conditions, including any weather events requiring stoppage or some or all of the Work
   9. Accidents.
   10. Meetings and significant decisions.
   11. Unusual events (refer to special reports).
   12. Stoppages, delays, shortages, and losses.
   13. Meter readings and similar recordings.

14. Emergency procedures.
15. Orders and requests of authorities having jurisdiction.
16. Change Orders received and implemented.
17. Written Modifications received and implemented.
18. Services connected and disconnected.
19. Equipment or system tests and startups.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals (consistent with the monthly requisition for payment), prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on, and delivery dates for, materials or items of equipment fabricated or stored away from Project site.

C. Field Condition Reports: Immediately upon discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Interpretation (RFI). Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence

2.5 CONSTRUCTION PHOTOGRAPHS *[edit as needed for project]*

A. Employ a qualified independent commercial photographer (minimum of three years' experience in commercial photography), mutually agreeable to Owner and Architect/Engineer, to take construction photographs.

B. Cooperate with photographer; provide access to Work, and reasonable use of temporary facilities including temporary lighting.

C. Take a comprehensive set of photographs, at monthly intervals, from commencement of Work until Substantial Completion of Project documenting the work performed during that month. Submit the photographs, with the monthly requisition for payment, to the Owner and the Architect/Engineer. Photographs shall be submitted monthly even if a requisition for payment is not submitted for that month.

D. Before beginning construction, take photographs of all existing conditions including sitework, existing buildings, structures and utilities. In particular, take photographs of any existing damage or deficiencies in existing conditions, including conditions adjacent to the project site, prior to commencement of work.

E. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.

F. Views
   1. Take photographs from a sufficient number of (at least three) different exterior views and from a sufficient number of interior views to show construction progress. Consult with Architect/Engineer for recommendations on views.
   2. Photograph from locations to factually illustrate condition of construction and state of progress.
   3. To the extent practicable, take successive monthly photographs from the same overall view as preceding monthly photographs.

G. Do not sell or display photographs in publications without permission of Owner.

H. Prints: Provide color prints:
   1. Quantity: 3 prints of each photograph
   2. Brilliance: Glossy
   3. Texture: Smooth
   4. Contrast: High
   5. Size: 8 by 10 inches
   6. Mount prints in clear plastic jackets with 1 inch binding margin at long edge (capable of 3-ring binder storage).
   7. Identify each print on back in lower right-hand corner, listing:
      a. Name of project
      b. Orientation of view including description of vantage point, in terms of location, direction viewed (by compass point), and elevation or story of construction
      c. Date and time of exposure
      d. Photographer's numbered identification of exposure
   8. Deliver one set of prints to Owner and one set to Architect; one set is for Contractor's file.

I. Digital Images: Submit a complete set of digital image electronic files as a Project Record Document on CD-Rom.
   1. Submit images exactly as originally recorded in the digital camera without alteration, manipulation, editing or modification.
   2. Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels and with an image resolution of not less than 1600 x 1200 pixels.
   3. Images shall have same aspect ratio as the sensor, uncropped.
   4. Provide following information:
      a. Date and Time: Include date and time in filename, if photograph is not accurately date stamped by camera.
      b. Orientation of view including description of vantage point, in terms of location, direction viewed (by compass point), and elevation or story of construction,
      c. Unique sequential identifier.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 01320

SECTION 01 32 02

PHOTOGRAPHIC DOCUMENTATION

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:
   1. Periodic construction photographs.

B. Related Sections include the following:
   1. Division 1 Section "Submittal Procedures" for submitting photographic documentation.

1.3 SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same label information as corresponding set of photographs.

B. Construction Photographs: Submit photographic view within seven days of taking photographs.
   1. Digital Images: Submit a complete set of digital image electronic files as a Project Record Document on CD-ROM. Submit images that have same aspect ratio as the sensor, uncropped.
   2. Identification: Provide with the following information:
      a. Date photograph was taken if not date stamped by camera.
      b. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
      c. Unique sequential identifier.

PART 2 -PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than 1600 by 1200 pixels.

PART 3 -EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
   1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
1. Date and Time: Include date and time in filename for each image.
2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.

C. Preconstruction Photographs: Before starting construction, take digital photographs of Project site and surrounding properties from different vantage points.
1. Flag construction limits before taking construction photographs.
2. Take eight photographs to show existing conditions adjacent to property before starting the Work.
3. Take eight photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Historic Materials: Before packing or crating historic materials, take digital photographs from different vantage points to record existing conditions of items to be handled.

E. Periodic Construction Photographs: Take 12 digital photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

End of Section

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

B. Refer to Article 9 of the General Conditions of Contract for additional submittal requirements.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals required for performance of the Work. Contractor shall submit and receive final written Architect/Engineer approval for submittals required by the Contract Documents including as specified herein prior to proceeding with any work affected by the products, components or assemblies to be submitted.

B. Related Sections include the following:

1. *Division 1 Section "LEED Green Building Summary Requirements" for submittals requirements of LEED reporting. [edit for project]*
2. Division 1 Section "Payment Procedures" for submitting Applications for Payment and the Schedule of Values.
3. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes and for submitting Coordination Drawings.
4. Division 1 Section "Construction Progress Documentation" for submitting schedules and reports, including Contractor's Construction Schedule and the Submittals Schedule.
5. Division 1 Section "Quality Requirements" for submitting test and inspection reports and for mockup requirements.
6. Division 1 Section "Closeout Procedures" for submitting warranties, Record Documents and operation and maintenance manuals.
7. Other Specification Sections for specific requirements for submittals in those Sections.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information that requires Architect/Engineer's responsive action.

B. Informational Submittals: Written information that does not require Architect/Engineer's responsive action. Submittals may be rejected for not complying with requirements.

1.4 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination and/or color selection. Architect/Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
   3. Do not submit any submittals for permit unless submittal has been approved by Architect/Engineer.

B. Submittals Schedule: Comply with requirements in Division 1 Section "Construction Progress Documentation".

C. Processing Time: Make submittals promptly in accordance with construction schedules, and in such sequence as to cause no delay. Make submittals far enough in advance to allow enough time for Contract and Architect/Engineer submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect/Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals (or resubmittals) enough in advance of the Work to permit processing.
   1. Initial Review: Allow 30 days for initial review of each submittal by Architect/Engineer. Allow additional time if coordination with subsequent submittals is required. Architect/Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If an intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 30 days for review of each resubmittal.
   4. Concurrent Consultant Review: Where concurrent review of submittals by Architect/Engineer’s consultants, Owner, or other parties is required, allow 30 days for each initial and resubmittal review. Transmit submittals required in the following Sections simultaneously to the Architect/Engineer and the indicated Architect/Engineer’s consultant. Final review comments on each submittal (and resubmittal) will be issued by the Architect/Engineer directly to Contractor. *[edit following list for project]*
      a. Civil Engineer:
         1) All sections listed in Division 2.
      b. Structural Engineer:
         1) Division 3 Section “Cast-in-Place Concrete.”
         2) Division 5 Section “Structural Steel.”
         3) Division 5 Section “Steel Joists.”
         4) Division 5 Section “Steel Deck.”
         5) Division 5 Section “Cold-formed Metal Framing.”
      c. Mechanical/Electrical Engineer:
         1) All sections listed in Division 15.
         2) All sections listed in Division 16.
      d. Commissioning Authority:
         1) Commissioning Plan.
         2) Section 01810 General Commissioning Requirements.
         3) Section 01815 HVAC Commissioning Requirements.

4) *Section 15995 Mechanical Systems Commissioning.*
5) *Section 16995 Electrical Systems Commissioning*.

D. Identification: Place a permanent label or title block on each submittal for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review, CQC review, and markings and action taken by Architect/Engineer.
3. Include the following information on label for processing and recording action taken:
a. Project name.
b. Date.
c. Name and address of Architect/Engineer.
d. Name and address of Contractor.
e. Name and address of subcontractor.
f. Name and address of supplier.
g. Name of manufacturer.
h. Submittal number and other unique identifier, including revision identifier.
1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 06100.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06100.01.A).
i. Number and title of appropriate Specification Section.
j. Drawing number and detail references, as appropriate.
k. Location(s) where product is to be installed, by drawing number as appropriate.
l. Other necessary identification.

E. Submittals shall include information as necessary to indicate its compliance with Contract Documents, relationship to other work, and other information as specified, including:
1. Identification of product or materials
2. Relation to adjacent structures or materials
3. Field dimensions, clearly identified as such
4. Applicable standards, such as ASTM number
5. Clear identification of submittal material previously submitted and its status.

F. Deviations: Encircle and specifically identify deviations from the Contract Documents on submittals. Substitutions and “or equal” products may not be processed through the submittal review process. Architect’s Engineer’s action on shop drawings cannot change the Work in the Contract Documents.

G. Contractor Review: Contractor shall review and approve all submittals for compliance with Contract Documents and field dimensions prior to submission to Architect/Engineer. Contractor’s approval shall be noted on the label or title block. The Architect/Engineer will returned, unreviewed, any submittal (or resubmittal) not bearing notation of the Contractor’s approval.

H. Additional Copies: Unless additional copies are required for final submittal, and unless Architect/Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal. Number of copies to be submitted for each submittal shall be as follows:

1. Four copies to Architect/Engineer; one copy to be forwarded by Architect/Engineer to Owner after review; two copies to be returned to Contractor after review
2. One copy to Concurrent Consultant (as appropriate)
3. One copy to Owner concurrent with submission to Architect/Engineer
4. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

I. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect/Engineer will return or discard submittals received from sources other than Contractor.
   1. Transmittal Form: Use CSI Form 12.1A, AIA G810, or equal.
   2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect/Engineer on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
   1. Note date and content of previous submittal.
   2. Note date and content of revision in label or title block and clearly indicate extent of revision including any changes which were other than those requested by Architect/Engineer.
   3. Resubmit submittals until they are marked "No Exceptions Taken" or "Note Markings."

K. Distribution: Reproduce and furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

L. Use for Construction: Use only final submittals with mark indicating "No Exceptions Taken" or "Note Markings" taken by Architect/Engineer.

1.5 CONTRACTOR'S USE OF ARCHITECT/ENGINEER'S CAD FILES [edit for project]

A. General: At Contractor's written request, copies of Architect/Engineer's CAD Drawing files will be provided to Contractor for Contractor's use in connection with Project, subject to the following conditions:
   1. A $100.00 per drawing service fee for use of CAD Drawings shall be paid by the Contractor to the Architect/Engineer. Use form at the end of this Section.
   2. Allow one week for processing, shipping and handling after Architect/Engineer receives service fee.
   3. Architectural Floor Plans shall be made available for use as backgrounds for preparation of shop drawings. No other CAD Drawing files will be made available.

PART 2 - PRODUCTS

2.1 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
   1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
   2. Mark each copy of each submittal to show which products and options are applicable.
   3. Include the following information, as applicable:
      a. Manufacturer's written recommendations.
      b. Manufacturer's product specifications.
      c. Manufacturer's installation instructions.
      d. Standard color charts.
      e. Manufacturer's catalog cuts.
      f. Wiring or piping diagrams showing factory-installed wiring or piping.
      g. Printed performance curves.
      h. Operational range diagrams.
      i. Mill reports.
      j. Standard product operation and maintenance manuals.
      k. Compliance with specified referenced standards.
      l. Test results by recognized testing agency.
      m. Application of testing agency labels and seals.
      n. Notation of coordination requirements.
      o. Performance characteristics and capacities
      p. Dimensions and clearances required.
   4. Submit Product Data before or concurrent with Samples.
   5. *Number of Copies: Submit four copies of Product Data to Architect/Engineer and one copy to Owner, unless otherwise indicated. Architect/Engineer will keep two copies, forward one to Owner and return one to Contractor after review. Mark up and retain version of returned copy as a Project Record Document.*

C. Shop Drawings: Prepare project-specific information, drawn accurately to scale, on original drawings. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data. Shop drawings shall be prepared by qualifier detailer(s).
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Dimensions.
      b. Identification of products.
      c. Fabrication and installation drawings.
      d. Roughing-in and setting diagrams.
      e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring.
      f. Shopwork manufacturing instructions.
      g. Templates and patterns.
      h. Schedules.
      i. Design calculations.
      j. Compliance with specified standards.
      k. Notation of coordination requirements.

l. Notation of dimensions established by field measurement.
m. Relationship to adjoining construction clearly indicated.
n. Seal and signature of professional engineer if specified.
o. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches .
3. *Number of Copies: Submit five opaque reproducible copies of each submittal. Architect/Engineer will retain four copies; remainder will be returned. Reproduce returned copies for distribution. Mark up and retain original returned copy as a Project Record Drawing.*

D. Samples: Submit Samples (physical examples) of materials, equipment or work for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Submit full-sized fully fabricated Samples cured and finished as specified and physically identical with the proposed material or product. Submit Samples for actual dye lots or production runs as available.
2. Samples shall include final treatments, such as “scotchguarding” or “fireproofing” where such treatments are a requirement on the actual product
3. Submit Samples that contain multiple, related components such as accessories together in one submittal package.
4. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample (including finish and composition)
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of appropriate Specification Section
   e. Location of intended use in the project.
5. Unless specified otherwise, submit full range of manufacturer’s applicable standard colors, textures and patterns for review.
6. Size: Provide Samples of sufficient size to show:
   a. All Salient features of the material or item, representative of the functional and aesthetic characteristics of the Product
   b. The extremes of variation in color, texture, finish and construction to be expected in the installed work.
   c. Functional characteristics of product or material, with integrally related parts and attachment devices.
7. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
   a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
8. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
   a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect/Engineer will return submittal with options selected.

9. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
   a. *Number of Samples: Submit three sets of Samples. Architect/Engineer will retain two Sample sets; remainder will be returned.*
      1) *Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.*
      2) *If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.*

E. Submittals Schedule and Construction Photographs: Comply with requirements specified in Division 1 Section "Construction Progress Documentation."

F. Application for Payment: Comply with requirements specified in Division 1 Section "Payment Procedures."

G. Schedule of Values: Comply with requirements specified in Division 1 Section "Payment Procedures."

H. Construction Quality Control Submittals: Comply with requirements specified in Division 1 Section(s) “Contractor Quality Control.”

I. Special Inspection Submittals: Submit all information required to comply with Montgomery County’s Special Inspections requirements. Submittals may include, but are not limited to:
1. *Steel fabrication shop drawings*
2. *Concrete mix design*
3. *Formwork and shoring design*
4. *Plan for removal and reshoring of formwork*
5. *Concrete quality control plan*
6. *Construction observations, inspections, and testing records and reports from Geotechnical Engineer and other testing agencies*
7. *Certification from Geotechnical Engineer and testing agencies regarding soils work and foundation placement*
8. *Written authorizations from testing agencies for stripping of formwork and shoring*
9. *Contractor, subcontractor and supplier certifications*

J. Subcontractor List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A or approved equal. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.

3. Drawing number and detail references, as appropriate, covered by subcontract.
4. Number of Copies: Submit four copies of subcontractor list, unless otherwise indicated. Architect/Engineer will return two copies.
   a. Mark up and retain one returned copy as a Project Record Document.

K. LEED Submittals: Provide required documentation requested to document LEED certification requirements; refer to Division 1 Section LEED Green Building Summary Requirements and the technical specifications. [edit for project]

2.2 INFORMATIONAL SUBMITTALS

A. General: Provide Informational Submittals required by other Specification Sections.
   1. *Number of Copies: Submit two copies of each submittal to Architect/Engineer, unless otherwise indicated. Architect/Engineer will not return copies. Submit one copy directly to Owner concurrently with submission to Architect/Engineer.*
   2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
   3. Test and Inspection Reports: Comply with requirements specified in Division 1 Section "Quality Requirements."

B. Coordination Drawings: Comply with requirements specified in Division 1 Section "Project Management and Coordination."

C. Qualification Data: Provide written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of Architect/Engineers and owners, and other information specified.

D. Welding Certificates: Provide written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

E. Installer Certificates: Provide written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

F. Manufacturer Certificates: Provide written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

G. Product Certificates: Provide written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

H. Material Certificates: Provide written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

I. Material Test Reports: Provide reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

J. Product Test Reports: Provide written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

K. Research/Evaluation Reports: Provide written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

L. Schedule of Tests and Inspections: Comply with requirements specified in Division 1 Section "Quality Requirements."

M. Preconstruction Test Reports: Provide reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

N. Compatibility Test Reports: Provide reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

O. Field Test Reports: Provide reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

P. Maintenance Data: Provide written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Division 1 Section "Closeout Procedures."

Q. Erection Drawings: Provide complete drawings indicating how components of the structure will be erected.

R. Design Data: Provide written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

S. Manufacturer's Instructions: Provide written or published information that documents manufacturer's recommendations, guidelines, and procedures for storing, installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

T. Manufacturer's Field Reports: Provide written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

U. Insurance Certificates and Bonds: Provide written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

V. Contractor’s Key Personnel: Comply with requirements specified in Division 1 Section “Project Management and Coordination.”

2.3 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect/Engineer.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, licensed in the State of Maryland, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect/Engineer. All submittals must bear the following certification, signed and dated by the Contractor, and by any subcontractor, sub-subcontractor or supplier who has prepared the submittal for the Contractor:

> "I certify that the requirements of the Contract Documents have been met and all dimensions, conditions and quantities are verified as shown on the attached Submittal."

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement complying with General Conditions of Contract certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

C. Work that requires submittals shall not commence until complete compliance with submittal requirements have been met. Submittals are not considered until Contractor receives acceptable Architect/Engineer's written disposition on the submittal. Submittals noted to be resubmitted shall be resubmitted until all items requiring modification or clarification have been met and no resubmission is required as indicated on the Architect/Engineer's disposition on the submittal.

3.2 ARCHITECT/ENGINEER'S ACTION

A. General: Contractor's responsibility for submitting true, accurate and complete submittals is not relieved by Architect/Engineer's review of and response to submittals. Architect's Engineer's action on shop drawings cannot change the Work in the Contract Documents.

B. General: Architect/Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.

C. Color Selection: Architect/Engineer will select colors within 60 days (to allow time for presentation to Owner and for Owner comments) after all color samples have been submitted for the items listed below. The submittal data shall be complete, including shop drawings, product data, and color samples, and all required submittals and materials shall be in compliance with the specifications and be subsequently approved by the Architect/Engineer. Color samples shall be actual samples of the material and not photographs. If there is a variation in color or lightness and darkness of the material, then two or more samples shall be submitted to show the range of variation.

1. Exterior Items, including, but not limited to the following:
    a. Cast stone.
    b. Brick and split faced CMU.
    c. Mortar.
    d. Exposed joint sealants.
    e. Roofing materials.
    f. Exposed metal flashing and trim.
    g. Aluminum entrances and storefronts.

h. Glass.
i. Glazed aluminum curtain wall.
j. Paint.
k. Louvers.
l. Signage.

2. Interior Items, including, but not limited to the following:
   a. Interior Architectural woodwork finishes.
   b. Exposed joint sealants.
   c. Wood door finishes.
   d. Aluminum storefront and entrances.
   e. Ceramic tile.
   f. Acoustical panel ceilings.
   g. Resilient floor tile.
   h. Resilient wall base.
   i. Carpet.
   j. Wall coverings.
   k. Gym equipment
   l. Paint.
   m. Toilet partitions.
   n. Signage.
   o. Lockers.
   p. Casework.
   q. Floor mats.

D. Action Submittals:
1. Architect/Engineer will review each required submittal for the limited purpose of checking for general conformance with the design concept as expressed in the Contract Documents.
2. Architect/Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it.
3. Architect/Engineer's action on a specific item shall not indicate approval of an assembly of which the item is a component.
4. Architect/Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
   a. Submittals Marked "No Exceptions Taken": The Work covered by the submittal is "accepted as specified" and the Work may proceed provided it complies with requirements of the reviewed submittal and the Contract Documents.
   b. Submittals Marked "Note Markings" or "Make Corrections as Noted": The Work covered by the submittal is "accepted as noted" and the Work may proceed provided it complies with Architect/Engineer's notations or corrections on the submittal and requirements of the Contract Documents. Resubmittal is not required unless Contractor cannot comply with noted changes; in which case, the Contractor shall resubmit for approval.
   c. Submittals Marked "Revise and Resubmit": Do not proceed with the Work covered by the submittal. Revise or prepare a new submittal according to the Architect/Engineer's notations and requirements of the Contract Documents, and resubmit without delay. Unmarked items may be fabricated only if indicated.
   d. Submittals Marked "Resubmit properly": Submittal was not reviewed because it did not contain the Contractor's signed approval prior to submission and/or

because the submittal is not in adequate condition for review. Contractor must resubmit.

e. Submittals Marked “Rejected”: Architect/Engineer will list reasons for rejection on the submittal or in the transmittal letter accompanying the submittal. Do not proceed with the Work covered by the submittal. Prepare new submittal according to the notations and requirements of the Contract Documents, and resubmit without delay.

f. Submittals Marked “Not Reviewed”: Submittal is not required by Contract Documents; Architect/Engineer will not review.

5. Structural Calculations: Submittal of calculations for permanent or temporary construction structural components will be reviewed by the Architect/Engineer only for compliance with stipulated design criteria. The Architect/Engineer’s review and/or any comments do not constitute any liability for the actual design of the structure.

E. Informational Submittals: Architect/Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect/Engineer will forward each submittal to appropriate party.

F. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

G. Submit required LEED submittal information concurrent with each product data and shop drawing submittal.[edit for project]

END OF SECTION 01330

Subcontractors and Major Material Supplier List

Project: From (Contractor):

Date: To (A/E):

A/E Project Number:

Contract For:

List Subcontractors and Major Material Suppliers proposed for use on this Project as required by the Construction Documents. (Attach supplemental sheets if necessary.)

Firm Name:
Contact:

Phone Number:
Fax Number:

Firm Address:

☐ Attachments

Signed by: Date:

Copies:
- ☐ Owner
- ☐ Consultants
- ☐ File

SECTION 01 33 05
SUBMITTALS

1.01 GENERAL PROVISIONS

a. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 REQUIREMENTS

a. Shop Drawings, products data, samples and schedule of values.

b. CQC and Commissioning requirement as required.

1.03 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

a. General:

1. Review and submit, to the Designer, shop drawings, project data and samples required by Specification Sections.

b. Shop Drawings:

1. Original drawings shall be prepared by General Contractor, Subcontractor, Supplier or Distributor, which illustrate some portion of the Work, showing fabrication, layout, setting or erection details.

(a) Shop drawings shall be prepared by a qualified detailer.

(b) Details shall be identified by reference to sheet and detail numbers indicated on Contract Drawings.

(c) Maximum sheet size shall be 30-inch by 42-inch.

(d) In addition to Architects requirement for shop drawing, provide one (1) copy to DCD for concurrent review.

c. Product Data:

1. Manufacturer's standard schematic drawings:

[Note to Designer: Delete information which is not applicable to project. Supplement standard information to provide additional information applicable to project.]

2. Manufacturers' catalog sheets, brochures, diagrams, schedules, performance charts, illustrations and other standard descriptive data.

[Note to Designer: Require the Contractor to clearly mark each copy to identify pertinent materials, products or models. Indicate dimensions and clearances required. Indicate performance characteristics and capacities. Indicate wiring diagrams and controls.]

d. Samples: [Note to Designer: Physical examples shall illustrate materials, equipment or work is judged. After review and approval, samples may be used in construction of project if not retained for comparison.]

1. Office samples of sufficient size and quantity shall clearly illustrate:

   (a) Functional characteristics of product or material, with integrally related parts and attachment devices.

   (b) Full range of color samples.

2. Mock-ups:

(a) Erect at project site at location acceptable to Designer, each mock-up complete, including work of all trades required in finished work.

e. General Contractor's Responsibilities:

1. Coordinate each submittal with requirements of Contract Documents.

2. The General Contractor's responsibility for errors and omissions in submittals is not relieved by the Designer's review and approval of submittals.

3. Notify the Designer in writing at time of submission, of deviations in submittals from requirements of Contract Documents or previous submissions.

4. Work that requires submittals shall not commence unless submittals with Designer's stamp and initials or signature indicating review and approval.

5. After Owner and Designer's review and Designer's approval, distribute copies. Provide one approved copy to the owner.

f. Submission Requirements:

1. Make submittals promptly in accordance with approved construction schedules, and in such sequence as to cause no delay in the work.

2. Submit required number of shop drawing for review.

3. Submit number of samples specified in each Section of the Specifications.

4. Forward submittals with transmittal letter, in duplicate.

5. Submittals shall include:

   (a) Date and revision dates.

(b) Project title and number.
(c) The names of:

(1) Designer
(2) General Contractor
(3) Subcontractor
(4) Supplier
(5) Manufacturer
(6) Separate detailer when pertinent.

(d) Identification of product or material.
(e) Relation to adjacent structure or materials.
(f) Field dimensions, clearly identified as such.
(g) Specification Section number.
(h) Applicable standards, such as ASTM number.
(i) A blank space, five-inch by four-inch, for the Designer's stamp.
(j) Identification of deviations from Contract Documents.
(k) General Contractor's stamp, and signed certifying review and approval of submittal.

g. <u>Resubmission Requirements</u>

1. Shop Drawings:

   a. Revise drawings as required and resubmit as specified for previous submittal.

   b. Indicate on drawings any changes which may have been made other than those requested by the Designer.

2. Product Data and Samples: Submit new data and samples as required from previous submittal.

h. <u>Distribution of Submittals After Review and Approval</u>

1. Distribute copies of shop drawings and product data that display the Designer's stamp to appropriate Subcontractors.

2. Distribute one approved copy of shop drawings and project data to the Project Manager.

3. Distribute Samples as directed by the Designer.

1.04 <u>SCHEDULE OF VALUES</u>

a. Prior to the first request for payment, the General Contractor shall submit to the Designer and DFS, Schedule of Values of the various portions of the work in sufficient detail to reflect various major components of each trade, including quantities when requested, aggregating the total contract sum, and divided so as to facilitate payments for work under each Section in accordance with the contract. The schedule shall be prepared in such form as specified or as the Designer or DFS may approve, and it shall include data to substantiate its accuracy. Each item in the Schedule of Values shall include its proper share of overhead and profit. This schedule, including breakdown and values, requires the approval of the Designer and DFS and shall be used only as a basis for the Contractor's request for payment.

End of Section

SECTION 01 35 01

SPECIAL PROCEDURES FOR HISTORIC MATERIALS

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes special procedures for historic treatment on Project including, but not limited to, the following:
   1. Delivery, storage, protection, and installation of existing historic materials.

1.3 SUBMITTALS

A. Shop Drawings: Indicate bracing, supports and attachment of historic items to new construction.

B. Pre-packing Photographs: Show existing conditions of historic materials, including finish surfaces that might be misconstrued as damage caused by Contractor's activities. Comply with Division 1 Section "Photographic Documentation." Submit before Work begins.

1.4 STORAGE AND PROTECTION OF HISTORIC MATERIALS

A. Removed and Reinstalled Historic Materials:
   1. Arrange and pay for packing, transporting, storage and delivery of historic materials.
   2. Pack or crate items. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Clean and repair historic items to functional condition adequate for intended reuse.
   5. Install items in locations indicated. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

B. Storage and Protection: When removed from their existing location, store historic materials within a weather-tight enclosure where they are protected from wetting by rain, snow, or ground water, and temperature variations. Secure stored materials to protect from theft.

PART 2 -PRODUCTS - (Not Used)

PART 3 -EXECUTION – (Not Used)

End of Section

SECTION 01 42 00

REFERENCES

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

D. Abbreviations and Acronyms for Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract

Documents:

ADAAG
Americans with Disabilities Act (ADA)
Accessibility Guidelines for Buildings and Facilities
Available from Access Board
www.access-board.gov

CFR
Code of Federal Regulations
Available from Government Printing Office
www.access.gpo.gov/nara/cfr

CRD
Handbook for Concrete and Cement
Available from Army Corps of Engineers Waterways Experiment Station
www.wes.army.mil

DOD
Department of Defense Military Specifications and Standards
Available from Department of Defense Single Stock Point
www.dodssp.daps.mil

FED-STD
Federal Standard (See FS)

FS
Federal Specification
Available from Department of Defense Single Stock Point
www.dodssp.daps.mil

Available from General Services Administration
www.apps.fss.gsa.gov/pub/fedspecs/index.cfm

Available from National Institute of Building Sciences
www.nibs.org

FTM
Federal Test Method Standard (See FS)

MIL
See MILSPEC
www.dodssp.daps.mil

UFAS
Uniform Federal Accessibility Standards
Available from Access Board
www.access-board.gov
(800) 872¬ 2253, (202) 272 ¬5434

MS MIL
See MILSPEC

MILSPEC
Military Specification and Standards
Available from Department of Defense Single Stock Point
(800) 8722253, (202) 2720080, (888) 2936498, (202) 5121530, (601) 6342355, (215) 6976257, (215) 6976257, (202) 6198925, (202) 2897800, (215) 6976257

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA Aluminum Association, Inc. (The) (202) 862-5100 www.aluminum.org

AAADM American Association of Automatic Door Manufacturers (216) 241-7333 www.aaadm.com

AABC Associated Air Balance Council (202) 737-0202 www.aabchq.com

AAMA American Architectural Manufacturers Association (847) 303-5664 www.aamanet.org

AASHTO American Association of State Highway and (202) 624-5800 Transportation Officials www.aashto.org

AATCC American Association of Textile Chemists and Colorists (The) (919) 549-8141 www.aatcc.org

ABMA American Bearing Manufacturers Association (202) 367-1155 www.abma-dc.org

ACI American Concrete Institute/ACI International (248) 848-3700 www.aci-int.org

ACPA American Concrete Pipe Association (972) 506-7216 www.concrete-pipe.org

AEIC Association of Edison Illuminating Companies, Inc. (The) (205) 257-2530 www.aeic.org

AFPA American Forest & Paper Association
(See AF&PA)

AF&PA American Forest & Paper Association (800) 878-8878 www.afandpa.org (202) 463-2700

AGA American Gas Association (202) 824-7000 www.aga.org

AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AHA	American Hardboard Association www.hardboard.org	(847) 934-8800
AHAM	Association of Home Appliance Manufacturers www.aham.org	(202) 872-5955
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960
AIA	American Institute of Architects (The) www.aia.org	(800) 242-3837 (202) 626-7300
AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America www.alca.org	(800) 395-2522 (703) 736-9666
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
AMCA	Air Movement and Control Association International, Inc. www.amca.org	(847) 394-0150
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020

AOSA	Association of Official Seed Analysts www.aosaseed.com	(505) 522-1437
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
APA	Architectural Precast Association www.archprecast.org	(239) 454-6989
API	American Petroleum Institute www.api.org	(202) 682-8000
ARI	Air-Conditioning & Refrigeration Institute www.ari.org	(703) 524-8800
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCA	Architectural Spray Coaters Association www.ascassoc.com	(856) 848-6120
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers www.ashrae.org	(800) 527-4723 (404) 636-8400
ASME	ASME International (The American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (212) 591-7722
ASSE	American Society of Sanitary Engineering www.asse-plumbing.org	(440) 835-3040
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9585
AWCI	AWCI International (Association of the Wall and Ceiling Industries International) www.awci.org	(703) 534-8300
AWCMA	American Window Covering Manufacturers Association (See WCSC)	
AWI	Architectural Woodwork Institute www.awinet.org	(800) 449-8811 (703) 733-0600
AWPA	American Wood-Preservers' Association	(817) 326-6300

	www.awpa.com	
AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
BIFMA	BIFMA International (Business and Institutional Furniture Manufacturer's Association International) www.bifma.com	(616) 285-3963
CCC	Carpet Cushion Council www.carpetcushion.org	(203) 637-1312
CCFSS	Center for Cold-Formed Steel Structures www.umr.edu/~ccfss	(573) 341-4471
CDA	Copper Development Association Inc.	(800) 232-3282
www.copper.org		(212) 251-7200
CEA	Canadian Electricity Association www.canelect.ca	(514) 866-6121
CFFA	Chemical Fabrics & Film Association, Inc. www.chemicalfabricsandfilm.com	(216) 241-7333
CGA	Compressed Gas Association www.cganet.com	(703) 788-2700
CGSB	Canadian General Standards Board www.pwgsc.gc.ca/cgsb	(819) 956-0425
CIMA	Cellulose Insulation Manufacturers Association www.cellulose.org	(888) 881-2462 (937) 222-2462
CISCA	Ceilings & Interior Systems Construction Association www.cisca.org	(630) 584-1919
CISPI	Cast Iron Soil Pipe Institute www.cispi.org	(423) 892-0137

CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CPPA	Corrugated Polyethylene Pipe Association www.cppa-info.org	(800) 510-2772 (202) 462-9607
CRI	Carpet & Rug Institute (The) www.carpet-rug.com	(800) 882-8846 (706) 278-3176
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(800) 463-6727 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
CSSB	Cedar Shake & Shingle Bureau www.cedarbureau.org	(604) 820-7700
CTI	Cooling Technology Institute (Formerly: Cooling Tower Institute) www.cti.org	(281) 583-4087
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EIMA	EIFS Industry Members Association	(800) 294-3462
www.eima.com		(770) 968-7945
EJCDC	Engineers Joint Contract Documents Committee www.asce.org	(800) 548-2723 (703) 295-6300
EJMA	Expansion Joint Manufacturers Association, Inc. www.ejma.org	(914) 332-0040
ESD	ESD Association	(315) 339-6937
FCI	Fluid Controls Institute www.fluidcontrolsinstitute.org	(216) 241-7333
FGMA	Flat Glass Marketing Association (See GANA)	

FM	Factory Mutual System (See FMG)	
FMG	FM Global (Formerly: FM - Factory Mutual System) www.fmglobal.com	(401) 275-3000
FRSA	Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc. www.floridaroof.com	(407) 671-3772
FSA	Fluid Sealing Association www.fluidsealing.com	(610) 971-4850
FSC	Forest Stewardship Council www.fscoax.org	52 951 5146905
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GANA	Glass Association of North America (Formerly: FGMA - Flat Glass Marketing Association) www.glasswebsite.com	(785) 271-0208
GRI	Geosynthetic Research Institute www.drexel.edu/gri	(215) 895-2343
GTA	Glass Tempering Division of Glass Association of North America (See GANA)	
HI	Hydraulic Institute www.pumps.org	(888) 786-7744 (973) 267-9700
HI	Hydronics Institute www.gamanet.org	(908) 464-8200
HMMA	Hollow Metal Manufacturers Association (See NAAMM)	
HPVA	Hardwood Plywood & Veneer Association www.hpva.org	(703) 435-2900
HPW	H. P. White Laboratory, Inc. www.hpwhite.com	(410) 838-6550
IAS	International Approval Services (See CSA)	

ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IESNA	Illuminating Engineering Society of North America www.iesna.org	(212) 248-5000
IGCC	Insulating Glass Certification Council www.igcc.org	(315) 646-2234
IGMA	Insulating Glass Manufacturers Alliance (The) www.igmaonline.org	(613) 233-1510
ILI	Indiana Limestone Institute of America, Inc. www.iliai.com	(812) 275-4426
ISSFA	International Solid Surface Fabricators Association www.issfa.net	(702) 567-8150
ITS	Intertek Testing Services www.itsglobal.com	(800) 345-3851 (607) 753-6711
IWS	Insect Screening Weavers Association (Now defunct)	
KCMA	Kitchen Cabinet Manufacturers Association www.kcma.org	(703) 264-1690
LMA	Laminating Materials Association www.lma.org	(201) 664-2700
LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864 (847) 577-7200
LSGA	Laminated Safety Glass Association (See GANA)	
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Maple Flooring Manufacturers Association	(847) 480-9138

	www.maplefloor.org	
MFMA	Metal Framing Manufacturers Association www.metalframingmfg.org	(312) 644-6610
MH	Material Handling Industry of America (See MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MIA	Marble Institute of America www.marble-institute.com	(440) 250-9222
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NAAMM	National Association of Architectural Metal Manufacturers www.naamm.org	(312) 332-0405
NAAMM	North American Association of Mirror Manufacturers (See GANA)	
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(281) 228-6200
NADCA	National Air Duct Cleaners Association www.nadca.com	(202) 737-2926
NAIMA	North American Insulation Manufacturers Association (The) www.naima.org	(703) 684-0084
NAMI	National Accreditation and Management Institute, Inc.	(304) 258-5100
NBGQA	National Building Granite Quarries Association, Inc. www.nbgqa.com	(800) 557-2848
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCPI	National Clay Pipe Institute www.ncpi.org	(262) 248-9094
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-3550

NEBB	National Environmental Balancing Bureau www.nebb.org	(301) 977-3698
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200
NETA	InterNational Electrical Testing Association www.netaworld.org	(303) 697-8441
NFPA	NFPA International (National Fire Protection Association International) www.nfpa.org	(800) 344-3555 (617) 770-3000
NFRC	National Fenestration Rating Council www.nfrc.org	(301) 589-1776
NGA	National Glass Association www.glass.org	(703) 442-4890
NHLA	National Hardwood Lumber Association www.natlhardwood.org	(800) 933-0318 (901) 377-1818
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NOFMA	National Oak Flooring Manufacturers Association www.nofma.org	(901) 526-5016
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NTMA	National Terrazzo and Mosaic Association, Inc. www.ntma.com	(800) 323-9736 (703) 779-1022

NTRMA	National Tile Roofing Manufacturers Association (See RTI)	
NWWDA	National Wood Window and Door Association (See WDMA)	
OPL	Omega Point Laboratories, Inc. www.opl.com	(800) 966-5253 (210) 635-8100
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDCA	Painting and Decorating Contractors of America www.pdca.com	(800) 332-7322 (703) 359-0826
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (508) 230-3516
PGI	PVC Geomembrane Institute www.pgi-tp.ce.uiuc.edu	(217) 333-3929
RCSC	Research Council on Structural Connections www.boltcouncil.org	(800) 644-2400 (312) 670-2400
RFCI	Resilient Floor Covering Institute www.rfci.com	Contact by mail only
RIS	Redwood Inspection Service www.calredwood.org	(888) 225-7339 (415) 382-0662
RTI	Roof Tile Institute (Formerly: NTRMA - National Tile Roofing Manufacturers Association) www.ntrma.org	(541) 689-0366
SAE	SAE International www.sae.org	(724) 776-4841
SDI	Steel Deck Institute www.sdi.org	(847) 462-1930
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEFA	Scientific Equipment and Furniture Association www.sefalabfurn.com	(516) 294-5424
SGCC	Safety Glazing Certification Council www.sgcc.org	(315) 646-2234

SIA	Security Industry Association www.siaonline.org	(703) 683-2075
SIGMA	Sealed Insulating Glass Manufacturers Association (See IGMA)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SMA	Screen Manufacturers Association	(561) 533-0991
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association www.smacna.org	(703) 803-2980
SMPTE	Society of Motion Picture and Television Engineers	(914) 761-1100

www.smpte.org

SPFA	Spray Polyurethane Foam Alliance (Formerly: SPI/SPFD - The Society of the Plastics Industry, Inc.; Spray Polyurethane Foam Division) www.sprayfoam.org	(800) 523-6154
SPIB	Southern Pine Inspection Bureau (The) www.spib.org	(850) 434-2611
SPI/SPFD	Society of the Plastics Industry, Inc. (The) Spray Polyurethane Foam Division (See SPFA)	
SPRI	SPRI (Single Ply Roofing Institute) www.spri.org	(781) 647-7026
SSINA	Specialty Steel Industry of North America www.ssina.com	(800) 982-0355 (202) 342-8630
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974

TCA	Tile Council of America, Inc. www.tileusa.com	(864) 646-8453
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
TPI	Truss Plate Institute, Inc. www.tpinst.org	(608) 833-5900
TPI	Turfgrass Producers International www.turfgrasssod.org	(800) 405-8873 (847) 705-9898
UL	Underwriters Laboratories Inc. www.ul.com	(800) 704-4050 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
USITT	United States Institute for Theatre Technology, Inc. www.usitt.org	(800) 938-7488 (315) 463-6463
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WCLIB	West Coast Lumber Inspection Bureau www.wclib.org	(800) 283-1486 (503) 639-0651
WCMA	Window Covering Manufacturers Association (See WCSC)	
WCSC	Window Covering Safety Council (Formerly: WCMA - Window Covering Manufacturers Association) www.windowcoverings.org	(800) 506-4636 (212) 661-4261
WDMA	Window & Door Manufacturers Association (Formerly: NWWDA - National Wood Window and Door Association) www.wdma.com	(800) 223-2301 (847) 299-5200
WIC	Woodwork Institute of California www.wicnet.org	(916) 372-9943

WMMPA	Wood Moulding & Millwork Producers Association www.wmmpa.com	(800) 550-7889 (530) 661-9591
WSRCA	Western States Roofing Contractors Association www.wsrca.com	(800) 725-0333 (650) 548-0112
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and

up-to-date as of the date of the Contract Documents.

CABO	Council of American Building Officials	
IAPM	International Association of Plumbing and Mechanical	(909) 595-8449
ICBO	International Conference of Building Officials www.icbo.org	(800) 284-4406 (562) 699-0541
ICBO ES	ICBO Evaluation Service, Inc. www.icbo.org/ICBO_ES/	(800) 423-6587

ICC International Code Council, Inc. (703) 931-4533 (Formerly: CABO - Council of American Building Officials)

www.intlcode.org

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web-site addresses are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	
CPSC	Consumer Product Safety Commission www.cpsc.gov	(800) 638-2772 (301) 504-0990
DOC	Department of Commerce www.doc.gov	(202) 482-2000
EPA	Environmental Protection Agency www.epa.gov	(202) 260-2090

FAA	Federal Aviation Administration www.faa.gov	(202) 366-4000
FDA	Food and Drug Administration www.fda.gov	(888) 463-6332
GSA	General Services Administration www.gsa.gov	(202) 708-5082
HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112
LBL	Lawrence Berkeley Laboratory (See LBNL)	
LBNL	Lawrence Berkeley National Laboratory www.lbl.gov	(510) 486-5605
NCHRP	National Cooperative Highway Research Program (See TRB)	
NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
PBS	Public Building Service (See GSA)	
RUS	Rural Utilities Service (See USDA)	(202) 720-9540
SD	State Department www.state.gov	(202) 647-4000
TRB	Transportation Research Board www.nas.edu/trb	(202) 334-2934
USDA	Department of Agriculture www.usda.gov	(202) 720-2791
USPS	Postal Service www.usps.com	(202) 268-2000

PART 2 -PRODUCTS (Not Used)

PART 3 -EXECUTION (Not Used)

End of Section

SECTION 01 45 00
CONTRACTOR QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and Supplemental Conditions, and other Division 1 Specification Sections, apply to this Section.

B. Commissioning Plan.

C. Section 01 91 13 General Commissioning Requirements.

D. Section 01 91 00 HVAC Commissioning Requirements.

E. Specification Section for Mechanical Systems Commissioning.

F. Specification Section for Electrical Systems Commissioning

1.2 INTENT

A. The intent of Contractor Quality Control (CQC) is to positively control the quality of Work, including the work of subcontractors and suppliers, through preparatory, initial and follow-up activities to assure delivery of Work that meets requirements of the Contract Documents for performance, quality and timeliness.

B. The Contractor shall execute a Contractor Quality Control program that meets the intent of CQC, using whatever manpower, time and resources are required, even where the quantity needed may exceed requirements of this Section or the approved CQC plan, at no additional cost to the Owner.

C. This Section provides minimum requirements for documentation of the CQC program, such that the Owner may assure itself of quality and timely Work. The Owner will rely on documentation from the CQC program to satisfy some for the payment requirements of General Conditions of Contract Paragraph 13.2.2, which requires “sufficient data to demonstrate the Contractor’s right to payment and compliance with the payment provisions of the Contract to the satisfaction of the Owner and the Architect/Engineer”. **In the absence of specified CQC documentation from the Contractor, the Owner reserves the right to withhold payment on undocumented work**.

1.3 RECOURSE

A. The Owner retains the right to the following actions in the event that the CQC fails to function in controlling the Work or fails to provide the visible quality control activities and documentation required:
   1. Changes to Staff and CQC Plan: The Owner reserves the right to require the Contractor to make changes in its CQC plan and operations including removal and replacement of personnel, as necessary, to obtain the quality specified.
   2. Contract Monitoring Report: The Owner may issue an unsatisfactory Contract Monitoring Report when the CQC documentation is inadequate or late and the Contractor has failed to correct the difficulty within 10 days of the original due date. The Contract Monitoring Report may prevent the Contractor from obtaining other Contracts from the Owner while unsatisfactory performance persists, and may lead to debarment of the Contractor from future bids.
   3. Notification of Noncompliance: The Owner's Project Manager or Construction Representative may notify the Contractor of any detected noncompliance with the Contractor Quality Control requirements. The Contractor shall, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor, will be deemed sufficient for the purpose of notification.
   4. Withholding of Payments and Completion: Failure to meet CQC requirements and failure to correct noncompliance subjects the Contractor to withholding, reduction or rejection of payments, and refusal of Owner to accept completion.
   5. Stop Work: If the Contractor fails or refuses to remedy construction deficiencies promptly such that the quality of ongoing Work cannot be assured, the Owner's Contract Administrator may issue an order stopping all or part of the Work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

1.4 DEFINITIONS AND ABBREVIATIONS

A. CQC System: Contractor Quality Control System; the Contractor's management system to prepare, initiate and verify the quality of Work required by the Contract Documents.

B. CPM: Critical Path Method; network scheduling method of describing the durations and interdependence of tasks of the Work, determining critical tasks that control the project completion time, and projecting the completion time of the Work.

C. HVAC and Electrical Commissioning: The process of bringing the Heating, Ventilating and Air-conditioning system and electrical system of the Work to a state of being fully tested and performing in accordance with the Contract

Documents, providing approved Operations & Maintenance manuals, and training the Owner's personnel to operate and maintain the system.

D. Definable Feature of the Work: A definable feature of work is a task which is separate and distinct from other tasks and has separate control requirements. It could be identified as being performed by different trades or disciplines, or it could be work by the same trade in a different location. Although each section of the specifications may generally be considered as a definable feature of work, there is frequently more than one definable feature under a particular section.

E. Thermal Envelope: The exterior structure of the building and foundation, including all systems and materials to control the migration of heating and cooling energy out of the building through conductance or unwanted air transfer (infiltration). Major areas of quality control include, but are not limited to, the following:

1. Gasketing joints between walls and floor or foundation, walls and roof, and at wall joints and corners;
2. Coverage and adhesion of insulation at foundation (below grade);
3. Fit and coverage of wall and roof insulation;
4. Gasketing and insulation around window and door frames, and other penetrations;
5. Proper installation of vapor retarders;
6. Verification that manufacturer's data on submittals meet specifications for thermal conductance, shading coefficient, and air leakage standards, permeability, and other specified requirements.

1.5 PAYMENT

A. All costs associated with CQC, including the cost of a full-time CQC Manager, must be included in the base bid.

B. Monthly CQC reports by the Contractor are part of the "sufficient data to demonstrate the Contractor's right to payment …" specified in General Conditions of Contract Paragraph 13.2.2. **Therefore, failure to execute the CQC program or to submit adequate, timely and accurate monthly CQC reports as judged by the Owner may be cause for rejection of the Contractor's Application for Payment.**

PART 2 - PRODUCTS

2.1 GENERAL

A. Software for Critical Path Method Schedules:

1. Primavera Project Planner 5.0.
2. *SureTrak Project Manager, Version 3.0.[as allowed at the Owner's discretion as alternate on smaller projects]*

B. Submittals: Submit software manual with sample output forms for all required and proposed CQC reports with the CQC plan.

C. Compact Diskettes (CDs): CDs containing all current Critical Path Method input and output files for the Work must be submitted with monthly CQC reports for progress payments. The CDs must be formatted as CD-ROM, 650 MB or higher, readable by most CD-ROM drives. Label CDs as follows:
1. Project name.
2. Project location.
3. Contract number.
4. Software and version.
5. Unique Schedule Number
6. List of all files.

D. Paper Copies: Submit paper copies as specified in Division 1 “Construction Progress Documentation”

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Documents. The quality control system shall consist of plans, procedures, staff, and organization necessary to produce an end product which complies with the Contract Documents. The system shall cover all construction operations, both on-site and off-site, and must be keyed to the proposed construction sequence.

3.2 CONTRACTOR'S QUALITY CONTROL PLAN

A. General: The Contractor must furnish for approval by the Owner, not later than 30 days after receipt of Notice to Proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of Contractor Quality Control System. The plan must identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Owner will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature or features of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of CQC Plan.

B. Content of the CQC Plan:
1. The CQC plan prepared by the Contractor must include, as a minimum, the following to cover all construction operations, both on-site and off-site, including work by the Contractor, subcontractors, fabricators, suppliers and purchasing agents:

a. CQC Organization Description: A description of the quality control organization, including a chart showing lines of authority and acknowledgement that the CQC staff must implement the three phase control system for all aspects of the Work specified. The staff must include a CQC system manager who must report to the Principal of the Contractor's firm. The Principal in this context must mean the individual with responsibility for the overall management of the firm including quality and production.

b. Staff Summary: The name, qualifications (in resume format including employers, responsibilities and dates of employment over a minimum of the past ten (10) years), duties, responsibilities, and authorities of each person assigned a CQC function.

c. Letter of Authorization: A copy of the letter to the CQC Systems Manager signed by the Principal which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager including authority to stop work which is not in compliance with the Contract. The CQC System Manager must issue letters of direction to all other quality control representatives specifying duties, authorities and responsibilities.

d. Submittal Management Plan: Procedures for scheduling, reviewing, certifying, and managing all submittals. These procedures must be in accordance with Section 01330 “Submittals.” A list of all required submittals with due dates and space for tracking return dates is required.

e. Contract Document Review Plan: The Contractor's procedures for performing constructability reviews of all elements of the Work and generating and tracking Requests for Information to the Architect/Engineer sufficiently in advance of the Work to allow adequate response time and avoid any delays in the Work. Fixed forms for submitting Requests for Clarification and tracking responses from the Architect/Engineer must be included.

f. Critical Path Control Plan: Initial CPM schedule for the project, including network chart, CDs with input files, and detailed task descriptions, together with procedures for tracking task progress required to update Critical Path Method (CPM) analysis and reports, and Contractor's management procedures for monitoring and alleviating potential time overruns as they develop during the Work.

g. List of Definable Features of Work: A list of definable features of work shall be submitted to the Owner prior to, and shall be reviewed during, the coordination meeting described in Paragraph 3.3 of this Section. The CPM plan and the list of definable features must be modified as applicable to include any additional features required by the Owner at no cost to the Owner.

h. Plan for Test Requirements: For each definable feature of work, list the test or standard of workmanship that defines quality (whether the testing is done by the Contractor or by other forces). Control, verification and acceptance testing procedures for each specific test must include the test name, Specification Section paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test.

i. Tracking Plan: Procedures for tracking preparatory, initial, and follow-up control phases and control, verifications, and acceptance tests including documentation.

j. Commissioning Program: Program for execution of Specification Section "Commissioning of HVAC System" and Specification Section "Commissioning of Electrical System" and the “Commissioning Plan”. Commissioning program must include a task network presentation of the total commissioning process, including but not limited to: commissioning meetings, completion of major mechanical and electrical work, flushing of hydronic systems, equipment start-up, Test and Balancing process, required Maintenance orientations, inspection and accessibility reviews, Operating and Maintenance manual submittals and approvals, performance tests, training sessions, and final Commissioning Report. **THE COMMISSIONING TASK NETWORK MUST BE EXPLICITLY INCLUDED IN THE CPM SCHEDULE, SHOWING CONDITIONAL LINKS TO (COMPLETION BEFORE) SUBSTANTIAL COMPLETION.**

k. Deficiency Correction Tracking Plan: Contractor's procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

l. Reporting Plan: Reporting procedures, including proposed reporting formats. The reporting plan will include at a minimum the following items:

1) Daily QC reports typed and maintained in chronological order in a binder at the CQC system manager's office at the field site, with duplicates provided to the Owner's Construction Representative on a daily basis. Report content must be in accordance with Paragraph 3.9.B "Daily Records" in this Section.
2) Daily briefing of the Owner's Construction Representative on CQC status, actions and plans.
3) Monthly summary reports to be submitted with Application for Payment, including at a minimum; current CPM Schedule Update and Analysis of the Work, Deficiency Tracking System report, Test Approval Log, and Submittal Tracking System report. The monthly summary report must provide information needed for the Architect/Engineer's Certification of the quality and timeliness of the Work. Report contents must be in accordance with Paragraph 3.9.C "Monthly Reports" of this

Section. Monthly CQC reports are required to be submitted monthly even if the Contractor does not submit an Application for Payment.

2. The CQC plan shall include forms approved by the Owner for all the above functions.
3. Reports which are incomplete, inaccurate, or inadequate as judged by the Architect/Engineer or Owner shall be cause for withholding payment under the Contract General Conditions.

C. Acceptance of CQC Plan: Acceptance (approval) of the Contractor's plan or interim plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Owner reserves the right to require the Contractor to make changes in his CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.

D. Notification of Changes: After acceptance by the Owner of the CQC plan, the Contractor must notify the Owner's Project Manager in writing a minimum of seven calendar days prior to any proposed change. Proposed changes are subject to acceptance by the Owner's Project Manager.

3.3 COORDINATION MEETING

A. Before the start of construction, the Contractor shall submit a preliminary Contractor's Quality Control Plan. Subsequently, the Contractor shall meet with the Owner's Project Manager, with its Quality Control staff, and other team members, to discuss the Contractor's Quality Control System. Any submittals required for this meeting shall be submitted to the Owner at least one week in advance. During this coordination meeting, a mutual understanding of the system details for the Quality Control Plan shall be developed, including the forms for recording the CQC operations, definable features of the work, control activities, testing, administration of the Quality Control Plan for both on-site and off-site work, and the interrelationship of Contractor's and Owner's quality goals. After the meeting, the Contractor shall submit a formal Quality Control Plan, consistent with the results of the meeting, to the Owner for approval. The Contractor and its Quality Control staff shall also attend any subsequent conferences, as requested by the Owner, as may be required to address deficiencies in the CQC system.

3.4 CONTRACTOR'S QUALITY CONTROL ORGANIZATION

A. CQC System Manager: The Contractor shall identify a qualified individual within his organization to be the CQC System Manager. The CQC System Manager shall be located at the site, will develop the CQC System, and will be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. This CQC System Manager shall be on the site at all times during construction, shall have no other duties, and shall be employed by the Contractor, except as noted in the following. An alternate CQC System Manager shall be identified in the plan to not exceed 2 weeks at any one time, and not more than 30 workdays during a calendar year. The requirements for the alternate CQC System Manager are the same as for the designated CQC System Manager. **THE CQC SYSTEM MANAGER SHALL NOT BE THE CONTRACTOR'S SUPERINTENDENT ON THIS JOB OR BE ASSIGNED ANY OTHER DUTIES**.

B. CQC Organizational Staffing: The Contractor must provide a CQC staff with complete authority to take any action necessary to ensure compliance with the Contract.

C. CQC Staff: Following are the minimum requirements for the CQC staff. These minimum requirements may not necessarily assure an adequate staff to meet the CQC requirements at all times during construction. The actual strength of the CQC staff may vary during any specific work period to cover the needs of the work period. When necessary for a proper CQC organization, the Contractor will add additional staff at no cost to the Owner. The following listing of minimum staff in no way relieves the Contractor of meeting the basic requirements of quality construction in accordance with Contract Documents. All CQC staff members shall be subject to acceptance by the Owner's Project Manager.

D. CQC System Manager: The CQC system manager shall be:
1. A graduate in construction management with an Associates degree or higher, and;
2. An experienced construction person with a minimum of 10 years' experience in construction management; 5 years of which must be in CQC, and;
3. Shall be assigned no other duties on this or any other job; and
4. Shall not be the Contractor's superintendent for this project.

E. Supplemental Personnel: The Contractor must provide as part of the CQC organization, as a minimum, specialized personnel for the following areas: *[edit positions and requirements for project]*

Expertise	Education	Related Experience	License	Responsibilities
HVAC Quality Control:	Associate degree or higher in mechanical engineering	5 years HVAC supervision experience		HVAC review for compliance with Contract Documents, quality, and applicable codes.

Electrical Quality Control	Associate degree or higher in electrical engineering	5 years electrical supervision experience		Electrical review for compliance with Contract Documents, quality, and applicable codes.
Commissioning Authority (to be hired by Owner)	*Bachelor's Degree in Mechanical Engineering*	*5 years Commissioning Experience*	*P.E.*	*Commissioning of Electrical and HVAC systems*
Building Envelope (including roofing) Quality Control		10 years construction industry experience or 5 years experience in Architectural firm, And 3 years in the employ of an independent firm which is regularly involved in building envelop evaluations and building envelope forensic evaluation processes and protocols.		Inspect and evaluate the building envelop systems for compliance with Contract Documents, quality and applicable codes.

1. These personnel shall assist and report to the CQC System Manager. Each person will be responsible for assuring the construction complies with the Contract Documents for their area of specialization. These individuals shall:
   a. be employed by the Contractor or employed on a consultant basis, unless waived in writing by the Owner's Project Manager;
   b. be responsible only to the CQC System Manager;
   c. be physically present at the site during work on their areas of responsibility;
   d. have the necessary education, training and experience to ensure Contract compliance; and
   e. not be the employee of any of the subcontractors.
2. *[edit for project] The Commissioning Authority will be retained by the Owner. The CQC System Manager will work with the Commissioning*

Authority to provide all access, documents, information, subcontractor testing and involvement needed to successfully commission the facility systems.

F. Organizational Changes: The Contractor shall obtain the Architect/Engineer's and Owner's Project Manager's acceptance before replacing any member of the CQC staff. Requests for changing personnel shall include the names, qualifications, duties, and responsibilities of each proposed replacement.

3.5 SUBMITTALS

A. Submittals shall be as specified in Division 1 Section “Submittals.” The CQC Organization shall be responsible for verifying that each requirement of Contract Documents has been explicitly addressed in the submittal and must certify that all submittals are in compliance with the Contract Documents.

3.6 CONTROL

A. Contractor Quality Control is the means by which the Contractor ensures that the Work complies with the Contract Documents. The controls shall cover all construction operations, including both on-site and off-site fabrication, and shall be keyed to the proposed construction sequence. The controls must include at least the following three phases of control to be conducted by the CQC System Manager for all definable features of work, as follows:

1. Preparatory Phase: This phase shall be performed prior to beginning work on each definable feature of work and shall include:
   a. A check to ensure that the portion of the CQC System for the work to be performed has been accepted by the Owner.
   b. A review of the Contract drawings and specifications by the CQC System Manager with the workers responsible for carrying out the construction.
   c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
   d. A check to assure that provisions have been made to provide required control inspection and testing.
   e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the Contract Documents.
   f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.
   g. Reviews to assure applicable safety requirements are met.
   h. Discussion with workers and supervisors of procedures for constructing the Work including construction tolerances and workmanship standards for that phase of work.
   i. The Owner's Construction Representative must be notified at least 24 hours in advance of beginning any of the required action of the

preparatory phase. This phase must include a preparatory meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions must be documented by separate minutes prepared by the CQC system manager and attached to the daily QC report. The Contractor must instruct applicable workers as to the acceptable level of workmanship required in order to meet Contract Documents.

2. Initial Phase: This phase must be accomplished at the beginning of a definable feature of work. The following must be accomplished:
   a. A check of preliminary work to ensure that it is in compliance with Contract Documents. Review minutes of the preparatory meeting.
   b. Verification of full Contract compliance. Verify required control inspection and testing.
   c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with sample panels or mock-ups, as appropriate.
   d. Resolve all differences.
   e. Check conditions to include compliance with applicable safety regulations. Review safety issues with each worker.
   f. The Owner's Construction Representative must be notified at least 48 hours in advance of beginning the initial phase. Separate minutes of this phase must be prepared by the CQC System Manager and attached to the daily CQC report submitted to the Owner's Construction Representative. Exact location of initial phase must be indicated for future reference and comparison with follow-up phases.
   g. The Initial phase should be repeated for each new crew to work on-site, or whenever quality standards are not being met.
3. Follow-up Phase: Daily checks shall be performed to assure continuing compliance with Contract requirements, including control testing, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC daily report. Final follow-up checks must be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by any deficient work. The Contractor shall not build upon or conceal non-conforming work.
4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be required to be conducted on the same definable features of work, as determined by the Owner's Construction Representative, if the quality of on-going work is unacceptable; or if there are changes in the applicable QC staff or in the on-site production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.7 TESTS

A. Testing Procedure: The Contractor shall perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract Documents. Testing includes operation, acceptance and/or performance tests when specified. Tests shall be documented in the test approval log. A list of tests shall be developed to include: the test name, entity contractually responsible for securing the testing, frequency, specification paragraph containing the test requirements, personnel and laboratory responsible for each type of test, and an estimate of the number of tests required. The Contractor shall perform the following activities and record and provide the following data:

1. Verify that testing procedures comply with Contract Documents.
2. Verify that facilities and testing equipment are available when needed for this Work and comply with testing standards.
3. Check test instrument calibration data against certified standards.
4. Verify that recording forms and test identification control number system, including all the test documentation requirements, have been prepared.
5. Results of all tests taken, both passing and failing tests, shall be recorded on the Quality Control report for the date taken. Reference Specification paragraph, location where tests were taken, and the sequential control number identifying the test. If necessary, actual test reports may be submitted later, if approved by the Owner's Project Manager, with a reference to the test number and date taken. An informational copy of tests shall be provided directly to the Owner's Construction Representative. Failure to submit timely test reports, as stated, may result in nonpayment for related work performed and disapproval of testing agency/facility for this contract.

3.8 SUBSTANTIAL AND FINAL COMPLETION INSPECTIONS

A. When the Contractor determines that the Work, or a designated portion thereof acceptable to the Owner, is Substantially Complete, the CQC System Manager shall conduct an inspection of the Work and develop a "punch list" of items which do not conform to the approved plans and specifications – including both uncompleted work and deficient work. This punch list of deficiencies, including the estimated date by which the deficiencies will be corrected, shall be included with the Contractor's request for Substantial Completion.

B. When the Contractor determines that the Work, or a designated portion thereof acceptable to the Owner, has achieved final completion, the CQC System Manager shall conduct an inspection to ascertain that all deficiencies have been corrected and so notify the Owner in writing. These inspections and any deficiency corrections required by this paragraph shall be accomplished prior to Final Payment and within the time limits specified in the Contract Documents and the Certificate of Substantial Completion.

3.9 DOCUMENTATION

A. All forms for documentation of CQC activities shall be submitted for approval by the Owner in the initial CQC System. The Owner may require use of its forms, or modifications to the Contractor's forms, at the Owner's discretion.

B. Daily Records: The Contractor shall maintain current daily records of quality control operations, activities, and tests performed, including the work of subcontractors and suppliers. These records shall be on an acceptable form and shall include factual evidence that required quality control activities and/or tests were performed, including but not limited to the following:
1. Contractor/subcontractor and their area of responsibility.
2. Operating plant/equipment with hours worked, idle, or down for repair.
3. Work performed each day; provide location, description, and by whom. Identify each phase of work performed each day by CPM task name or activity number.
4. Test and/or control activities performed with results and references to Contract Documents requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
5. Material received with statement as to its acceptability and storage.
6. Identify submittals reviewed, with contract reference, by whom, and action taken.
7. Off-site surveillance activities, including actions taken.
8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
9. List instructions given/received and conflicts in Contract Documents.
10. Contractor's verification statements.
11. These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract Documents. The original record shall be maintained by the Contractor on site in chronological order in a three-ringer binder. Three copies of these records in typed report form shall be furnished to the Owner's Construction Representative daily within 48 hours after the date(s) covered by the report. As a minimum, one report shall be prepared and submitted for every seven days of no work and on the last day of a no work period. All calendar days must be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. All reports from the CQC System Manager shall include copies of test reports and copies of reports prepared by subordinate quality control personnel.

C. Monthly Reports: Contractor shall issue monthly reports summarizing activity, results, and status of the CQC program. Reports shall be in compliance with the approved CQC System and be typed, accurate and timely with two copies to be provided to the Owner, and one to the Architect/Engineer. Reports must cover the following minimum items, and any additional reports or data required by the Owner' s Project Manager, at no additional cost the Owner:

1. CPM Update and Analysis: Updated CPM analysis for the project to include, network analysis chart, current projected completion date, description of items on the critical path, management moves to prevent time overrun or recoup existing time overruns, analysis of items which could become critical path items if small delays occur.
2. Deficiency Tracking System report: Summarize each deficiency tracked during the reporting month, including all new deficiencies observed, all prior deficiencies that have not been resolved, and management actions to resolve all deficiencies. Provide a separate listing of known work with unresolved deficiencies as of the report date.
3. Test Approval Log: List all tests conducted during the reporting period and results.
4. Submittal Tracking System report: List the status of all submittals required on the project, including original deadline for submittal per approved CQC plan, each date of submittal or re-submittal, and final action date by the Architect/Engineer or current status.

3.10 COMMISSIONING FORMS

A. Commissioning Forms: The Contractor's QC team shall complete required forms at each indicated phase and submit these forms with other required submittals.

B. Other Forms: The Owner reserves the right to require specific additional or replacement QC forms provided by Owner to the Contractor, whenever the Owner believes such forms will permit better assurance of quality in the Work.

3.11 NOTIFICATION OF NONCOMPLIANCE

A. The Owner's Project Manager or designee may notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor must, after receipt of such notice, immediately take corrective action. Such notice, when delivered to the Contractor shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Owner's Contract Administrator may issue an order stopping all or part of the Work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

3.12 OWNER AND ARCHITECT/ENGINEER REPORTING OF DEFICIENCIES

A. The Owner, Architect/Engineer, and other design consultants will visit the site periodically and may issue field reports to the CQC System Manager. Any issues or deficiencies in the Work identified in any such field reports shall be recorded in the CQC Documentation and corrected as part of the CQC System.

B. Progress meetings will be conducted regularly (typically every two weeks) by the Architect/Engineer and shall be attended by the Owner, Contractor, CQC System Manager, and applicable sub-contractors. Any issues or deficiencies in the Work identified in these meetings shall be recorded in the CQC Documentation and corrected as part of the CQC System.

END OF SECTION 01440

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Sections include the following:
1. Division 1 Section "Summary" for other work restrictions.
2. Division 1 Section "Submittal Procedures" for procedures for submitting copies of implementation and termination schedule and utility reports.
3. Division 1 Section "Execution Requirements" for progress and final cleaning requirements.
4. Division 1 Section "Indoor Air Quality (IAQ) Management" for procedures for protecting indoor air quality.
5. Divisions 2 through 16 Sections for environmental (heat, ventilation, and humidity) requirements for products in those Sections.
6. Division 2 Section "Dewatering" for disposal of ground water at Project site.

1.3 DEFINITIONS

A. Permanent Enclosure: As determined by Architect/Engineer, permanent or temporary roofing is complete, insulated, and weathertight; exterior walls are insulated and weathertight; and all openings are closed with permanent construction or substantial temporary closures.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities for project use without cost, including, but not limited to, Owner, Architect/Engineer, Commissioning Authority, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.5 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, project identification sign, and parking areas for construction personnel.

B. Project Identification Sign: Submit shop drawings for approval showing plan elevation, details and finishes for Project Identification Sign.

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Temporary Use of Permanent Facilities
   1. Contractor must obtain prior written Owner approval before using any permanent facility, system or service not specified on the Contract Documents. The Owner's approval of Contractor request for use of permanent facilities, system or services shall be totally at the Owner's discretion.
   2. Contractor shall be responsible for operation, maintenance, protection and restoration of each permanent facility, system or service during its use as a construction facility before Substantial Completion, regardless of Owner's approval of use. If used by Contractor, Contractor shall return permanent facility, system and services to "like new" condition prior to turnover to the Owner at Substantial Completion; this includes but is not limited to cleaning, replacement of filters, replacement of burnt out lamps and replacement of worn parts. Warranties for all permanent facilities, systems and services shall start at Substantial Completion regardless of any prior use by the Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Portable Chain-Link (Site Enclosure) Fencing: Minimum 2-inch , 9-gage, galvanized steel, chain-link fabric fencing; minimum 8 feet high with galvanized steel pipe posts; minimum 2-3/8 inch OD line posts and 2-7/8 inch OD corner and pull posts, with 1-5/8 inch OD top and bottom rails. Provide concrete bases for supporting posts.

B. Lumber and Plywood: Unless noted otherwise, comply with requirements in Division 6 Section "Miscellaneous Carpentry."

C. Paint: Comply with requirements in Division 9 painting Sections.

2.2 TEMPORARY FACILITIES

A. General: Maintain all temporary facilities and controls necessary for the performance of the Work. Comply with all applicable codes and regulations of authorities having jurisdiction; obtain permits as required. Locate and install all facilities and controls where acceptable to the local authorities having jurisdiction, utility, and Owner and remove same and terminate, in a manner suitable to the utility owner, at completion of the Work or when otherwise directed. Pay all costs associated with the provision and maintenance of temporary facilities and controls including power, water, and fuel (if any) consumed until Substantial Completion.

B. Field Offices, Contractor: Provide prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading; of sufficient size to accommodate needs of construction personnel. Provide at time of project mobilization. Keep office clean and orderly. Field office shall include the following:
 1. Conference room or area of sufficient size to accommodate meetings of 10 individuals. Furnish room with conference table, chairs, and 4-foot- square tack board.
 2. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 3. Lighting fixtures capable of maintaining average illumination of 20 foot-candles at desk height.

C. *[Edit for project]* Field Office, Owner: Provide prefabricated or mobile unit with serviceable finishes, weather-tightness, ventilation, temperature controls, and foundations adequate for normal loading; of sufficient size to accommodate needs of Owner personnel. Provide at time of project mobilization. Keep Owner’s office clean and orderly; provide for weekly trash removal and cleaning. Provide security for trailer. Owner’s Field office shall include the following:
 1. Two personnel stations each with: office desk, reference table, chair, 4-foot square tack board, personal computer, and 4-drawer filing cabinet.
 2. One drafting table and drafting chair.
 3. Drawing “hanger” system of sufficient size to hold all Contract Drawings and Shop Drawings.
 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 5. Lighting fixtures capable of maintaining average illumination of 20 foot-candles at desk height.
 6. Provide temporary toilets, wash facilities, and drinking water for use of Owner personnel.
 7. Provide temporary telephone service. Install one telephone line for each personnel station and an additional dedicated telephone line for a facsimile machine. Provide dedicated high-speed (DSL or T-1) lines to each computer.
 8. Sufficient electrical outlets

D. Storage and Fabrication Sheds: Provide weather-tight sheds sized, furnished, and equipped to accommodate tools, materials and equipment for construction operations.
 1. Store combustible materials apart from building.
 2. Provide sheds sized to storage requirements for products of individual Sections, allowing for access and orderly maintenance and inspection of products.

E. Storage and Staging Areas: The Contractor shall be responsible for coordination, protection and safekeeping of products stored on site under this Contract including soil cut and fill. Refer to Contract Documents for any defined staging areas.
 1. Move stored products that interfere with construction of the Work, or operations of the Owner or separate contractors.
 2. Obtain and pay for use of additional storage or staging areas as needed for the Work.

3. Provide storage areas sized to storage requirements for products of individual Sections, allowing for access and orderly maintenance and inspection of products.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. Heating Equipment: Unless Owner authorizes use of permanent heating system, provide UL Listed or FM approved vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   3. *[Edit for project] If Owner authorizes use of permanent heating system, protect indoor air quality in accordance with Division 1 "Indoor Air Quality Management", including but not limited to the following measures:*
      a. *Filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 must be used at each return air grill, as determined by ASHRAE 52.2-1999, and all HVAC systems, equipment and pathways shall be dust and particulate free at the time of substantial completion of that phase of construction, in accordance with SMACNA "IAQ Guidelines for Occupied Buildings Under Construction."*
         1) *Replace filters during construction as necessary to protect equipment and indoor air quality.*
      b. *HVAC supply and return ductwork, registers and equipment shall be kept clean, free of dust, debris, moisture, gaseous and microbial contamination during storage, handling installation and punch-out.*
      c. *During the progress of construction, install new filtration media throughout the HVAC system. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 8 or better, dependant upon equipment and designed static pressure limitations, as determined by ASHRAE 52.2-1999.*

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate temporary facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

C. Location of Contractor's and Owner's field trailers shall be approved by Owner prior to installation.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Provide and pay for all temporary utility service and systems as needed for the efficient construction of the facility until Substantial Completion.
   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
   2. Contractor is solely responsible for cost of, the coordination with the utilities for, and the timeliness of, the installation of temporary utilities until Substantial Completion. The Owner does not guarantee the availability of temporary utilities at the site, and does not guarantee the timing of permanent utility installation. The Contractor shall verify the availability of temporary permanent utilities prior to bid and shall arrange for, and pay for, all utility permits, inspections, connections, etc. necessary for provision of temporary utilities. No time extension will be granted based on the Contractor's failure to obtain temporary utilities in time to support completion of the project.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install temporary water service and distribution piping in sizes and pressures adequate for construction.
   1. Provide potable water approved by local health officials.
   2. Wash Facilities: Supply with potable water for personnel to wash-up for sanitary condition. Dispose of drainage properly. Provide cleaning compounds appropriate for each condition.
   3. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation as required to prevent freezing.
   4. Remove all temporary piping and connections after use is no longer required. Restore source of supply to its pre-construction condition.

D. Sanitary Facilities: Provide temporary self-ventilated portable toilets for use by all construction personnel throughout the construction period. Keep toilet facilities clean, sanitary, provided with all appurtenances and in compliance with applicable codes and regulations. Service as often as necessary to prevent accumulation of wastes and creation of unsanitary conditions. Remove at Substantial Completion.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
   1. Within 30 calendar days of Notice-to-Proceed, Contractor shall submit in writing to the Architect/Engineer and Owner for review only, three copies of its method and time schedule for heating during construction, which shall concur with his general progress schedule.
   2. After the building or portion thereof is completely enclosed by either permanent construction or substantial temporary materials, and before installation of finishes, Contractor shall pay for and provide heat therein of not less than 55 degrees F., or more than 75 degrees F., which shall be continuously maintained in the enclosed area until the project is accepted.
   3. Contractor shall provide one accurate recording Fahrenheit thermometer at a place designated by Owner's Construction Representative, and one additional accurate

thermometer for every 2,000 square feet of floor space, located as directed by Owner's Construction Representative in order to determine if the specified temperatures are maintained. Contractor shall furnish daily to the Owner's Construction Representative three copies of a signed statement of temperatures recorded every three hours.

4. Contractor, with the written approval of the Owner, may use the permanent heating system as specified for the project once it has been tested, flushed out and chemically treated, and is ready to operate. Contractor shall pay all energy costs for heating during construction and provide meters if required. Contractor shall coordinate the work so that the permanent heating system for the building will be available and ready to provide heat as soon as the building is closed in.
5. Contractor shall arrange and pay for operation of the heating system including all costs to put in first-class condition all portions of the permanent heating system used for heating during construction prior to turnover and acceptance by Owner.
6. The installation and operation of heating devices shall comply with all safety regulations including provisions for adequate ventilation and fire protection. Heating devices, which may cause damage to finish surfaces, shall not be used.
7. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

F. Temporary Ventilation: Provide adequate ventilation in enclosed areas throughout construction period required to: facilitate progress of Work; to protect Work and products against excessive dampness and heat; to prevent moisture condensation on surfaces; to provide suitable environmental conditions for installation and curing of finish materials; to provide adequate ventilating to meet health regulations for safe working environment; and, to prevent hazardous accumulations of dusts, fumes, mists, vapors or gases in areas occupied during construction. Provide local exhaust ventilating to prevent harmful dispersal of hazardous substances into atmosphere of occupied areas. Dispose of exhaust materials in manner that will not result in harmful exposure to persons or property. Provide ventilating operations at all times personnel occupy an area subject to hazardous accumulations of harmful elements. Continue operation of ventilating system for as long as required after cessation of construction activities to assure removal of harmful elements.

G. Electric Power Service: Provide electric power service and distribution system (meeting NEC requirements) of sufficient size, capacity, and power characteristics required for efficient construction operations.
1. Equip service with meter, main disconnect, and over current protection.
2. Provide branch distribution system from temporary power source with distribution boxes and outlets located so that power is available throughout active work areas.
3. Permanent receptacles may be utilized during construction. Replace any receptacle plates and wiring devices damaged during construction.
4. Remove all temporary wiring after it use is no longer required. Restore source of power to its pre-construction condition.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, safety and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements.
2. Provide branch distribution system from temporary power source with distribution boxes and outlets located so that lighting is available throughout active work areas.
3. Provide 1 watt per sq. ft. lighting to exterior staging and storage areas after dark for security purposes. Provide 0.25 watt per sq. ft. lighting to interior work areas after dark for security purposes. Provide a lighting level of 150 foot-candles per sq. ft. minimum on surfaces receiving finishes.
4. Permanent lighting system may be utilized during construction with Owner approval. Restore permanent lighting systems used during construction to original condition. Maintain lighting and provide routine repairs.

I. Telecommunications Service: Provide and pay for all costs (including installation, maintenance and monthly service costs) for telecommunications systems for the performance of the Work and for the Owner's trailer.
   1. Provide temporary telephone service in the field offices for use by construction and Owner personnel. Install one telephone line for each field office.
   2. Provide additional telephone lines for the following:
      a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
      b. Provide a telephone line at each first-aid station.
   3. Provide Contractor superintendent with a cellular telephone for use when away from field office.
   4. Provide dedicated high speed (DSL or T-1) lines in Contractor's and Owner's field offices for computer (e-mail and internet) use.

J. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.

3.3 SUPPORT FACILITIES AND CONTROLS

A. General: Comply with the following:
   1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
   2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion after approval by Owner. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions approved by Owner.

B. Traffic Controls: Comply with requirements of authorities having jurisdiction prior to any work affecting public roads, sidewalks or other public right-of-ways.
   1. Maintain traffic on all streets adjacent to or leading to the site. Where construction operations interfere with the free movement of traffic, provide approved traffic controls, flagmen or similar devices to efficiently control traffic movement. With prior approval, provide detours as necessary for unimpeded traffic flow. Comply with approved traffic management plans when provided.
   2. Protect existing site improvements including curbs, pavement, sidewalks and utilities. Keep streets, drives, and walks adjacent to site and haul routes clean and free of dirt, debris, and litter caused by construction operations.
   3. Provide means of removing mud and debris from vehicle wheels before entering public streets. Clean mud and debris from public streets and sidewalks as required.

4. Track-equipped vehicles are not allowed on paved areas.
5. Maintain access for fire-fighting equipment and access to fire hydrants at all times.
6. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Haul Routes:
1. Consult with authorities having jurisdiction to establish public thoroughfares allowed to be used for haul routes and site access.
2. Confine construction traffic to approved haul routes at approved hours.
3. As required, provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

D. Maintenance of Access: Contractor shall provide and maintain until Substantial Completion, means of safe access to, around and within the site, for vehicular and personnel traffic.
1. Provide and maintain means of access (including access roads, construction personnel parking area and walkways) constructed to sustain the weight and easy movement of construction personnel and equipment used in construction of the Work.
2. Provide and maintain means of access constructed to sustain the weight and easy movement of any Emergency vehicle required by governing authority. Provide and maintain access to site fire hydrants, free of obstructions, at all times.
3. Contractor shall, without additional compensation from Owner, furnish labor and materials necessary to repair and maintain the means of access in an acceptable condition to meet performance requirements.
4. Remove all snow and ice in an expeditious manner to protect and prosecute the Work.

E. Temporary Signs: Provide temporary signs where needed to inform public and individuals seeking entrance to Project. Unauthorized signs are not permitted.
1. Provide temporary, directional signs for construction personnel and visitors.
2. Maintain and touchup signs so they are legible at all times.

F. Project Identification Sign: Contractor shall furnish and install one project sign as indicated below and as approved by Owner within thirty days of commencement of construction:
1. Owner will provide *(See attached for)* sample layout for project identification sign.
2. Sign shall be installed near the project entrance at a location of high visibility approved by Architect/Engineer and Owner.
3. Sign shall be installed and maintained plumb and level.
4. Sign shall be fabricated from one-inch thick medium density overlaid exterior plywood laminated with waterproof glue. All edges of sign shall be banded with 1 inch by ½-inch pine banding. All nails, nuts, bolts and other connecting hardware shall be galvanized.
5. Sign shall be supported by two 4” by 4” structural wood post supports set in 12 inch diameter concrete footings to a depth of four feet and so that sign is raised a minimum of four feet above grade.
6. Sign shall be lettered by a professional sign painter with use of graphics in accordance with the general layout indicated. Submit shop drawing indicating sign construction and lettering.

7. Letter style shall be Helvetica Medium. Letter color shall be gloss white. All surfaces of sign shall receive one coat exterior primer followed by two coats of exterior gloss enamel. Surface color shall be Dark Blue --Sherwin Williams 33-24 or equal.
8. Contractor shall repair any deterioration or damage to the sign during the construction.
9. At completion of the project, Contractor is responsible to remove and dispose of the sign, supports and foundations and to restore area.
10. No other free-standing signs will be allowed except those required by law. All other contractor signage shall be trailed mounted; subject to Owner’s approval. Subcontractor trade signs are not permitted.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction and the requirements of other Sections. Maintain the Project site, excavations, and construction free of water from rain or snow, spring or ground water, backing up of drains, and other water sources.
1. Dispose of water in a lawful manner that will not result in flooding Project site or adjoining properties nor endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations and to protect the Work.
3. As necessary, provide and operate sufficient dewatering and pumping equipment to maintain the site and the Work free of standing water.

H. Waste Disposal Facilities: Comply with requirements specified in Division 1 Section "Construction Waste Management."

I. Lifts and Hoists: Furnish and maintain hoists, staging, rigging, scaffolding, and runways required in the execution of the work. Erect, equip, and maintain such temporary work in accordance with statutes, laws, ordinances, rules, and regulations of the governing authorities and insurance companies having jurisdiction..
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

J. Temporary Elevator Use: The elevators constructed under the requirements of Division 14 shall only be used for construction purposes, or during the construction period, with written permission from the Owner, in which case such use shall be limited to a single car. Elevators may be used by the Contractor as necessary for testing and inspection only without Owner approval. Temporary enclosures or hoistway opening protection, cab finish protection (protective padding), protection of damage to car, door and door frames, hoisting machine, platforms, etc shall be provided by the Contractor. Any repairs, or replacements, required to restore the elevator equipment to its original, like new, condition shall be made by the Contractor at his own expense prior to Substantial Completion. Owner is not responsible for providing telephone service for elevator use during construction.

K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

L. Temporary Use of Permanent Stairs: Cover finished permanent stairs with protective covering of plywood or similar material so finishes will be undamaged at time of Substantial Completion.

M. Design of Temporary Structures: The structural design of all items used in the construction of the building and not a permanent part thereof, including but not necessarily limited to hoisting towers, shoring for concrete and masonry work, the temporary bracing for structural steel, and the shoring of cut earth banks, is the sole responsibility of the Contractor.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Comply with permit requirements and authorities having jurisdiction. Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that prevent air, water, and soil contamination or pollution or other undesirable effects.

B. Tree and Plant Protection: Comply with contract requirements, permit requirements and authorities having jurisdiction. As a minimum:
1. Preserve and protect existing trees and plants designated to remain.
2. Provide 6 foot high barriers around drip line, with access for maintenance.
3. Consult with Architect/Engineer; remove agreed-on roots and branches which interfere with construction.
4. Protect areas within drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding, and continuous running water.
5. Replace trees and plants damaged by construction operations.

C. Temporary Erosion and Sedimentation Control: Comply with permit requirements and authorities having jurisdiction. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
1. Inspect, repair, and maintain erosion-control and sedimentation-control measures during construction until pavement has been installed.
2. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow, and from waste disposal areas. Prevent erosion and sedimentation.
3. Minimize amount of bare soil exposed at one time.
4. Provide temporary measures such as berms, dikes, silt fences, drains, and other soil and erosion control devices required by authorities having jurisdiction.
5. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
6. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

D. Stormwater Control: Comply with permit requirements and authorities having jurisdiction. Provide methods to control surface water to prevent damage to site or adjoining properties. Maintain excavations free of water; provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater. Grade site to drain; protect site from ponding water. Where required, provide, operate, and maintain pumping and dewatering equipment. Provide water barriers required to protect site from soil erosion.

E. Dust Control: Execute Work by methods that minimize raising dust from construction operations. Provide positive and effective means of dust control both within the building and on the surrounding site. Contractor shall apply water and/or use other methods acceptable to Owner to minimize dust in the air. Comply with requirements of governing agencies.

F. Noise Control: Perform all work within the time limits and requirements imposed by the authorities having jurisdiction. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum within the limits.

G. Pest Control: Engage a pest-control service to minimize attraction and harboring of rodents, roaches, insects and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

H. Site Enclosure Fence: Before construction operations begin, provide and erect specified site enclosure fence in a manner that will prevent people and animals from entering construction site except by entrance gates.
1. Extent of Fence: As noted on construction drawings or, if not noted, as required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide one key to Owner’s Construction Representative.
3. Construction fence shall be of chain link or other Owner-approved construction, erected in a substantial manner, straight, plumb and true.
4. Gates shall be built into fence at such approved locations as are necessary, be well cross-braced and hung on heavy strap hinges with proper post and hook for double gates. Provide heavy hasps and padlocks for each gate.
5. Maintain the fence and gates in good condition for the duration of the construction operations and then remove them completely from the site, unless otherwise directed by the Owner.
6. Restore site to original condition after removing fence.

I. Security: Provide adequate security and lighting devices to prevent unauthorized entrance, vandalism, theft, use, and similar violations of security to Work and existing facilities. Install substantial temporary enclosure around partially completed areas of construction including all exterior openings. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security; lock entrances at the end of each workday. Coordinate with Owner’s security program to prevent security violations.

J. Protection of Installed Work: Protect installed Work and provide special protection where specified in individual Specification Sections.
1. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
2. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
3. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials compatible with material being protected.
4. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer. During the construction period after the installation of the

roofing system, Contractor shall be responsible for damages to the roof caused by work or materials of the other trades.

5. Prohibit traffic at landscaped areas.

K. Protective Barriers: Provide barriers to protect existing facilities, the Work and adjacent properties from damage from demolition and construction operations. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing facilities. Provide protective barriers to protect plant life designated to remain. Protect vehicles, stored material and structures from damage. *[Edit for project]*

1. *Provide temporary partitions and ceilings required to separate work, to prevent penetration of dust and moisture into work areas, to prevent damage to existing areas and equipment, and to provide fire separation required by the Fire Marshal.*
2. *Construction: Framing, plywood and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces; STC rating of 35 in accordance with ASTM E90, maximum Flame Spread Rating of 75 in accordance with ASTM E84*.
3. *Paint surfaces exposed to view from public or occupied areas.*

L. Safety: Provide safety protection to all machinery, equipment, and temporary and permanent facility hazards to prevent unsafe conditions and to comply with the safety requirements of the authorities having jurisdiction, OSHA and MOSHA.

1. Protect all hazards with adequately constructed guardrails, fences or barricades and provide warning signs, lanterns, warning lights, and the like, as necessary to prevent unsafe access. To this end, dispose, store, guard, and protect the premises and all Work, materials, equipment and both permanent and temporary construction so as to preclude the unauthorized use thereof and particularly to eliminate possible consequent injury to all persons.
2. Institute and maintain a safety program for worker safety at the site.
3. Do not load or permit any part of the Work to be loaded so as to endanger its safety.
4. At completion of the Work, all temporary security, safety, construction aids and protections shall be removed.

M. Existing Underground Utilities: Comply with all laws and regulations concerning the identification and locations of all underground utilities. Utilities data on Drawings are based upon information obtained by Architect/Engineer and have not been verified by Architect/Engineer. Architect/Engineer and Owner are not be responsible or liable for accuracy of the data supplied. Data shall not be relied upon by Contractor in complying with Contract Documents or safety requirements. Report to the utility any break, leak, dent, gouge, groove, or any other damage to facilities whether or not caused by the Contractor. Contractor shall notify Owner, Architect/Engineer and nearby occupants of any emergency situations that may arise.

N. Temporary Enclosures: Provide temporary weather-tight enclosures and temporary heating for protection of the Work in progress and completed, from exposure (freezing or frost damage), foul weather, other construction operations, and similar activities as required by Contract Documents. Provide temporary weathertight enclosure for building exterior as needed to maintain acceptable working conditions and to maintain specified environmental controls for product installation.

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

2. Provide protection as necessary to ensure adequate working areas during the months that temperature drops below 40 degrees F. Protection shall be consistent with the approved construction schedule to permit the continuous progress of all work necessary to maintain an orderly and efficient sequence of construction operations.
3. Provide all "weather protection" material and be responsible for all costs, including for required heating to maintain a minimum temperature of 40 degrees F (see specific Sections for stricter environmental controls for some materials), at the working surface.
4. See elsewhere in this Section for temporary heating requirements.

O. Fire Exits: Maintain, for the entire length of the Work, all required exits to conform with regulations of authorities having jurisdiction

P. Temporary Fire Protection: Provide fire protection and prevention in accordance with all applicable Federal, State and local codes and regulations and authorities having jurisdiction. Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Develop and supervise an overall fire-prevention and fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct construction personnel in methods and procedures. Post warnings and information.
2. Prohibit smoking in hazardous fire-exposure areas.
3. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
4. All flammable liquid and material shall be properly stored in UL listed containers, properly handled, and kept to an absolute minimum at the site.
5. Provide temporary standpipes and hoses as necessary for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.
6. Provide and maintain fire extinguishers, and other fire-fighting equipment, as required by locations and classes of fire exposures.

3.5 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to meet specification requirements, achieve indicated results, and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion unless authorized in writing by the Owner.

D. Termination and Removal: Remove each temporary facility, utility, equipment, material or control when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than request for Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed or damaged because of interference with temporary facility. Repair damaged Work or existing facilities, clean exposed contaminated surfaces, and replace damaged construction that cannot be satisfactorily repaired or cleaned.
   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
   2. At Substantial Completion, clean and restore permanent facilities and equipment used during construction period to original condition. Comply with final cleaning requirements specified in separate Division 1 Section.

END OF SECTION 01 50 00

SECTION 01 52 04

CONSTRUCTION WASTE MANAGEMENT

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for the following:
   1. Recycling no hazardous construction waste.
   2. Disposing of no hazardous construction waste.

B. Related Sections include the following:
   1. Division 1 Section "Special Procedures" for additional requirements.
   2. Division 1 Section "Temporary Facilities and Controls" for environmental-protection measures during construction.
   3. Division 4 Section "Unit Masonry Assemblies" for disposal requirements for masonry waste.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

C. Recycle: Recovery of construction waste for subsequent processing in preparation for reuse.

D. Salvage: Recovery of construction waste and subsequent sale or reuse in another facility.

1.4 PERFORMANCE GOALS

A. Salvage/Recycle Goals: Owner's goal is to salvage and recycle as much no hazardous construction waste as possible including the following materials:
   1. Construction Waste:
      a. Masonry and CMU.
      b. Lumber.
      c. Wood sheet materials.
      d. Metals.
      e. Roofing.

f. Insulation.
g. Carpet and pad.
h. Gypsum board.
i. Piping.
j. Electrical conduit.
k. Packaging: Regardless of salvage/recycle goal indicated above, salvage or recycle 100 percent of the following uncontaminated packaging materials: 1) Paper. 2) Cardboard. 3) Boxes. 4) Plastic sheet and film. 5) Polystyrene packaging. 6)Wood crates. 7)Plastic pails.

1.5 SUBMITTALS

A. Waste Management Plan: Submit 3 copies of plan within 30 days of date established for the-Notice-to-Proceed.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan.
2. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
3. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
4. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
1. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.

3. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.

PART 2 -PRODUCTS (Not Used)

PART3-EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Owner. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
   1. Comply with Division 1 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.

B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.
   1. Distribute waste management plan to everyone concerned within three days of submittal return.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
   2. Comply with Division 1 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
   1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
      a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   2. Polystyrene Packaging: Separate and bag materials.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
   1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.4 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

End of Section

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

B. See specifically Articles 9 and 12 of the General Conditions of Contract.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project products including product delivery, storage, protection, and handling; warranties; product options, comparable products and substitutions; and quality of workmanship. Refer to individual Specification Sections for products' technical requirements.

B. The Contract is based on the products and standards specified in the Contract Documents without consideration of proposed substitutions or Comparable Products. Owner may reject proposed substitutions or Comparable Products at its discretion.

C. Related Sections include the following:
1. Division 1 Section "Alternates" for products selected under an alternate.
2. Division 1 Section "References" for applicable industry standards for products specified.
3. Division 1 Section "LEED Summary, Requirements & Goals" for LEED-related product and submittal requirements.
4. Division 1 Section "Closeout Procedures" for submitting warranties for Contract closeout.
5. Divisions 2 through 16 Sections for specific requirements for products including warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.

B. Comparable Product: Contractor proposed product that is demonstrated and approved through submittal process, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product. Comparable products are allowed when "or equal" is indicated in the individual product specification. The terms "Comparable Product" and "Or Equal Product" are considered interchangeable and of the same definition.

C. Substitution: Contractor proposed change to a product required by the Contract Documents where the original product does not allow "or equal" products or the proposed changed product does not qualify as an "or equal" product.

D. Basis-of-Design Product: A specific manufacturer's product named and accompanied by the words "basis-of-design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.4 PRODUCT SUBSTITUTION REQUESTS

A. General: Any proposed substitution must maintain the quality standards established by the Contract Documents for the specified product without any detrimental effect to the Owner. Refer to Section 12.6 of the General Conditions of Contract for additional requirements.

B. Justification for Request: Owner will not consider requests for substitution after Contract Award, except for extenuating circumstances as follows. Requests may be considered or rejected at discretion of Owner.
   1. The product is no longer manufactured.
   2. The product is not available due to a strike, lockout or bankruptcy.
   3. The product is not available due to an Act of God.
   4. The specified product is identified as incompatible or inappropriate for the project.
   5. The specified item fails to comply with building code requirements.
   6. The manufacturer or fabricator declares a specified product to be unsuitable for the use intended and refuses to warrant its installation.
   7. The requested substitution will provide the Owner with a cost savings without affecting the desired effect of the specified product.

C. Substitution Request Procedures: If the substitution request is justified per the preceding article, submit each substitution request per the following procedures:
   1. Limit each request to one proposed substitution.
   2. Substitution Request Form: Use CSI Form 13.1A or approved equal. Complete all lines. If a line is not applicable, indicate "N/A.". Identify the product to be replaced and the product to be substituted. Include Specification Section number, title and paragraph and Drawing numbers and titles.
   3. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified material or product cannot be provided.
      b. Coordination information including a list of any changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate the proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitution with those of the product specified. Significant qualities may include attributes

such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of Architect/Engineers and Owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Accurate cost information, including a proposal of change, if any, to the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
m. Other information as necessary to assist evaluation.

D. Architect/Engineer Review: Architect/Engineer will review Contractor's written request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect/Engineer will return request to Contractor, without recommendation to the Owner, to record noncompliance with these requirements:
1. Written explanation stating one of the above reasons for justification of the substitution.
2. Requested substitution does not require unacceptable revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce desired results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not unnecessarily adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution has been coordinated, and is compatible, with other portions of the Work.
8. Requested substitution provides specified warranty.
9. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

E. Architect/Engineer’s Action: If necessary, Architect/Engineer will request additional information or documentation for evaluation within one week of receipt of a substitution request. Within seven days of receipt of all required information or documentation, the

Architect/Engineer will provide the Owner (with a copy to Contractor) with a recommendation to approve or reject the proposed substitution request.

F. Owner Action: Within seven days of receipt of the Architect/Engineer's recommendation, the Owner will issue a written decision accepting or rejecting the proposed substitution. The rejection of any proposed substitution by the Owner will be final and without further recourse by the Contractor. In making such determinations, the Owner may, but will not be required to, rely upon the recommendations of the Architect/Engineer. If the event of Owner rejection, the specified product shall be provided.

G. Submission of a Shop Drawing, Sample or Product Data indicating a proposed variance from the Contract Documents is not a proper submission and does not constitute a Substitution Request. Approval of a Shop Drawing, Sample or Product Data indicating a proposed variance from the Contract Documents does not constitute approval of a Substitution.

1.5 COMPARABLE ("OR EQUAL") PRODUCT REQUESTS:

A. General: Any proposed Comparable Product Request must maintain the quality standards established by the Contract Documents for the specified product without any detrimental effect to the Owner. Refer to Section 12.6 of the General Conditions of Contract for additional requirements.

B. Comparable Product Request Procedures:
1. Limit each request to one proposed Comparable Product.
2. Submit each comparable product request for consideration if specifically permitted by the individual Specification Section.
3. Identify the product to be replaced and the product to be substituted. Include Specification Section number, title and paragraph and Drawing numbers and titles.

C. Architect/Engineer Review: Owner will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect/Engineer will return requests to Contractor, without recommendation to the Owner, to record noncompliance with these requirements:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents; that it is consistent with the Contract Documents and will produce the desired results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of Architect/Engineers and owners, if requested.
5. Samples, if requested

D. Architect/Engineer's Action: If necessary, Architect/Engineer will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Within seven days of receipt of all required information or documentation, the Architect/Engineer will provide the Owner (with a copy to Contractor) with a recommendation to approve or reject the proposed comparable product request.

E. Owner Action: Within seven days of receipt of the Architect/Engineer's recommendation, the Owner will issue a written decision accepting or rejecting the proposed comparable product. The rejection of any proposed comparable product by the Owner will be final and without further recourse by the Contractor. In making such determinations, the Owner may, but will not be required to, rely upon the recommendations of the Architect/Engineer. If the event of Owner rejection, the specified product shall be provided.

F. Submission of a Shop Drawing, Sample or Product Data indicating a proposed comparable product is not a proper submission and does not constitute a Comparable Product Request. Approval of a Shop Drawing, Sample or Product Data indicating a proposed comparable product does not constitute approval of a Comparable Product.

1.6 OTHER THAN "BASIS-OF-DESIGN" PRODUCT SPECIFICATION SUBMITTAL:

A. If the Contractor submits a product other than the product specified as the basis of design, <u>and the submitted alternate manufacturer is named in the relevant specification Section</u>, that submittal shall be processed in accordance with requirements in Division 1 Section "Submittal Procedures." Contractor shall submit all required evidence to show alternate product's compliance with technical requirements and equivalency with the basis-of-design product. The Architect/Engineer may directly approve or disapprove this type of submittal; Owner review and action is not required.

1.7 QUALITY ASSURANCE

A. Source Limitations: To the fullest extent possible, provide products of the same kind from a single source. When specified products are available only from sources that do not, or cannot, produce a quantity adequate to complete project requirements in a timely manner, consult with the Architect/Engineer and Owner to determine the most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. After a determination has been made, provide products from sources producing products that possess these qualities, to the fullest extent possible.

B. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

C. Whenever the Contract Documents require that a product complies with Federal Specifications, ASTM Designations, ANSI Specifications or other association standard, the Contractor shall present an affidavit from the manufacturer certifying that the product complies therewith. Where requested or specified, submit supporting test data to substantiate compliance.

D. Nameplates and labels: Except for required labels and operating data, do not attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products that will be exposed to view in occupied spaces or on the exterior.

1.8 OWNER-FURNISHED PRODUCTS

A. See Specification Section 01 10 00.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions and recommendations.

B. Delivery and Handling:
1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products upon delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Provide appropriate equipment and qualified personnel to move products on-site without damage.
6. Each product shall be marked with unique identifiers including the project name, specifications reference and any other information needed to identify the product's specific use on the Project.

C. Storage:
1. Comply with product manufacturer's written instructions and recommendations for temperature, humidity, ventilation, and weather-protection requirements for storage.
2. Store products to allow for inspection and measurement of quantity or counting of units.
3. Prevent product contact with materials that may cause corrosion, discoloration or staining.
4. Store materials in a manner that will not endanger Project or temporary structures.
5. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
6. Provide off-site storage when site does not permit adequate on-site storage or protection.
7. Store cementitious products and materials on elevated platforms.
8. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
9. Protect stored products from damage and liquids from freezing.

1.10 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
3. Refer to *Divisions 2 through 16* Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 1 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION AND PROVISION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Products required to be supplied in quantity within a Specification Section shall be of the same manufacture, shall be interchangeable, and shall be the same with regard to function, texture, pattern and color. To the greatest extent possible, provide products from a single source.
3. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
4. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
5. Materials specified on the Contract Documents by reference to title, symbol, or number of a Commercial or Industry Standard, Federal Specification, ASTM designation, ANSI designation, Manufacturer's data, or other similar reference standard are identified hereby as the minimum requirement for the quality of materials required hereunder. References are to the latest editions of same, except as indicated otherwise. If not in contradiction to the building code or regulations of other governmental agencies as may have jurisdiction, such reference documents shall be considered as an integral part of these specifications as if repeated word for word herein.
6. In case of conflict between differing specifications for a product, the most stringent specification (or the most stringent combination of specifications) shall apply. Contact the Architect/Engineer regarding interpretation of specifications as required.
7. Do not use products salvaged from existing premises, except as specifically specified on the Contract Documents.
8. Where products are accompanied by the term "as selected," Architect/Engineer will make selection.
9. Where products are accompanied by the term "match sample," sample to be matched is Architect/Engineer's.

10. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

B. Product Selection Procedures:
   1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
   2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
   3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   5. Where Specifications specify products or manufacturers by name, accompanied by the term "or equal" or "or approved equal," comply with the Contract Document provisions concerning "comparable products" to obtain approval for use of an unnamed product
   6. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 1 "Product Substitutions" Article for consideration of an unnamed product or system.
   7. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 1 "Other than Basis-of-Design Products" Article for consideration of an unnamed product by the other named manufacturers.
   8. Compliance with Standards, Codes, and Regulations: Where Specifications only require compliance with an imposed code, standard, or regulation, select a product that complies with the standards, codes, or regulations specified. Provide an affidavit from the manufacturer certifying that the product complies with standards, codes, or regulations and submit supporting test data to substantiate compliance, if requested by Owner.
   9. Visual Matching Specification: Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect/Engineer's sample. Architect/Engineer's decision will be final on whether a proposed product matches.
      a. If no product available within specified category matches and complies with other specified requirements, comply with provisions in Part 1 "Product Substitutions" Article for proposal of product.
   10. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, and textures" or a similar phrase, select a product that complies with other specified requirements.
      a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect/Engineer will select color, pattern, density, or texture from manufacturer's product line that does not include premium items.
      b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect/Engineer will select color, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS

A. Products shall be applied, installed, connected, erected, used, adjusted, cleaned and conditioned in accordance with the respective manufacturer's instructions and recommendations unless more stringent requirements are specified.

B. Verify and coordinate clearances, dimensions and installation of adjoining construction, equipment, piping, ducts, conduits, or other mechanical or electrical items or apparatus.

C. Prior to fabrication, field measure actual existing conditions as applicable to ensure proper fit.

D. Inspect each item of material or equipment immediately prior to installation. Reject damaged and defective items.

E. Recheck measurements and dimensions of Work, as an integral step of starting each installation. Whenever stock manufactured products are specified, verify actual space requirements for setting or placing into allotted space.

F. Anchor each product securely in place with positive anchorage devices designed and sized to withstand expected loads. Anchors shall be accurately located and aligned with other Work.

G. Allow for expansion of materials and building movement.

3.2 PROTECTION OF INSTALLED WORK

A. Clean, protect, adjust and perform maintenance on installed Work as necessary to ensure freedom from damage and deterioration at time of Substantial Completion. Remove protective devices when no longer needed.

B. Provide special protection where specified in individual Specification Sections.

C. Provide temporary and removable materials for protection of installed products. Control activity in immediate work area to minimize damage.

D. Protect finished Work from damage, defacements, stains, scratches, and wear.

E. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

F. Protect finished floors, stairs, and other surfaces from traffic dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

H. Prohibit traffic from lawn and landscaped areas

3.3 QUALITY STANDARDS

A. Workmanship specified or indicated on the Drawings by reference to title, symbol, or number of a Commercial or Industry Standard, ASTM designation, ANSI designation, Manufacturer's data, or other similar reference standard is identified hereby as the minimum requirement for the quality of workmanship required hereunder. References are to the current issues of same, except as indicated otherwise. If not in contradiction to the building code or regulations of other governmental agencies as may have jurisdiction, such referenced documents shall be considered as an integral part of these specifications as if repeated word for word herein.

B. Architect/Engineer may require that copies of certain reference specifications be kept at the job site.

C. Damaged products shall be not installed as part of the Work. At the Owner’s sole discretion, the Owner may approve the use of repaired items in the Work. The Contractor shall bear all costs related to replacing or repairing and refurbishing damaged products.

3.4 WORKMANSHIP

A. Note that the quality required for certain workmanship specified in respective Specification sections may be better than that established by the identified reference standards.

B. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

C. Perform work by persons qualified to produce workmanship of specified quality.

3.5 MANUFACTURERS’ INSTRUCTIONS

A. When work is specified to comply with manufacturers' instructions, submit copies as specified in 01 33 00, distribute copies to persons involved, and maintain one set in field office.

END OF SECTION 01 60 00

SECTION 01 60 01

MATERIAL AND EQUIPMENT

1.01 GENERAL PROVISIONS

a. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 1 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 PRODUCTS

a. Products include material, equipment and systems.

b. Comply with Specifications and referenced standards as minimum requirements.

c. Components required to be supplied in quantity within a Specification Section shall be the same, and shall be interchangeable.

d. Do not use materials and equipment removed from existing structures, except as specifically required, or allowed, by the Contract Documents.

1.03 WORKMANSHIP

a. Comply with industry standards except when more restrictive tolerances or specified requirements indicate more rigid standards or more precise workmanship.

b. Perform work by persons qualified to produce workmanship of specified quality.

c. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, and racking.

1.04 MANUFACTURERS' INSTRUCTIONS

a. When work is specified to comply with manufacturers' instructions, submit copies as specified in Section 01300 SUBMITTALS, distribute copies to persons involved, and maintain one set in field office.

b. Perform work in accordance with details of instructions and specified requirements.

1.05 TRANSPORTATION AND HANDLING

a. Refer to CONTRACT AND GENERAL CONDITIONS and Specifications' Sections for requirements pertaining to transportation and handling of materials and equipment.

b. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturers' unopened containers or packaging, dry.

c. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

d. Promptly inspect shipments to assure that products comply with requirements, that quantities are correct, and products are undamaged.

1.06 STORAGE AND PROTECTION

a. Refer to CONTRACT AND GENERAL CONDITIONS and Specifications' Sections for requirements pertaining to storage and protection of materials and equipment.

b. Store products in accordance with manufacturers' instruction, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturers' instructions.

c. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

d. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

e. Arrange storage to provide access for inspection. Periodically inspect to assure that products are undamaged, and are maintained under required conditions.

End of Section

SUBSTITUTION REQUEST
(After the Bidding Phase)

Project: Substitution Request Number:

From:

To: Date:

A/E Project Number:

Specification Title: Description:

Section: Page: Article/Paragraph:

Proposed Substitution:

Manufacturer: Address: Phone:

Trade Name: Model No.:

Installer: Address: Phone:

History: New product 2-5 years old 5-10 yrs old More than 10 years old

Differences between proposed substitution and specified product:

Point-by-point comparative data attached - REQUIRED BY A/E

Reason for not providing specified item:

Similar Installation:

Project: Architect:

Address: Owner:

Date Installed:

Proposed substitution affects other parts of Work: No Yes; explain

Savings to Owner for accepting substitution: ($).

Proposed substitution changes Contract Time: No Yes [Add] [Deduct] days.

Supporting Data Attached:	Drawings	Product Data	Samples	Tests	Reports

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The Undersigned certifies:

- Proposed substitution has been fully investigated and determined to be equal or superior in all respects to specified product.
- Same warranty will be furnished for proposed substitution as for specified product.
- Same maintenance service and source of replacement parts, as applicable, is available.
- Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
- Cost data as stated above is complete. Claims for additional costs related to accepted substitution which may subsequently become apparent are to be waived.
- Proposed substitution does not affect dimensions and functional clearances.
- Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.
- Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitted by:

Signed by:

Firm:

Address:

Telephone:

Attachments:

A/E's REVIEW AND ACTION

a. ☐ Substitution approved - Make submittals in accordance with Specification Section 01330.
b. ☐ Substitution approved as noted - Make submittals in accordance with Specification Section 01330.
c. ☐ Substitution rejected - Use specified materials.
d. ☐ Substitution Request received too late - Use specified materials.

Signed by: Date:

Additional Comments:

- ☐ Contractor
- ☐ Subcontractor
- ☐ Supplier
- ☐ Manufacturer
- ☐ A/E

End of section

Advancement of Construction Technology

REQUEST FOR INTERPRETATION

Project: To: Re:		R.F.I. Number: From: Date: A/E Project Number: Contract For:	
Specification Section:	Paragraph:	Drawing Reference:	Detail:
Signed by:			Date:
Response:			
Attachments			
Response From:	To:	Date Rec'd:	Date Ret'd:
Signed by:			Date:
Copies: Owner	Consultants		File
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SECTION 01 73 00
EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
   1. General installation of products.
   2. Progress cleaning.
   3. Starting and adjusting.
   4. Protection of installed construction.
   5. Correction of the Work.

B. Related Sections include the following:
   1. Division 1 Section "Project Management and Coordination" for field survey and layout requirements.
   2. Division 1 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
   3. Division 1 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
   4. *Division 1 Sections "Construction Waste Management" and "Indoor Air Quality (IAQ) Management" for LEED-related requirements*.

1.3 SUBMITTALS

A. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.
   1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
   2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
   1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
   3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
   4. Do not proceed with Work until unsatisfactory conditions have been corrected. Proceeding with Work indicates acceptance of surfaces and conditions; the cost of any corrective measures is the responsibility of the Contractor.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Require compliance with manufacturer’s printed installation instructions, including each step in sequence. Do not omit preparatory steps or installation procedures unless specifically modified or exempted by Contract Documents. See Specification 01 60 00 for specific requirements.

E. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect/Engineer accordance with the requirements specified in Specification Section 01 31 00.

3.3 INSTALLATION

A. General: See Specification Section 01 60 00 for Product Installation requirements.

B. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
   4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.

C. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

D. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

E. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect/Engineer.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.5 STARTING AND ADJUSTING

A. See other Specification Sections for additional information on start-up and testing of building components.

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 1 Section "Quality Requirements."

3.6 PROTECTION OF INSTALLED CONSTRUCTION

A. See Specification Section 01 60 00 for product protection requirements.

B. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.7 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 1 Section "Cutting and Patching."
   1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 73 00

SECTION 01 73 29- CUTTING AND PATCHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:
1. Divisions 2 through 16 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.
2. Division 7 Section for Firestopping

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.4 SUBMITTALS

A. Cutting and Patching Proposal: For each specific type of requested cutting and patching, submit a written proposal to Architect/Engineer for approval at least 10 days before any cutting and patching will be performed. Proposal shall include the following information:
1. Extent: Describe amount, location, and size of proposed cutting and patching, and indicate why this cutting cannot be avoided
2. Procedures: Specifically describe how cutting and patching will be performed,
3. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
4. Products: List products to be used. Provide specific information on products as requested by Architect/Engineer.
5. Trades: Indicate the firms or entities that will perform the cutting and patching.
6. Dates: Indicate when cutting and patching will be performed.
7. Structural Elements: Where cutting and patching involve modifying structural elements, submit details and engineering calculations, generated by an engineer registered in the State of Maryland, indicating structural integrity of proposed modification.
8. Effect on weatherproof integrity of the Work.
9. Utilities: List utilities that cutting and patching activities will affect. Indicate utilities that will need to be temporarily out of service and the planned length and time of the outage. Indicate utilities that will need to be relocated.
10. Cost proposal when applicable.

11. Architect/Engineer's Approval: Obtain Architect/Engineer’s approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.5 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could reduce their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or results in increased maintenance or decreased operational life or safety.

C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or results in increased maintenance or decreased operational life or safety.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect/Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

E. Fire-Rated Assemblies: At penetrations of fire-rated assemblies, completely seal penetration with firestop in accordance with Division 7 Section.

F. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.6 WARRANTY

A. Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void or diminish required or existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed. Comply with provisions of Section 01700.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations. Protect surroundings areas from any dust or other residue resulting from cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

3.3 PERFORMANCE

A. General: Cut in-place construction to provide for installation or removal of components of the Work, and subsequently patch as required to restore surfaces to their original condition. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time after approval, and complete without delay.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage retained elements or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
   1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
   2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
   3. Concrete and masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill. Do not damage or cut any steel reinforcing unless specifically allowed by the approved cutting and patching proposal.
   4. Structure: Do not damage or cut any structural framing unless specifically allowed by the approved cutting and patching proposal.
   5. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
   6. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

7. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
   1. Inspection: Test and inspect patched areas after completion to demonstrate integrity of installation.
   2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
      a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
      b. Restore damaged pipe covering to its original condition.
   3. Floors and Walls: Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
      a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
   4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
   5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
   6. Utilities: Where utilities are to be removed, relocated, or abandoned, by-pass before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe, duct, or conduit to prevent entrance of moisture or matter after by-passing and cutting.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove debris, paint, mortar, oils, putty, and similar materials.

E. Painting: Where patching occurs in previously painted surface, provide appropriate prime coat followed by first finish coat of paint. Provide final finish coat over entire area containing patch; for continuous surface extend to nearest vertical break or intersection, for an assembly refinish entire unit. Except where indicated otherwise, finish in sheen and color to match existing.

END OF SECTION 01 73 29

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Substantial Completion.
2. Final Completion.
3. Warranties.
4. Record Documents.
5. Operation and Maintenance data and manuals.
6. Training of Owner's personnel.
7. Spare Parts and Attic Stock Material
8. Final cleaning.

B. Related Sections include the following:
1. Division 1 Section "Payment Procedures" for requirements for Applications for Payment for Substantial and Final Completion.
2. Division 1 Section "Execution Requirements" for progress cleaning of Project site.
3. Divisions 2 through 16 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

A. General: Refer to General Conditions Article 14.2.

B. Procedures: Before requesting Architect/Engineer and Owner inspection for determining Substantial Completion, perform the following items. List ay of the items below that are incomplete in request.
1. Perform a complete inspection of the Work. Prepare a list of items to be completed and/or corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
2. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases including Fire Marshall's report.
4. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.

5. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
6. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
7. Complete startup testing of systems.
8. Submit test/adjust/balance records.
9. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
10. Advise Owner of changeover in heat and other utilities.
11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
12. Complete final cleaning requirements, including touchup painting.
13. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
14. Complete functional performance testing.

C. List Of Incomplete Items (Punch List)
1. Submit copies of punch list simultaneously to the Owner and Architect/Engineer. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
2. Organize list of spaces in sequential order, starting with exterior areas first.
3. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
4. Include the following information at the top of each page:
    a. Project name.
    b. Date.
    c. Page number.

D. Architect/Engineer and Owner Inspection and Approval: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect/Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect/Engineer will prepare and sign the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect/Engineer, that must be completed or corrected before certificate will be issued. After Owner receipt of a Certificate of Substantial Completion signed by the Architect/Engineer and Contractor, the Owner will determine whether to accept based on its review, observations and knowledge. The Owner’s signature approval of the Certificate of Substantial Completion executes the Certificate. In reviewing the Certificate, the Owner may, but is not obligated to, rely on the signature approval of the Architect/Engineer in determining Contract compliance.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.4 FINAL COMPLETION

A. General: Refer to General Conditions Article 14.3.

B. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
1. Submit a final Application for Payment according to Division 1 Section "Payment Procedures."
2. Submit certified copy of Architect/Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect/Engineer. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report and warranty.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.

C. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect/Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect/Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued. In processing the Certificate, the Owner may, but is not obligated to, rely on the signature approval of the Architect/Engineer in determining Contract compliance.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 WARRANTIES

A. Provide all properly executed warranties prior to, or with, request for Substantial Completion.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated partial portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.6 RECORD DOCUMENTS

A. General:
1. Maintain one copy of Contract Documents and each submittal during the construction period for Project Record Document purposes.
2. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
3. Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Provide files and racks for secure storage. Do not use Project Record Documents for construction purposes.
4. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Owner's and Architect/Engineer's reference during working hours.
5. Submit final Record Documents to Architect/Engineer at time of Substantial Completion.

B. Record Drawings: Maintain at site one updated and current set of annotated project Record Drawings from project Notice-to-Proceed until Completion of the Work. Keep set available for use and inspection by Architect/Engineer and Owner. Submit completed set of Record Drawings to Architect/Engineer prior to Final Completion.
1. Maintain one set of blue- or black-line white prints of all of the Contract Drawings and Shop Drawings. Mark Record Drawings to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Drawings.
   a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
   b. Accurately record information in an understandable drawing technique.
   c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Contract Modification, Change Order or Field Order.
   k. Revisions made following Architect/Engineer's Supplemental Instructions.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.
3. Mark completely and accurately the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on the Contract Drawings.

4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note numbers of Field Orders, Alternates, Change Orders, and Supplemental Instructions, and similar revisions, where applicable.
7. Prepare new Drawings instead of preparing Record Drawings where Architect/Engineer determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
   a. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
   b. Consult Architect/Engineer for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared Record Drawings into Record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
8. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Organize Record Drawings including newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

C. Record Specifications: Maintain at site one updated and current set of annotated project Record specifications, including addenda, field orders, and contract modifications, from project Notice-to-Proceed until Completion of the Work. Keep set available for use and inspection by Architect/Engineer and Owner. Submit completed set of Record Specifications to Architect/Engineer prior to Final Completion.
1. Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
3. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

D. Record Product Data: Submit one annotated copy of each Product Data submittal prior to Final Completion. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual, instead of submittal as Record Product Data, prior to Substantial Completion.
1. Maintain samples in clean dry condition; do not use for construction purposes.
2. Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
3. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
4. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
5. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.7 OPERATION AND MAINTENANCE DATA AND MANUALS

A. Operation And Maintenance Documentation Directory
   1. Organization: Include a section in the directory for each of the following:
      a. List of documents.
      b. List of systems.
      c. List of equipment.
      d. Table of contents.
   2. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system. System is defined as: An organized collection of parts, equipment, or subsystems united by regular interaction. Subsystem is a portion of a system with characteristics similar to a system.
   3. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
   4. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
   5. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."
   6. Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Manuals, General
   1. Provide three (3) sets of all manuals. Review each manual for accuracy and completeness before submitting.
   2. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system.
      a. Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
      b. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets. Use as many binders, up to 3” thick, as necessary to avoid overloading of binders.
         1) If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.

2) Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

c. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab with non-erasable ink to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

d. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.

e. Each manual shall contain the following materials, in the order listed:
   1) Cover page.
   2) Table of contents.
   3) Manual contents.

3. Cover Page: Enclose cover page in transparent plastic sleeve. Include the following information:
   a. Subject matter included in manual.
   b. Name and address of Project.
   c. Name and address of Owner.
   d. Date of submittal.
   e. Name, address, and telephone number of Contractor.
   f. Name and address of Architect/Engineer.
   g. Cross-reference to related systems in other operation and maintenance manuals.

4. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   a. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

5. Manual Contents:
   a. System Description: Provide general overall of system or subsystem covered by the manual.
   b. Submittal and Product Data: Include all final approved submittal data. If submittal was not required for review, include descriptive product data.
   c. Equipment Supplier: Include the name, address and telephone number of the manufacturer's agent and/or service agency supplying or installing and starting up of the equipment.
   d. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
      1) Prepare supplementary text on 8-1/2-by-11-inch white bond paper if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
   e. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams.

1) Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
2) Attach reinforced, punched binder tabs on drawings and bind with text. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
3) If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations. Do not use original Project Record Documents as part of operation and maintenance manuals.

f. Final Commissioning Checklist: filled out by Contractor and approved by Commissioning Authority with specified data and submitted data.
g. Parts List: edited to omit reference to items which do not apply to this installation.
h. Coordination: Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.
i. Schedule: Submit three copies, and the quantity of return copies required by the Contractor, <u>by the completion date of equipment placement</u>. All operations manuals must be approved (i.e. submitted, reviewed by Architect/Engineer, corrected, and approved by the Architect/Engineer) prior to Substantial Completion. SUBSTANTIAL COMPLETION WILL NOT BE GRANTED WITHOUT APPROVED OPERATION AND MAINTENANCE MANUALS.
    1) Include a complete operation and maintenance directory.
    2) Correct or modify each manual to comply with Architect/Engineer's comments.
    3) Submit 3 copies of each corrected manual within 15 days of receipt of Architect/Engineer's comments.

C. Operation Manuals
1. Assemble a complete set of operation information indicating proper operation of each system, subsystem, and piece of equipment not part of a system.
    a. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
    b. Prepare a separate manual for each system and subsystem, in the form of an instructional manual, for use by Owner's operating personnel
2. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Operating procedures.
    e. Operating logs.
    f. Wiring diagrams.
    g. Control diagrams.
    h. Piped system diagrams.

i. Precautions against improper use.
j. License requirements including inspection and renewal dates.

3. Descriptions: Include the following:
   a. Product name and model number.
   b. Manufacturer's name.
   c. Equipment identification with serial number of each component.
   d. Equipment function.
   e. Operating characteristics.
   f. Limiting conditions.
   g. Performance curves.
   h. Engineering data and tests.
   i. Complete nomenclature and number of replacement parts.
4. Operating Procedures: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Instructions on stopping.
   f. Normal shutdown instructions.
   g. Seasonal and weekend operating instructions.
   h. Required sequences for electric or electronic systems.
   i. Special operating instructions and procedures.
5. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
6. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

D. Product Maintenance Manuals
1. Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
2. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
3. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
4. Product Information: Include the following, as applicable:
   a. Product name and model number.
   b. Manufacturer's name.
   c. Color, pattern, and texture.
   d. Material and chemical composition.
   e. Reordering information for specially manufactured products.
5. Maintenance Procedures: Include manufacturer's written recommendations and the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Schedule for routine cleaning and maintenance.
   e. Repair instructions.

6. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
7. Warranties and Bonds: Include three copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
    a. Include procedures to follow and required notifications for warranty claims.

E. Systems and Equipment Maintenance Manuals
1. Assemble a complete set of maintenance data indicating maintenance of each system, subsystem, and piece of equipment not part of a system.
    a. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
    b. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's maintenance personnel
2. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
3. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
4. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
    a. Standard printed maintenance instructions and bulletins.
    b. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
    c. Identification and nomenclature of parts and components.
    d. List of items recommended to be stocked as spare parts.
5. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
    a. Test and inspection instructions.
    b. Troubleshooting guide.
    c. Precautions against improper maintenance.
    d. Disassembly; component removal, repair, and replacement; and reassembly instructions.
    e. Aligning, adjusting, and checking instructions.
    f. Demonstration and training videotape, if available.
6. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
    a. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
    b. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
7. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

8. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
9. Warranties and Bonds: Include three copies of warranties, maintenance bonds, and Maintenance service contracts as specified in various Specification Sections. Provide lists of circumstances and conditions that would affect validity of warranties or bonds.
   a. Include procedures to follow and required notifications for warranty claims.

1.8 TRAINING OF OWNER'S PERSONNEL

A. Program Structure: Develop and implement an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections. Owner shall be given comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of equipment.
   1. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect/Engineer.
   2. Coordinate scheduling of training with Commissioning Authority. Provide coordination with Contractor personnel, subcontractors, suppliers, and manufacturer’s representatives for the efficient scheduling of instruction.
   3. Submit two copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   4. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with Owner, through Architect/Engineer, with at least seven days' advance notice. Coordinate and adjust schedule to minimize disrupting Owner’s operations.
   5. Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, their schedules and course content, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
      a. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
   6. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual.
   7. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
      a. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.
   8. Set up instructional equipment, including the use of overhead projectors, sliders, videos, and audio taped material, at instruction location.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Operations manuals.
    c. Maintenance manuals.
    d. Project Record Documents.
    e. Identification systems.
    f. Warranties and bonds.
    g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.
    h. Normal shutdown instructions.
    i. Operating procedures for emergencies.
    j. Operating procedures for system, subsystem, or equipment failure.
    k. Seasonal and weekend operating instructions.
    l. Required sequences for electric or electronic systems.

m. Special operating instructions and procedures.

5. Adjustments: Include the following:

   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:

   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:

   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

9. Attendance and Evaluation: For each training module, submit list of participants and length of instruction time. At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test. For each participant and for each training module, submit results and documentation of performance-based test.

10. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before training.

11. At completion of training, submit one complete training manual(s) for Owner's use.

12. Schedule: All Owner training shall be completed prior to Substantial Completion. SUBSTANTIAL COMPLETION WILL NOT BE GRANTED WITHOUT COMPLETION OF OWNER TRAINING.

1.9 SPARE PARTS AND ATTIC STOCK MATERIAL

A. Provide spare parts and extra (attic) stock materials in quantities specified in individual Specification Sections.

B. Deliver to Project site and place in locations as directed; obtain receipt from Owner's representative.

C. Submit document, at or before time of request for inspection for Substantial Completion, listing items and quantities; attach receipts.

1.10 FINAL CLEANING

A. General: Provide final cleaning just prior to Substantial Completion. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

C. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscaped areas, free of rubbish, waste material, litter, obstructions and other foreign substances.
    b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
    c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
    d. Remove tools, construction equipment, machinery, and surplus material from Project site.
    e. Remove snow and ice to provide safe access to building.
    f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, dust, films, and similar foreign substances.
    g. Clean resilient flooring, stone flooring, tile, pavers and other similar hard interior surfaces including associated bases. Refer to individual manufacturer's recommendations and requirements for sealing, buffing, waxing and polishing.
    h. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    i. Sweep concrete floors broom clean in unoccupied spaces.
    j. Vacuum carpet and similar soft surfaces, removing debris, soil and excess nap. Shampoo to remove any visible soil or stains remaining after vacuuming.

k. Clean transparent and reflective materials, including mirrors and glass in doors and windows, to clear shine. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped, scratched or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

l. Remove labels that are not required as permanent labels.

m. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
   1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

n. Clean exposed surfaces of mechanical, electrical, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

o. Replace parts subject to unusual operating conditions.

p. Clean plumbing fixtures, drinking fountains, and similar equipment, to a sanitary condition, free of stains, including stains resulting from water exposure.

q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

r. Leave Project clean and ready for occupancy.

D. Avoid disturbing natural weathering of exterior surfaces.

E. Heating, Ventilating, and Air Conditioning Systems:
   1. Clean permanent filters and replace disposable filters for units operated during construction. Clean exposed surfaces of diffusers, registers, and grills.
   2. Clean ducts, blowers, and coils for units operated without filters during construction.

F. Pest Control: Engage an experienced, licensed exterminator to make a final inspection and rid Project of rodents, insects, and other pests. Submit a report prepared by the exterminator indicating successful completion of this work.

G. Comply with safety standards and manufacturer’s instructions for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION 01 77 00

SECTION 01 78 01
PROJECT RECORD DOCUMENTS

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.

B. Related Sections include the following:
   1. Division 1 Section "Closeout Procedures" for general closeout procedures.
   2. Division 1 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Divisions 2 through 16 Sections for specific requirements for Project Record Documents of the Work in those Sections.

1.3 SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set(s) of marked-up Record Prints.

B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one copy of each Product Data submittal.
   1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.

PART 2 -PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of blue- or black-line white prints of the Contract Drawings and Shop Drawings.
   1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an understandable drawing technique.

c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.

2. Content: Types of items requiring marking include, but are not limited to, the following:
   a. Dimensional changes to Drawings.
   b. Revisions to details shown on Drawings.
   c. Depths of foundations below first floor.
   d. Locations and depths of underground utilities.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Construction Change Directive.
   k. Changes made following Architect's written orders.
   l. Details not on the original Contract Drawings.
   m. Field records for variable and concealed conditions.
   n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
   1. Record Prints: Organize Record Prints and newly prepared Record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
   2. Identification: As follows:
      a. Project name.
      b. Date.
      c. Designation "PROJECT RECORD DRAWINGS."
      d. Name of Architect.
      e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
   3. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record

Product Data.

4. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
   3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

B. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

PART 3 -EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.

B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

End of Section

SECTION 01 78 02

OPERATION AND MAINTENANCE DATA

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.

B. Related Sections include the following:
1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
4. Divisions 2 through 16 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

A. Final Submittal: Submit one copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
1. Correct or modify each manual to comply with Architect's comments. Submit 3 copies of each corrected manual within 15 days of receipt of Architect's comments.

1.5 COORDINATION

A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 -PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Organization: Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.
   3. List of equipment.
   4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 MANUALS, GENERAL

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Owner.
   4. Date of submittal.
   5. Name, address, and telephone number of Contractor.
   6. Name and address of Architect.
   7. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
   1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
   4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
   5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Water leak.
   3. Power failure.
   4. Water outage.
   5. System, subsystem, or equipment failure.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   1. System, subsystem, and equipment descriptions.
   2. Performance and design criteria if Contractor is delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
   5. Operating characteristics.
   6. Limiting conditions.
   7. Performance curves.
   8. Engineering data and tests.
   9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
   1. Startup procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
   4. Regulation and control procedures.
   5. Instructions on stopping.
   6. Normal shutdown instructions.
   7. Seasonal and weekend operating instructions.
   8. Required sequences for electric or electronic systems.
   9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUAL

A. Content: Organize manual into a separate section for each product, material, and finish.

Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard printed maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

3.1 MANUAL PREPARATION

PART 3 -EXECUTION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
2. Comply with requirements of newly prepared Record Drawings in Division 1 Section "Project Record Documents."

G. Comply with Division 1 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

End of Section

COMMISSIONING PLAN

FOR

Name of the Project

Montgomery County Government
Site Name
Site Address
City, MD

Generic Cx Plan

Prepared By:

Table of Contents:

Commissioning (Cx) Plan:

1. **Introduction:**
   This Commissioning plan shall outline the commissioning process for { enter the name of the project }. Herein described are the responsibilities of the various parties involved in the design, construction, and Commissioning process and the procedures by which all parties will endeavor to ensure the facility is designed, installed, started, tested, and documented to meet MCGs needs and to ensure that the operators personnel are fully trained.

2. **Overview:**
   The commissioning process involves all the parties involved in the design and construction process as well as MCG and the Commissioning Authority. It begins very early in the design process when the facility is being programmed and the initial concepts and requirements for the building are being formulated. It continues throughout the design and construction process, past acceptance of the building and systems, and into the early occupancy of the building. Primary elements of Commissioning include:
   - Identifying and documenting the needs MCG and the requirements of the facility.
   - Ensuring that the designed systems are commensurate with and meet MCG's needs
   - Ensuring that the systems installed are operable and maintainable
   - Testing of the systems to ensure that they are interacting and performing optimally
   - Ensuring that the design intent, the installations and the O&M requirements are clearly and thoroughly documented
   - Training of the operators and the facility staff to ensure they operate and maintain the facility per the design intent
   - Identifying, tracking, recording, and reporting all deficiencies of the Work through the Deficiency Correction Tracking Plan (as stipulated in Section 01440 – Contractor Quality Control)
   - Document warranty start and end dates
   - Assemble all records of Code Authority inspections and approvals
   - Forwarding recommendation to the County that the all systems are ready for issuance the “Substantial Completion Certificate”.

3. **Roles and Responsibilities Protocols:**

   i) **Parties Involved in the Cx Process**
   Architect: Architectural Consultant retained by MCG: {enter Architects name, address, and no.s}
   Architect/Engineer (A/E): Reference to the design team (Architect, MDE, EDE)
   ATC Contractor (ATC): Sub Contractor retained by MC to install automatic temperature control systems (Section _____ Contractor):
   { enter name, address, and no.s }
   Construction Manager: Party retained by MCG to manage and oversee the design and construction of the facility (Section _____ Contractor):
   { enter name, address, and no.s }
   Cx Coordinator:

Commissioning Authority (CA): Individual or company retained by MCG to oversee the Cx process:
{ enter name, address, and no.s }
Commissioning Agent (CxA): Individual or company retained by Architect to develop Cx Plan and oversee the Cx process within the A/E team
Commissioning Coordinator (CxC): Individuals with various parties who are members of the CT as commissioning pertains to that party's scope of work, and who act as a liaison between that party and other parties involved in commission
Electrical Contractor (EC): Sub Contractor retained by GC to install Electrical Systems (Div. 16 Contractor):
{ enter name, address, and no.s }
Cx Coordinator:
Sprinkler Contractor: Contractor retained by the general Contractor to install Sprinkler System.

Electrical Design Engineer (EDE): Sub Consultant retained by Architect to design electrical systems (Div. 16 Engineer):
{enter EDE name, address, and no.s}

Fire Alarm Contractor (FAC): Contractor retained by GC or EC to install the fire alarm systems for the facility:
{enter name, address, and no.s}
Cx Coordinator:
Vertical Transportation Contractor: Contractor retained by the General Contractor to install elevator, escalator etc.

General Contractor (GC): Contractor retained by MCG to construct the facility:
{enter EDE name, address, and no.s}
Cx Coordinator
Mechanical Contractor (MC): Sub Contractor retained by GC to install Mechanical Systems (Div. 15 Contractor):
{enter name, address, and no.s}
Cx Coordinator:
Mechanical Design Engineer (MDE): Sub Consultant retained by Architect to design electrical systems (Div. 15 Engineer):
{enter name, address, and no.s}
MCG: Reference to MCG's team of project managers, inspectors, and operators.
Operator(s): Personnel in direct employ of MCG who will be responsible for operating and maintaining the facility.
Security System Contractor (SSC): Sub Contractor retained by EC [GC] to install Security Systems (Section _____ Contractor):
{ enter name, address, and no.s}
TAB Contractor (TAB): Sub Contractor retained by MC to test, adjust, and balance mechanical systems): TAB subcontractor must be approved by the Montgomery County prior to hiring.
(Section _____ Contractor):
{ enter ATC name, address, and no.s}

ii. **Responsibilities:**
All parties involved in the design and construction of the facility bear responsibility in the Cx process. The Cx process does not fundamentally change the responsibilities of the team

members from conventional projects without a formal Cx process. The Cx process supplements, or ideally merely formalizes, the responsibilities all parties.

The role of the CA is to oversee the process and to endeavor to assist all other parties in achieving the goals of the project.

A/E retains all responsibility for designs. CA reviews during the design process are to assist the A/E and are intended to be constructive. Comments are generally suggestions. It shall be the A/E's sole responsibility to incorporate or disregard CA comments. A/E shall respond to the comments with justification for disregarding any of the comments.

Contractors retain all responsibility for the installations. CA inspections and tests will determine the adequacy and completeness of the installations again to assist the contractor in providing a sound installation. CA testing does not alleviate contractor's responsibility for ensuring the systems are complete and functional.

Detailed responsibilities are indicated below. These responsibilities relate to the Cx process and do not encompass all aspects of the project.

Some scopes or tasks indicated in the following list of responsibilities are further detailed:

Phase	MCG Responsibilities	Architect & CxA Responsibilities	Engineer Responsibilities	Contractor Responsibility	CA Responsibility	CM Responsibility
Programming	• Develop the Program for the facility. • Identify the requirements, goals, preferences, MCG standards or guidelines that will impact the design of the facility	• Assist MCG in documenting the requirements of the facility • Notify MCG of codes and regulations that affect the facility	• Assist MCG in documenting the requirements of the facility • Notify MCG of codes and regulations that affect the facility	N/A	N/A	N/A
Conceptual Design	• Clearly communicate requirements, preferences, and budget targets to A/E in a timely manner. • Select CA • Review and comment on the conceptual design • Identify operations or facilities personnel for the facility who will be involved in key decisions throughout the design/construct process and eventually operate the facility. • Review preliminary Cx plan	• Endeavor to fully understand MCG's requirements and preferences and propose design alternatives to meet those requirements. Advise MCG of advantages, disadvantages, and limitations of various alternatives. • Attend design meetings and present alternatives. • Document the primary thought processes that result in the concepts that will form the basis of design. • Prepare the initial Cx Plan and submit to MCG and CA for review	• Endeavor to fully understand MCGs requirements and preferences and propose design alternatives to meet those requirements. Advise MCG of advantages, disadvantages, and limitations of various alternatives. • Attend design meetings and present alternatives. • Document the primary thought processes that result in the concepts that will form the basis of design.	• N/A	• Review and comment the initial Cx Plan	•

Phase	MCG Responsibilities	Architect & CxA Responsibilities	Engineer Responsibilities	Contractor Responsibility	CA Responsibility	CM Responsibility
Schematic Design	• Review design intent and design criteria documentation • Review suggestions and alternatives proposed by A/E and CA and decide upon direction for design. • Attend design meetings. • Appropriately involve anticipated Operators in key decisions made during this phase. • Copy CA on all pertinent correspondence.	• Attend design meetings and present alternatives. • Draft a appropriate portions of a "Design Intent" narrative in accordance with the MCG "Model Design Criteria" to communicate expectations and limitations of facility/systems and equipment. Submit to MCG and CA for review. • Consult with CA and consider incorporating CA's input. • Copy CA on all pertinent correspondence. • Incorporate and update the Cx Plan	• Attend design meetings and present alternatives. • Draft a appropriate portions of a "Design Intent" narrative to communicate expectations and limitations of facility/systems and equipment. Submit to MCG and CA for review. • Consult with CA and consider incorporating CA's input. • Copy CA on all pertinent correspondence.	• N/A	• Conduct Cx kick off meeting • Observe, review, and assist communications between MCG and A/E. • Conceive/propose alternatives/issues for design consideration. • Review the conceptual design documents • Review correspondence and advise on design direction. • Endeavor to ensure MCG's best interests are incorporated in design. • Attend design meetings selected by CA to facilitate performance of work. • Review, edit and supplement the Design Intent and Design Criteria documentation	• N/A

Phase	MCG Responsibilities	Architect & CxA Responsibilities	Engineer Responsibilities	Contractor Responsibility	CA Responsibility	CM Responsibility
Design Development and Construction Document Design	• Schematic Design Phase responsibilities apply also to this phase. • In a timely manner, perform detailed review of all documents prepared by A/E and CA and issue comments to clarify or specify requirements and/or preferences, including specifically those of Operators. • Endeavor to fully understand the design intent and the Contract Documents and request clarifications as appropriate. • Develop PM Codes to be used. These codes should be those to be incorporated in the CMMS (computerized maintenance management system). These codes will be used to index the equipment and associated documentation.	• All responsibilities of the Schematic Design Phase apply. • Prepare thorough, accurate, and clear contract documents. • Send CA one copy of all review submissions. • Specify materials and finishes that do not outgas excessive air contaminants and/or cause poor IAQ. • Incorporate Cx specifications or related edits in the construction specifications • Read and respond to MCG's and CA's comments and questions in a timely fashion. Incorporate MCG's and CA's comments/suggestions in Contract Documents when A/E does not feel they will adversely affect the project. • Update Design Intent narrative and author a "Design Criteria" narrative. • Incorporate the PM code indexes developed by MCG on equipment nomenclature into the design documents. • Include in the documents the requirements for the MCG Operation and Maintenance Support Information (OMSI) format for the hard copy [and the electronic copy] of the operation and maintenance information. • Finalize the Cx Plan including all perteniant Cx specifications, Checklist and FPT.	• All responsibilities of the Schematic Design Phase apply. • Prepare thorough, accurate, and clear contract documents. • Specify systems that are operable and maintainable and that meet MCGs requirements • Read and respond to MCG's and CA's comments and questions in a timely fashion. Incorporate MCG's and CA's comments/suggestions in Contract Documents when A/E does not feel they will adversely affect the project. • Incorporate Cx specifications or related edits in the appropriate sections of the construction specifications • Update Design Intent narrative and author a "Design Criteria" narrative in accordance with the MCG "Model Design Criteria". • Prepare and submit clear and orderly calculations to MCG and CA for review and comment. Respond in writing to comments.	• N/A	• Applicable Schematic Design responsibilities apply. • Review construction documents for systems included in the Cx scope. • Review design phase submissions as described below • Prepare, edit and/or supplement specifications to identify Cx requirements • Issue comments resulting from reviews to MCG and A/E in a timely fashion. • Attend key design/review meetings as selected by CA and as required to facilitate work. • Review design calculations selected by CA. • Expand the Cx Plan	• N/A

Phase	MCG Responsibilities	Architect & CxA Responsibilities	Engineer Responsibilities	Contractor Responsibility	CA Responsibility	CM Responsibility
Construction	• Attend progress meetings to observe progress and decide upon direction for open issues. • Provide [resident] inspector to thoroughly inspect construction through all phases of installation. Inspector shall identify deficiencies in a timely manner. • Involve operators in the inspection process and communicate their observations and requirements. • Witness equipment startup related tests • Avail operators for required training and demonstrations.	• Issue necessary changes in construction and copy CA. • Review shop drawings and product data. Contact CA prior to approval of pertinent systems/equipment and incorporate CA's comments in A/E's markup or approval. • Inspect construction in accordance with MCG - A/E agreement. • Issue clarifications or interpretations of Design Intent as required. • Maintain a record set of shop drawings, product data, warrantees, test reports, balance reports, start up certifications, etc. • Review O&M manuals and incorporate CA's comments in mark up or approval.	• Issue necessary changes in construction and copy CA. • Review shop drawings and product data. Contact CA prior to approval of pertinent systems/equipment and incorporate CA's comments in A/E's markup or approval. • Inspect construction in accordance with MCG - A/E agreement. • Author appropriate portions of a "Systems Overview" that will be included in the O&M information and be used for operator training • Issue clarifications or interpretations of Design Intent as required. • MDE shall review and approve balancing reports • Maintain a record set of shop drawings, product data, warrantees, test reports, balance reports, start up certifications, etc. • Review O&M manuals and incorporate CA's comments in mark up or approval.	• Attend coordination meetings called by CA • As outlined in Construction Specifications. Generally to completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment prior to Acceptance Phase. • Include Cx requirements in price and plan for work. Itemize individual Cx tasks by system/area in the project schedule. • Provide a Commissioning Coordinator (CxC). The GC, EC, and MC shall each designate a commissioning coordinator who will be a member of the CT when specifically dealing with systems under their scope. • Prepare and submit required draft forms and systems information. • Complete approved start up checklists and submit along with other installation certification information such as balancing reports, warrantees, testing results, etc. • Schedule and coordinate Cx efforts required by appropriate subs and vendors. Participate in respective portions of start ups and training • Demonstrate the systems as specified • Certify that systems have been installed and are operating per Contract Documents. • Submit all O&M information, instruction postings and diagrams, etc. • Maintain an updated set of record documentation	• Conduct Cx meeting • Review applicable project documentation (shop drawings, product date, TAB reports, record drawings, O&M information, etc.) for adequacy and to ensure system functionality. • Review and approve start up checklist forms. • Inspect installation periodically, as follows: • After completion of major equipment floor plan layout but prior to the installation. • After installation of major equipment, but prior to hook up with piping and duct. • After completion installation of all major equipment, duct, piping, electrical equipment and wiring, sprinkler, fire alarm etc. but prior to installation of ceiling and drywalls. • Attend selected progress meetings to observe progress and help expedite completion. • Witness selected tests start-ups, and equipment training. • Compile O&M information and systems overview and format the O&M manuals	• Attend progress meetings to observe progress and decide upon direction for open issues. • Facilitate the coordination of the commissioning work by the CA, and, with the GC and CA, ensure that commissioning activities are being scheduled into the master schedule. • Review and approve the Cx Plan • Provide a Resident Commissioning Coordinator (CM CxC) • Provide resident inspector to thoroughly inspect construction through all phases of installation. Inspector shall identify deficiencies in a timely manner. May be the same person as the CM CxC • Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CA. • Review and approve the functional performance test procedures submitted by the CA, prior to testing. • Witness equipment startup related tests • Assist the GC in coordinating the training of owner personnel. • Review

Phase	MCG Responsibilities	Architect & CxA Responsibilities	Engineer Responsibilities	Contractor Responsibility	CA Responsibility	CM Responsibility
Acceptance	• Witness/participate in functional performance tests. • Inspect installations and identify deficiencies. • Schedule and provide qualified operators and maintenance personnel to attend all training sessions. • Provide facilities for training sessions and personnel and equipment to videotape the training sessions. • Endeavor to fully understand design intent; system and equipment inspections, operation, maintenance, repair and troubleshooting of systems and equipment.	• Witness key tests and verifications as selected by A/E. • Consult on and resolve any design related issues/problems that arise during this phase.	• Witness key tests and verifications as selected by A/E. • Consult on and resolve any design related issues/problems that arise during this phase. • Participate in the systems level training program for the operators.	• As outlined in Construction Specifications. • Generally assist CA in verification and functional performance testing. • Provide technicians to work at direction of CA as specified. • Correct any work not in accordance with Contract Documents.	• Verify (spot check: minimum 10%) TAB reports. • Verify (spot check, minimum 10%) control component calibration. • Verify (spot check) equipment performance certifications. • Functionally test systems and equipment. • Review training plan. • Record Cx procedures.	• Witness/participate in functional performance tests. • Inspect installations and identify deficiencies. • Assist the GC in coordinating the training of owner personnel. • Review commissioning progress and deficiency reports • Coordinate the resolution of non-compliance and design deficiencies identified in all phases of commissioning. • Sign-off (final approval) on individual commissioning tests as completed and passing. Recommend completion of the commissioning process to the PO.

Phase	MCG Responsibilities	Architect & CxA Responsibilities	Engineer Responsibilities	Contractor Responsibility	CA Responsibility	CM Responsibility
Warranty / Post Acceptance Period	• Operate and maintain the facility per the design intent • Log system parameter and document any deficiencies • Notify design/construct team of any significant changes required or of any unanticipated occupancy requirements that become evident. • Inform the design construct team of any salient alterations or changes to the systems and their setup and indicate why it was necessitated. • Endeavor to learn the characteristics of the facility to better quantify the requirements. Notify the design construct team of any significant deviations from the anticipated requirements.	• Consult with MCG as necessary to convey and maintain design intent and respond to any identified deficiencies.	• Consult with MCG as necessary to convey and maintain design intent and respond to any identified deficiencies.	•	• Periodically monitor the facility as applicable • Perform opposite season FTP as necessary • Issue recommendation for "Substantial Completion", based on full satisfaction of spot check and system performance test result.	• Assist the CA as necessary in the seasonal or deferred testing and deficiency corrections required by the specifications.

iii. **Commissioning Protocols:**
CA will coordinate the Cx activities throughout the design and construction process. CA shall communicate the requirements of design Cx via an initial kick-off meeting in which the initial Cx Plan is presented and reviewed. CA shall communicate the requirements of installation related Cx via an another kick-off meeting within [30] day of award of contract in which the construction phase Cx Plan is presented and reviewed.

CA shall solicit participation of the appropriate parties and ensure that the tasks are being executed and responsibilities are being met.

CA shall report progress of the Cx to MCG [CM]

A/E shall notify CA of all design review or other key meetings relative to the CA's scope of work at least two weeks in advance.

iv. **Management Protocols:**
This generally describes the relationships between parties
Include the following as appropriate:
[The CM was retained by MCG and subsequently reports to the MCG project manager. All work directives shall be routed through the CM.]
[The CA has been retained by MCG and subsequently reports to the MCG project manager and/or the MCG Cx Coordinator. All work directives initiated by the CA will go directly to MCG with no copies to other parties. MCG will then act upon it as appropriate]
[The CA has been retained by the CM and subsequently reports to the CM Cx Coordinator. Any work directives initiated by the CA shall go directly to the CM for them to act on as appropriate]
The GC has been hired by the [CM] [MCG] and therefore reports to

v. **Communication Protocols relating to Cx:**
Correspondence shall generally be routed directly between corresponding companies with copies going to all parties of the Cx Team. The primary exception to this is when it relates to a work directive.

No communication from the CA shall be interpreted as a work directive. All channels for directing work are dictated in the agreements between the applicable parties. A deficiency list resulting from testing may be requested by the responsible party to expedite work, but this is not imply that it is complete or that the identified deficiencies shall be acted upon or how to resolve them.

Specific communications are itemized below. Many of the items included are discussed in further detail elsewhere in the plan. This presents a brief synopsis of the information flow. Note that these procedures are an initial guide:

Communication Protocols: These protocols are submitted as a general guide but can be changed at the applicable Cx kick off meeting based on mutual agreement with the MCG PM providing the final approval of any change.

RFI: Correspondence is direct between the two parties with copies of requests and responses copies to all parties concerned. MCG [PM][Cx Coordinator] shall be copied on all correspondence to and from CA

Design Documents for Review: [MCG, PM][CM, CxC] shall distribute these to the CA.

Design Review Comments: CA shall send these directly to the A/E and copy [MCG PM][CM,CxC]

Cx Plan: Developed by CxA and distributed to [CA, MCG, PM][CM, CxC] to be returned back to the A/E for inclusion in the project documents.

Submittals and Shop Drawings: [MCG, CA] Review Comments on Shop Drwgs: Sent directly to the A/E by the CA. A/E to consider and incorporate at their discretion.

Identified Deficiencies: Deficiencies shall be reported to MCG. At the request of any party, these may be distributed directly by the CA to that party FOR INFORMATION ONLY.

Requests for Meetings: In general request by the contractor for a meeting with the CA shall be routed through MCG who will then determine the validity. Note that every attempt should be made to deal with Cx issues at regularly scheduled Cx Meetings.

Control Sequence Modifications: CA shall make every attempt to thoroughly review the sequences during the submittal phase and address any issues prior to the submittal approval. However, CA and the ATC may incorporate minor changes to the sequence during testing when it is apparent that it improves the control of the equipment but does not fundamentally change the sequence. The time required by the ATC for this type of modification is addressed in Section 15959. Any and all changes must be thoroughly documented in the record documents.

Scheduling Coordination: CA shall provide Cx scheduling input to the contractor to be incorporate in the overall project schedule.

Notification of Completion Milestones: Contractor shall notify MCG at least two weeks prior to an anticipated completion milestone (such as start up completed and ready for FPT). [MCG, Cx Coordinator][CM, Cx Coordinator] shall then coordinate the tests between all required parties.

Action List: CA maintains a categorized Action List, which tracks the Cx related action items. CA distributes these at their judgment or at the request of any party. [CA to maintain these in the ComIT project file.]

Start Up Checklist and Test Documents: As further described later in this Plan the Cx specs, the GC will provide initial "generic" start up checklists to the CA for review and input. The contractor shall synthesize these with the manufacturer specific start up procedures and submit these along with the manufacturer's start up procedures to the CA for review and approval. The final reviewed and approved checklists are then completed and signed by the contractor, submitted and spot checked by the CT. They are then included in the Commissioning Record and ComIT

Functional Performance Test Documents: The initial Functional performance tests are prepared by CxA and updated/completed by GC for CA approval during the construction. CA forwards the generated FPT forms to the CM for information purposes and to be subsequently distributed by them. CA uses ComIT (or the content thereof) to form a baseline for the standard of care for the testing and edits them to be project specific. Throughout the Cx process, CA maintains a current record of the testing procedures and keeps the ComIT project file up to date for all to access the current progress. Cx distributes hard copies of the testing procedures at completion of any significant stage of Cx.

Recommendation for Substantial Completion: Upon successfully completion of Functional Performance Test observed and approved by the CA and with full satisfaction of the spot check and performance test results, CA shall forward a recommendation to the County for issuance of Substantial Completion Certificate.

vi. **Cx Coordination Meeting:**
CA shall schedule and conduct a Cx coordination meeting near the beginning of the design. The following should be discussed at this meeting:

- MCG model Cx plan
- requirements of Cx
- responsibilities of the design parties
- management protocols
- required submittals
- schedule

vii. **CA Review of Submittals:**
CA shall review submittals relating to key systems or equipment. Review is for Cx facilitation and does not replace the review of the A/E. CA shall provide comments on shop drawings and product data to A/E for inclusion in A/E's review.

CA shall also request information to facilitate preparation of FPTs and Training

The following shall be submitted to the CA:

- Shop drawings/product data AND START UP/CHECK OUT PROCEDURES (produced by the manufacturer) on key pieces of equipment including:
    - Chillers
    - Ice Storage Tanks
    - Fan Coil Units
    - Pumps
    - Boilers
    - Air Handling Equipment
    - Fans
    - Terminal Units
    - Packaged or Split system AC Units
    - Variable Speed Drives
    - Hydronic Specialties
    - Meters and Gauges
    - Steam Specialties
    - Water Heaters
    - Air Compressors
    - Vacuum Pumps
    - Clean Steam Generators
    - Fire Alarm system
    - Security systems
    - Communication Systems
    - Emergency Generators

- Vertical Transportation system (elevator, escalator etc.)
- Specialty equipment for Bus and Automotive maintenance Facility
- Specialty Equipment for Fire Station.
- Electrical Switchgears
- Distribution Transformers
- UPS system
- Lightning Protection
- Grounding System
- Specialty Lighting fixtures and Lighting Controls
- Motor Control Centers
- Automatic Transfer Switches

…

- Draft Start Up checklists for all equipment along with the associated manufacturer specific start up procedures
- Draft balancing reports
- Automatic Temperature Control shop drawings
- Test and Balance reports
- Performance/Capacity certifications
- Factory tests and manufacturer's start up procedures
- O&M Information
- Warrantees

Contractor shall provide one copy of indicated submittals for CA.

viii. **Construction Inspection:**
CA shall conduct construction inspections as deemed appropriate by CA, record observations, and copy MCG [CM] and A/E.

A/E shall conduct construction inspections specified in MCG - A/E agreement, record observations, and copy MCG [CM][GC] and CA.

[CM] [and] [MCG] will provide [resident] construction inspectors to inspect the installations

ix. **Action List:**
GC with input from CA shall maintain an Action List tracking Action Items (required information, identified deficiencies, work required, etc.). Each item shall be tracked with the initiator, the parties responsible, due date, the date of closure, and a description of the resolution. Each item shall be categorized for sorting and tracking and for documentation on applicable forms.

CA will disseminate this list to keep all parties informed.

x. **Identification and Resolution of Deficiencies or Additional Work Required:**
Any party can identify deficiencies including the CA. Those forwarded to GC and a copy to CA will be documented in the Action List. These shall be items of discussion at progress meetings to determine their legitimacy and decide on appropriate action. However, inclusion in the Action List is not a direction to proceed with any resolution or action. Only MCG, A/E, CM, GC etc., as stipulated in the contracts governing the project, can direct work. CA has no authority to direct work or to authorize change orders. CA will record and forward any perceived deficiencies to MCG [CM] for further action.

The party responsible for the deficiency is responsible to resolve it. Direction to proceed with the resolution is given by MCG, A/E, CM, GC etc., as stipulated in the contracts governing the project

xi. **Start up Checklist and Test Development:**
Purpose: Start up checklists and tests document the normal procedure of ensuring that systems are properly installed. Checklists are developed during the Construction Phase by the respective subcontractor in cooperation with the CA. They are completed by the contractor.

Creation: The contractor shall create the checklists and tests for each system and piece of equipment. The content of the checklist may originate from generic checklists generated by ComIT and from the instructions prepared by the manufacturer of the system or equipment. Contractors shall synthesize this content onto a form for each type of system or equipment. They shall then forward the checklist and the associated start up instructions from the manufacturer to the GC or CM as applicable that will compile and organize them and forward them to the CA. In addition to the activities required to start the system or component the following shall also be included on the forms:

- Nameplate data, product numbers, serial numbers, etc. to fully define the asset to the operation and maintenance personnel for purposes of maintaining the equipment
- Capacity data
- Name of technician with place for signature
- Date of completion
- Indication that associated documentation has been submitted including
- Shop Drawings and Product Data
- Installation and Start Up instructions
- O&M Data
- Sequences
- Review
- Signature
- Representative Checklists

Review: CA shall review the start up checklists and request any additional information required to meet the Cx criteria.

Signature: The individual executing the start up must complete, sign and date the start up checklist for any given equipment. Any outstanding items or non-conformance shall be clearly indicated and highlighted on the checklist.

Representative Checklists: Representative checklists can be found in ComIT of this plan. Contractors may use this as a guide for development of job specific checklists.

xii. **Electronic Nameplate Data Submittal:**
As indicated above in the submittal of checklists, nameplate data shall be submitted on all equipment. All nameplate data must be submitted in electronic format. If ComIT is used, that format will be acceptable for electronic submittal of this data. If ComIT is not used, all nameplate data shall be submitted electronically in a format that can be imported to either an Excel file or Access database. Data provided in word processor format is not

acceptable. All elements of data must be discrete fields or cells. The field format will be provided by MCG. PM codes for equipment will be provided by MCG.

xiii. **Contractor Notification:**
Contractor shall completely install, thoroughly inspect, start-up, test, adjust, and balance systems and equipment. All activities shall be documented on specified forms. Contractor shall notify [MCG][CM] writing that systems are complete and ready for verification and functional performance testing. MCG[CM] shall then coordinate and schedule the testing and checkout times.

Contractor shall notify CA at least 14 days in advance of any tests, start-ups, or training. CA shall witness selected tests and start-ups.

xiv. **Execution of FPTs:**
Scheduling: After contractor's notification that systems are ready for testing and submittal and review of all the required submittals, Owner shall schedule the testing. Generally tests shall be scheduled to allow efficient and contiguous testing of inter-related systems and equipment.

Phasing: Non-interdependent segments of the project can be phased. Phasing of this project is described below
{Describe Phasing of the FPT}

Completeness: All systems must be completed and ready for FPT. TAB must be complete and the control systems must be tested and started for the respective system or component.

Participation: Participation of the appropriate sub contractors is typically required. The extent of the participation is indicated in the generic test procedures presented below and in the Construction Specifications

Test Documentation: CA will conduct, test, and/or witness tests as applicable. CA will record test results on the forms developed for the testing [and incorporate it into ComIT]. CA will Pass or Fail the testing and record the date and time of the test. Deficiencies shall clearly be indicated in when the test is failed. When all related testing is completed successfully, CA shall recommend acceptance of the system or component.

Deficiencies and Re-testing: When deficiencies are identified during testing, depending on their extent or magnitude, they can be corrected during the test and the testing can continue to successful completion. More significant deficiencies will require failure of the test and re-testing. Deficiencies of this magnitude will result in an action item on the Action List. The resolution of the deficiency will then subsequently be tracked by the CA via the Action List. All tests shall be repeated until successful completion

Sampling: Some types of identical equipment (such as terminal devices) will be tested using a sampling strategy. The sample percentage is indicated in the generic test procedures listed below.

Failure Limit on Sample Tests: With the sampling percentages is listed a failure limit. This limit indicates the maximum percentage of the tested devices that may have any test that fails before an entirely new sample must be tested. This is based on the concept that if many failures occur it is a result of inadequate start up by the contractor. When the maximum number of failures is reached, testing on that sample will be terminated and retesting will be scheduled.

- Where sample tests involve multiple systems (i.e.: checking strainers on different hydronic systems), the maximum failure limit will apply per system.
- The responsible contractors shall pay the CA's cost of that sample test, and redo the start up for the applicable devices.
- All work necessitated by sample failures shall be at no cost to MCG.

Opposite Season Testing: Testing procedures shall be repeated and/or conducted as necessary during appropriate seasons. "Opposite season" testing will be required where scheduling prohibits thorough testing in all modes of operation. Air Handler and Central heating system testing for heating related modes of operation and control loops shall be tested during outside air temperatures below 35°F.

xv. **Acceptance Criteria:**

Expand on and revise these as necessary for individual projects specific needs.
The acceptance criteria will generally be as follows unless more specifically indicated with individual tests. CA may exercise professional judgment to relax requirements and pass tests when appropriate.

- Capacity and/or equipment performance will generally be as specified ±5%
- Efficiency where specifically indicated in the documents will be ±5%. Where inferred from manufacturers catalogued data, criteria will be ±10%
- Balancing related criteria will be ±5% for water and ±10% for air
- Accuracy/repeatability on sensing devices will be as specified for the device. CA and TAB will use calibrated gages for independent validation and use judgment in passing or failing the devices. In many cases, the coordination of multiple related sensors is more important than absolute accuracy.
- Loop response and setpoint deviation criteria will be as specified
- HVAC Sequence related criteria will be as explicitly specified in the documents and as interpreted by the CA. Code required sequencing shall be per the applicable code.
- Generally phase imbalance on a motor shall be no more than 2% (Amps, and Volts)
- Noise Levels:
  - Occupied spaces: As indicated in the Design Criteria Narrative. Otherwise as recommended in the most current version of the ASHRAE Handbooks for the applicable occupancy
  - Max 77dba at 3' from a UPS
  - Max 65dba at 7' from an Engine Generator Set
  - As required by current local ordinances.
- Indoor Environmental Parameters (T, RH, CO2, VOC): As indicated in the Design Criteria Narrative. Otherwise as recommended in the most current version of the ASHRAE Handbooks for the applicable occupancy.
- Air Pressurization: As indicated in the Design Criteria Narrative. Otherwise as indicated in the most current version of the ASHRAE Handbooks for the applicable occupancy. Smoke/shaft pressurization shall be as required by NFPA to maintain maximum door opening forces and to restrict the passage of smoke.
- Indoor Lighting Levels: As indicated in the Design Criteria Narrative. Otherwise as recommended in the most current version of the IES Handbooks for the applicable occupancy.

- Electrical Systems: In accordance with manufacturer's recommendations of individual components and devices, NFPA 70B and International Electrical Testing Association (NETA) testing specifications NETA ATS-1991.

xvi. **Training Procedures:**
Adequate and thorough training of the operators and the facilities staff is vital to effective transition and early occupancy of the building. A key goal of the Cx team is to ensure this is accomplished.

Contractor shall submit training plan to CA for review. Training plan shall summarize training sessions with topics to be covered and approximate duration.

All parties will be involved in the training process. Many of the documents created and gathered throughout the Cx process will be used in training. Detailed requirements for training are include in the construction specifications. Training will be conducted both on site an in a classroom setting as suits the subject matter.

GC will compile the training agendas of the subs and vendors and submit a comprehensive training plan to the CA, A/E and MCG for review. Training plan shall include at a minimum:

- Topic and applicable spec section
- Scheduled date(s) for the session
- Location and setting (classroom or field)
- Lead Instructor and instructors qualifications
- Co instructors and their qualifications
- Session outline or agenda
- Anticipated duration
- Who should attend each session

GC will be responsible for video taping the training sessions for MCG.
Subcontractors and Vendors will typically conduct training on the equipment or systems they install and cover proper operation, maintenance, repair, and diagnosis of the component. For instance the chiller manufacturer will conduct training on the proper operation and maintenance of the chiller. The controls contractor will conduct training on the operation and maintenance of the control system. This training will typically be accomplished towards the end of the Construction Phase.

Subcontractors or Vendors must document the training sessions. Documentation shall include the name of the instructor, an outline of the topics covered, the duration of the session, any material handed out during the training, and the names of the attendees. The instructor and the attendees will initial the document listing their name. Training shall follow handouts that at least list the key points in bullet form presentation style or follow detailed written documentation. Training will not be approved unless it contains accompanying written documentation.

Facility and Systems Overview and Operational Intent training will typically be conducted in a classroom setting and shall be conducted by the CA and CxAand or A/e. Training material shall be organized and formatted for MCGs future use.

xvii. **Participation:**
Generally required participating parties are indicated with the individual tests. Typically, multiple parties are required for any given test, yet participation for any given party is only

required for the respective portion of the test for which the party is responsible. For instance, ATC does not have to be present for capacity testing of an air handler, only the control related performance testing. In many cases, the maximum required time in hours is indicated in parenthesis for any given test. The time is typically per unit system unless indicated otherwise(i.e.: 1 hr per air handler tested). If no time is indicated, participation is required throughout the entire test.

Frequently, on multiple samples where a given party does not directly conduct the test, the participation of that party will only be required for an initial quantity of systems/equipment. CA will continue with the remaining portion of the sample without assistance from the contractor. In this case the time requirement will be indicated as total.

It is required that the parties be available on site throughout the testing of any given system for which they are required participants. Therefore time for which they are not directly involved can be spent performing other work (typically addressing identified punch list items or failed tests)

No party involved with the project is prohibited from participation in or witnessing of any tests. Any contractor may elect to witness all tests on their systems even if their involvement is not directly required (for instance, ATC involvement is sometimes required on the first few of a sample and not on the entire sample)

CA will endeavor to coordinate effectively with the individual contractors throughout FPT and minimize their required involvement

4. **Generic Functional Performance Test(FPT):**

   i. **General**

   Tests indicated herein are general functional testing requirements that apply to typical equipment, systems, sub-systems, etc. CxA shall prepare itemized testing plans and procedures with input from CA that will:

   - specify individual tests and procedures that meet the general requirements of this plan
   - serve to document and record the testing procedures and the results of the tests.
   - Incorporate as a minimum the applicable content of ComIT

   ii. **Coordination Between Testing Parties:**

   Factory Start Ups: For many systems and equipment, factory start-ups are specified. These generally are Start Up related activities that will be reviewed and checked during functional performance testing. All costs associated with the factory start-ups are included with the bid unless otherwise noted. In general, contractor shall make notification of when these factory start-ups are occurring and coordinate these with witnessing parties. CT members may witness many of these start ups at their discretion. Aspects of functional performance testing accomplished during the factory start up may be accomplished and approved by the CT if they judge they meet the intent of the FPT.

   Independent Testing Agencies: For systems where independent testing agencies are specified, the cost of this testing is included with the bid unless otherwise noted. Much of the testing performed by these independent agencies will cover aspects required in the start-ups and functional performance tests. Contractor and testing agencies shall coordinate with the CT so that they can witness the testing and approve the applicable aspects of the FPTs. CT may in some cases independently spot check work of the testing agencies if the tests were not witnessed. However it is not the intent for the CT to re-accomplish testing that is specified in the construction specifications. For instance much of the testing requirements for the electrical systems will be performed by the independent electrical testing agency provided under the bid. CT will witness the indicated sample of the testing and record the results in the record of functional performance testing.

iii. **Prerequisites:**
All equipment, components and devices applicable to the test must be started and this start up must be documented. This includes completion of the checklists, pressure testing of equipment, duct, pipe, etc., flushing/cleaning of applicable systems, completed labeling and identification, completed insulation of applicable systems, completed TAB, etc..

Unless specifically agreed to by MCG and CA, all support systems shall be complete prior to FPT. An air handler for instance will require that

- the electrical system serving it is completed and tested
- the hydronic systems serving it have been balanced and FPTed
- Balancing has been accomplished on the air and watersides.
- The control systems have been started and calibrated.

The CA shall determine the optimal sequence of testing

iv. **Instrumentation:**
Standard instrumentation used across generic systems shall be provided by the GC with CA input for spot-checking balancing, controls and electrical power quality.

Proprietary instrumentation required to verify performance of specialty equipment shall be provided by Contractor and made available to CA. Generally, no testing equipment will be required beyond that required to perform Contractors work under these Contract Documents.

All equipment used for testing and calibration shall be NIST/NBS traceable and calibrated within the preceding 6-month period. Certificates of calibration shall be submitted.

5. **Common Elements for All Systems:**

i. **General:**
Submittal Documentation: Have the required submitted documentation convenient to testing area. Validate that all required documentation has been submitted and is per the contract requirements (very cursory review).

Start Up Documentation: Contractor shall provide the start up documentation at the time of testing. Review the start up tests and checklist documentation. The checklists and start up tests/measurements shall be spot checked at the beginning of FPT

Access: Contractor shall demonstrate that access is sufficient to perform required maintenance.

Trends: Trends on control systems shall have been established as required in the documents. These shall generally be review prior to or during FPT.
Power Outage Simulation
All dynamic systems powered by electricity shall be tested to simulate a power outage to ensure proper sequencing. Those on emergency power or uninterruptible power shall be tested on all sources.

Capacities and TAB: Capacities and adjusted and balanced conditions as applicable will generally be checked.

Sequence Verification: All modes of operation and actions shall be verified for equipment/system samples.

Configurations: Configurations shall be compared against the contract documents

Mode Coordination: Verify modes (heating and cooling for instance) are coordinated and do not overlap or "fight".

Optimal Settings: All adjusted, balanced, controlled systems shall be assessed to determine the optimal setting for the system as applicable. The optimal settings should be determined to establish reliable, efficient, safe and stable operation.

Dynamic Graphics: The graphic for all components, systems, and areas sampled and required to be represented by a graphic shall be checked for adequacy and accuracy. Furthermore, when set points are required to be adjustable, verify that they can be adjusted directly from the graphic screen.

ii. **TAB Verification of Mechanical Systems:**
CA will review TAB reports.

Participants shall include CA, MCG, and TAB .

The CA will select up to 10% of the readings from the balancing reports and require the balancing contractor to spot-check them. The maximum failure rate for this sample is 10% and the system shall be re-balanced and re-documented if this is exceeded. The readings selected by the CA may include supply air diffuser readings (both minimum and maximum readings for VAV boxes), main and branch supply duct traverse readings, outside/return air flow readings, exhaust air flow readings, water flow readings, water pressure drop readings through coils, heat exchangers, etc. For all readings a deviation of more than 10% between the verification reading and reported data shall be considered as failing the verification process. All readings that fail the verification process shall require balancing again. Contractor shall coordinate a spot check walk through with the CA, County PM, Maintenance Section Representative and the Engineer of Record for randomly checking the validity of the balancing report.

iii. **HVAC System Pumps Functional Performance Test:**
Participants shall include CT, MC (1), TAB(1), and ATC (1)(where pumps are automatically controlled).

Sample 50%, max failure limit 20%

CA shall review start-up checklist, and TAB report.

Contractor shall demonstrate that strainers are clean.

Pumps shall be manually started individually. Pressure differential, KW (or slip on the motor), and flow shall be checked at shut-off, wide open, and balanced (or controlled) condition. Generally the reading from the instrumentation provided with the pump (thermometers and pressure gages and flow meters as applicable) will be acceptable if used to validate an action as opposed to checking balancing.

For pumps designed with automatic starting of back up pump on primary pump failure, enable automatic controls, start primary pump, throw disconnect switch of primary pump, and validate that standby is energized. Perform this test on both pumps.

For variable speed pumps, manipulate control valves to change flow conditions and observe control response. Ensure stable control response to step change in flow conditions. Check for the applicable acceleration and deceleration of the pumps. Manually ramp pump speed from min. to max. to ensure stable operation of pumps and record/defeat any critical frequencies. Record representative part load output from the drive (using VFD read out). Check calibration of control input. Check drive bypass operation if applicable.

Simulate power outage and ensure orderly and automatic restart

iv. **Hydronic Systems Functional Performance Test:**
Participants shall include CT, MC

Sample: All systems, 20% (of strainers), max failure limit 5%

Check system make up and pressurization. Record optimal settings. Ensure air is removed by bleeding the sample rate of coils or high points. Ensure expansion tanks are properly charged.

CA shall review start-up checklist, pressure test documentation, and TAB report.

Blow off selected strainers to ensure the system is flushed and clean

Refer to TAB verification

v. **Water Cooled Chiller Functional Performance Test:**
Participants shall include CT, MC (1), TAB (1), and ATC (2).

Sample 100%

Start the {air handling units}, {fan coil units},chilled water pumps, {condenser water pumps} and enable the chiller control system.

Verify that flow is established by the condenser water proof of flow switch.

Verify that flow is established by the chilled water proof of flow switch.

Verify the chiller start sequence.

{Verify functioning of "soft start" sequences, record motor amperage as a time function.}

Verify cooling tower controls function properly.

{Confirm that the control system calculates the chiller load and provides a trend log of the load imposed.} Record chiller amperage and voltage at full load and part load conditions.

Verify the chiller shut down sequence when the air-handling unit(s) and/or fan coil unit(s), etc. are shut down by the Contractor to remove load on the chilled water system.

Verify the operation of the condenser pump, chilled water pumps and the cooling tower when the air handling or terminal unit(s) are restarted by the Contractor.

Verify proper stage-up and stage-down sequence of multiple chillers. Check for excessive chiller cycling at part load for chillers with staged capacity control.

Check capacity and efficiency of the chiller

Check calibration of remote current limit or remote setpoint indication

Verify proper suction, head, and oil pressures.

Simulate power outage and ensure automatic and orderly restart.

vi. **Air Cooled Chiller Functional Performance Test:**
Participants shall include CT, MC (1), TAB (1), and ATC (2).

Sample 100%

Start the {air handling units}, {fan coil units},chilled water pumps, and enable the chiller control system.

Verify that flow is established by the chilled water proof of flow switch.

Verify the chiller start sequence.

{Verify functioning of "soft start" sequences, record motor amperage as a time function.}

{Confirm that the control system calculates the chiller load and provides a trend log of the load imposed.} Record chiller amperage and voltage at full load and part load conditions.

Verify the chiller shut down sequence when the air-handling unit(s) and/or fan coil unit(s), etc. are shut down by the Contractor to remove load on the chilled water system.

Verify the operation of the chilled water pumps and controls when the air handling or terminal unit(s) are restarted by the Contractor.

Verify proper stage-up and stage-down sequence of multiple chillers. Check for excessive chiller cycling at part load for chillers with staged capacity control.

Check calibration of remote current limit or remote setpoint indication

Verify proper suction, head, and oil pressures.

Simulate power outage and ensure automatic and orderly restart.

vii. **Chilled Water/Glycol Primary System Functional Performance Test:**
Participants shall include CT, MC(1), TAB(1), and ATC(8).

Sample 100%

CA shall review start-up checklists and TAB reports.

Verify the cooling enable/disable sequences

Verify proper stage up and stage down of the chillers by the control system as load is varied. Load can be varied by manipulating valves, starting/stopping chilled water terminals and/or changing the staging control parameters

Verify proof and enunciation of individual chillers upon failure. Simulate failures that cause both an automatic reset of the chiller (typically temporary condenser water flow loss) and manual reset of the chillers. Verify that chiller requests are removed appropriately and the next chiller in rotation is energized

Verify rotation and/or re-prioritization of multiple chillers as applicable, whether manual or automatic rotation is employed.

Ensure the static pressure setting of the make up water system are coordinated and that the entire system is under positive pressure throughout all modes of operation

viii. **Building Chilled Water Loop Connection FPT:**
Participants shall include CT, MC(1), TAB(1), and ATC(1)

Sample All

Open building control valve, measure and record flow to the building and pressure differential.

Command the building valve to close and ensure adequate shut off

[In both the coupled and decoupled modes.]Enable automatic control of the building loop and trend performance. Make at least one step change in the loop setpoint during the trend period.

Refer to HVAC Systems Pumps for pump testing. Additionally, with a fixed setpoint on the building valve control loop, establish a trend on the pump control loop. Observe normal control function. Introduce one setpoint step change and observe response.

[Change setpoint to cause a change between coupled mode and decoupled mode and back]. Observe system performance. Trend all values and print trend for documentation.

ix. **Hot Water/Glycol Primary System Functional Performance Test:**
Participants shall include CT, MC (2), TAB(4), and ATC (8).

Sample 100%

CA shall review start-up checklists and TAB reports.

Verify the heating enable/disable sequences

Verify proper stage up and stage down of the boilers by the control system as load is varied. Load can be varied by manipulating valves, starting/stopping hot water terminals and/or changing the staging control parameters

Verify proof and enunciation of individual boilers upon failure. Verify that chiller requests are removed appropriately and the next boiler in rotation is energized

Verify rotation and/or re-prioritization of multiple boilers as applicable, whether manual or automatic rotation is employed.

Ensure the static pressure setting of the make up water system are coordinated and that the entire system is under positive pressure throughout all modes of operation

x. **Cooling Tower Water System Functional Performance Test:**
Participants shall include CT, MC (1), TAB (1) , and ATC (2).

Sample 50%, max failure limit 20%

CA shall review start-up checklists and TAB reports.

Verify the tower enable/disable sequences

Verify proper stage up and stage down of the towers by the control system as load is varied. Load can be varied by manipulating valves, starting/stopping hot water terminals and/or changing the staging control parameters

Verify proof and enunciation of individual towers upon failure. Verify that tower requests are removed appropriately and the next tower in rotation is energized

Verify rotation and/or re-prioritization of multiple boilers as applicable, whether manual or automatic rotation is employed.

Check the NPSH on the pumps throughout various modes of operation

Check the sump level control to ensure air is not drawn into the system and that no air pockets exist in the suction piping

xi. **Water Boiler Functional Performance Test:**
Participants shall include CT, MC (1), TAB (1), and ATC (2).

Sample 100%

CA shall review start-up checklist and TAB report.

Contractor shall start and warm-up the boiler.

Verify that burner modulates/stages to maintain water temperature.

Verify proper operation of makeup water system, including chemical treatment, etc.

Observe combustion efficiency tests conducted by the Contractor for boiler at full load and part load conditions.

Test applicable safeties

Simulate power outage and ensure automatic and orderly restart

xii. **Steam to Hot Water Converter Functional Performance Test:**
Participants shall include CT, MC (1), TAB (1), and ATC (1).

Sample 50%, max failure limit 20%

CA shall review start-up checklist and TAB report.

Contractor shall start and warm-up the converter.

Record Hot water system pressurization and ensure that the air has been removed and the system is under positive pressure at all points in the system.

Verify proper steam pressure upstream of valve and proper water flow through converter.

Verify that steam valve(s) modulates/stages to maintain water temperature. Verify proper sequencing of valves where applicable. Observe control response to varying loads and ensure stable response. Loads should be varied by contractor by starting and stopping air handling units or other suitable means.

Set valves and flow for full heating and verify maximum heating capacity.

Verify that condensate is flowing freely and that traps are operating properly.

Verify proper operation of makeup water system, including chemical treatment, etc., where applicable.

xiii. **Steam Pressure Reducing Stations and Systems Functional Performance Test:**
Participants shall include CT, MC (1), TAB (1), and ATC (1).

Sample 50%, max failure limit 20%

CA shall review start-up checklist and TAB report.

Observe system operation and pressure control as system load is varied. System load can be varied with false loading coils, converters, etc. or by blowing relief valve. Record system pressures and flows. Monitor runtime and operation of the condensate pumps. Ensure they alternate correctly.

Fail condensate pumps to ensure backup operation. Check level alarming on condensate receiver.

Blow relief valves to ensure proper discharge. Verify no excessive hammering and adequate draining from the drip pan elbow.

xiv. **Domestic/Industrial Hot Water Converter Functional Performance Test:**
Participants shall include CT, MC (1), TAB (1), and ATC (1).

Sample 50%, max failure limit 20%

CA shall review start-up checklist and TAB report.

Verify that domestic piping has been disaffected and take a water sample.

Contractor shall start and warm-up the converter.

Verify proper steam pressure upstream of valve and proper water flow through converter.

Verify that steam valve(s) modulates/stages to maintain water temperature. Verify proper sequencing of valves where applicable. Observe control response to varying loads and ensure stable response. Loads should be varied by contractor by starting and stopping air handling units or other suitable means.

Set valves and flow for full heating and verify maximum heating capacity.

Verify that condensate is flowing freely and that traps are operating properly.

Record the city water pressure at inlet and outlet of the PRV.

xv. **Fan Coil Unit Functional Performance Test:**
Participants shall include CT, MC (2 hrs total), TAB (2 hrs total), and ATC (2 hrs total).

Sample 20%, max failure limit 10%

CA shall review start-up checklists and TAB reports.

Verify automatic start/stop of fan and open/close of outdoor air damper.

Start heating and cooling system, manipulate control device to obtain maximum cooling and heating. Measure temperatures and pressures to determine capacity.

Weather permitting cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

Check calibration of control devices and for stable control response.

Check for free and adequate flow of AC condensate.

Simulate power outage and ensure automatic and orderly restart.

Verify changeover for two pipe systems.

xvi. **Miscellaneous Terminal Unit Functional Performance Test:**
Participants shall include CT, MC, TAB, and ATC.

Sample 20%, max failure limit 10%

CA shall review start-up checklists and TAB reports.

Verify automatic start/stop of fan and open/close of outdoor air damper as applicable.

Start heating and cooling system, manipulate control device to obtain maximum cooling and heating. Measure temperatures and pressures to determine capacity.

Weather permitting cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

Check calibration of control devices and for stable control response.

Check for free and adequate flow of AC condensate as applicable.

Simulate power outage and ensure automatic and orderly restart.

Verify changeover for two pipe systems as applicable.

xvii. **Air Handling Unit Functional Performance Test:**
Participants shall include CT , MC, TAB, and ATC.

Sample 50%, max failure limit 10%

CA will select a representative amount or all air-handling units for testing.

CA shall review start-up checklists and TAB reports.

Verify automatic start/stop of fan and open/close of outdoor air damper.

Start heating and cooling system, manipulate control device to obtain maximum cooling and heating. Measure temperatures and pressures to determine capacity.

Weather permitting cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

Check calibration of control devices and for stable control response and component performance including chilled water coils, hot water coils, steam coils, humidifiers, economizer cycles, etc. Ensure proper coordination of control loops and that no fighting or energy wastes result

Check for free and adequate flow of AC condensate.

For variable speed fans, manipulate air terminal units to change flow conditions and observe control response. Ensure stable control response to step change in flow conditions. Manually ramp fan speed from min. to max. to ensure stable operation of fans. Record representative part load output from the drive. Check calibration of control input. Check drive bypass operation if applicable.

For fans with inlet vanes, manipulate air terminal units to change flow conditions and observe control response. Ensure stable control response to step change in flow conditions. Manually modulate vanes from min. to max. to ensure stable operation of fans. Record representative part load power draw on the motor. Check calibration of control input.

Ensure minimum required ventilation rates are maintained across the full range of control where applicable.

Test all interfaces with the fire alarm system and all smoke control sequences.

Verify interlocks with exhaust fans where applicable.

Test proof alarming where applicable.

Test operation of applicable safeties including freeze stats, high and low static devices, smoke detection, etc. Check AH component status in each event

Check system status and operation in the Off, Unoccupied, and Occupied Mode of operation. Validate proper start up and shut down sequences

Simulate power outage and ensure automatic and orderly restart.

xviii. **Fan/Air System Functional Performance Test:**
Participants shall include CT , MC, TAB, and ATC.

Sample 30%, max failure limit 10%

CA shall review start-up checklist and TAB reports.

Verify start/stop control sequences

Check the capacity of the fan at maximum conditions

Cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

For variable speed fans, manipulate air terminal units to change flow conditions and observe control response. Ensure stable control response to step change in flow conditions. Manually ramp fan speed from min. to max. to ensure stable operation of fans. Record representative part load output from the drive. Check calibration of control input. Check drive bypass operation if applicable.

For fans with inlet vanes, manipulate air terminal units to change flow conditions and observe control response. Ensure stable control response to step change in flow conditions. Manually modulate vanes from min. to max. to ensure stable operation of fans. Record representative part load power draw on the motor. Check calibration of control input.

Verify interlocks with exhaust fans where applicable.

Test all interfaces with the fire alarm system and all smoke control sequences.

Test proof alarming where applicable. [. Simulate failures of fans and ensure proper start up of back up fans]

Test operation of applicable safeties including freeze stats, high and low static devices, smoke detection, etc.

Simulate power outage and ensure automatic and orderly restart.

xix. **HVAC - VAV Air Terminal Functional Performance Test:**
Participants shall include CT , MC, TAB, and ATC.

Sample 25%, max failure limit 10%

CA shall review start-up checklists and TAB reports.

Check the calibration of zone temperature sensors

Set boxes for both minimum and maximum flow (typically by setting the space temperature setpoint up and down) and check the calibration of the flow settings

Check the stability of the zone temperature control loop for the damper and any associated heating devices by changing the space set points and observing the response.

Cause all applicable modes of operation using false loading where practical. Check proper sequence for switching modes and proper operation within a mode.

Determine the optimal settings for the control parameters

Simulate and test the unoccupied and emergency mode response of the box where applicable

Check the capacity of the heating device where applicable

xx. **Cooling Tower/Chemical Treatment Functional Performance Test:**
Participants shall include CT , MC, TAB, and ATC.

Sample 50%, max failure limit 10%

CA shall review start-up checklists and TAB reports.

Activate cooling tower fan start using control system command. Verify proper start sequence

After chiller start-up, confirm stable and coordinated control of the towers. Check the loop response for both the towers and the bypass valves as applicable.

Verify that the system starts properly in cold weather without causing chiller failures or lockouts.

Check capacity of the tower during warm weather

Weather permitting, check the tower in all modes of operation

Verify make-up water valve is functioning and that level differential is adequate for start up so as not to pull air. Activate chemical treatment feed valve, verify make-up of chemical treatment system, pump, and controls.

Treatment supplier shall sample cooling tower water weekly and test for suspended solids. Record solids meter reading for each sample to verify accuracy. Continue sampling to assure solids concentration maintenance of 2000 ppm for three samples.

[Record reading on tower make-up water supply meter, compare to chiller load summation of ton-hours. Make-up water use should be 4 gal per ton or 2.5% of the total flow. Report variance. Record amount of chemical used, forward to water treatment contractor for review and approval based upon amount of make-up water used.]

xxi. **Desiccant Dehumidification Systems Functional Performance Test:**
Participants shall include CT , MC, TAB, and ATC.

Sample 50%, max failure limit 10%

Review start up documentation

Provide humidification source to load the space.

Spot-check the setup and calibration of control elements and sensing devices.

Start system and validate process and regeneration airflows are as required. Allow humidity to rise or use false humidification load to test the capacity of the unit. Validate leaving air dew point can be obtained per spec. Vary load or change setpoint of the humidity to observe response of the dehumidification control loop. Set the humidity setpoint too much higher that current value and validate that no dehumidification results.

Place system in all modes of operation and validate sequences. Generally validate that all control tolerances are maintained.

Validate the regeneration control loop.

For close regeneration cycles validate the capacity of the cooling coils and check the tuning of the control loop.

xxii. **ATC Compressed Air System Functional Performance Test:**
Participants shall include CT members and ATC

CT members will witness manufacturers start up tests

CA will review start up checklists

Isolate Plant Air

Verify automatic drain operation

Monitor normal operation of the compressor. Time run and off cycles to ensure proper operation (per the manufacturers recommendations) Bleed air at variable rates to ensure capacity. Ensure proper rotation.

Open disconnect on one compressor and validate the standby operation of the compressor.

xxiii. **Natural Gas Systems Functional Performance Test:**
Participants shall include CT and MC

Sample: 100% systems 20% of outlets.

Test operation of safety devices including earthquake shut off and electrically operated shut off valves.

Test outlets to ensure proper pressure and delivery. Test pressures throughout systems.

xxiv. **Carbon Dioxide and Nitrogen Cylinder Gas Systems Functional Performance Test:**
Participants shall include CT , and MC

Sample 100% of systems and 20% of outlets

Review start ups and generally review the configuration

Test adequate pressure and flow to random outlets throughout the facility

Check all indications, safeties, interface with the FMS and enunciation.

Test the standby bank switching functions of the manifold. Verify the switchover is enunciated.

xxv. **Shaft (Elevator and Stairwell) Pressurization Systems Functional Performance Test:**
Participants shall include CT , MC, ATC, EC, and FAC

Sampling: 100%

View start up reports

Check interfaces between the systems

Test must be conducted below 20°F to assess the worst case of pressure difference throughout the shaft

Initiate a fire/Smoke Evacuation condition by releasing smoke into a smoke detector. Observe system start up and actuation.

Measure the extremes of pressure at the top and bottom of the shaft relative to outside and the opposite side of doors. This measurement shall be with all doors closed, with the exit door open, and with two random floor doors open along with the exit door. Ensure door opening force is less than 35# and that all floors are at least .1"wg positive.

Validate all enunciation and override functions.

Verify Elevator Recall functions when applicable

xxvi. **Automatic Temperature Controls Functional Performance Test:**
Participants shall include CT , MC, and ATC.

Controls system sampling will typically correspond to the sampling rate of a system or piece of equipment. These sampling rates are indicated above for the respective item.

Contractor shall operate the equipment and subsystems through all specified modes of control and sequences of operation including full and part load conditions, and emergency conditions.

Verify that equipment operates in accordance with design intent and approved control diagrams. This shall include checking the operation of dampers, valves, and smoke detectors, high and low limit controls, of a sample of 25% of components with a maximum failure limit of 10%.

Analog Input Sensors: (at a sample of 50% of the inputs on the sampled devices (see above for device samples) with a maximum failure rate of 10%) Spot check analog input sensors (space temperature sensors, outside, return, and mixed air temperature sensors, discharge air temperature sensors, chilled water and hot water temperature sensors, and humidity sensors, air and water differential pressure sensors, airflow monitoring stations, etc.) for acceptable accuracy (which is generally as specified for the device).

Valves, Dampers and Actuators: (at a sample of 50% of the inputs on the sampled devices (see above for device samples) with a maximum failure rate of 10%) Ensure that valves and dampers and their actuators close off or seal against the maximum pressure differential. Ensure that the actuators stroke throughout the correct range and that the positioners are set correctly where applicable

Establish trends of control system points for a minimum of a two-week period prior to and throughout the Acceptance period. Trends shall be analyzed to identify any control problems, lack of capacity, control loops fighting or unstable, etc.

Spot (at a sample of 50% of the inputs on the sampled devices (see above for device samples) with a maximum failure rate of 10%) check the operation of all automatic switches (pressure switches, current switches, flow switches, etc.) to ensure that they are adjusted to proper make and break settings

Verify the stand-alone functionality of the controllers. Generally disconnect LAN communication wiring and ensure that the controller functions properly and that the loss of communication is acknowledged by the interface. Restore communications and ensure an orderly restoration to normal control.

Verify that the EMS interface, EMS software, graphics and functions are in accordance with design intent and approved control diagrams

Check dial in communications where applicable to ensure functionality

xxvii. **Indoor Environment Testing/Monitoring Functional Performance Test:**
Participants shall include CT .
Sample 25%, max failure limit 10%

Spot check and monitor key environmental parameters for various spaces including:
Indoor Temperatures and Humilities
Air Quality:
CO2 levels
VOC levels
Airborne particulate
In-zone parameter deviations
Pressurization
Noise level
Air Movement
Light Levels
Where applicable, check all monitors, emergency switches, containment provisions, etc..

xxviii. **Warm and Cold Rooms Functional Performance Test:**
Participants shall include CT and MC.

Sample 50% Failure Limit 10%

Review start up procedures and O&M documentation.

Change set points on all variables controlled to verify control and capacity. Observe loop response and validate that the steady state control is within required tolerance for HW, Glycol, Humidifiers, and dehumidifiers as applicable. Temperature control shall be within ±.5°F.

Test all alarming and enunciation functions. Validate warning set points are entered and functional.

xxix Sprinkler System Commissioning
Starting Procedures: proceed as follows:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Verify that specialty valves, trim, fittings, controls, and accessories have been installed correctly and operate correctly
5. Verify that specified tests of piping are complete.
6. Check that damaged sprinklers and sprinklers with paint or coating not specified have been replaced with new, correct type of sprinklers.
7. Check that sprinklers are correct type, have correct finish and temperature ratings, and have guards where required for applications.
8. Check that potable water supplies have correct type of backflow preventer.
9. Check that fire department connections have threads compatible with local fire department equipment and have correct pressure rating.
10. Fill wet-pipe sprinkler systems with water.
11. Energize circuits to electrical equipment and devices.
12. Adjust operating controls and pressure settings
13. Coordinate with fire alarm system tests. Operate systems as required.

xxx Emergency Generators and Emergency Distribution Systems Functional Performance Test:

Participants shall include CT, EC

Sample 100% of generators, 100% Utility feeds, 25% Distribution breakers, 50% of ATSs.

Spot-check start-ups and factory tests. Record system settings and parameters

Open normal breakers to simulate various levels of power outages including all utility feeds, single feed, transformers, and distribution panels.

With each outage test configuration, observe generators start and take load. Record volts, amps, frequency, and power factor phase angle for all phases for all generators. Monitor engine temperatures. Monitor battery charge.

With each partial outage, record timing parameters of tiebreaker closure.

With each outage test configuration, fail generators successively (by simulating different support system component failures including fuel delivery as well as engine safety trips including high temp, high oil pressure, low oil pressure, overspeed) and observe priority demand control dump load to the highest priority. Restore generators and see the demand control restore all priority blocks. Ensure generator support systems remain to highest priority.

Observe fuel delivery capacity at peak loads. Fail sample delivery systems de-energizing the feed pumps. Verify low-level alarms on the day tanks.

With systems operating on emergency power, spot check power parameters of all systems on emergency power. Emergency testing of individual systems are covered under those systems. In conjunction with the generator testing, test the UPS systems. Refer to that item below for more detail.

Measure noise levels

Restore normal breakers and observe systems retransfer to normal. Record timing of tiebreakers opening. Observe generator cool down and shut down sequence and record parameters.

a) **Switchgear:**
Participants shall include CT, EC

Sample: 20%; Failure Limit 10%

Review the start up documentation

Test the operation of the protective relaying and validate the digital metering.

Test the mechanical (key) interlocks for generator and service switchgear as applicable.

b) **Motor Control Centers:**
Participants shall include CT, EC

Sample: 20%; Failure Limit 10%

Review the start up documentation

Test the overload protection using primary of secondary current injection methods

Test the operation of the starters in Hand and Off. Automatic control will generally be tested with the FPT of the device.

Spot-check insulation resistance on the MCC bus and control circuits.

Conduct insulation resistance, short circuit, and ground tests of motors.

c) **Distribution Transformers:**
Participants shall include CT, EC

Sample: 20%; Failure Limit 10%

Review start up documentation

Spot check insulation resistance, turns ratios, and polarity for each type of transformer to ensure they are per the requirements.

d) **Distribution Panel boards and Assoc Loads:**
Participants shall include CT, EC

Sample: 20%; Failure Limit 10%

Review start up documentation

Spot check phase balance. Ensure proper, thorough and accurate identification of load. Trip breakers and validate load identified. Test GFI breakers.

Receptacle Polarity Test: Spot check receptacles installed or reconnected under this contract with a receptacle circuit tester. Tester shall test for open ground, reverse polarity, open hot, open neutral, hot and ground reversed, hot or neutral and hot open.

Ground-Fault Receptacle Circuit Interrupter Tests: Test each receptacle or branch circuit breaker having ground-fault circuit protection to assure that the ground-fault circuit interrupter will not operate when subjected to a ground-fault current of less than 4 milliamperes and will operate when subjected to a ground-fault current exceeding 6 milliamperes. Perform testing using an instrument specifically designed and manufactured for testing ground-fault circuit interrupters. "TEST" button operation will not be acceptable as a substitute for this test. Replace receptacles that do not shutoff power with 5/1000 of an ampere within 1/40th of a second and retest. Submit test report signed by Test Engineer who performed this test.

e) **Tie Breakers:**

Participants shall include CT, EC

Sample 50%

Test operation by opening normal breakers. Record timing parameters of breaker closure and coordination with other breakers

Test manual tie operation and key lock out.

f) **Automatic Transfer Switch:**
Participants shall include CT, EC

Sample 50%

Observe the transfer switch during power outage simulation (both during outage and retransfer to normal). Validate timing and sequences.

Test the load test function and the maintenance bypass function.

g) **Uninterruptible Power System:**
Participants shall include CT, EC

Sample 100%

Provide load bank to simulate near rated capacity of the UPS and or cooling capability.

Test the operation of the Manual Override Transfer Switch

Observe the UPS during a power outage. Record all parameters including input and output Voltage, Current, Frequency, KVA, and Power Factor, Also record the same battery parameters on the DC bus along with the Amp-Hr capacity and time remaining. Validate the downstream electrical disturbances are within spec for all transitions (normal to battery to emergency to battery to normal)

h) **Lighting and Lighting Control System:**
Participants shall include CT, EC

Sample 20%, Failure Limit 10%

Spot check the lighting systems start up and ensure that the all lamps are operational and fixtures are clean.

Spot-check occupancy sensor placement and test reliability of activation/deactivation.

Test photocells for functionality and accuracy

Spot check switches to ensure proper operation and circuiting

Spot check lighting schedules to ensure they are programmed per the CT direction.

Spot check lighting levels to ensure compliance with IES for the respective occupancy

Test operation of circuits by changing system Date and Time to cause various circuits to switch modes. For rooms with occupancy sensors, validate the circuit energizes with occupancy in the space after the lights have been swept off. Test warning flicker prior to off sweep. Test cleaning and shed features.

For exterior fixtures, simulate night mode to validate function. Measure and record light level to ensure they meet the requirements and are generally provide adequate security. Check for excessive light level fluctuations or dark spots.

i) **Fire Alarm System:**
Participants shall include CT, EC, and FAC

Spot-check location of sensors and switches to ensure conformance with requirements.

Verify sampling of all types of devises. Cause activation of the device, assure alarms are initiated and resulting response is per the requirements.

Verify interfaces with all other inter-related systems or equipment including FMS, sound systems, security systems, HVAC systems, vertical delivery systems, etc.

Validate output devices (speakers and strobes) meet the code criteria (96 dba at 10' and 117 candela at peak)

Test all functions and sequences associated with the elevator recall system.

Activate high temperature detectors in the elevator machine room. Verify all sequences including elevator shunt off, elevator recall including alternate floors when main floor is in alarm.

Activate smoke detector and verify all smoke control sequences and ensure fire/smoke dampers actuate as required.

Activate a sample of sprinkler flow switches. Validate that appropriate zone enunciates and alarms sound.

Verify audio aspects of the system function as required. Verify paging messages can be heard throughout the building.

Testing of the HVAC response is included with the associated equipment. Coordinate testing of the fire alarm system with the testing of the individual HVAC systems including shaft pressurization systems.

Ensure that the system functions while using all sources of power including normal, emergency, and battery. Check battery life by simulating an extended outage.

j) **Security Systems:**
Participants shall include CT, EC, and SSC

Sample: 30% Failure Limit: 2%

Spot check installation and device placement for conformance with the design documents

Issue three-access card with varying access levels and spot check access devices (card readers). One of the access cards shall be assigned total access. One moderate access, and the third minimal. Ensure that access is granted/denied appropriately. Ensure record of entry is received appropriately.

Check emergency call stations to ensure they alarm to the central console.

Jumper glass break sensors to test sample.

Spot check video signals from CCTV cameras. Validate that signal is strong and clear. Check remote control of camera view including those that are repositioned by emergency stations.

Verify breech signal is received for a sample of doors with door contacts.

6. **Glossary of Terms:**

Action Item: This is any issue that requires an action, response, work, etc. It can be an RFI, a work directive, a clarification, a to do item, an identified deficiency, etc.

Action List: This is a list that is maintained by the Cx that includes all action items that relate to Cx activities. These must be categorized as appropriate.

ComIT: Commissioning Information Tool developed for MCG to establish a basic standard of care for Cx testing and checkout procedures. The full version that facilitates developing the tests is licensed and copyrighted. ComIT Viewer is shareware that can be used to view existing tests and record the results. This tool contains a database of tests and checklists for equipment and systems typically found in MCG facilities.

Commissioning (Cx): The process of ensuring that all building systems perform interactively according to the design intent, the systems are efficient and cost effective and meet MCG's operational needs.

Commissioning Coordinator: This is an individual in various parties that is designated the contact for that party relative to Cx activities.

Commissioning Team (CT): The group of parties involved with the commissioning process of any given system. The team will generally include a core group involved with all systems. This core group will generally include the CA, [the CM's Cx Coordinator], MCG's Cx Coordinator, GC's Cx Coordinator. On any given system the team will also include the Cx Coordinator of the contractor(s) responsible for the systems or equipment.

Construction Documents: Generally the part of the Contract documents that dictate the installation (all but item a. above)

Contract Documents: The documents governing the relationships between parties involved in the design and construction of this project including: Agreements/Contracts, Construction Plans, Specifications, Addenda, Change Orders, Commissioning Plan

Contractor: As used herein is a general reference to the applicable installing party and can therefore refer to the GC, subcontractors, or vendors.

Deficiency: an installation or condition that is not in conformance with the construction documents and/or the design intent.

Facility Management System (FMS): the computer based control or automation system.

Functional Completion: A milestone that marks the completion of the Acceptance Phase and successful completion of the FPT

Functional Performance Testing: The detailed and thorough testing of the building systems and their interactions with the building components and other building systems

IAQ: Indoor Air Quality

Party: Person, company or entity. The parties are individually defined below

Project Manager (PM): Person in employ of MCG who is in charge of the design and construction coordination

RFI: Request for Information

Start Up: Typically used to refer to the static testing or check out of systems or equipment to ensure that they are complete, properly installed, and ready for dynamic testing. This will typically be documented via checklists or forms

Start Up Checklist Item: This is an item of check out inspections that simply require a Yes/No or OK/Not response. These are used as one component to the equipment start up verification (start up tests being the other)

Start up Test: This is a test involved with equipment start up. It differs from a checklist item in that a measurement is required to be documented or a sequence of events must be documented such that it requires more than a binary response.

Trending: monitoring and recording a history of parameters typically using the facility management system

7. General CA Roles and Responsibilities

i. **General:**
CA will conduct reviews of interim design submissions. These reviews will constitute a conceptual review only. The reviews are not meant to replace existing technical review performed by A/E or any other entity.. The following submissions will be reviewed:

Schematic Design

Design Development

Construction Document Design

MCG shall send CA one copy of all documents being submitted including drawings, specifications, calculations, etc.

CA shall review information relating to the systems indicated above in the Cx scope

CA will issue comments in writing to the A/E within two weeks of receipt of documents. Review will generally be a conceptual review of key aspects relating to cost effectiveness, functionality, controllability, maintainability, and generally to ensure that MCG's requirements are being met. Review will not constitute a detailed check of the documents, however discrepancies, omissions, etc. will be noted where found. Further definition of the scope of the review follows

Frequently a question or comment will be solely to document the reasons for (not) implementing an alternative. The A/E response will be incorporated in the Design Intent document.

A/E will respond in writing to CA comments. Individual responses to comments shall be provided. Where a comment is rejected, A/E shall substantiate the reasons for rejecting it.

ii. **CA Schematic Design Review:**
Schematic design review will be completed towards the end of the Schematic Design Phase. CA will generally review the schematic design for conformance to the Program and concepts outlined in the conceptual design. CA will also review for conformance to any MCG standards or protocols.

CA will suggest alternatives for consideration or potential improvements to:
Cost effectiveness
Facilitate Cx
Energy efficiency
IAQ
Required reliability or redundancy
Operability and Maintainability

Whereas the CA will identify any non-conformance with codes noted in the course of their review, this will not be a focus of the review
Whereas the CA will offer their experience relative to the adequacy of the stated facility requirements

iii. **CA Design Development and and Construction Documents Phase Reviews:**
The scope of the reviews in this phase will include the items in the Schematic Phase and expand to include the following additional issues:

Control system and strategy adequacy

Component integrity and efficiency

Adequacy of training requirements

Engineering assumption and calculation
CA will specifically review for coordination between various specification divisions in the documents relative to the Cx process. Cx will ensure that the Cx documents are adequately incorporated, clearly communicated, and coordinated throughout the divisions.

iv. **General Design Documentation:**
Documentation of the design intent, concepts, criteria etc. facilitates all involved party's (interdisciplinary as well as inter-functional) understanding of the facility's goals, evolution, constraints, limitations, assumptions on which it was based, etc. It is dynamic documentation that will change as the facility evolves. It supplements the design, installation, O&M and training information with the background assumptions, parameters, etc. drove the evolution of the facility.

The MCG Model Design Criteria shall establish the format and the minimum for content. This model shall be used as the basis and virtually all parties involved in the design process will have input to it. The MCG CxC will coordinate the compilation of this document, and the CA will review and comment.

v. **Cx Specifications:**
CA shall develop/review Cx specifications for incorporation by the A/E in the Contract Specifications.. Generally the CA will review and edit the construction specifications to ensure that the Construction, Acceptance, and Warranty Phase Cx procedures are clearly identified. This will typically involve editing of existing specification sections as well as provision of additional sections dedicated to the Cx procedures.

A/E shall incorporate the Cx procedures indicated in the plan and discussed throughout design. A/E will then forward the applicable sections to CA for review and editing. CA will edit specification and return them. Specifications shall be exchanged via electronic media unless compatibility of word processing software cannot be resolved. CA shall use the editing features of the word processing software to illuminate the edits made (assuming software compatibility can be resolved).

The Cx spec outlines the roles and responsibilities of the contractors relating to Cx during the Construction, Acceptance, and Warranty Phases. It identifies the extent of start up and testing that is required and what involvement the contractor will have. It also summarizes tasks that need to be completed in the start up of the systems.

Cx Specifications shall generally stipulate the requirements of the construction phase Cx and the responsibilities of the various contractors involved. The specifications will supplement this Cx Plan.

End of Section

Division 04 00 00
Brick and Masonry

1. Masonry

a) The Masonry Subcontractor shall build sample panels each approximately 4 feet by 6 feet at project site when directed by the Designer showing bond, jointing and mortar color and allowable texture variation of the face brick, structural facing tile or concrete masonry units. Include wall ties reinforcing, flashing, and back-up in each sample.

b) Walls of cavity construction may be used with a minimum of 1 ½ inch air space between face brick and back-up, and 3/8 inch parge on the face of back-up masonry.

c) The Masonry Subcontractor shall install all access panels, lintels, dovetail anchors, or other accessories that are furnished under other Sections but are to be built into masonry.

d) Pre-faced concrete masonry units, when specified, shall meet the requirements of ASTM C744.

e) Specify actual brick sizes for each project.

f) Specify full grouting of all hollow metal door frames adjoining masonry.

g) At completion of masonry work, all exposed masonry walls shall be thoroughly cleaned by approved methods.

h) Masonry accessories when fabricated from ferrous metal shall be galvanized as follows:

   (1) Reinforcement for exterior walls - Hot-dip galvanize in compliance with ASTM A153, Class B-2.

   (2) Reinforcement for interior walls - Galvanize wire ASTM A-116.

   (3) Accessories embedded in exterior walls - Hot-dip galvanize after fabrication in compliance with ASTM A153.

i) For exterior wall installations, include relieving angles at locations determined by the Designer. When angles are fabricated from ferrous metal, they shall not be hot-dip galvanized after fabrication in accordance with ASTM A386 or A123 as applicable. All hot-dip galvanized items shall be stamped to indicate the ASTM number and ounces of zinc per square foot of surface.

j) Specify Portland-cement-lime mortar with hydrated lime and Portland-cement conforming to ASTM Specification C-150 or C-175. The Masonry Subcontractor shall use a mix that conforms to ASTM C270, Table II, Mortar Proportioned by Volume, minimum compressive strength 750 psi (Type N). Greater Strength mortars when required shall be specified as recommended by the Brick Institute of America. Designer shall indicate the desired mix in the Specifications. Mortar shall be subject to testing by an independent testing laboratory.

k) Masonry requirements, other than those indicated herein, shall follow the recommendations of the Brick Institute of America.

l) The Masonry Subcontractor shall furnish, install and maintain in safe and adequate conditions all staging and scaffolding that are necessary for the proper execution of the work in this Section. The requirements of Section 01500 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS in relation to staging, do not apply to this Section of the Specifications.

m) Copings and window sills shall have at least 1 inch overhang. Brick window sills shall be avoided but if used, proper flashing and drainage shall be used.

n) Specifications shall instruct Masonry Subcontractor to submit samples of each type of block proposed for the project for the Designer's approval. More than one submittal may be required.

o) Brick pavers less than 1 ½ inches thick are specified in Section 07201 ROOFING AND FLASHING.

p) Install flexible wall flashing when furnished in Section 07201 ROOFING AND FLASHING.

q) Unit masonry flooring shall be furnished and installed in Section 09630, UNIT MASONRY FLOORING.

r) Specify the sealing of backs of exterior wall stone.

s) For stone on exterior wall installations, include relieving angles at locations determined by the Design Engineer. When angles are fabricated from ferrous metal they shall be hot-dip galvanized after fabrication in accordance with ASTM A386 or A123 as applicable. All hot-dipped galvanized items shall be inspected for compliance with ASTM requirements and shall be stamped to indicated the ASTM number and the ounces of zinc per square foot of surface.

t) Unfinished or unprotected concrete masonry units (CMU) are prohibited for exterior exposure.

2. Brick

a) Brick and Block Work.

(1) Face brick shall be solid, hard burned, sand molded, or wire cut brick with water absorption of not more than 10 percent for an average of 5 bricks when tested

by the five-hour boiling test in accordance with ASTM Designations C67 and which shall conform to the requirements of ASTM C216, Grade SW, Type FBS.

(2) Exterior paving brick shall conform to ASTM C902, Grade sx, Type 1, with absorption of not more than 8 percent with the five-hour boil. Laminated brick will not be accepted. Final cleaning shall be by steam, or other methods if approved by the Designer. If area is subject to various chemicals, the brick shall pass ASTM text C279, type L.

(3) Concrete masonry units used for back-up shall meet the requirements of ASTM C90, "Hollow Load-Bearing Concrete Masonry Units" or of ASTM C145 "Solid Load-Bearing Concrete Masonry Units.

(4) All bricks shall have a low rate of suction at the time they are placed in the work; to secure this low rate of suction, the brick shall be thoroughly wetted and not allowed to dry out. The suction of the brick shall be so reduced that specimens of brick, taken from the scaffold, shall not gain more than 0.7 of an ounce (20 grams) in weight when placed in 1/8 to 1/4 inch of water for one minute.

(5) All head joints and bed joints in both face brick and back-up work shall be completely filled with mortar.

(6) All head joints and bed joints on brick and masonry units shall be tooled to give a concave finish. This shall be done with a round tool slightly larger than the joints, before the mortar hardens, and with sufficient force to press the mortar tight against the unit on both sides of the joint. All mortar smears shall be removed. A struck flush joint may be used in certain instances.

(7) All masonry work shall be adequately tied and reinforced.

(8) All newly laid brickwork shall be satisfactorily covered at night and during showers, and inclement weather and periods of works stoppages.

(9) Provide weep holes in masonry in accordance with the Brick Institute of America. All cavity shall be free of excess mortar.

b) Structural facing tile shall be of select quality and meet the specifications and standards of the Facing Tile Institute. All cutting should be done with power saws.

c) Cold weather requirements.

(1) No brick or block masonry shall be laid when the outside air temperature is below 40 degrees F. except where weather protection materials have been furnished and installed by the General Contractor in accordance with Section 01500, CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS.

(2) All masonry materials shall be heated to 40 degrees F. immediately before installation.

(3) No frozen work shall be built upon, and any such work shall be removed.

(4) All completed masonry sections shall be properly covered and cured at 40 degrees F. temperature for a minimum of 24 hours following placement of mortar.

End of Section

Division 07 20 00
Thermal and Moisture Protection

A) All packaged materials specified shall be delivered to the site in unopened approved packaging with manufacturers' name, material identification and UL and Factory Mutual label where required.

B) All surfaces adjacent to the work shall be protected from damage.

C) Waterproofing

(1) All surfaces subject to hydrostatic water pressure shall be waterproofed.

(2) Any membrane system that may be subjected to damage shall be properly protected.

(3) Require that the Waterproofing Subcontractor guarantee in writing to make prompt repairs at his own expense to include labor and material to all waterproofing work that develops leakage within five (5) years of the date of acceptance. The guarantee should also be signed by the general contractor. The document listing conditions for substantial completion will list the performance of work under the guarantee as a condition of the substantial completion.

(4) Provide minimum 10 mil Poly ethylene vapor barrier under slab and crawl spaces for radon abatement.

(5) Foundation Waterproofing

(a) If during the design process it is determined that footing drain tiles are required, then the foundation and below grade walls will be waterproofed and a drainage board system will be provided. The minimum drain tile size will be 6", unless otherwise approved by the County.

(b) Both manufacturer/supplier and installer will have had a minimum of five (5) years experience.

(c) It is required that the generic waterproofing type specified have a minimum application history of five (5) years.

(d) Designer will provide <u>all</u> typical and <u>all</u> unique details for proper definition of quality and intent for installation of the waterproofing system. Manufacturer's most durable, demanding, and premium details will be required.

(e) Use of asphaltic treated expanded polystyrene drainage board with geotextile fabric shall not be used.

(f) If it is determined that exterior applied insulation of either the foundation or below grade wall is required, then a drain tile system will be provided. Only extruded polystyrene insulation is acceptable for exterior applied foundation or exterior applied below grade wall insulation application.

D) Damp proofing

(1) Specify damp proofing for exterior surfaces of all foundation walls enclosing usable interior areas and pits below exterior finish grade.

(2) Specify a protective coating over all structural steel in contact or encased in exterior masonry tile or stone.

E) Vapor Retarder & Air Barrier

(1) Consultant will submit to the County, in written form, a summary of building components, building use, anticipated temperature and humidity range, and any other information pertaining to the inclusion or exclusion of the use of either a vapor retarder or air barrier. If, after a thorough and comprehensive technical review, it is determined by the consultant that the facility is borderline for inclusion or exclusion of both/either a vapor retarder or air barrier, then the consultant will provide a listing of positives and negatives with the consultant's recommendation. The County will review the submission and consultant's recommendation and approve course of design.

(2) The material, means and method for installation of a vapor retarder or air barrier will be designed such that:

(a) The finished product will be fully functional with a life expectancy comparable to the assembly it is incorporated into.

(b) The location within the building assembly is "constructible", and the vapor retarder or air barrier will not become damaged due to normal trade work during subsequent construction activity.

(c) The installation and placement of the vapor retarder or air barrier does not create a costly encumbrance to the inevitable roof system replacement.

F) Caulking/Sealants

(1) Clearly distinguish between all areas to receive either caulking or sealants on drawings as well as specifications.

(2) Specify proper joint preparation.

(3) Oil base caulking will not be permitted. Silicon sealant will not be used on exterior locations for other than glass/glazing installation.

G) Fireproofing

(1) It is preferred that interior fireproofing material (if required) for the roof assembly be such that ***<u>the integrity will not be damaged during the inevitable roof replacement.</u>***

(2) Fire barriers or thermal barriers required by the current codes for foam plastic insulations will be strictly observed.

H) Flashing and Sheet Metal

(1) Steep Slope Roof

(a) Built-in gutters are prohibited.

(b) Use of spike and ferrule mounted gutters is prohibited. Gutters will have both hanger/spacer and brackets.

(c) Gutter sheet metal will be of sufficient gauge or weight to support the weight of a 250 lb. man and ladder as well the accumulation of heavy snow and ice.

(d) Gutter metal selection which allows soldered joints is preferred to the use of metals which can only be pop-riveted and caulked.

(e) Corrugated downspout are preferred to the use of smooth surfaced downspout.

(f) **<u>All</u>** gutter edge conditions for steep roof application will provide ice dam protection.

(g) Leaf and debris strainers shall be used at all gutter outlets. Gutter screen which fully overs the gutter is strongly discouraged.

(2) Low Slope Roof

(a) Use of interior area drains is preferred to the use of a gutter collection system. A gutter collection system (see also aforementioned steep sloped) is preferred to the use of through wall or over edge scupper system.

(b) Area Drain

(1) The minimum area drain size is 4".

(2) Where a roof area is contained by walls or parapets such that a plugged area drain will cause excessive water buildup, area will be provided with a primary and secondary method for drainage of water from the roof area.. The design assumption is that the primary drainage system is plugged/inoperable where the water exits the building.

(3) In all cases, the design of storm water drainage and flashing will reflect requirements for heavy snow and ice conditions.

I) Siding

Use of an Exterior Insulation Finish System (EIFS) requires prior County approval. If however, the EIFS is approved, only extruded polystyrene insulation can be used for insulative substrate purposes.

J) Insulation

(1) Minimum density of rigid insulation board and components of rigid composite insulation board used within the roof/building envelope substrate will be 1.8 lbs. per cubic foot.

(2) Multiple layer application of rigid insulation board with staggered joints is required for low slope roof applications, and where possible for steep sloped roofs, except for Protected Roof Membrane Assemblies (PRMA).

a. On metal decks, regardless of what membrane system is specified, the first layer of insulation, a flat board, will be mechanically attached to the metal deck, and all subsequent layers shall be adhered to the first layer using hot asphalt (or other County approved adhesive).

b. The top layer of insulation for all roofs shall be 1-inch monolithic high density wood fiber insulation. ¾-inch fiber glass insulation may be specified in a ddition to the wood fiber for use with Built-up Membranes, Modified Bitumen membranes, or Hybrid BUR/Modified Bitumen systems.

(3) Use of rigid cellular glass insulation (foam glass) is generally prohibited. Use of rigid phenolic foam insulation is prohibited.. However, if products provide unique special properties required for successful construction of the project, use may be considered, upon submission of written documentation by the consultant.

(4) Specified R-values for insulation will be aged R-value in accordance with RIC/TIMA Roof Insulation Specimen Conditioning Procedures, or comparable ASTM test methods. Design R-value will be on five (5) year aged R-value retention. Specified and design R-value will be thermal resistance at 75 F for all components of the building envelope including but not limited to the foundation, walls, and roof. Note: The design R-value of five (5) years, assuming that the installed R-value degrades down to the five (5) year design value, means that the installed R-value during construction must be higher than the design R-value.

(5) The R-value must comply with ASHRAI 90.1 Guideline 7500.

K) Roofing

(1) Roofing work on any given area of roof shall be made completely watertight and weatherproof in the same working day. Phased construction is generally prohibited.

(2) All roofing materials shall be in the Manufacturers' original unopened containers, rolls with labels intact, legible and including fire resistance classifications. If roofing materials arrive in tanker trucks, a copy of the delivery slip showing content of materials shall be furnished. Materials shall be stored on clean raised platforms with weather protective covering when stored outside. All wet or damaged materials shall be immediately removed from the project site.

(3) Roof System Selection

General roof system component selection includes structural deck, air barrier (if needed), vapor retarder (if needed), insulation, roof membrane, roof membrane flashing, sheet metal flashing, interior fire proofing (if needed), and interaction of the roof system components with various building components such as walls, parapets, HVAC equipment, electrical services, design slope, and storm water management (e.g. drains and gutters). In addition, roof system component <u>selection must consider the needs for the inevitable roof system replacement,</u> access, foot traffic, equipment maintenance, and building component replacement (e.g. HVAC equipment).

(4) Roof Slope

(a) Steep Slope Roof

(1) Preferred 6" per foot slope.
(2) Minimum 4" per foot slope.

(b) Low slope Roof

(1) Preferred 3/4" per foot slope.
(2) Minimum 1/2" per foot slope.
(3) It is required that slope be built into the structural deck unless otherwise approved by the County, with use of tapered insulation reserved for use for crickets and saddles to promote positive drainage.
(4) In all cases positive slope will be provided for low slope roof applications.

(5) Roof Deck Types

(a) Use of structural gypsum decking is generally prohibited, unless prior approval is granted from the County.

(b) If precast concrete roof decking is selected, care will be taken in the structural and roofing design to prevent structural shifting through expansion and contraction which may cause splits and cracks in the roof membrane and flashing.

(c) Lightweight Concrete

(1) Use of lightweight insulating concrete roof decks and fills consisting of perlite or vermiculite insulating aggregates, Portland cement and water are prohibited.

(2) Use of lightweight insulating concrete fill consisting of pre-generated foam with Portland cement sand and water is discouraged. However, the County must approve use of the product prior to specifying or using. Approval must be granted prior to or during schematic design review.

(d) Regardless of type of roof deck selection, structural notes for framing will define both the minimum BOCA code requirements and the actual design load capability as provided by the design from the consultant.

(6) Roof Membrane Systems - Low Slope

(a) A membrane which is fully adhered to the prepared substrate is preferred to the use of a partially or mechanically fastened membrane.

(b) Loose laid roof membranes are prohibited.

(c) Roof membrane products which have been manufactured and marketed by the manufacturer a minimum of five (5) years are required. The installing contractor will also have a minimum of five (5) years experience in roof system installation.

(d) E.P.D.M. Membrane Systems

(1) Minimum field sheet thickness will be 60 mils.

(2) Use of scrim reinforced E.P.D.M. is prohibited.

(3) Fully adhered membrane system is required.

(4) Use of white pigmented E.P.D.M. is prohibited.

(e) Built-up Roof Membrane Systems (**MOST PREFERRED)**

(1) The use of an SBS granular cap sheet is required. Gravel or slag surfacing may be used as a deduct alternate only. Smooth surfaced BUR is prohibited

(2) Felt type for use in built-up roof will be ASTM Type VI fibrous glass.

(3) A minimum of four (4) ply membrane, excluding base sheet, is required.

(f) Modified Bitumen Membrane Systems

(1) Minimum system will consist of two plies. Each ply will be constructed of modified bitumen with reinforcing scrim(s).

(2) SBS modified asphalt products are required. Use of SBS and APP blend asphalt products is prohibited.

(3) The combined weight of the two ply sheets (excluding mopping asphalt) will be a minimum 140 lbs. per 100 square feet.

(4) Finished surface will be a granular surface. Flood coat and gravel as a finished surface is prohibited.

(g) PVC Membrane Systems

(1) PVC is generally prohibited. However, if product provides unique special properties required for successful construction of the project, use may be considered. Designer will submit request and justification for use of product prior to or during schematic design review.

(h) PIB Membrane Systems

(1) PIB is generally prohibited. However, if product provides unique special properties required for successful construction of the project, use may be considered. Designer will submit request and justification for use of product prior to or during schematic design review.

(i) CSPE (Hypalon) Membrane Systems

(1) Use of loose laid/ballasted system is prohibited. The use of the product in either the fully adhered system, or the mechanically attached system shall be approved by the County.

(j) Protected Roof Membrane Assembly (PRMA)

(1) Use of PRMA is prohibited with metal roof decks. <u>PRMA is strongly encouraged for use on concrete deck assemblies</u>.

As PMRA may accumulate vegetative debris, which may promote fungus growth, and therefore should not be used on roof areas that support or are near the fresh air intake for the facility. This design consideration is especially important at facilities that may serve immune system deficient persons.

(2) Use of a liquid kettle modified bitumen with polyester reinforcement is preferred to the use of sheet type membranes. In all designs, membrane will be fully adhered to the prepared substrate.

(3) Separate use of individual pavers and filter fabric with extruded polystyrene insulation is preferred to the use of stone ballast and filter fabric with extruded polystyrene insulation.

(4) Use of expanded polystyrene on PRMA roofs or any exposed exterior use is prohibited.

(k) Use of Sprayed in Place Polyurethane Foam Insulation System is prohibited.

(l) Use of low slope roof membranes not contained in the aforementioned will be considered based on the unique design requirements of the project. Designer will submit request and justification for use of product prior to or during schematic design review.

(m) It is preferred that the designer have specified and overseen installation of a minimum of three (3) projects prior to specifying a particular generic low slope roof system type.

(7) Roof Systems - Steep Slope, GENERAL

(a) Roof system products which have been manufactured and marketed by a manufacturer a minimum of five (5) years are required. The installing contractor will also be required to have five (5) years experience.

(b) It is preferred that the designer have specified and overseen installation of a minimum of three (3) projects prior to specifying a particular generic steep slope roof system type.

(c) It is preferred that the design of a steep slope roof system be simple, with limited dormers, valleys, angle changes, and elevation changes.

(d) Placement of mechanical equipment on steep roof is generally prohibited, however, if due to some special situation which leaves absolutely no other option, access must be maintained for the equipment on a year around all weather condition basis.

(8) Shingle Type Systems

(a) Ventilation for shingle type systems is required. It is required that the ventilation area required by BOCA standards be increased above the minimum by a factor of not less than 1.33.

(b) Shingle products will be of a minimum twenty-five (25) year quality. Fiberglass shingles are preferred to the use of organic reinforced shingles. Heavier weight shingles are preferred to light weight shingles.

(c) Underlayment for shingle type roof applications will meet or exceed the most stringent requirements of both the BOCA code and the recommendations of the NRCA-RWM for areas with severe winter weather.

(9) Slate/Tile Type Systems

(a) Underlayment for slate/tile type roof applications will meet or exceed the most stringent requirements of both the BOCA code and the recommendations of the NRCA-RWM for areas with severe winter weather.

(b) On slate type systems, sheet metal caps for ridges and hips are preferred to the use of combing slate. Use of preformed ridge, hip, and termination type tile is required on tile type systems.

(c) Base bid for slate/tile type systems will include a minimum 2% overage to be delivered to the County for on-site storage at the completion of the work.

(d) Valley construction for slate/tile type systems will be open. Closed valley construction is prohibited.

(e) Ventilation for slate/tile type systems is required. It is required that the ventilation area required for shingle roof applications by BOCA standard, be increased above the minimum by a factor of not less than 1.33, and that the area be used in the design of the slate/tile system.

(10) Sheet Metal Type Systems:

(a) Embossed finish or panels with stiffening ribs to reduce oil canning is required.

(b) If a manufactured sheet metal system provided by an independent supplier is specified as the base bid product, contractor shop/field fabricated sheet metal systems will be excluded from the base bid. Use of contractor shop/field fabricated sheet metal system may be considered during the submittal review process as a substitution, along with a cost credit to the County. Specifications will clearly state this position.

(c) Unless otherwise approved by the County, metal roof will be a standing mechanically locked seam system, not less than 1-1/2" high.

(d) Use of metal which can be soldiered is strongly recommended for all critical junctions of the roof.

(e) Ventilation for non-load bearing sheet metal type systems placed over a wood substrate is required. It is required that the ventilation area required for shingle roof applications by BOCA standard, be increased above the minimum by a factor of not less than 1.33, and that the area be used in the design of the metal system.

(11) Use of Sprayed in-place Polyurethane Foam Insulation System is prohibited.

(12) Use of steep slope roof system not contained in the aforementioned, will be considered based on the unique design requirements of the project.

(13) Generally, for all steep sloped systems, designer will provide a complete comprehensive written specification(s) which fully defines quality requirements and intent, along with complete scale roof system details for **all** typical and **all** unique conditions to include but not limited to:

(a) rake
(b) eaves
(c) hip and ridge
(d) valley
(e) step flashing
(f) vent stack
(g) roof curb
(h) water diverter/saddle
(i) skylight
(j) apron flashing or wall transitions
(k) all termination points
(l) gutter and scuppers
(m) dormers
(n) all transitions

(14) In all steep roof applications, consultant will carefully and diligently determine if snow guard protection is required.

L) Flashing

(1) In all roof system designs, the flashing material and the method of installation will be the manufacturer's premium and most durable material and design.

(2) Height Requirements

(a) The preferred height for new construction of base flashing is 12" above the finished height of the roof.

(b) The minimum height for new construction of base flashing is 10" above the finished height of the roof.

(c) HVAC air handling units which produce condensate will be placed on steel frames above the finished roof with a minimum height of 24" above the finished height of the roof, or per the NRCA/SMACNA design guidelines, which ever is greater. Use of a curb is prohibited for other than the supply and return air ducts.

(3) Sheet Metal

(a) The use of appropriate gauge/weight/thickness of stainless steel or copper for exterior metal flashing is preferred.

(b) Where necessary for securement, the use of continuous concealed cleats/hook strips is required. Cleats/hook strips will be constructed of the next commercially available lower gauge, higher weight, greater thickness of metal type being fastened to the cleat/hook strip. The use of exposed fasteners for construction of sheet metal flashing will be approved by the County prior to specifying or use and is strongly discouraged.

(c) All joint designs for sheet metal flashing will be specifically selected by the designer to meet the project requirements. Broad sweeping general references are not acceptable. All typical and all unique joints will be detailed in the contract documents.

(d) The use of two piece (receiver and insert) counter flashing is required at all roof level windows, roof level doors, common walls, and high parapet walls(where a stone coping is used). Design will include the use of wind clips for holding the insert in place, and the height of the base flashing will be from the height of the wind clip fastener penetration of the base flashing. Deviation from this requirement requires prior County approval.

(e) The use of skirt and flange (umbrella and sheet metal roof jack) if preferred over the use of a pitch pocket. The pitch pocket detail is the detail of last resort and must be approved by the County prior to specifying or use.

M) Roof System Fasteners

(1) Designer will thoroughly investigate fastener requirements to determine specific project needs. Broad sweeping general references are unacceptable.

(2) As a minimum, it is required that only fasteners with coatings as tested per DIN Standard 50018 with 15 cycles in a Kesternick Cabinet with a maximum 15% surface area corrosion be specified for securement of roof assembly.

N) Roof Warranty

(1) The manufacturer's roof warranty will provide for both the cost of labor and material for repair of leaks due to poor workmanship or material failure.

(2) Manufacturer's roof warranty will be a complete systems warranty to include all components of the roof.

(3) A non-prorated non-penal sum manufacturer's roof warranty is required for build-up roof systems and is preferred for all other low sloped roof systems. In no case will the warranty be limited to less than complete roof installation cost.

(4) Manufacturer's roof warranty will cover the cost for removal and replacement of damaged or wet insulation which is the result of leaks from poor workmanship or failed materials.

(5) A minimum 20 year manufacturer's roof warranty is required for built-up roof systems. A minimum 15 year manufacturer's roof warranty is required for all other

low sloped roof systems. A minimum 25 year manufacturer's roof warranty is required for steep sloped roof systems.

(6) Warranty will not exclude from coverage damage to the roof system for wind gusts less than 55 m.p.h. Warranty may exclude damage for wind launched debris or projectiles which are not part of this roofing system.

(7) The prime/general contractor and all appropriate subcontractors and sub-subcontractors are to provide a two (2) year total roof system warranty in addition to the manufacturer's roof warranty. Performance of work required under this listed warranty/guarantee will be listed as part of the conditional acceptance of the building at substantial completion.

O) General Roof System Requirements, ALL ROOF TYPES

(1) As a minimum, roof membrane and flashing will be designed in accordance with UL I-60 or Factory Mutual (FM) I-60 wind uplift requirements. UL or FM I-90 wind uplift is preferred. Building which serve major emergency needs during natural disasters should be considered for possible I-120 construction.

(2) General design will be in accordance with the most stringent recommendations and guidelines established in the most current edition of the Sheet Metal and Air Conditioning Contractor's National Association (SMACNA) Architectural Sheet Metal manual and the most current edition of the NRCA Roofing and Waterproofing Manual and will be construed as mandatory requirements for design and construction unless waived by the County upon request and justification by the designer.

(3) Use of an Underwriter Laboratory (UL) Class "A" fire rated roof system for topside burn is preferred.

(4) If a conflict should arise between the various references contained within this document, the most stringent, durable, and costly method or material will be used in the design and construction.

(5) Designer should attempt to limit tripping hazards in areas for foot traffic.

(6) Walk/Traffic pads are required around all equipment requiring routine maintenance and along travel paths to equipment. All equipment requiring routine maintenance will be located, designed, and installed so as to provide year around all weather access.

(7) Exterior Access

(a) Exterior ladder access between roof elevation changes greater than three feet (3') but less than eight feed (8') will be provided. Elevations greater than eight feed (8') will be provided with walk out door, large maintenance hatch from interior stairway access or exterior stairway access. Waiver of this requirement must be submitted with justification by the designer prior to or during schematic design review.

(b) If for reasons of facility security, limiting access is required, designer will provide County with alternatives other than total removal of access. If no other reasonable alternatives are available, County will grant waiver.

(8) Hanging or support of duct work, plumbing, fire sprinkler lines, conduit of any type from the structural roof deck (except for poured in place concrete and upon County review precast-cast concrete planks) is prohibited.

(9) Designer will review and incorporate all architectural requirements contained within other corrections of the BOCA code including the BOCA National Mechanical Code (i.e. Section , Outdoor Installation).

P) Design/Build Construction

(1) Where the County opts for use of a design/build construction contract, all preferences and minimum standards are binding as stated.

(2) Where Roof and Exterior Design Criteria requires submission by the designer prior to or during schematic review, proposer will reference specific deviations (if any) and provide justification for deviation in proposal submission.

(3) If, due to the nature of the request for submission of the original proposal, the level of detail required by the Roof and Exterior Design Criteria is not practical, proposer will so state and will provide an outline as to when during the design/build process required design information will be submitted.

(4) When the roof and exterior design guidelines are incorporated into a design/build bid document (request for proposal), and if a conflict should arise between the guidelines and other bid/proposal document provisions and requirements, the most stringent, costly premium, durable provision will be used by the proposer/designer.

Q) Construction Additions, Renovations, and Reroofs

(1) Guidelines, preferences, and minimum standards contained within the Roof and Exterior Design Criteria are binding as stated, with the following exceptions and additions.

The preferred - Base flashing height at:

(a) Tie-in of new construction to existing construction is 12" with a minimum of 8" finished height above the roof membrane.

(b) When replacing any existing roof mounted equipment and when installing any new roof mounted equipment on an existing roof system which create condensate drainage, work will meet requirements stated aforementioned L.2.c, Flashing.

(c) Use of sawcut reglet/raggle mounted receiver and insert counter flashing is required, except where impractical, when existing construction height is higher than new construction. Use of built-in receiver and insert counter flashing is required when new construction height is higher than existing construction height. If, due to existing construction it is impractical for a sawcut reglet/raggle to be used, then a surface mounted counter flashing is acceptable with the counterflashing consisting of a surface mounted receiver with separate insert counter flashing.

(d) Where existing construction does not provide positive slope for drainage, the most cost effective and practical application of tapered insulation, tapered saddles and crickets, and the addition of new drains, gutters, and scuppers will be used to provide positive drainage.

(e) Unless specific requirement for R-value is provided elsewhere, the minimum reroof R-value will be R=17 or the minimum standard from ASHRAE standards for new construction, whichever is greater. If due to limitations of the existing construction, the minimum R-value stated is not practical, design will maximize total R-value which is practical.

(f) All areas of roofing to be demolished will be tested for Asbestos Containing Materials. Where positive test results are found, Designer will immediately notify the County for direction and guidance.

(g) Designer will take all due care in the design and detailing when an addition is added to an existing facility. Design will provide necessary closures, heights, and detailing to prevent unfavorable interaction between existing and new construction which may result in moisture infiltration into the facility. Components of particular concern include, but are not limited to, roof, walls, foundation, site drainage, drainage tiles, and utility penetrations into the facility.

R) Flashing Versus Roof Area - Design of Roof Complexity (NEW AND ADD. WORK)

(1) It has been the County's experience that simple roof design, as relates to the geometry or configuration, yields the most maintainable roof system. This is primarily due to the fact that simple designs have less flashing, which are the primary cause of roof system leaks. A few reasons that flashing leak are:

(a) Poor design

(b) Poor installation

(c) Improper or inadequate maintenance

It is therefore in the County's best interest to limit, except where absolutely required for the function of the building, the overall complexity of the roof configuration, and simplify the roof design.

(2) For purposes of defining flashing, the following is to be included, measured in lineal feet:

a.	eave/gutter	h.	ridge
b.	rake	i.	valley
c.	hip	j.	roof curbs
*d.	base flashing	k.	coping
e.	gravel stop/metal edge	l.	step flashing
f.	apron flashing	m.	vent stacks and pipe flashing
g.	expansion/control joints	n.	wall transitions

* Note: Often base flashing is run continuously up the vertical and across the top of a parapet wall providing a watertight construction, which is then covered with coping metal for aesthetic reasons. In this case, the lineal footage used would exclude the coping lineal footage.

(3) For the purpose of determining the level of simplicity of design, it is **P**referred that the design not exceed the **C**omplexity **R**atio of **9.0** for steep slope roof systems or **7.5** for low slope roof systems when calculated for the entire building.

(a) **Complexity Ratio =** $\mathbf{\dfrac{\underline{\text{Flashing Lineal Footage}}}{\text{Square Root of Roof Area}}}$

(b) When a combination of steep and low slope roof systems is used the **P**referred **C**omplexity **R**atio will be calculated as follows:

$$\mathbf{PCR^{(mixed\ design)} = \frac{\text{Steep Slope Area}}{\text{Total Roof Area}} \times 9.0 + \frac{\text{Low Slope Area}}{\text{Total Roof Area}} \times 7.5}$$

(c) When the Preferred Complexity Ratio is exceeded, the Consultant will provide a written explanation as to cause for the elevated ratio and recommendations for reduction of the ratio. The County will review the causes and recommendations and approve course of design to be taken. Please note, recommendations for reduction of the ratio should include impact on space layout, security, HVAC and lighting impact, cost of construction, and architectural aesthetics.

(d) In a combined project of both steep and low sloped roofing, the Complexity Ratio for the individual steep component shall not exceed **9.9**, nor shall the Complexity Ratio of the low sloped component exceed **8.25**.

S) Mechanical Units penetration

(a) Air handling units which are placed on steel will be designed as side discharge units, with the duct penetration curb occurring a minimum of four feet (4') from the support steel legs.

(b) If the unit has to be placed on a unit curb (last resort), then the unit will be designed as side discharge unit, with the duct penetration occurring a minimum of four feet (4') from the curb, and the unit will be fitted with an emergency overflow condensation pan, in addition to the normal unit condensation collection system.

T) RESERVED FOR FUTURE USE

U) The preferences and minimum standards contained within the Roof and Exterior Design Criteria are cursory in nature and are not intended to be comprehensive and all encompassing. Failure by the County to specifically reference, state a preference, or a minimum standard for a building component does not lessen the need for complete and thorough component integration and design.

V) The County shall be the final arbitrator and judge as to whether the intent and needs as provided by the Roof and Exterior Design Guidelines have been met/satisfied by the proposer/designer.

End of Section

Division 08 00 00
Doors and Windows

A. Doors

1. Metal doors shall be of 18 gauge material for interior and 16 gauge material for exterior doorways. Doors shall be flush type, 1 3/4 inches thick with a maximum height of 7 ft. - 0 inches.
2. Metal frame shall be 16 gauge material for interior and 14 gauge material for exterior doorways. All corners shall be mitered and welded.
3. Hollow metal doors and frames where required to have fire resistive ratings shall be labeled and meet the detailed requirements of Underwriters' Laboratories, Inc.
4. All exterior hollow metal doors and frames shall be hot-dip galvanized (ASTM A526) with a coating weight of G60.
5. All exterior openings shall be weather stripped all around.
6. All metal doors composed of styles and rails shall be of heavy duty type.
7. Cross reference to Masonry Section, that full grouting of hollow metal door frames is required.
8. Pivot type hinges are prohibited.
9. Hold open arm type door closer on exterior doors will not be allowed.

B. Metal Windows

1. The Metal Windows that are not thermally broken are not acceptable.
2. The manufacturing and performance requirements for aluminum windows shall be in accordance with ANSI/AAMA "Voluntary Specification for Aluminum Prime Windows and Sliding Glass Doors." All types of aluminum windows shall meet the applicable Primary Performance Requirements of this standard.
3. The minimum requirements for the manufacture of steel windows, in each of the types listed above, shall be in accordance with the "Steel Window Institute" Specifications, for heavy intermediate windows.
4. When exterior steel windows and frames are specified, they shall be hot-dip galvanized after fabrication in accordance with ASTM 386.

C. Glass and Glazing

1. The Glass and Glazing section shall include, but not be limited to glass, plastic glazing, Including installation materials and aluminum entrance systems if not part of a correlated window system if not part of a correlated window system in SECTION 08501 METAL WINDOWS.
2. Type and thickness of glass shall meet the requirements of Federal Specification DD-G-451.
3. Safety glazing material shall be specified for installation in hazardous locations. "Safety glazing material" shall mean tempered glass, laminated glass, wire glass or rigid plastic which adheres to the ANSI Standard Z97.1 (Safety Glazing Code).
4. "Hazardous locations", mean those installations, glazed or to be glazed in commercial or public buildings, known as framed or unframed glass entrance doors including fixed glazed panels adjacent to entrance and exit doors which because of their locations present a barrier in the normal path traveled by persons going into or out of such buildings.

5. Each light of safety glazing material shall be permanently labeled and shall be legible. The label shall identify the labeler, the nominal thickness, the type of safety glazing material and the fact that said material meets the test requirements indicated above.
6. Specifications for aluminum doors and frames shall comply with the recommendations of the "Architectural Aluminum Manufacturers Association (A.A.M.A.).
7. All insulating glass shall be factory-sealed units having a 20-year written guarantee and conforming to the requirements of "Insulating Glass Certification Council" IGCC - CBA.
8. Design the glazing system so that building movements due to wind loads and thermal effects are not transferred to the glass.
9. The replacement of glass broken after the installation of glass as specified in this Section and the cleaning of all glass is not included in this Section, but is specified in SECTION 01700 - CONTRACT CLOSEOUT.
10. Glass panels from floor to ceiling shall be protected by some type of device or rail to prevent people from walking through or into the glass.

End of Section

SECTION 08 70 00
FINISH HARDWARE

PART 1 - GENERAL
The General Condition of Contract requirements supersedes this section.

1.01 SUMMARY:

A. Section Includes: Finish hardware except as otherwise specified or specifically omitted herein.

B. Related Sections:

1. Section 06200 - Finish Carpentry: Installation of finish hardware.
2. Section 08100 - Standard Steel Doors and Frames.
3. Section 08210 - Wood Doors.
4. Section 08410 - Aluminum Entrances and Storefronts: Aluminum glazed doors.
5. Division 16 – Access Control System.

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere.

1. Windows
2. Cabinets of all kinds, including open wall shelving and locks.
3. Signs, except as noted.
4. Toilet accessories of all kinds including grab bars.
5. Installation.
6. Rough hardware.
7. Folding partitions, except cylinders where detailed.
8. Sliding aluminum doors.
9. Angle sill threshold.
10. Corner guards.

1.02 SUBSTITUTIONS & SUBMITTALS:

A.. Requests for substitutions must be made in writing to the Architect 10 days prior to the bid date. All request for substitution are to be made in accordance with Division 1, General Requirements, section # 01631 Substitutions. In addition to the General Requirements, If proposing a substitute, submit that product data along with physical samples showing the proposed item and a detail cost breakdown of savings. No substitutions will be allowed after the project has been awarded to a General Contractor.

1. Items listed with NO SUBSTITUTE have been requested by the county to match existing products. No alternate products will be considered for review, provide products as specified herein.

B. SUBMITTALS: Submit, for review, six (6) complete copies of the finish hardware schedules within three (3) weeks after the purchase order is received by the hardware supplier. Organize schedule into “Hardware Sets" with an index of doors and heading, indicating complete designations of every item required for each door or opening. Include the following information:

1. Type, style, function, size, quantity and finish of each hardware item.
2. Name, part number and manufacturer of each item.
3. Fastenings and other pertinent information.
4. Location of hardware set cross referenced to indications on drawings both on floor plans and in door schedule.
5. Explanation of all abbreviations, symbols, and codes contained in schedule.
6. Mounting locations for hardware.
7. Door and frame sizes and materials.
8. Submit manufacture's technical data and installation instructions for the electronic hardware.
9. Catalog cuts.
10. Submit any samples necessary, as required by the Architect/Owner.

C. Templates: Where required, furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware.

1.03 QUALITY ASSURANCE:

A. Qualifications:

1. Obtain each kind of hardware (latch and locksets, exit devices, hinges, and closers) from only one manufacturer, although several may be indicated as offering products complying with requirements.

2. Hardware supplier to be a qualified, Factory Authorized, direct Contract Hardware Distributor of the products to be furnished. In addition, the supplier to have in their regular employment an certified Architectural Hardware Consultant (AHC) who will be made available at reasonable times to consult with the Owner, Architect, and/or Contractor regarding any matters affecting the finish hardware on this project.

3. Pre-Installation Conference for Finish Hardware and/or Electronic Hardware: Prior to installation of the hardware, the hardware consultant shall arrange a conference between the contractor, installers and related trades to review materials, procedures and coordinating related work.

B. Schedule Designations: Except as otherwise indicated, the use of one manufacturer's numeric designation system in schedules does not imply that another manufacturer's products will not be acceptable, unless they are not equal in design, size, weight, finish function, or other quality of significance. See 1.02 A for substitutions.

C. Exit Doors: Openable at all times from the inside without the use of a key or any special knowledge or effort.

D. Fire-rated openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80. This requirement takes precedence over other requirements for such hardware. Provide only such hardware which has been tested and listed by UL for the type and size of door required, and complies with the requirements of the door and the door frame labels. Latching hardware, door closers, ball bearing hinges, and seals are required whether or not listed in the Hardware schedule.

1. Where panic exit devices are required on fire-rated doors, provide supplementary marking on door UL label on exit device indicating "Fire Exit Hardware."

1.04 DELIVERY, STORAGE, AND HANDLING:

A. Acceptance at the Site: Individually package each unit of finish hardware complete with proper fastening and appurtenances, clearly marked on the outside to indicate contents and specific locations in the Work.

B. Deliver packaged hardware items at the times and to the locations (shop or field) for installation, as directed by the Contractor.

1.05 PROJECT CONDITIONS:

A. Coordination: Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Upon request, check the Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.06 WARRANTY:

A. Provide written guarantee from hardware manufacture, as well as hardware supplier, as follows:

1. Hinges: Life of Building "Lifespan"
2. Locksets: Three (3) years
3. Exit Devices: Three (3) years
4. Closers: Ten (10) years
5. Electronic closers & electric hinges: Two (2) years.
6. All other Hardware: Two (2) years.

Warranty shall commence with substantial completion of the project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Approval of manufacturers other than those listed shall be in accordance with paragraph 1.02 A, except for items marked No Substitute.

<u>Item</u>:	<u>Manufacturer</u>:	<u>Approved</u>:	<u>Approved</u>
Hinges / Electric Hinges	Stanley	Hager	Mckinney

Locksets	BEST	No Substitute	
Cylinders /Cores /Keys	BEST	No Substitute	
Closers	Norton	LCN	Sargent
Exit Devices	Von Duprin	Corbin Russwin	Sargent
Keyed Removable Mullion	Von Duprin	Corbin Russwin	Sargent
Pulls /Push	Rockwood	Hager	Ives
Stop / Silencers	Rockwood	Hager	Ives
Kickplates / Mop	Rockwood	Hager	Ives
Thresholds/Seals/Sweeps	Zero	National Guard	Pemko
Automatic Door Operators	Stanley	Horton	
Rapid Entry System	Knox Box	No Substitute	

B. Furnish all items of hardware required to complete the work in accordance with specifications and plans.

C. Carefully inspect Project for the extent of the finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware furnish finish hardware to specification.

2.02 MATERIALS:

MORTISE LOCK SPECIFICATIONS:

A. Mortise locks and latchesets shall be BEST 35H series. Locksets shall be heavy-duty with a solid, 3/4 inch throw latchbolt made of self lubricating stainless steel. Functions and design as indicated in the hardware groups. Deadbolt functions shall be 1 inch projection made of hardened stainless steel. Both deadbolt and latchbolt are to extend into the case a minimum of 3/8 inch when fully extended. Furnish locksets and latchsets with sufficient curved strike lip to protect door trim. Provide locksets with BEST 7-pin interchangeable core cylinders. Mortise cylinders shall have a concealed internal set screw for securing the cylinder to the lockset. The internal set screw will be accessible only by removing the core from the cylinder body. All mortise locksets and latchsets must conform to ANSI A156.13, Series 1000, Operational Grade 1 and be listed by UL. Lockset must fit ANSI A115.1 door preparation. Locksets and latchsets to have self-aligning, thru-bolted trim. Auxiliary dead-latch to be made of one-piece stainless steel, permanently lubricated. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers which contain a hollow cavity are not acceptable. Spindle to be such that if forced it will twist first, then break, thus preventing forced entry. Levers to be operated with a roller bearing spindle hub mechanism.

1. Locks shall have minimum 3/4" throw. All deadbolts shall have 1-inch minimum throw.
2. Comply with requirements of local security ordinances.
3. Lock Series and Design: BEST 35H 14H.
4. Interchangeable Core Cylinders: BEST 7-Pin with “WC” - Premium keyway. Except Police Stations shall be Patented keyway.

CYLINDRICAL LOCK SPECIFICATIONS:

B. Cylindrical lever type locksets shall be BEST 93K series. Locksets shall be extra heavy-duty type with 2-3/4 inch backset, or greater as specified, with a 9/16 inch throw latchbolt. Provide locksets with BEST 7-pin interchangeable core. Locksets and latchsets must conform to ANSI A156.2, Series 4000, Grade 1, and be UL listed. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty. Locksets and latchsets with levers must fit modified ANSI A115.2 door preparation. Locksets to have anti-rotational studs that are thru-bolted. Keyed lever shall not have exposed “keeper” hole. Each lever to have independent spring mechanism designed to control the lever only. Outside lever sleeve to be seamless, of one piece construction, made of a hardened steel alloy. Keyed lever to be removable only after core is removed, by authorized control key, to allow access to knob “keeper”. Hub, side plate, anti-rotational studs to be a one-piece casting with a shrouded locking lug. Locksets outside locked lever must withstand 1400 inch pounds of torque. In excess of that, a replaceable part will shear, not allowing entry by lever. Permanent core face must be the same finish as the lockset finish.

1. Locks shall have minimum 9/16" throw. All deadbolts shall have 1-inch minimum throw.
2. Comply with requirements of local security ordinances.
3. Lock Series and Design: BEST 93K 14D.
4. Interchangeable Core: BEST 7-Pin with “WC” - Premium keyway. Except Police Stations shall be Patented keyway.

C. Hinges: Outswinging exterior doors shall have nonremovable pin hinges. Exterior hinges to be brass, bronze or stainless steel material. Hinges to be extra heavy weight for high frequency openings or doors 36” and over in width. All hinge open widths shall be minimum, but of sufficient size to permit door to swing 180. Furnish hinges with Stanley “Lifespan” five knuckle, concealed ball bearings.

1. Furnish 3 hinges per leaf to 7 foot 6 inch height. Add one for each additional 30 inches in height or fraction thereof. Provide power transfer hinge at each card reader lockset or electrified exit device requiring card access. Provide hinges as listed in schedule.

D. Exit Devices: Furnish all sets at wood doors with sex bolts unless otherwise specified in Wood Door Section/ Hardware blocking. Trim of exit devices to match trim of locksets. Provide rim devices at single doors. Provide two rim devices with key removable mullion at pairs of doors. Concealed or surface mounted vertical rod exit devices shall not be permitted. Furnish cylinder dogging (CD) at all non-fire rated exit devices. Furnish electric latch retraction feature at door openings requiring card access.

Exit Device Series and Design:

1. Von Duprin 99 Series x 994L-06 Breakaway trim
2. Corbin Russwin ED 5000 x Freeweeling trim
3. Sargent 80 Series x ETL Freeweeling trim

Exit Device shall be UL listed for Accident Hazard or Fire Exit Hardware, and shall be tested in accordance to meet or exceed ANSI Standard A156.3 Grade 1.

E. Surface Door Closers: Full rack and pinion type with removable non-ferrous cover. Provide sex bolts at all wood doors unless otherwise specified in wood door section for hardware blocking. Place closers inside building, stairs, and rooms. Closers shall be non-handed, non-sized and adjustable.

Closer Series and Design:

1. Norton 7500 / 7501
2. LCN 4040 / 4041
3. Sargent 280 / 281

Closers shall be multi-size 1 through 6 at all doors rated or not. Exterior and high frequency openings shall receive heavy duty closer. Low frequency interior openings shall receive barrier free closer. All closers shall be cast iron or cast aluminum. Flush transom offset brackets shall be used where parallel arm closers are listed for doors with fixed panels over. Provide drop brackets are required at narrow head rails. Set exterior doors closers to have 8.5 lbs maximum pressure to open, interior non rated at 5 lbs., rated openings at 12 lbs.and meet all ADA requirements. Closers shall meet ANSI Standard A156.4 Grade 1 and shall be UL listed to be in compliance with UBC7.2 and UL 10C, Positive Pressure Fire Test.

F. Kickplates: Provide with four beveled edges (4BE), 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors unless otherwise specified x .050 gauge, stainless steel. Furnish Type "A" screws to match finish.

G. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

H. Screws: All exposed screws shall be Phillips head, unless otherwise noted.

I. Key Control: Provide one (1) key cabinet similar to Lund Key Control, model, with a capacity of one (1) hook per keyset, plus an additional one hundred fifty (150) percent expansion. Cabinet shall be prepared to accommodate a keyed mortise cylinder. Provide one (1) BEST mortise cylinder keyed to the existing Montgomery County Government Grandmaster Key System. In addition provide one set of Keystone 600 software for key management as produced by BAS.

J. Silencers: Furnish silencers on all interior frames, 3 for single doors, 2 for pairs. Omit where any type of seals occur.

K. Rapid Entry System: Furnish one (1) Knox Box Model 3200-R, recessed mount heavy duty Knox Box with Model 3200-RMK recessed mounting kit at primary entrance to building no higher then 5 feet above finish grade level. County shall approve location of box before installation. Substitutes are not acceptable.

2.03 FINISH:

A. Generally to be BHMA 626 Satin Chrome or 630 Stainless Steel finish.
   1. Protection Plates, Push, Pulls design shall be selected by Architect.

B. Spray door closers to match other hardware, unless otherwise noted.

C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.05 KEYING REQUIREMENTS:

A. Provide BEST brass construction cores and keys during the construction period. Plastic construction cores shall not be permitted. Construction control and operating keys and core shall not be part of the County's permanent keying system or furnished on the same keyway or key section as the County's permanent keying system. Permanent cores and keys shall be prepared according to the approved keying schedule and shall be furnished to the County prior to occupancy.

B. All cylinders and cores shall be BEST Premium or Patented 7-pin, interchangeable core. Permanent cores shall be keyed into the existing Montgomery County Government Grandmaster key system. No Substitute will be accepted.

C. Permanent keys and cores shall be stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys shall also be stamped "Duplication Prohibited."

D. Grand Masterkeys, Masterkeys and other Security keys shall be transmitted to Montgomery County Government by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:
   1. One (1) each Grand Masterkeys
   2. Four (4) each Masterkeys
   3. Three (3) each Change keys each keyed core
   4. Five (5) each Construction masterkeys
   5. One (1) each Control keys
   6. One hundred (100) key blanks – Deliver direct to County Locksmith.

F. The County, or the County's agent along with the General Contractor, shall install the permanent BEST cores. Any other services shall be paid for by the General Contractor. Construction cores shall be returned to the General Contractors hardware supplier once the perm cores are installed.

G. Keying schedule: General Contractor shall submit three (3) copies of separate detailed schedule indicating clearly how the County's final instructions on keying of locks have been fulfilled.

PART 3 - EXECUTION

3.01 HARDWARE LOCATIONS:

A. Hinges:

1. Bottom Hinge: 10 inches from door bottom to bottom of hinge.
2. Top Hinge: 5 inches from door top to top of hinge.
3. Center Hinge: Center between top and bottom hinge.
4. Extra Hinge: 6 inches from bottom of top hinge to top of extra hinge.

B. Lock: 38 inches from finished floor to center of lever or knob.

C. Push Bar: 44 inches from bottom of door to center of bar.

D. Push Plate: 44 inches from bottom of door to center of plate.

E. Pull Plate: 42 inches from bottom of door to center of pull.

F. Exit Device: 39-13/16 inches from finished floor to center of pad.

G. Deadlock Strike: 44 inches from floor, centered.

3.02 INSTALLATION:

A. Hardware is to be installed by experienced finish hardware installers only.

A. Install finish hardware in accordance with the approved hardware schedule, the manufacturers' printed instructions and in accordance with "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute. Prefit hardware before finish is applied; remove and reinstall after finish is complete and dry. Install and adjust hardware so that parts operate smoothly, close tightly, and do not rattle.

C. Installation shall conform to local governing agency security ordinance.

3.03 ADJUSTING:

A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly.

B. Inspection: Hardware supplier shall inspect all hardware furnished within 10 days of contractor's request and include with his guarantee a statement that this has been accomplished. Inspector or Contractor shall sign off the hardware as being complete and correctly installed and adjusted. Further corrections of defective material shall be the responsibility of his representative.

3.04 SCHEDULE OF FINISH HARDWARE:

A. Legend of listed manufacturers:
ST Stanley

BE Best
VD Von Duprin
LC Norton
ZO Zero
RO Rockwood

B. The items listed in the following "Schedule of Finish Hardware" shall conform throughout to the requirements of the foregoing specification. The last column of letters in the Hardware Schedule refers to the manufacturer abbreviation listed above.

C. The Door Schedule on the Drawings indicates which Hardware Set is used with door.

3.05 HARDWARE GROUPS:

NOTE: Architect, insert Hardware Groups as necessary for project. Example shown below.

HW Group 01 (Standard Interior Door Hardware)

Each opening shall have:

3 ea. Hinges
1 ea. Entry or Storeroom Lockset
1 ea. Surface Mounted Closer
1 ea. Kickplate
1 ea. Floor Mounted Stop
1 ea. Silencers

HW Group 02 (HARDWIRED CARD READER LOCKSET for Single Interior Door)

Each opening shall have:

2 ea. Hinges NRP
1 ea. Electric Hinge 8 wire
1 ea. IDH-Max Card Reader Lockset
1 ea. Power Supply & Reader Interface
1 ea. Surface Mounted Closer
1 ea. Kickplate
1 ea. Floor Mounted Stop
3 ea. Silencers

HW Group 03 (HARDWIRED CARD READER for Single Interior or Exterior Exit Doors)

Each opening shall have:

3 ea. Hinges NRP
1 ea. Power Transfer Hinge 8 wire

1 ea. Electrified Rim Exit Device
1 ea. Wall Mounted Card Reader
1 ea. Power Supply & Reader Interface
1 ea. Surface Mounted Closer
1 ea. Kickplate
1 ea. Floor Mounted Stop
3 ea. Silencers
1 ea. Recessed Door Contact

HW Group 04 (HARDWIRED CARD READER for Pairs of Interior or Exterior Exit Doors)

Each opening shall have:

6 ea. Hinges NRP
1 ea. Power Transfer Hinge 8 wire
2 ea. Electrified Rim Exit Device
1 ea. Key Removable Mullion
1 ea. Wall Mounted Card Reader
1 ea. Power Supply & Reader Interface
2 ea. Surface Mounted Closer
2 ea. Kickplate
2 ea. Floor Mounted Stop
2 ea. Silencers
2 ea. Recessed Door Contact

HW Group 05 (STAND-ALONE BATTERY CARD READER LOCKSET for Single Interior or Exterior Door)

Each opening shall have:

3 ea. Hinges NRP
1 ea. BASIS V Card Reader Lockset
1 ea. Surface Mounted Closer
1 ea. Kickplate
1 ea. Floor Mounted Stop
3 ea. Silencers
1 ea. Recessed Door Contact

End of Section

~~DIVISION 08 70 01~~
LOCKS

1. MANUFACTURERS:

A. Approval of manufacturers other than those listed below shall be in accordance with paragraph 1.02 A.

Product:	Manufacturer:	Approved:
Locksets	BEST	None
Cylinders / Cores	BEST	None
Keys	BEST	None

2. PRODUCTS:

MORTISE LOCK SPECIFICATIONS:

A. Mortise locks and latchesets shall be BEST 35H series. Locksets shall be heavy-duty with a solid, 3/4 inch throw latchbolt made of self lubricating stainless steel. Functions and design as indicated in the hardware groups. Deadbolt functions shall be 1 inch projection made of hardened stainless steel. Both deadbolt and latchbolt are to extend into the case a minimum of 3/8 inch when fully extended. Furnish locksets and latchsets with sufficient curved strike lip to protect door trim. Provide locksets with BEST 7-pin interchangeable core cylinders. Mortise cylinders shall have a concealed internal set screw for securing the cylinder to the lockset. The internal set screw will be accessible only by removing the core from the cylinder body. All mortise locksets and latchsets must conform to ANSI A156.13, Series 1000, Operational Grade 1 and be listed by UL. Lockset must fit ANSI A115.1 door preparation. Locksets and latchsets to have self-aligning, thru-bolted trim. Auxiliary deadlatch to be made of one-piece stainless steel, permanently lubricated. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers which contain a hollow cavity are not acceptable. Spindle to be such that if forced it will twist first, then break, thus preventing forced entry. Levers to be operated with a roller bearing spindle hub mechanism.

1. Locks shall have minimum 3/4" throw. All deadbolts shall have 1-inch minimum throw.
2. Comply with requirements of local security ordinances.
3. Lock Series and Design: BEST 35H 14H.
4. Interchangeable Core Cylinders: BEST 7-Pin with “WC” - Premium keyway. Except Police Stations shall be Patented keyway.

CYLINDRICAL LOCK SPECIFICATIONS:

B. Cylindrical lever type locksets shall be BEST 93K series. Locksets shall be extra heavy-duty type with 2-3/4 inch backset, or greater as specified, with a 9/16 inch throw latchbolt. Provide locksets with BEST 7-pin interchangeable core. Locksets and latchsets must conform to ANSI A156.2, Series 4000, Grade 1, and be UL listed. Locksets and cores to be of the same manufacturer to maintain complete lockset warranty. Locksets and latchsets with levers must fit modified ANSI A115.2 door preparation. Locksets to have anti-rotational studs that are thru-bolted. Keyed lever shall not have exposed “keeper” hole. Each lever to have independent spring mechanism designed to control the lever only. Outside lever sleeve to be seamless, of one piece construction, made of a hardened steel alloy. Keyed lever to be removable only after core is removed, by authorized control key, to allow access to knob “keeper”. Hub, side plate, anti-rotational studs to be a one-piece casting with a shrouded locking lug. Locksets outside locked lever must withstand 1400 inch pounds of torque. In excess of that, a replaceable part will shear, not allowing entry by lever. Permanent core face must be the same finish as the lockset finish.

1. Locks shall have minimum 9/16" throw. All deadbolts shall have 1-inch minimum throw.
2. Comply with requirements of local security ordinances.
3. Lock Series and Design: BEST 93K 14D.
4. Interchangeable Core: BEST 7-Pin with “WC” - Premium keyway. Except Police Stations shall be Patented keyway.

3. KEYING REQUIREMENTS:

A. Provide BEST brass construction cores and keys during the construction period. Plastic construction cores shall not be permitted. Construction control and operating keys and core shall not be part of the County's permanent keying system or furnished on the same keyway or key section as the County's permanent keying system. Permanent cores and keys shall be prepared according to the approved keying schedule and shall be furnished to the County prior to occupancy.

B. All cylinders and cores shall be BEST Premium or Patented 7-pin, interchangeable core. Permanent cores shall be keyed into the existing Montgomery County Government Grandmaster key system. No Substitutes will be accepted.

C. Permanent keys and cores shall be stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys shall also be stamped "Duplication Prohibited."

D. Grand Masterkeys, Masterkeys and other Security keys shall be transmitted to Montgomery County Government by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:
   1. One (1) each Grand Masterkeys
   2. Four (4) each Masterkeys
   3. Three (3) each Change keys each keyed core
   4. Five (5) each Construction masterkeys
   5. One (1) each Control keys
   6. One hundred (100) key blanks – Deliver direct to County Locksmith.

F. The County, or the County's agent along with the General Contractor, shall install the permanent BEST cores. Any other services shall be paid for by the General Contractor. Construction cores shall be returned to the General Contractors hardware supplier once the perm cores are installed.

G. Keying schedule: General Contractor shall submit three (3) copies of separate detailed schedule indicating clearly how the County's final instructions on keying of locks has been fulfilled.

4. FINISH:

A. Generally to be BHMA 626 Satin Chrome. Note; Architect shall verify finish to suit overall design requirements.

End of Section

SECTION 14 00 00

Elevators

GUIDE SPECIFICATION

The following Guide Specification is intended to be typed verbatim into the contract specification. An asterisk beside an item in the following indicates an item that is variable for each project. Where [ ] appear indicates requirements which are optional depending upon the type of elevator being provided. The handling of such items will be decided by consultation between the Project Manager and The Consultant. The Project Manager is expected to modify other portions as necessary to accurately reflect conditions of the project.

[TRACTION, HYDRAULIC] [PASSENGER, FREIGHT] ELEVATORS

PART 1 - GENERAL

1.1 SCOPE: Contractor shall provide all services and materials to furnish and install an [electric, hydraulic] [passenger, freight elevator] [passenger elevator with freight capability] described by the Contract Documents. *[EN1]

1.1.1 General Conditions, Amendments to the General Conditions, Special Conditions, Instruction to Bidders, Division 1 and all addenda of these specifications are part of the Elevator Specifications.

1.1.2 Applicable Documents:

a. Americans with Disabilities Act (ADA), and the equivalent Maryland state codes, whichever are more stringent

b. ANSI/ASME A17.1, Safety Codes for Elevators and Escalators as adopted by the State of Maryland (also referred to herein as the Elevator Safety Code)

c. ASTM A167, Steel, Sheet Stainless

*NOTE: Numbers in brackets are listed at the end of the document as End Notes; e.g., [EN1].

d. ASTM A366, Steel, Sheet, Carbon, Cold Rolled, Commercial Quality

e. AWS D1.1, Structural Welding Code - Steel

f. NFPA 70, National Electric Code

1.1.3 Permits and Codes:

1.1.3.1 All equipment and installation work shall comply with requirements of the Elevator Safety Code, and other applicable codes of the State of Maryland, and County. Requirements of Appendix F of the Elevator Safety Code shall apply, and references to the Elevator Safety Code include Appendix F.

1.1.3.2 Give necessary notices, obtain licenses and permits, and pay fees and other costs, including making arrangements for all inspections and tests required by regulating agencies, in accordance with the General Conditions as amended, the Supplemental Conditions, and Division 1 of this specification.

1.1.3.3 File necessary plans, prepare documents, and obtain necessary approval of governmental departments having jurisdiction and required certificates of inspection for work, in accordance with the General Conditions as amended, the Supplemental Conditions, and Division 1 of this Specification, and deliver same to the Project Manager before requesting acceptance and final payment for work.

1.1.3.4 Contractor is not relieved from furnishing and installing work shown or specified which may be beyond requirements of ordinances, laws, regulations and codes.

1.2 CONSTRUCTION DRAWINGS: [If provided] Drawings are partly schematic in nature and do not attempt to show exact details. The Contractor shall carefully check space requirements to ensure that equipment being provided can be installed in the spaces allotted. No extra will be allowed for differences between actual measurements and scaled measurements or stationing.

[Alternate for Renovation] Drawings are partly schematic in nature. The Drawings show the best known location of existing equipment, but do not attempt to show exact details. The Contractor shall verify exact distances between points shown on the Drawings by actual measurements at the site. No extra will be allowed for differences between actual measurements and scaled measurements or stationing.

1.3 CUTTING AND PATCHING: Openings required in the exterior of the existing structure shall be done by drilling or cutting. Contractor shall provide all pipe sleeves, anchor plates, hanger supports, inserts, and bolts required for his work. [Applicable to renovation only]

1.4 DEMOLITION: The Contractor shall remove existing elevator and ancillary equipment. All equipment to be disposed of shall be removed from the site. [Applicable to renovation only]

1.5 STANDARD PRODUCTS: Unless otherwise indicated, the equipment to be furnished under these Specifications shall be the standard product of manufacturer's regularly engaged in the production of such equipment. Apparatus, equipment and systems furnished must be similar and equal thereto with respect to quality, functional performance, capacity and efficiency. Where the actual equipment furnished requires certain changes in pipe location, controls, electrical equipment and foundations, the Contractor shall coordinate such changes and submit them for approval.

1.6 SUBMITTALS:

1.6.1 Shop Drawings: Submit shop drawings for approval. They shall contain enough detailed information to determine that the equipment conforms to the requirements of this Specification and not less than the following information:

a. Shop drawings and catalog cuts for all contractor furnished material and equipment, including but not limited to doors, frames, car enclosure, car frame, controls, motors, guide rails, and brackets. Motor data must include temperature rise ratings in a form that can readily be measured in the field after installation.

b. Location of machinery and controls in machine rooms, layout of the hoistway in plan and elevation and all other layout information and clearance dimensions required by the Elevator Safety Code. The elevator equipment is to be arranged in a neat and workman-like manner so that all valves, fittings, etc., are readily accessible.

c. [Traction Elevators] Arrangement and connection details of machine beams, deflector sheaves, and rails. Provide calculations and drawings for the County review and approval.

d. [Traction Elevators] Arrangement and connection details of pit equipment including buffers, compensating devices (if any), and pit ladder.

[Hydraulic Elevators] Coordination information including rail, buffer and jack beam reactions, and including data as specified in <u>Rule 300.7 and Rule 301.2 of the Elevator Safety Code</u>. [EN2] Detail of pit ladder. Specification for hydraulic oil.

e. Complete information on motor, electrical services, controls, and all other coordination information.

1.6.2 Wiring Diagrams: Complete wiring and single line diagrams showing the electrical connections, functions, and sequence of operation of all apparatus connected with the elevators, both in the machine room and in the hoistway, shall be furnished in triplicate. One set shall be mounted on 1/8-inch masonite, covered with 5-mil mylar with all edges secured with 2-inch vinyl tape, and mounted in the elevator machine room. The other two sets shall be delivered to the Owner.

1.6.3 Operations and Maintenance Manuals: Furnish an operation and maintenance manual covering the stipulated mechanical systems and equipment. The manual shall comply with all requirements indicated in the Project Closeout section of the specifications. Furnish one complete draft manual for Owner review prior to the time that system or equipment tests are performed.

The manual shall be complete in all respects for all equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:

a. Drawing or diagram showing equipment location.

b. Wiring and control diagrams with data to explain detailed operation and control of each component.

c. Step-by-step procedure for start-up, operation and shutdown.

d. Preventative maintenance schedule.

e. Lubrication schedule including type, grade, temperature, range and frequency.

f. Safety precautions, including diagrams and illustrations as needed for clarity.

g. Test procedures.

h. Parts lists, with manufacturers' names and catalog numbers. Lists shall be complete for the materials installed.

i. Serial number of each major piece of equipment.

j. Service organizations and sources of spare parts with names, addresses, and telephone numbers.

1.7 MATERIAL AND EQUIPMENT:

1.7.1 General: Material and equipment shall be new, of the best quality used for the purposes in good commercial practice, the best of their respective kinds, and as specified. Equipment shall be a standard product of reputable manufacturers. Where two or more units of the same class of equipment are required, those units shall be products of a single manufacturer. Furnish equipment complete with all parts necessary for proper operation.

Material and equipment shall be cleaned, free of corrosion, and selected to provide quiet operation.

1.7.2 Type capacity, size and rating of all equipment shall be as indicated on the Drawings, and/or herein specified.

1.7.3 Delivery and Storage: Material and equipment shall be suitably protected against corrosion, dirt, mechanical damage, weather and chemical damage before and during installation as recommended by the manufacturer and as approved by the Project Manager. Replace defective and damaged equipment and materials.

1.8 ELEVATOR - ELECTRICAL:

1.8.1 Provide electrical components of the elevator equipment and systems, including motors, motor starters, controllers, control instruments, switches, conduit, wire, and relays under this Division as specified herein and as necessary for complete and operable systems. Furnish interconnecting wiring for components of equipment as an integral part of the equipment. Interconnecting conduit and wiring connecting such assemblies shall conform to Division 16.

1.8.2 Electrical equipment and wiring shall conform to applicable paragraphs of Electrical Specifications and National Electrical Code.

1.8.3 For equipment with electrical components, provide UL label on each component for which published standards exist.

1.9 PAINTING: All exposed metal work furnished in these specifications, except as otherwise specified, and shall be properly painted after installation.

1.10 MAINTENANCE: The Contractor shall furnish maintenance service of the equipment for a period of twelve months after completion and final acceptance of the elevator. This service shall include regular systematic examinations of the installation by competent and trained employees of this Contractor; and shall include all necessary adjustments, lubrication, cleaning, supplies and parts to keep this equipment in operation, except such parts made necessary by misuse, accidents or negligence not caused by this Contractor. Contractor shall furnish written reports of each service call, whether routine or emergency, describing services performed. Basic service work shall be performed during regular working hours of regular working days. Emergency callback service shall be available on a 24-hour, 7-day basis.

1.11 SPARE PARTS: Provide spare parts required for maintenance of the elevator, including a complete set of fuses and contacts for all control equipment. The spare parts shall be placed in a cabinet, approximately 24 inches by 42 inches, provided by the Contractor, with doors equipped with a lock and two keys. The cabinet shall be mounted in the machinery room as directed. The minimum spare parts shall be in place at project closeout are as follows:

a. One door operator motor.

b. One of each type of door operator circuit board for each three cars or fraction.

c. One set of car door hanger sheaves for each car.

d. One set of hoistway doors hanger sheaves for each five hoistway doors or fraction.

e. One set of door pickup rollers.

f. One complete door interlocks for each five hoistway doors or fraction.

g. One car gate switch per five cars or fraction.

h. Cables and circuit boards for door protective devices, one of each type.

i. Spare printed circuit board of each type in the controller and power supply, one set per five cars or fraction.

j. Three spare lamps of each size and type per car.

k. One set of each type of car guide rollers per five cars or fraction.

l. Two hoistway limit switches.

m. One terminal landing button assembly for each two assemblies installed.

n. One intermediate landing button assembly for each five assemblies or fraction installed.

o. One set of each type of counterweight guide rollers per five counterweights or fraction.

The following shall apply to hydraulic elevators only:

p. One replacement valve assembly for each type.

q. One complete set of pump and jack seals and gaskets.

PART 2 - PRODUCTS

2.1 GENERAL: The completed elevator installation shall conform to the Elevator Safety Code except as specifically otherwise indicated or specified. The installation, including equipment, material, workmanship, design, and tests shall be in accordance with the standards, rules and Specifications referenced. All material and equipment shall be new. Electrical materials shall meet and bear evidence of meeting the requirements of Underwriter's Laboratories or Factory Mutual Systems. The equipment shall be the product of a manufacturer regularly engaged in the manufacture and installation of this type of equipment. Working parts shall be accessible for inspection, servicing and repair. Adequate means shall be provided for the lubrication of all wearing parts that require lubrication.

2.1.1 DESCRIPTION AND PERFORMANCE: Installation will be in accordance with the following details and consist of:

Quantity and Type	[ ] New Electric [Traction, Hydraulic] Elevator(s)
Load (Capacity)	[ ] Pounds [EN3]

	Car Speed	[ ] Feet Per Minute
	Leveling	+/- 3/8-inch with any load
Operation	[Passenger or Dual-Purpose Elevators]	Selective Collective Automatic as normal mode, Car-Switch Automatic Floor-Stop mode or function al equivalent selectable by switch. [Freight Elevators] Car Switch Automatic Floor-Stop mode or functional equivalent.
	Performance, Floor-to-Floor	[ ] seconds for [ ] feet rise [EN4]
	Control	Solid State Microprocessor
	Power Supply	Primary Power to be [208, 480] volts, 3 phase, 60 hertz [EN5] Secondary Power Supply (to Traction Motors) to be Solid State
	Rise	[ ] feet
	Number of Stops	[ ]
	Number of Openings	[ ] at front of hoistway [ ] at rear
	Lighting Supply	120 volts, 1 phase, 60 hertz
	Clear Car Inside	Not less than [ ] square feet clear floor area [EN6]
	Type of Doors for Car and Hoistway Entrances	[Single speed, Two speed], [center opening, side opening] [EN7]
	Hoistway Entrance and Car Opening Size	[ ] wide X [ ] high

2.2 GENERAL MATERIALS:

2.2.1 Where stainless steel is specified, it shall be corrosion resisting steel, Type 304 with 150-grit finish on exposed surfaces. Stainless steel shall have the grain of belting in the direction of the longest dimension. All Surfaces shall be smooth and without waves.

2.2.2 Where cold-rolled steel is specified, it shall be low carbon steel rolled to stretcher level standard flatness, commercial quality, Class 1, matte finish, complying with ASTM A 366.

2.2.3 Tamper-proof screws shall be used throughout for all face plates.

2.2.4 All light globes shall be 5,000-hour long-life.

2.2.5 All elevator keys shall be installed to match the County standards, Elevator Products Company #2, as manufactured by Chicago Lock Company, for fireman's control switch key, and Elevator Products Co. #1 for all other keys. Provide three keys of each type per elevator.

THE FOLLOWING IS AN ALTERNATE SECTION 2.3 FOR TRACTION ELEVATORS: [EN8]

2.3 ELEVATOR MACHINERY:

2.3.1 MACHINE: A [geared, gearless] traction machine, designed and manufactured to meet or exceed the requirements of the specified duty, shall be furnished. It shall include driving motor, direct current electro-mechanical brake, [steel worm, bronze gear,] and traction sheave, all mounted on a base or bedplate.

[The worm shall be high grade steel and the worm gear shall be phosphor bronze of best quality. The end thrust of worm shaft shall be taken by high grade self-aligning ball bearings, in both directions.] The traction sheave shall be of heavy alloy iron, accurately turned and grooved for the hoist ropes. The drive sheave shall have dustproof bearings with suitable means for ample lubrication [and adjustable supporting shaft for proper alignment of the worm and gear. Soundproofing shall be provided for the geared machine, designed to minimize the transmission of noise and vibration to the building structure.] Safety guards on exposed rotating equipment and cable guards on new and existing equipment shall be provided.

2.3.2 MOTOR: The [direct current, alternating current] motor shall be especially designed for elevator service. It shall have torque and speed capability ample for the specified duty when operated with the solid-state power supply and control system furnished.

2.3.3 SHEAVES: Deflecting sheaves shall be of heavy alloy iron, accurately grooved to fit ropes, of suitable size according to conditions, and fitted with heavy steel shaft.

2.3.4 BEAMS: The hoist machine and sheaves shall be supported by structural beams furnished and set in place by the Contractor.

2.3.5 GOVERNOR: The car overspeed controls and safety shall be operated by a centrifugal speed governor located at the top of the hoistway in the machine room.

2.3.6 BUFFERS: [Oil buffers, spring buffers] shall be installed in the pit as a means for stopping the car and counter- weight at the bottom limits of travel.

2.3.7 GUIDE RAILS: Steel guide rails that meet the requirements of the Elevator Safety Code, including the guidelines of Appendix F, shall be provided for each car and counterweight.

2.3.8 ROLLER GUIDES: Polyurethane roller guides shall be provided for each car and counterweight. Car rollers shall have a minimum diameter of six inches.

2.3.9 COUNTERWEIGHT: A 40% counterweight with steel frame and filler weights restrained as required by the Elevator Safety Code shall be furnished.

2.3.10 COUNTERWEIGHT GUARD: A metal counterweight guard shall be furnished and installed at the bottom of the hoistway.

2.3.11 ROPES: The hoist ropes shall be elevator rope as required by the Elevator Safety Code. Hoist rope fastenings shall be mechanical type (other than tapered socket secured with Babbit metal or thermosetting resin) acceptable under Paragraph 212.9a(2) of the Elevator Safety Code. Governor ropes shall be steel.

THE FOLLOWING IS AN ALTERNATE SECTION 2.3 FOR HYDRAULIC ELEVATORS:

2.3 ELEVATOR MACHINERY: Each elevator shall have a positive displacement hydraulic pump driven by an electric motor and operating a hydraulic cylinder with direct plunger. The machine and all its components shall meet the requirements of the Elevator Safety Code.

2.3.1 POWER UNIT: Each elevator shall include a Power Unit consisting of the motor, pump, drive assembly, oil control unit, oil reservoir, and oil drip pan, all mounted on a structural steel base and supports. Each power unit shall have the capability of delivering oil pressure and volume to lift the assembled elevator with rated load at rated speed. Volume of each oil reservoir shall be sufficient to lift its elevator through the rise specified, plus normal overtravel. Each power unit shall have a muffler in the discharge oil line near the pump and an enclosure of steel panels lined with sound-absorbing material. Maximum sound generation of 60 dbA within the range of 20 Hz to 20 KHz, measured within the machine room.

2.3.2 HYDRAULIC PUMP: The pump shall be a submerged self-contained power unit or a discrete pump-motor set mounted outside the oil reservoir. The pump shall be designed and manufactured for oil-hydraulic elevator service. It shall provide steady discharge with minimum pulsations, and its output shall not vary more than 10% between no-load and full-load conditions of the elevator car.

2.3.3 PUMP MOTOR: The pump motor shall be designed for oil-hydraulic elevator service, of standard manufacture, and of duty rating to provide the service specified herein.

2.3.4 DRIVE ASSEMBLY: Drive assembly shall be either direct coupling or multiple V-belts and sheaves. The number and size of belts and sheaves shall be sufficient to assure continued safe operation with a single belt failure.

2.3.5 OIL CONTROL UNIT: The oil control unit shall include the necessary valves all built into a single housing; welded manifolds with separate valves for each function will not be accepted. All adjustments shall be accessible and shall be made without removing the assembly from the oil line.

a. Relief valve shall be externally adjustable and shall be capable of bypassing the total oil flow without increasing back pressure more than 50% above working pressure.

b. Up start and stop valve shall be externally adjustable, and designed to bypass oil flow during start and stop of the motor pump assembly. Valve shall close slowly, insuring smooth up starts and stops.

c. Check valve shall be designed to close quietly without permitting any perceptible reverse flow.

d. Lowering valve and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth down starts and stops. The leveling valve shall be designed to level the car to the floor in the direction the car is travelling when slowdown is initiated.

2.3.6 HYDRAULIC JACK: A hydraulic jack assembly that meets the requirements of the Elevator Safety Code shall be mounted under the car platform.

a. Cylinder shall be formed from seamless or drawn-on- mandrel steel tube, protected on the exterior with triple fiberglass wrapping sealed with epoxy resin. The cylinder may be provided in sections, provided they are factory assembled, inspected and approved for alignment, and marked for proper reassembly at the site. Length of each cylinder shall be sufficient to accommodate the matching plungers. Diameter of each cylinder shall be sufficient for sleeving at some future time.

b. Plunger shall be polished seamless steel tubing or pipe. Length of each plunger shall be sufficient to lift its car through the rise specified, plus normal overtravel. Plunger shall be provided in sections not exceeding 16 feet per section, joined with internal threaded couplings. It shall be factory polished while assembled and marked for proper reassembly at the project site.

2.3.7 PIPE AND FITTINGS: Provide pipe and fittings of the size, type and weight recommended by the manufacturer. Connections shall be welded and/or bolted-flange only. Provide two manual gate or ball valves in line for each elevator, one adjacent to pump and one adjacent to the jack. Underground piping shall be covered for corrosion resistance in the same manner as specified for the jack cylinder.

Underground piping shall be installed in an outer containment of plastic (including fiberglass) designed to prevent ground contamination with leaking hydraulic fluid.

2.3.8 BUFFERS: Spring buffers shall be installed in the pit as a means for stopping the car at the bottom limits of travel.

2.3.9 GUIDE RAILS: Steel guide rails that meet the requirements of the Elevator Safety Code, including the guidelines of Appendix F of ANSI A17.1, shall be provided for the car.

2.3.10 LOW OIL INDICATOR: Provide indicator light on controller to indicate that reservoir is low on oil.

2.3.11 HYDRAULIC OIL: Provide hydraulic fluid that meets the requirements of the elevator manufacturer with minimum flammability.

2.4 ELEVATOR CAR:

2.4.1 CAR FRAME, PLATFORM, AND SAFETY: A car frame and platform fabricated from steel shall be provided. [Traction and roped hydraulic machines only] A safety plank with [Type A, Type B, Type C] car safeties shall be provided.

2.4.2 SLING ISOLATION: [Traction machines] Each car shall include a means to isolate the complete car enclosure from the sounds and vibrations transmitted from the machine room through the hoist ropes. The preferred method is spring isolation of the complete car sling and enclosure assembly from the hoist rope terminations at the car sling. Acceptable alternates include:

a. A rubber mounted hitch plate.

b. A platform mounted on rubber pads.

2.4.3 CAR ENCLOSURE: The car enclosure shall be steel and shall comply with the Elevator Safety Code. Exterior of car enclosure shall receive a sound deadening material coating.

2.4.3.1 CAR FRONT: Return panels with integral entrance columns of 14 gauge satin finish stainless steel shall extend from finished floor to underside of the fascia. Return panel(s) shall be arranged for the mounting of applied fixtures. The fascia shall be stainless steel.

2.4.3.2 CAR TOP: The car top shall be 14 gauge cold-rolled steel suitably reinforced. Finish shall be [matte white painted or as selected for the specific project].

2.4.3.3 HANDRAILS ON SIDES AND REAR: One and one-quarter inch round handrails [stainless steel or as selected for the specific project] shall be provided on the two sides [and at the rear of the car enclosure, single-door cars only].

2.4.3.4 WALL AND FLOOR FINISH: Furnish and install [stainless steel and laminate interiors of the style offered as standard by the car manufacturer, or as selected for the specific project. Freight cabs will usually be painted steel]. Furnish and install [sheet vinyl floors, or as selected for the specific project, on passenger and dual purpose cars][two-inch tongue-and-groove, kiln-dried oak flooring, or steel with embossed nonskid pattern, or as otherwise selected, on freight cars] [EN9]. Colors will be selected by the Owner from samples offered as standard by the car manufacturer.

2.4.3.5 PROTECTIVE PAD HOOKS AND PADS [for passenger elevators that may occasionally be used to move furniture or small quantities of construction materials]: Protective pad hooks [of stainless steel or as selected for the specific project] and fire retardant protective pads of quilted canvas duck shall be provided at all walls except the entrance walls. [If a group of two or more elevators, select one of the group for this provision].

2.4.3.6 EXHAUST FAN: A two-speed exhaust fan shall be mounted on the car top.

[Alternate]

EXHAUST FAN AND HEATER: A two-speed exhaust fan shall be mounted on the car top. A fan-forced electric heater with selectable 800-watt and 1200-watt elements shall be mounted in the front wall or side wall near the car operating panel, exact location to be approved by the Project Manager.

2.4.3.7 CAR OPERATING PANELS: A two-segment car operating panel shall be furnished inside the car. A car top operating station shall be furnished. The inside panels shall comply with all ADA standards and be configured as follows:

a. An accessible panel segment shall contain a bank of illuminated, tamper-resistant buttons marked to correspond to the landings served, an emergency call button, keyed stop switch, and door-open button. The emergency call button shall be connected to a bell that serves as an emergency signal. Raised Braille markings, which comply with requirements for the handicapped shall be furnished for the car buttons.

b. An access-controlled panel segment shall contain light switch, utility outlet, fan switch, infrared door edge disable switch, and switch for operating mode selection. [Add any special switches such as in-car heater, access control]. Access shall be limited by a door or panel with lock keyed as specified in Paragraph 2.2.5.

2.4.3.8 TELEPHONE CABINET: A telephone cabinet shall be mounted beneath the car operating panel. Necessary wires shall be included in the car traveling cable. Telephone set and autodialer shall be a Ramtech Corp. Model R2A-S.

2.4.3.9 INTERCOM: Provide an intercom for communication between the car and the Phase 1 fire service recall landing.

2.4.3.10 INTERIOR CAR LIGHTING:

[Passenger and dual-purpose cars] Lighting shall be [indirect, with one 48-inch fluorescent lamp on each side arranged to project light efficiently onto the ceiling and protected with a satin finish stainless steel cove reflector, or as selected for the specific project].

[Freight Cars, Enclosed] Lighting fixtures shall be for fluorescent lamps and shall be recessed, with the bottom of the fixture flush with the car ceiling. Provide at least two 48-inch fluorescent lamps per car up to 40 square feet platform area. Provide one additional 48-inch lamp per 30 square feet or fraction over 40 square feet.

[Freight Cars, Open] Lighting fixtures shall be porcelain lamp holders for incandescent lamps, not fewer than two per car. Provide metal-cage guards for each lamp.

2.4.3.11 EMERGENCY CAR LIGHTING: A Nylube Products Model EL-SS emergency power unit shall be provided to illuminate the elevator car and provide current to the alarm bell in the event of power failure. If emergency power circuit is available, car lighting and alarm bell also shall be connected to the X-Panel of the building.

2.4.3.12 EXTERIOR CAR LIGHTING AND POWER: Provide a work light with switch and a duplex utility outlet on the car top. The light shall be located to illuminate the cartop operating station, the hoistway door mechanisms, the car locator mechanism, and limit switches.

2.4.3.13 ALARM BELL: Furnish and install a Nylube Model ELB-6 alarm bell.

2.4.3.14 EMERGENCY EXIT: Provide car top or side wall emergency exit in accordance with the requirements of Elevator Safety Code. Locks shall be as specified in Paragraph 2.5.5.

2.4.4 TRAVELING CABLES: A traveling cable shall be provided for electrical connections between each car and its hoistway. Each cable shall have adequate conductor capacity for all control, communication and lighting functions specified herein. In addition, provide two spare lighting/utility circuits, and four spare communications circuits in each cable. Each cable shall have flame retarding and moisture resisting outer cover. Cables shall be flexible and shall be suitably suspended to relieve strains in the individual conductors.

2.5 POWER AND CONTROL DEVICES:

2.5.1 SOLID STATE POWER SUPPLY: [Direct current traction machines only] Provide solid state power supply for [460V, 208V], 3 phase input and DC output with volt age and current capability ample to operate the elevator at the specified conditions.

[Hydraulic machines only] MOTOR STARTER: Provide a reduced-voltage motor starter for [460V, 208V], 3 phase power with voltage and current capability ample to operate the pump motor.

2.5.2 SOLID STATE POWER CONTROL:

[Traction machines only] Provide a solid state power controller to operate the hoist motor, brake, and other electromechanical devices. The controller shall include interfacing pilot electromechanical devices as required for accepting the necessary elevator hoistway switches and operating switches. These include, as a minimum, terminal slowdown devices, overtravel limit switches, solid state magnetic leveling switches, inspection operating pushbuttons, emergency stop switches and governor over-speed switch.

[Hydraulic machines only] Provide a solid state power controller to operate the control valve and other electromechanical devices. The controller shall include interfacing pilot electromechanical devices as required for accepting the necessary elevator hoistway switches and operating switches. These include, as a minimum, terminal slowdown devices, overtravel limit switches, solid state magnetic leveling switches, inspection operating pushbuttons, emergency stop switches and governor over-speed switch.

2.5.3 MICROPROCESSOR ELEVATOR LOGIC CONTROL: The operation shall be accomplished utilizing microprocessor computer logic control. The elevator control program shall be contained in nonvolatile, programmable, read only memory. Control shall be constructed such that future alterations in elevator operation may readily be made by altering the read only memory. Safety circuits shall be monitored and controlled by the programmable logic control with redundant protection. The microprocessor elevator logic control shall be contained in a NEMA 1 cabinet.

2.5.4 FAULT DIAGNOSIS: Capability shall be provided to diagnose faults to the level of individual circuit boards and individual discreet components for both the Solid State Power Controller and the Elevator Logic Controller. (Capability to diagnose faults within an individual circuit board is not required.) IF THE EQUIPMENT FOR FAULT DIAGNOSIS IS NOT COMPLETELY SELF-CONTAINED WITHIN THE CONTROLLERS BUT REQUIRES A SEPARATE, DETACHABLE DEVICE, THAT DEVICE SHALL BE FURNISHED TO THE OWNER, AT NO ADDITIONAL COST, AS A PART OF THIS SPECIFICATION.

2.5.5 FIREFIGHTERS' SERVICE: All elevator control functions, car operating devices, and hall operating devices necessary for "firefighters' service - automatic elevators" as required by the Elevator Safety Code shall be provided. The "designated level" shall be [ ], and the "alternate level" shall be [ ] [EN10]. Provide a key box for each recall station and for each elevator machine room door, the box locks to match the Seattle Fire Department standard key.

2.5.6 KEYED STOP SWITCH: An keyed stop switch shall be provided in the car, designed to cut off current supply to motor, apply brake and bring the car to rest independent of the regular operating devices.

2.5.7 TERMINAL LIMIT SWITCHES: Terminal limit switches shall be provided in the hoistway designed to automatically stop the car at terminal landings. The final hoistway limit switches shall be designed to automatically cut off the power and apply the brake, should the car travel beyond either terminal landing.

2.5.8 AUTOMATIC LEVELING DEVICE: The elevator shall be provided with a two-way automatic maintaining leveling device.

2.5.9 CAR AND HALL POSITION INDICATORS: A recessed car position indicator shall be installed. [A hall position indicator shall be installed at the main floor landing.] [EN11] The position of the car in the hoistway shall be shown by the illumination of the indication corresponding to the landing at which the car is stopped or passing.

2.5.10 HALL BUTTONS: At each terminal landing, a recessed, tamper resistant signal push button shall be provided. At each intermediate landing, a button fixture shall be provided containing recessed, tamper resistant "UP" and "DOWN" push buttons. When a call is registered by momentary pressure on a landing button, that button shall become illuminated and remain illuminated until the call is answered. An elevator use-control switch with lock keyed as specified in Paragraph 2.2.5 shall be provided in the bottom terminal hall fixture. The "ON" position shall allow any specified operating mode, and the "OFF" position shall cause the car to park at the bottom terminal landing. Raised Braille markings that comply with requirements for the handicapped shall be furnished for the car buttons.

2.5.11 CAR DIRECTION LANTERNS AND SOUND SIGNALS: Direction lanterns shall be provided in each car adjacent to (or integrated with) the car position indicator. A chime shall also be furnished on the car that will sound once for the "UP" direction and twice for the "DOWN" direction as the doors are opening.

2.5.12 HALL DIRECTION LANTERNS AND SOUND SIGNALS: Hall direction lanterns and sound signals shall be provided as follows: [EN12]

a. For groups of two or more cars, provide direction lanterns above each hoistway door. Provide a gong or chime for each hoistway door. Interconnect lanterns and gongs/chimes with the car controllers to provide advance notice of car arrival.

b. For single-car installations and two-car groups with limited traffic, provide direction lanterns recessed into car entrance door jambs. On cars with center-opening doors, direction lanterns may be located on the car rear wall, provided that they are readily visible from the landing. Provide a gong or chime, readily audible from the landing that sounds as the doors begin to open.

2.6 ENTRANCES:

2.6.1 HOISTWAY ENTRANCES:

[Passenger and Dual Purpose Elevators] Provide new UL labeled metal doors and hoistway door frames. Doors shall be [stainless steel, cold-rolled steel]. Bottom of doors shall be provided with removable phenolic guides that run in the sill slots with minimum clearance. [EN13] Doors shall be designed to accommodate hoistway pressurization of 0.10 inches water column while remaining fully operational. Doors shall be designed for low air leakage under pressurization. [EN14]

[Freight Elevators] Provide new UL labeled hoistway door frames and [manually] [power-] operated biparting door assemblies, complete with guides and accessories for proper operation.

a. Doors shall be designed so that upper and lower panels counterbalance each other.

b. The lower edge of the upper door section shall be provided with a fire-resistive safety astragal and narrow 1/2 round molding with nonshearing and noncrushing properties with respect to foreign objects, up to 3/4-inches thick, upon which the two door sections may close. Rubber bumpers shall be provided on the lower edge of the upper panel frame near each jamb, mounted to provide the astragal safety action specified. The rubber bumpers and safety astragal shall be designed for replacement.

c. The upper edge of the lower door section shall be equipped with a metal sill designed to be level with the landing when the doors are fully open. The sills shall be of sufficient size and strength to bridge the space between the building sill and the car platform and to support a trucking load commensurate with the load class of the elevator car. The sill shall extend the full width of the door opening.

d. If powered doors are used, the hoistway doors and car doors shall be actuated by separate door operators.

e. Doors shall be designed to accommodate hoistway pressurization of 0.10 inches water column while remaining fully operational. Doors shall be designed for low air leakage under pressurization. See Endnote 14.

2.6.2 FASCIA PLATES: Fascia plates, fabricated from #14 gauge steel, shall be fastened to the header and the sill above. Fascia plates shall have manufacturer's standard enamel finish.

2.6.3 LANDING SILLS: [Passenger Elevators] Provide extruded aluminum sills, together with all necessary supports and hardware for installation. [EN15] Install in accordance with manufacturer's recommendations. Grout sills solidly their full length after installation.

[Freight and dual purpose Elevators] Provide steel sills to match the doors selected, together with all necessary supports and hardware for installation. Install in accordance with manufacturer's recommendations. Grout sills solidly their full length after installation.

2.6.4 DOOR HANGERS AND TRACKS: Hangers and tracks shall be provided at each car and hoistway entrance. Tracks shall be of bar steel with the working surface contoured to match the sheaves. The hangers shall be designed for power operation and have provisions for vertical and lateral adjustment. Hangers shall be designed for two point suspension of the door panel. Hanger sheaves shall be polyurethane with prelubricated and sealed bearings.

2.6.5 DUST COVER: Dust covers, fabricated from #14 gauge steel, shall be furnished at each landing. Dust covers shall have manufacturer's standard enamel finish.

2.6.6 CAR DOORS:

[Passenger and Dual Purpose Elevators] The car entrance shall be provided with doors of minimum 16 gauge facing into the car [stainless steel, or as selected for the specific project], extending around the leading door edges, suitably reinforced, with integral hangers. Zone restrictors, designed to prevent car doors from being opened when the car is outside a landing zone, shall be included in all car doors.

[Freight Elevators] The car entrance shall be provided with [manually] [power] operated biparting doors compatible with the hoistway doors. Doors shall be designed so that upper and lower panels counterbalance each other for ease of operation.

2.6.7 DOOR OPERATOR: [Passenger and Dual Purpose Elevators] A door operator with direct current motor shall be provided to open and close the car and hoistway doors simultaneously. Opening speed shall not be less than 2-1/2 feet per second. Closing speed shall not exceed the limitations set by the Elevator Safety Code. Controls and interlocks that meet the requirements of the Elevator Safety Code shall be provided.

2.6.8 DOOR EDGE PROTECTIVE DEVICE: Each passenger car door shall be provided with an Adams "Infrared Curtain Unit", Janus Elevator Products "Panaforty", or equal infrared type reopening device extending the full height.

2.6.9 TOE GUARD: Toe guards, fabricated from 14-gauge steel, shall be furnished at the lowest landing of each hoistway, and on each car sill. Toe guards shall have manufacturer's standard enamel finish.

2.6.10 FINISHES: Structural members and other components for which finish is not otherwise specified shall have prime coat finish.

2.6.11 HOISTWAY ACCESS SWITCHES: Provide hoistway access switches, keyed as specified in Paragraph 2.2.5, at upper terminal landing. Provide switches also at lower terminal landing where walk-in pit is not provided.

2.7 PIT AND MACHINE ROOM:

2.7.1 EMERGENCY STOP SWITCH: In each elevator pit, provide an emergency stop switch accessible from the pit access door.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELEVATOR SYSTEMS:

3.1.1 GENERAL: Comply with manufacturer's instructions and the Elevator Safety Code for work required during installation. Comply with the requirements of Appendix F for seismic Zone 3 conditions.

3.1.2 PREINSTALLATION MEETING: Prior to installation of any elevator equipment, a meeting of Contractor and Elevator Subcontractor shall be held to review installation approach and identify any special circumstances pertaining to this installation.

3.1.3 BEAM INSTALLATION: [Traction elevators only] install the machine beams and any sheave beams in accordance with a design approved by Project Manager and Montgomery County.

3.1.4 JACK INSTALLATION: [Hydraulic elevators only] install the jack in a hole excavated, cased and lined to accommodate it.

a. Casing shall be steel, not less than 1/4-inch in thickness, and with interior diameter not less than eight inches larger than the outside diameter of the wrapped jack cylinder.

b. Prior to insertion of the cylinder, the casing shall be lined with plastic in such a manner as to prevent ground contamination with leaking hydraulic fluid. If the cylinder is shipped in sections, joint areas shall be wrapped with triple fiberglass sealed with epoxy resin prior to insertion.

c. Install cylinder plumb and true with the hoistway. Following installation, backfill between the liner and the jack with clean, dry, salt-free sand in such a manner that alignment of the jack is not disturbed.

d. The Project Manager shall be given prior notice of the arrival of each jack at the job site. The Project Manager shall be given ample opportunity to inspect each jack before it is installed.

3.1.5 RAILS: Install rail brackets as needed to meet the requirements of the Elevator Safety Code, including the guidelines of Appendix F for seismic zone 3 conditions. Align rails plumb and accurately centered for elevator car position and travel.

3.1.6 DOORS: Install doors to provide smooth operation under normal conditions and to provide reliable operation under pressurized-hoistway conditions. Install hoistway doors in such a manner that air leakage is minimized under pressurized-hoistway conditions.

3.1.7 WELDED CONSTRUCTION: Provide welded connections for installation of elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance and replacement of worn parts. Comply with standards of AWS D1.1 for workmanship and for qualifications of welding operators.

3.1.8 COORDINATION: Coordinate elevator work with work of other trades, for proper time and sequence to avoid construction delays. Use benchmarks, lines and levels designated by Contractor, to ensure dimensional coordination of the work. Coordinate installation of hoistway entrances with installation of elevator guide rails, for accurate alignment of entrances with cars. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

3.1.9 SOUND ISOLATION: Mount rotating and vibrating elevator equipment and components on vibration-absorption mounts, designed to effectively prevent transmission of vibrations to structure, and thereby eliminate sources of structure-borne noise from elevator system.

3.1.10 LUBRICATION: Lubricate operating parts of systems, including ropes, if any, as recommended by manufacturers.

3.2 FIELD QUALITY CONTROL:

3.2.1 ACCEPTANCE TESTING: Upon nominal completion of each elevator installation, and before permitting use of elevator (either temporary or permanent), perform acceptance tests as required and recommended by Code and governing regulations or agencies. Advice Contractor, Project Manager, and inspection departments of governing agencies, in advance, of dates and times tests are to be performed on elevators. Advise Contractor and Project Manager, in advance, of dates and times for inspections by governing agencies. Central Plant engineers and Electricians shall be notified in advance of these tests, and shall be given ample opportunity to be present.

3.2.2 OPERATING TESTS: Load each elevator to its rated capacity and operate continuously for 30 minutes over its full travel distance, stopping at each level and proceeding immediately to the next. Record temperature rise of motor during

30-minute test period. Record speed up and down and leveling relative to landing sills at the end of the period. Requirements are as follows:

a. List rise within manufacturer's tolerances.

b. Speed within 10% of specified speed.

c. Leveling within +/- 3/8-inch. Record failures of elevator to perform as required.

3.3 PROTECTION: At time of final completion of elevator work (or portion thereof), provide suitable protective coverings, barriers, devices, signs or such other methods or procedures to protect elevator work from damage or deterioration. Maintain protective measures throughout remainder of construction period. Contractor is responsible for damage and wear during the construction period, and shall repair or replace, to the Owner's satisfaction, any components worn significantly or damaged before the Owner obtains beneficial use.

3.4 INSTRUCTION AND MAINTENANCE:

3.4.1 Instruct Owner's personnel in proper use, and operations and maintenance of elevators. Review emergency provisions, including emergency access and procedures to be followed at time of failure in operation. Train Owner's personnel in use of fault diagnosis and reprogramming [EN16] hardware and software.

3.5 CONDITIONS PRECEDENT TO FINAL ACCEPTANCE:

3.5.1 INSTRUCTIONS TO OPERATORS: The Contractor shall have completed instruction of the designated employees of the Owner in the operation and care of equipment and systems.

3.5.2 TESTS: All tests shall have been performed and acceptance certified by authorities having jurisdiction.

3.5.3 CODE COMPLIANCE CERTIFICATIONS: Where available from the authorities having jurisdiction, all state and local permit certificates shall be provided.

3.5.4 SUBMITTAL OF EQUIPMENT MANUALS: All manuals shall have been submitted and approved as provided in Paragraph 1.6.3.

3.5.5 SUBMITTAL OF CONSTRUCTION RECORD DRAWINGS: Construction drawings of the work shall have been marked to show changes and actual installation conditions, sufficient to form a complete record for Owner's purposes. Give particular attention to work which will be concealed and difficult to measure and record at a later date, particularly items which may require servicing or replacement during the life of the projects, such as valves, traps, dampers, etc. Site utilities drawings shall indicate exact locations and elevations of pipe and utilities.

3.5.6 FINAL CHECK: Make a final check of each elevator operation, with Owner's personnel present and just prior to date of substantial completion to determine that control systems and operating devices are functioning properly. Any and all damage and/or significant wear shall have been repaired.

3.5.7 CLEANING: The work site shall be clean. The Contractors shall clear away all debris, surplus materials, etc., resulting from their work or operations, leaving the job and equipment furnished in a clean, first-class condition.

PART 4 - RELATED REQUIREMENTS:

Elevator-related requirements to be included on drawings and/or other Divisions of the Specifications:

DIVISION 5 - METALS

1. Machine room walls and ceilings - white glossy.

2. Machine room floors - Parker #1075 Porch & Deck paint, Maroon.

3. Pit walls from floor up five feet - white glossy.

4. Pit floors - Certified Laboratories - Seal Brite.

DIVISION 15 - MECHANICAL

1. Heating and Cooling or Ventilation to maintain machine room temperature between 40 degrees F and 85 degrees F. Requirements of some vendors may be more stringent.

2. Consider potential requirement for heating oil tank of hydraulic elevators.

3. Special sprinkler controls as required.

DIVISION 16 - ELECTRICAL

1. Pit light.

2. Pit utility power, 110v.

3. Elevator lobby and machine room smoke detectors, installed complete for initiating firefighter's service phase.

4. Elevator power, 208 or 480 volt, 3 phase, to a fused/breakered disconnect in machine room. If machine room and/or hoistway top are sprinklered, a shunt-trip breaker is required.

5. Elevator car lighting and utility power, 120 volt, 1 phase, to a fused/breakered disconnect in machine room. If emergency power is available, include this function.

ENDNOTES

1. *At the end of this section is a list of elevator-related requirements to be included elsewhere in the Construction Documents.*

2. *Usual practice is for the elevator contractor to provide the machine and sheave beams, the rails, and the connections of these to the structure. The elevator contractor is required to provide data on the loads imposed by these elements on the structures to which they are fastened. He is also required to provide data on the loads imposed on the pit floor by rails (braking action), buffers, and hydraulic jacks.*

3. *In specifying the load limits of freight or dual-purpose elevators, consideration should be given to the potential for misuse. For example, if paper or other dense material is to be moved from floor to floor, the potential for overload should be considered. If a fork-lift truck or other heavy-lift vehicles are to be used or readily available around the elevator, Class C machines should be considered.*

4. *This is defined as the start of door movement to close until 90% open. Standards are about 6 seconds for traction machines, more for hydraulic. This item is important only in buildings with heavy dependence on elevators.*

5. *Add any emergency power requirements for one or more cars.*

6. *If programming indicates a need for special inside care dimensions (e.g., for a particular size of supply cart), put the requirements here. This will apply to inside height as well as clear floor dimensions.*

7. *For heavily used elevators, single-speed center opening doors are preferred. In all installations, no more than two panels per opening are preferred.*

8. *Alternate sections are presented for conventional traction and direct-action hydraulic machines. For less-common alternatives, such as roped hydraulic, one or both alternatives may be modified.*

9. *Ceramic tile or other brittle, non-resilient materials are not to be used.*

10. *Levels to be determined during design and included herein.*

11. *Hall position indicators are not warranted on low-rise machines, and should be limited to one at the main floor in high-rise buildings. Additional position indicators must have specific justification and approval.*

12. *For heavily used car groups, the intent is to provide direction lantern and sound systems that work with group dispatch controller for best service. This feature is rarely warranted on one-car installations, and may be of marginal value on some two-car groups.*

13. *Programming requirements may dictate stronger doors, particularly on passenger machines with frequent freight use.*

14. *The fire service requirement to be operational has two aspects: 1) minimizing the fan size to pressurize the hoistway by minimizing leakage, and 2) hanging and powering the door in such a way that it will operate relatively freely under pressurized conditions.*

15. *Nickel silver, bronze, steel, or other material may be used if justified for specific installations.*

16. *As used herein, "reprogramming" refers to changes in operating parameters such as speed, acceleration, jerk, pre-opening, door speed, and door dwell.*

17.

End of section

SECTION 22 00 04

PLUMBING BASIC MATERIALS AND METHODS

A. Scope

These standards and procedures apply to the selection and installation of pipe, pipe fittings, valves, and piping accessories for domestic hot and cold water, heating water, cooling water, steam and condensate, sanitary and storm drains, rainwater leaders, compressed air, vacuum, and most gases. Special piping requirements, including fittings, valves, and accessories, will be identified in the related section.

B. Design Criteria

Codes, Regulations, and Standards

All products, materials, equipment, and installation work shall conform to the following codes, regulations, and standards of latest issue:

1. American Standards Association

2. International Building Code

5. Underwriters Laboratories Standards

6. Factory Mutual Standards

7. State of Maryland Codes

8. County Fire Code

9. American Water Works Association

10. ASME B31.1 for piping design and B31.8 for fuel oil and natural gas pipes

11. ASTM requirements

C. Products, Materials and Equipment

1. Pipe and Fittings

a) All pipe and fittings shall conform to the appropriate ASA standard.

b) Thermometers shall be industrial quality, glycerin type, insertion pattern, including wells when located in piping. Scale length shall be 9 inches. Scale range shall be 30 to 240 degrees Fahrenheit in hot water piping, or 0 to 100 degrees Fahrenheit in central cooling water or chilled water piping.

c) Gages shall be 4 inch minimum size with a scale range approximately twice the operating pressure. Units of measurement shall be shown on the face plate.

2. Valves

a) Valves shall be of domestic manufacture (Hammond, Kennedy, or Victualic) and conform to the appropriate ASA,ASTM, and ASME standards.

b) Valves and packing materials shall be specifically designed for the service intended.

c) Valves shall be flanged or threaded; may be solder pattern for 2 inch and smaller copper piping. Natural gas and hot water valves to be seal welded.

d) Valves shall be rising stem type with union bonnet or other type if the application dictates.

e) Relief valves shall be rated in accordance with the ASME code.

f) Plug valves larger than 2 inch size shall be lubricated type.

g) Balancing valves shall be plug type.

3. Strainers

a) Strainers in 2 inch and smaller piping shall be wye type.

b) Strainers in larger than 2 inch piping shall be basket type, except steam piping.

c) Strainers in steam piping shall be wye type.

d) Strainer screens shall have a free area not less than three times the free area of the pipe line. Perforations shall be 1/16 inch size.

1) Screens in steam strainers shall be stainless steel.

2) Screens in other strainers shall be brass.

e) Strainers shall be of domestic manufacture.

4. Sleeves

a) Sleeves shall be either galvanized schedule 40 pipe or galvanized sheetmetal.

b) Sleeves shall be galvanized pipe where exposed to view, where flooding may occur, or where penetrating floors on grade or exterior walls below grade.

5. Hangers

a) Hangers for exposed piping shall be rods with pipe rings; 3/8 inch minimum rod size.

b) Concrete inserts shall be used in new construction; shall be cast, not stamped, metal.

6. Motors

a) Motors that are installed in equipment exposed to the weather shall be totally enclosed type, drip proof, even though a weatherproof cover is provided.

7. Vibration, Acoustic Treatment and Seismic Bracing

a) Equipment vibration must be compensated for during the design stages. Mountings and connections shall be carefully arranged.

b) Rotating equipment on grade shall have spring type or rubber-in-shear vibration isolators.

c) Rotating equipment in areas not on grade shall have spring type vibration isolators and inertia bases.

d) Inertia bases shall be equal in weight to all equipment located thereon. The vibration isolators shall support the equipment, including the inertia base.

e) Springs shall be large diameter, stable type which do not require guides or snubbers.

f) Mechanical rooms shall have acoustic treatment on walls and ceiling if adjacent areas will be affected by noises generated in the mechanical room.

g) Seismic restraint provisions shall be carefully included so as to meet the intent of the Uniform Building Code and the Uniform Mechanical Code and any other local codes having jurisdiction with more stringent requirements; and not diminish vibration isolation provisions.

D. Execution

1. Pipe and Fittings

a) Threaded connections shall be tapered V-threads per ASA standards.

b) Piping shall be carefully arranged to allow ample movement and flexibility for expansion and contraction due to temperature changes.

c) Piping shall not be installed below slabs on grade; except for waste and vent piping.

d) Branch connections, particularly in heating systems, shall have not less than two 90 degree changes in direction, with reasonable pipe lengths to allow for pipe movement.

e) Expansion loops are preferred to manufactured expansion joints or flexible connections.

f) Horizontal distribution from vertical mains shall, generally, occur in the ceiling of the floor served and down-feed to the devices.

g) Provide unions, or flanged connections, and isolation valves at equipment so equipment may be conveniently removed for repair.

h) Provide electrically insulating dielectric couplings at connections between copper pipe and zinc (galvanized) coated pipe.

i) Joints in black steel piping larger than 2 inch size shall be welded, threaded or flanged.

j) Welding outlets (thread-o-lets) may be used only where branch piping is smaller than the main; otherwise, welding tees shall be used.

k) Welding shall be performed by welders certified by the National Certified Pipe Welding Bureau.

l) Thermometers shall be shown on the drawings at all locations where a fluid mixing or heat transfer occurs and located so they may be read from the floor.

m) Gages shall be shown on the drawings and located on all services entering the building, at pressure reducing valve outlets, pump inlets and outlets, etc. Gages shall be mounted on 1/2 inch size pipe extensions with 1/2 or 1/4 inch shut-off valves.

2. Valves

a) Valves shall be provided to permit isolation of portions of the building piping systems for maintenance, alterations and repair work without shutting down entire systems.

b) Valves shall be installed to isolate all equipment for repairs.

c) Valves shall be installed with the stem vertical, preferably; not less than horizontal under any circumstance.

d) Where multiple services distribute from a pipe shaft, stagger the valves so they may be conveniently reached; all valves must be completely accessible.

e) Valves shall be installed with adequate room to permit removal of the bonnet, disk and trim without removing the valve from the line.

f) Globe valves shall be provided where throttling is required; except for balancing valves.

g) Valve tags shall be provided for each valve where the destination is not visible from the valve; shall state service and destination.

3. Strainers

a) Wye strainers shall be equipped with a gate valve.

b) Strainers shall be provided ahead of automatic control valves, traps, and in main service piping to buildings. Traps provided for a device having an automatic control valve will not require strainers.

c) Strainers sized up to 1 1/2” shall be made of brass or bronze; portable water system strainers 2” or larger shall be double-coated with electrostatically applied heat fused epoxy on interior and exterior.

4. Sleeves

a) Provide sleeves for all piping penetrations through concrete and masonry.

b) Sleeves shall extend 2 inches above all finished concrete floors and sealed with “Link Seal” or equal.

c) Sleeves for insulated piping shall be sized to allow the insulation to pass through.

d) Sleeves through exterior walls below grade shall be sealed with Link Seal or approved equal.

e) Sleeves through floors and firewalls shall be firestopped with U.L. Listed firestopping material.

5. Hangers

a) Pipe rings shall be sized to encircle the insulation when a vapor barrier is required; shall have protective shields as indicated in the insulation section.

b) Pipe rings may penetrate the insulation when a vapor barrier is not required.

6. Headers

a) Every service entering a building shall include a service header.

b) Provide a shut-off valve in the service piping immediately upon entry into the building.

c) All meters, strainers, pressure reducing valves, back-flow preventers, major branch distribution connections, etc., shall occur at the header.

d) When incoming domestic water service exceeds 80 PSI, provide a pressure reducing station with two PRV's in parallel, each valved to operate independently.

e) The header shall be arranged so that bypass connections will ensure service to the building when maintenance is required on various components.

f) Components shall be spaced apart with two pipe diameters between flanges.

g) Header assemblies shall be located generally four feet above the floor.

h) Header assembly with backflow protective devices shall not be installed higher than five feet (5') from centerline of uppermost devices. Any bypass lines installed for servicing of backflow device shall have a like-kind device installed in line.

7. Pressure Reducing Valves

Pressure reducing valves sized 1-1/2" shall be Watts Series US or USB; sizes 2" or larger shall be Watts Series 1150.

E. Piping Pressure Testing

1. General

a) The pressure testing requirements defined herein apply to all piping systems.

b) Testing shall be performed by the Contractor on all piping after erection; before insulation covers the joints being tested. Furnish all necessary equipment and material and make all taps in the pipe, as required. The Owner's designee will witness the tests.

c) The following piping and equipment shall not be subjected to pressure testing:

1) Rotating machinery, such as pumps, turbines, and compressors.

2) Pressure-relieving devices, such as rupture discs and pressure safety relief valves, when the relief pressure is within ten percent of the test pressure.

3) All vessels, regardless of rating, when using gas pressure for testing.

4) Pressure gauges where the test pressure exceeds their scale range.

5) In-line instrumentation.

2. Test Procedures:

a) Two pressure gauges shall be installed for each testing system; installed as close as possible to the low point of the piping system.

b) Calibration records for gauges used for testing shall be submitted to Owner's witness.

c) All vents and other connections that can serve as vents shall be open during filling so that all air is vented prior to applying test pressure to a system.

d) If the maximum operating conditions of piping attached to a vessel are the same as those of the vessel, the piping and the vessel may be tested together. If the vessel has different maximum operating conditions, it must be isolated and tested separately.

e) Examination for leakage shall be made at all joints and connections. The piping system shall show no visual evidence of weeping or leaking. Any visible leakage shall be corrected at the Contractor's expense.

f) If the pressure falls after the pressurizing source is shut off, the source of pressure loss must be determined and corrected. The system must be able to hold the test pressure for the test duration specified without any detectable loss.

g) If the ambient air temperature is less than 40 degrees Fahrenheit (F) at the time of pressure testing, the test medium must be heated as required to achieve the following temperatures when filling is complete:

1) 70 degrees F minimum for pipe wall thickness one inch or less.

2) 100 degrees F minimum for pipe wall thickness greater than one inch.

h) Piping designed for vapor or gas which is specified to be hydrostatically tested shall be provided with additional temporary supports, if necessary, to support the weight of the test liquid.

3. Special Requirements for Gaseous Pipe Testing:

a) A preliminary pneumatic test not to exceed 25 psig shall be applied to the piping system prior to final leak testing as a means of locating major leaks. Examination for leakage, detected by soap bubbles, shall be made at all joints and connections. After all visible leaks have been corrected, the pressure in the system shall gradually be increased to not more than one-half of the test pressure, after which the pressure shall be increased in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. The piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leakage. Any visible leakage shall be corrected at the Contractor's expense.

4. Testing Media Requirements:

a) Clean, fresh water shall be used for hydrostatic testing.

b) Oil-free clean dry air shall be used for gaseous testing.

c) After hydrostatic testing, all water shall be drained immediately. Care shall be taken not to pull a vacuum during draining - open all vents.

5. Test Repairs:

a) Materials such as gaskets, bolting, etc., damaged during tests and flushing shall be replaced.

b) New gaskets shall be used each time a flanged joint is made up.

c) Any welded joint that is defective shall be repaired in accordance with the applicable requirements. Repaired components shall be reexamined by the original method to determine freedom from defects, and all repaired joints shall be retested. Costs for such repair shall be the responsibility of the Contractor.

6. Test Records: Records shall be made by the Contractor for each piping installation. These records shall include, at a minimum, the following items:

a) Date of test.

b) Description and identification of piping tested, size(s).

c) Test fluid and initial and final temperatures.

d) Test pressure.Initial and final.

e) Test duration.

f) Remarks, to include such items as: leaks (type, location); repairs made on leaks.

g) Signature and date of person witnessing the test.

h) Certification by Contractor and reviewed by the Owner.

F. Equipment Performance Testing

1. Each piece of equipment for which performance capacities are identified in relation to various pressures and pressure differentials, or temperatures and temperature differentials shall be installed and tested in-place to verify that the required capacity can be achieved. Each final performance verification test shall be performed in the presence of the Owner's representative.

G. Cleaning of Piping Systems

1. Following assembly and testing, piping systems not specifically listed a "not to be wetted" shall be flushed with water to remove any debris and other foreign material. Flushing velocities shall be a minimum of 2.5 feet per second. Cone strainers shall be inserted in the connections to attached equipment and left there until cleaning has been accomplished to the satisfaction of the Owner's representative.

End of Section

SECTION 23 00 00

HEATING VENTILATION AND AIR CONDITIONING

A. Scope

These standards and procedures apply to the design and installation of heating systems, air moving and cleaning systems, electric elements, direct-fired natural gas heating systems, cooling, humidifying, and dehumidifying systems to appropriately interface with existing resources/ systems.

Electric heat may be used as a supplement for a heat pump. Radiant heating is acceptable where applicable. Mechanical constant volume mixing boxes are to be avoided and shall not be used without review. DX with Variable air volume (VAV) system must be avoided. For outdoor chiller and cooling tower shall be provided heat tape / heater to protect the system from freezing.

Provide economizer cycle (air and or water side) as applicable.

B. Design Criteria

Codes, Regulations and Standards

All work shall conform to the following codes, regulations and standards of latest issue:

1. County Energy Guideline
2. International Building Code (2000)
3. SMACNA
5. ASHRAE Standards
6. National Fire Protection Association Standards
7. U/L
8. NAFM

Design Review and Submittal

1. Schematic drawings shall be submitted identifying all systems, and include single line flow diagrams,heating and cooling load calculations, boiler, chiller, air handlers, fan coil and other terminal units, DX units, pumps and other major equipment sizing calculations, energy and life cycle cost analyses. Special occupancy zones shall be called out and systems identified.An outlined specification shall also be submitted along with the schematic design package. The Schematic submission shall include at least three different HVAC systems along with their life-cycle cost analyses.

2. Design development submittal should include the design drawing of the accepted system based on the life cycle cost analyses as determined by the County Project Manager.The submission package shall include double lined duct layouts for the entire building, equipment layout in the mechanical room, piping schematic; hot, chilled and condenser water flow diagrams showing all major equipment and devices, DX system, drawing sheet(s) indicating the spaces for installation details of all equipment and also equipment schedule, and detailed outline of specifications. This also includes revised (if any) and final zone by zone heating and cooling load calculations; boiler, chiller, air handlers, fan coil and other terminal units, DX units, pumps and other major equipment

sizing calculations, final and revised(if necessary) energy and life cycle cost analyses for the selected option, equipment schedule and control diagrams.

3 Construction document shall be submitted at 50% and 90% which includes all demolition drawings, new systems designed drawings, installation details of all equipment and devices with their support systems and house keeping pad, fancing around outdoor units. Drawings must show servicing spaces and catwalk, schedule for all major equipment, riser diagrams, double lined air distribution system with thermostat locations, volume dampers, smoke detectors etc. hot and chilled waterflow diagram showing all major equipment and devices, control schematic and sequence of controls. This also includes a full and detailed specifications with county standard boiler plate. This document must identify all ADD and DEDUCT Alternates with short description. The drawings shall be self explanatory and free from ambiguities, errors and ommisions

General Requirements

1. Central heating, ventilating, and air conditioning systems are preferred with equipment located in basement and penthouse mechanical rooms.

2. Roof-mounted equipment shall be avoided if possible. If required, equipment shall have weatherproof enclosures and screening and must receive prior approval from the Project Manager.

3. Ful consideration should be given to air intake and exhaust discharge requirements and locations.

4. For renovation project provide demolition drawings for existing systems that will not be reused.

Specific Criteria

1. Heating

   a. Heating shall be by circulating hot water where appropriate to building.

   b. Hot water converter selection shall include a 0.001 water side fouling factor.

   d. Hot water systems shall be two pipe design with reverse return and down-feed.

   e. Hot water systems shall be zoned according to building orientation with flow water temperature reset by outdoor temperature.

   f. Steam coils should be used only for preheat utilizing a two position valve. Use low pressure steam no greater than 15 psig.

   g. Select finned pipe radiation to extend for entire length of each glass area.

2. Ventilation

a. All building spaces suitable for present or future occupancy shall be served by mechanical ventilation.

b. Wherever the designer required to provide 100% outdoor air in order to comply with the code, the design must call for installation of Energy Recovery Unit.

c. Fan rooms shall not be used as supply or exhaust air plenums.

d. High velocity system design shall not be provided for systems less than 20,000 cfm (ref. Chart C-9, ASHRAE 1981 Fundamentals).

e. Provide perfecters in all fan systems over 5000 cfm.

f. Air intakes shall be a minimum of eight (8) feet above grade; air exhaust discharges shall be at the highest point of the building, if possible.

g. Ventilation shall be provided through centrally ducted systems, or individual ventilating assemblies such as fan coil units or unit ventilators.

3. Air Conditioning

a. Use chilled water design temperature rise of 10-14°F where appropriate to building.

b. Independent cooling shall be used for applications requiring year-round control of temperature.

c. Air cooled condensers or cooling towers shall be used in lieu of City water cooled condensers.

4. Specific Interface Requirements

a. Chilled water is available from the central plant system on a seasonal basis; flow is obtained by a pressurized differential between supply and return mains, with temperatures adjusted by outdoor conditions. Details are explained in Section 15535 CENTRAL COOLING WATER SYSTEM.

b. Provide bypass relief valves across isolating valves in branch lines from CCW flow and return.

C. Products, Materials and Equipment

1. Heating Materials

a. Condensate piping shall be Schedule 80, black steel.

b. Hot water piping shall be Type L copper with branch piping more than 25 lineal feet long to be 3/4" minimum. Schedule 40 black steel pipe may be used for 6" or larger in Mechanical Rooms.

c. Joining of 6" or larger pipe and fittings shall be Victaulic couplings and fittings or approved equal.

2. Ventilation Materials

See Section 15880 AIR DISTRIBUTION

3. Air Conditioning Materials

Chilled water piping shall be the same as for hot water.

4. Heating Equipment

a. Hot water heating systems shall be closed type.

b. Air vents shall be automatic with a cast iron or non-ferrous body, copper ball float and needle or ball type air valve.

c. Hand valves for radiators or convectors should be packed type suitable for servicing.

d. Surface mounted convectors shall have sloping top. Avoid custom enclosures.

5. Ventilation Equipment

a. Preferred fan design is single inlet, single width centrifugal type with backwardly inclined air foil blades, however, utilization of airfoils, propellers, and duct axial flow fans is encouraged where appropriate.

b. Fan volume control (VFD) shall be provided when the system has features to cause a variance in volume.

c. Provide rigid structural steel base for both fan and motor with slide rails for drive adjustment. Inertia bases are required for fans not on grade floors. Hinged motor bases are acceptable.

d. Filters shall have an 85% efficiency (dust spot method using atmospheric dust) at 500 feet per minute face velocity.

6. Air Conditioning Equipment

a. Maximum fin density for coils shall be 10 fins per inch.

b. Air vents shall be automatic with a cast iron or non-ferrous body, copper ball float and needle or ball type air valve.

c. Independent chilled water system shall have an open type expansion tank fitted with automatic fill, overflow, and gauge glass. Use bladder type expansion tank.

d. Selection of the chiller type (centrifugal, screw, air cooled etc.) shall receive prior approval from County Engineer.

e. The EER value of chiller and the DX unit shall not exceed 10, otherwise, prior approval from county Project Manager is needed.

f. Air cooled, screw chiller and cooling tower shall be located so that noise level (db) at the property line shall not exceed as dictated by the county noise contro code/ regulations.

g. The efficiency of the boiler shall not be less than 90%, otherwise prior approval from Count Project Manager is needed.

h. The boiler system shall be designed with a modular type,(more that one boiler) with reverse return system. The boiler system capacity shall not exceed 30% redundancy.

i When designing condensing boiler modular system, ensure that mufflers be installed and on the vertical sections of the exhaust and combustion air piping systems.

j. The space between two boilers in the modular system design shall be at lease 12" inches.

Maintenance

1. Heating

a. Sectionalize down fed hot water piping systems with isolating and drain valves to simplify servicing without draining large volumes of water during routing maintenance and repair.

b. The exhaust and combustion air piping system shall be designed and specify in accordance with manufaturer'r requirements.

c. Each boiler in the modular system must have lo-water cut-off, hi-limit reset and pressure relief valve.

d. The boiler and chiller/cooling tower make-up water system shall be designed in accordance with WSSC and any other applicable local, state and national code and standard.

e. The air cooled chiller and the tower supply and return piping shall have valves to isolate the equipment from the system. The valves shall be installed inside the building.

f. Independent water chillers shall have controls that prevent the chiller from operating unless chilled water pump, condenser water pump, condenser fan, etc. are operating.

g. Install bypass relief valves across isolating shut-off valves in branch piping for the CCW flow and return main.

D. EXECUTION

Maintenance

1. Heating

a. Sectionalize down fed hot water piping systems with isolating and drain valves to simplify servicing without draining large volumes of water during routing maintenance and repair.

b. Locate valves for hot water coils or other major heating components so that each unit and its control valve can be serviced without draining an entire system or riser.

c. Provide a hose end drain valve on each hot water coil.

d. Provide gate valves at all air vents.

e. Locate expansion tanks at the highest point possible and on the suction side of the pump(s), and fit with gauge glass, drain, vent, and shut-off valve. The expansion tank shall be bladder type.

f. The hot water heating system shall have at least two pumps: main and stand-by shall be controlled to run in cycle.Convectors and radiators shall be valve controlled, dampers will not be accepted.

g. Do not use PVC pipe for condenser water line in hydranic heat pump system.

2. Ventilation

a. Fan Bearings shall be ball type (selected for extended life) lubricated with grease fittings extended through fan casing for easy access, sealed ball bearing type permanently lubricated or sleeve type oil lubricated.

b. Provide each fan drive with an easily removable guard assembly protecting drive and shaft, with access for tachometer use.

c. Each air filter shall have a dedicated adjustable inclined manometer installed to indicate filter pressure drop.

d. Locate all air heating and cooling coils so that water jet or steam cleaning may be employed. Provide ductwork access panels on each side.

3. Air Conditioning

a. Provide a balancing valve in the return piping from each individual cooling coil.

b. Provide gate valves at the inlet and outlet of each cooling coil, or other major component. Locate valves so that each cooling unit, and its control valve, can be serviced without draining an entire system or riser.

c. Provide access panels in ceilings or partitions for servicing concealed valves or vents.

d. Chilled water piping shall have pressure gauges and thermometers at evaporator inlet and outlet.

End of section

SECTION 23 00 01

Mechanical Identification

A. Scope

These standards and procedures apply to the tagged and painted identification of piping, duct work, and equipment.

B. Design Criteria

1. All piping, ductwork, and equipment shall be color coded as follows: (The manufacturer and listing are only for the purposes of identifying appropriate paint colors.)

Service	Color	Comparable to Cowman Campbell
Steam	Aluminum	#1201
Condensate	Orange	#333
Hot Water Heating	Buff	#514
Central Cooling Water	White	#300
Cold Water	Dark Blue	#324
Cold Water-Non Potable	Light Blue	#561
Hot Water - Potable	Bright Yellow	#339
Hot Water-Non Potable	Dark Yellow	#341
Gas	Green	#331
Air	Black	#321
Fire Service	Red	#342
Waste, Soil Vent, Rain Leader	Brown	#329
Duct work (including insulated)	Grey	#337
Equipment & Fans	Grey	#337
Other Services	Grey	#337

2. Piping and ducts shall have the name of the service and direction of flow either painted or tagged in place. Steam lines (with pressure greater than 10 psi), gas and air lines will also indicate pressure and temperature.

3. Each major piece of equipment or system shall have its name and I.D.# (as specified in contract drawings) either painted or tagged in place.

4. Each valve shall be tagged to indicate the service, and equipment, I.D.# and temperature of the line controlled.

C. Products

1. Color coding will consist of semi-gloss enamel finish coat.

2. Equipment nameplates shall be laminated black plastic with lettering cut through to white background. Plastic strips with raised letters made by a marking device are not acceptable.

3. Valve tags shall be sized 1" x 2-1/2" and constructed of 0.030 inch thick brass inscribed with lettering 5/16 inch high. Laminated plastic tags, constructed similarly to nameplates, will also be acceptable.

D. Execution

1. Color coding will occur under three conditions where equipment and lines are in mechanical areas, finished areas, and concealed.

   a. In mechanical spaces and other maintenance areas, surfaces will be painted.

      The following methods shall be used to paint equipment and systems.

      (1) All surfaces to be painted shall have at least one primer coat and one finish coat.

      (2) Insulated surfaces shall be coated with an appropriate primer-sealer before applying the finish coat.

      (3) Zinc coated surfaces shall be properly primed before applying the finish coat.

      (4) Factory finished surfaces shall not be repainted unless the original finish has been damaged.

      (5) Stainless steel and chrome plated surfaces shall not be painted.

   b. In finished areas, color banding rather than painting shall be employed with two (2) inch bands appearing every 20 feet and/or at least once in each space. Colored tape shall generally be used, except when unavailable, banding may be painted on.

   c. Where piping and ductwork are concealed, they should be color banded minimally at each provided access point, where the line penetrates a wall or floor, and every 15 feet along horizontal and vertical lines.

2. One example of taped banding should be located in the vicinity of painted surfaces to indicate the corresponding relationship.

3. Information appearing on each major piece of equipment or system shall typically be painted in black, two (2) inch, block style lettering.

4. Nameplates shall be used for equipment too small for two (2) inch lettering.

End of Section

Section 23 00 04

DIRECTIONS FOR USE OF GUIDE SPECIFICATION (this section)

A. The Guide Specification names a certain manufacturer and vendor. We have selected the provider based on the product and acceptable local performance. We have made a substantial effort to determine that this provider can meet specifications. There shall be no exceptions to the approved vendor.

B. This section is a guide specification that shall be modified to the extent necessary to meet the needs of the particular project, however, the final specification shall not deviate from the basic concepts and requirements set forth. Make an exact copy of the guide specification and then modify it to meet the particular project needs and numbering system. Do not try to blend it with your own standard specification or that of a vendor. If you require vendor support, you must utilize the approved vendor. Your primary input will be the Sequence of Operation, Points Matrix and indication of point locations on the drawings. We are constantly upgrading our guide specification and will indicate important changes through the review process. We will occasionally make an official update and send it to all holders of the FDI manual. We encourage direct communication.

C. Here are some fundamental concepts for your design process:

1. The standard for HVAC control systems includes a PC Based, but not PC host dependent, Local Area Network DDC System with a highly distributed architecture. Electric/Electronic actuators and sensors shall be utilized. For new construction pneumatic actuators are only to be used in specifically accepted, limited applications. Pneumatic systems are only acceptable for small additions to existing pneumatic systems.

2. The DDC system shall provide freeze protection as a backup to local dedicated thermostats which must be shown on drawings and called out in specifications.

3. At the time of bid, the county would like to have a parts price list guaranteed for the duration of the contract.

4. Any large fans with inlet vanes must be specified with electric actuators of high quality and installed by the fan manufacturer. We would prefer a variable frequency/torque starter controlled fan.

5. Mechanical drawings and specifications shall call out valve CV and pressure requirements, anticipated close off pressure differential, line size, damper size, and indicated actuator function (including: 2 Position, Modulating, Spring Return, Normally Open, Normally Closed, Etc.).

6. In general the county wishes to use rotating valves so that the same actuator may be used for both dampers and valves. When space and pressures permit, use ball or shoe valves instead of lift and lay valves. We would prefer to reduce a 4" line down to 2" in order to use a ball valve rather than use a 4" lift and lay valve with a lower CV. Butterfly valves are not acceptable for modulation use if the required CV is less than that of the largest ESBE valve (CV=491). Butterfly valves with the plate

riveted or bolted to the stem are not acceptable. Use DEMCO, Vicatulic or approved equal.

7. The control architecture specified requires that all inputs and outputs occur at the smallest, most highly distributed level of stand alone control equipment. The intention is that no single failure will impact a large segment of equipment. These I/O devices shall provide for dry contact, resistive, 0-10 VDC and 4-20 ma. inputs. Outputs shall include 0-10 VDC.

8. Provide points matrix showing all input/output requirements.

9. Provide sequence of operation for all controlled equipment.

10. If thermometers and gauges are part of this package then ensure that they are well described for good quality and readability from the floor; per requirements indicated elsewhere in Volume 3.

Specifications for Environmental Control Systems

<u>Index</u>

Section 1. Purpose

A. To make known County building control systems standard.
B. To set material and construction standards for building control systems for both new construction and renovations.
C. To provide seamless interface between new or modified building control systems and existing systems.
D. To standardize building control performance.
E. To gain the advantage of standardized shared training programs across County departments.
F. To gain the advantage of shared expertise across departments.
G. To gain the advantage of standardized shared inventory.
H. To gain the advantage of an enterprise approach to negotiation for parts and service contracts.
I. To avoid the financial burden to the County of supporting service, maintenance, parts and upgrades for multiple control systems.

Section 2. Specifications

A. Furnish and install a complete Building Automation System (BAS) utilizing networked Direct Digital Control (DDC) technology for control and monitoring of the building heating, ventilating and air conditioning systems as described in this specification.

B. System shall consist of stand-alone DDC panels, sensors, automatic valves, actuators, dampers, operating software, operator training, and warranty.

C. The Control Company shall make available program language training to employees of the County.

D. The Control Company shall provide all technical data needed to service, maintain, repair, and program the control system to the County.

1. The contractor shall provide to the Owner two (2) copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the system.

2. The contractor shall instruct the owner's designated representatives in these procedures during the start-up and test period. The instruction shall consist of two separate training components: on-site, project specific training and off-site factory training.

3. On-site trainings shall be provided in accordance to the commissioning requirements.

4. Off-site trainings shall be provided in accordance to the commissioning requirements.

5. Provide training materials bound in six (6) manuals for use during all training sessions.

6. Provide one set of the special tools, manuals and test instruments specifically manufactured or modified for or by the system manufacturer for the use by the factory technicians in the instrumentation, troubleshooting, and repairs of installed devices. Include portable test terminals, test boxes; circuits card extenders, calibration modules, etc.

7. Submit shop drawings reflecting final “as-built” condition. Deliver five (5) copies of drawings (AutoCAD). All devices shall be identified with the County acronyms shown in the bid documents and unique software identification. (Example: OS12DA; O = Opera House; S = Supply Fan; 12=Fan Designator; DA = Discharge Air.)

8. Provide five (5) copies of reproducible record drawings and computer disks. These record drawings shall accurately depict the final as built conditions and shall be on Architectural/Mechanical backgrounds provided by the A/E as computer disks. These drawings shall include accurate depiction of wire runs, including cable identification, conduit size, location of junction boxes, source of power, devices, sensors, controlled equipment (motor starters, valves, Chillers, dampers, AHUs, etc.). All devices shall be identified with the County acronyms and unique software identification as described in the above paragraph. The building control system, including all hardware and software components shall be warranted for a period of one year following owner’s beneficial use of system. For phased project completion, the warranty shall also commence in phases. Any manufacturing defects arising during this period shall be corrected without cost to the owner.

9. Provide five (5) bound copies of the O&M manuals, describing operation, maintenance and servicing requirements of the HVAC control system and associated equipment. Provide the following information in separate sections each with tab index:

a) Material list.
b) Technical literature for all equipment including catalog sheets, calibration, adjustments and operation instruction, and installation instructions, (the operator’s instruction portion may be separately bound).

c) Schematic diagrams of proprietary hardware adequate for repair work down to the component level. (nondisclosure agreements will be signed by the County as required).
d) List of spare parts (with model numbers) recommended for purchase by the owner.
e) System description and complete sequence of operation.
f) Reduced size (11 inch by 17 inch) copies of record drawings.
g) Input/Output (I/O) summary forms for the system listing all connected analog and binary input and output functions and the number type of points.
h) Control programs specified to this system.
i) Point to point checkout list used in commissioning.

E. Demonstrated backward compatibility. Backwards compatibility means the system shall have a documented history of backwards compatibility for a minimum of the last 5 years. Future compatibility shall be supported for no less than 10 years. Defined as:

1. The ability to upgrade existing field panels to current level of technology, and extend new field panels on a previously installed network.

2. The ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers or protocol converters.

F. Local support. Local support means: Manufacturer shall have fully dedicated Service Department facility within 50 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. Distributors or licensed installing contractors that are not factory direct Branch Offices of the control system manufacturer are not acceptable.

G. Standard Manufacture. Standard manufacture means: Materials and equipment shall be the cataloged products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements. These standard components, shall be new, regularly manufactured and not custom designed or fabricated specifically for this project. All components and software shall have been previously tested and proven in regular use.

H. Utilize networked Direct Digital Control (DDC) technology for control and monitoring of the building heating, ventilating and air conditioning systems as described in this specification.

I. Provide open communications system. System shall be capable of utilizing standard protocols as follows as well as be able to integrate third-party systems via existing vendor protocols. System shall be capable of BACnet communication according to ASHRAE standard SPC-135A/95. System shall be capable of OPC server communications according to OPC Data Access 2.0 and Alarms and Events 1.0.

The following BACnet objects and services must be supported by the system.

1. BACnet standard objects, that, at minimum, must be supported by the system:
2. Device
3. Analog Input
4. Analog Output
5. Binary Input

6. Binary Output
7. Notification Class

The following BACnet services must be supported for the system to act as a BACnet server as described below:

a.) For the system to communicate with/on a BACnet network, it must support the following:

BACnet Service	Initi	Execute
Who-Has		X
I-Have	X	
Who-Is		X
I-Am	X	

b.) For the system to allow other BACnet devices to monitor its point values, the system must support the following:

BACnet Service	Initi	Execute
Read Property		X

c.) For the system to allow other BACnet devices to command its point values, the system must support the following:

BACnet Service	Initiate	Execute
Write Property		X

d.) For the system to be able to send alarms to other BACnet devices and receive alarm acknowledgement, the system must support the following:

BACnet Service	Initiate	Execute
Add List Element		X
Remove List Element		X
Acknowledge Alarm		X
Get Alarm Summary		X
Confirmed or Unconfirmed Event Notification	X	

e.) If the system will be sending messages to other BACnet devices via COV, it must support the following:

BACnet Service	Initiate	Execute
Subscribe COV		X

Confirmed or Unconfirmed COV Notification	X	

The following BACnet services must be supported for the system to act as a BACnet client as described below:

a.) For the system to communicate with/on a BACnet network, it must support the following:

BACnet Service	Initi	Execute
Who-Has		X
I-Have	X	
Who-Is		X
I-Am	X	

b.) For the system to be able to monitor point values from other BACnet devices, the system must support the following:

BACnet Service	Initi	Execute
Read Property	X	

c.) For the system to be able to command point values in other BACnet devices, the system must support the following:

BACnet Service	Initiate	Execute
Write Property	X	

d.) For the system to be able to receive alarms from points in other BACnet devices, the system must support the following:

BACnet Service	Initiate	Execute
Add List Element	X	
Remove List Element	X	
Acknowledge Alarm	X	
Get Alarm Summary	X	
Confirmed or Unconfirmed Event Notification		X

e.) If the system is capable of receiving BACnet point messages via COV, it must support the following:

BACnet Service	Initiate	Execute

Subscribe COV	X	
Confirmed or Unconfirmed COV Notification		X

J. All system peer-to-peer network controllers, central system controllers and local user displays shall be UL Listed under Standard UL 916, category PAZX; Standard ULC C100, category UUKL7; and under Standard UL 864, categories UUKL, UDTZ, and QVAX and be so listed at the time of bid.

K. All floor level controllers shall comply, at a minimum, with UL Standard UL 916 category PAZX; Standard UL 864, categories UDTZ and QVAX and be so listed at the time of bid.

L. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

M. The BAS contractor shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.

N. The building automation system (BAS) shall conform to the following standard for Year 2000 Compliance:

1. The system shall not produce errors when processing date data (including calculating, sorting or displaying) from, into and between the years 1999 and 2000 and leap year calculations in the year 2000, to the extent that date information provided from other systems, is accurate.

2. The BAS supplier shall provide documentation to support the individual device(s) Year 2000 Compliance. This document shall include a listing of compliance by device and any exceptions to the above definition.

O. The control system must be cable of seamless integration with the existing building control system. Seamless integration means:

The HVAC control system will full functionality and data exchange with the current standard as well as a fully modular architecture, permitting expansion through the addition of more distributed processing units, input/output units, sensors, actuators or operator stations.

P. The design of the BAS shall network operator workstations and stand-alone DDC Controllers. The network architecture shall consist of three levels.

1. A county-wide Management Level Network (MLN) Ethernet network based on TCP/IP protocol.

2. A high performance, peer-to-peer Building Level Network (BLN)

Access to all levels of the BAS system architecture shall be totally transparent to the user when accessing data or developing control programs.

The design of BAS shall allow the co-existence of new DDC Controllers with existing DDC Controllers in the same network without the use of gateways or protocol converters.

System shall have the capability to communicate with a BACnet network over Ethernet or BACnet/IP (according to Annex J).

System shall have the capability to be an OLE for Process Control (OPC) Server for dynamic communication with third party systems (OPC Clients) over an Ethernet network. At a minimum, the following must be supported:

a. Data Access
b. Alarms & Events

Q. Energy Management. DDC Controllers shall have the ability to perform any or all the following energy management routines.

a. Time-of-day scheduling
b. Calendar-based scheduling
c. Holiday scheduling
d. Temporary schedule overrides
e. Start-stop time optimization
f. Automatic Daylight Savings Time switchover
g. Night setback control
h. Enthalpy switchover (economizer)
i. Peak demand limiting
j. Temperature-compensated duty cycling
k. Fan speed/cfm control
l. Heating/cooling interlock
m. Cold deck reset
n. Hot deck reset
o. Hot water reset
p. Chilled water reset
q. Condenser water reset
r. Chiller sequencing
s. Prioritize alarm signals in at least 3 levels of criticality
t. Trending
u. Trouble-shooting and Diagnostics

R. The software programs specified in this Section shall be provided as an integral part of DDC controllers and shall not be dependent upon any higher level computer for execution. All programs shall be executed automatically without the need for operator intervention and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described in the Sequence of Operations.

Management Level Network

1. All PCs shall simultaneously direct connect to the Ethernet and Building Level Network without the use of an interposing device

2. Operator Workstation shall be capable of simultaneous direct connection and communication with BACnet, OPC, and Apogee networks without the use of interposing devices.

3. The Management Level Network shall not impose a maximum constraint on the number of operator workstations.

4. When appropriate, any controller residing on the peer to peer building level networks shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.

5. Any PC on the Ethernet Management Level Network shall have transparent communication with controllers on the building level networks connected via Ethernet, as well as, directly connected building level networks. Any PC shall be able to interrogate any controller on the building level network.

6. Any break in Ethernet communication from the PC to the controllers on the building level networks shall result in an alarm notification at the PC.

7. The Management Level Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3

8. Access to the system database shall be available from any client workstation on the Management Level Network.

BUILDING LEVEL NETWORK

1. All operator devices either network resident or connected via dial-up modems shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the peer-to-peer BLN. No hardware or software limits shall be imposed on the number of devices with global access to the network data at any time.

2. The peer-to-peer BLN network shall support a minimum of 100 DDC controllers and/or local PC workstations

3. The system shall support integration of third party systems (fire alarm, security, lighting, PCL, chiller, boiler) via panel mounted open protocol processor. This processor shall exchange data between the two systems for interprocess control. All exchange points shall have full system functionality as specified herein for hardwired points.

4. Field panels on the BLN must be capable of integration with multiple open standards including Modbus, BACnet, and Lonworks as well as with third party devices via existing vendor protocols.

5. Each PC workstation on the BLN shall support a minimum of 4 peer to peer networks hardwired or dial up.

6. All PC's on the BLN shall be capable of simultaneously connecting to the Ethernet and Building Level Network without the use of an interposing device

7. Operator Workstations on the BLN shall be capable of simultaneous direct connection and communication with BACnet, OPC, and Apogee networks without the use of interposing devices.

8. When appropriate, any controller residing on the BLN shall connect to Ethernet network via an Ethernet Module.

FLOOR LEVEL NETWORK and APPLICATION SPECIFIC CONTROLLERS (ASC)

1. Each Standalone DDC Controller shall be able to extend its performance and capacity through the use of remote Application Specific Controllers (ASC's) through the Floor Level LAN Device Networks.

2. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor. Provide the following types of ASC's as a minimum:

   a. UNITARY CONTROLLERS:
   Provide for control of central HVAC systems and equipment including, but not limited to, the following:

   - Rooftop units
   - Packaged air handling units
   - Built-up air handling systems
   - Chilled and condenser water systems, including cooling tower
   - Steam and hot water systems
   - Exhaust fans system

   UC's shall include all point inputs and outputs necessary to perform the specified control sequences. Provide a hand/off/automatic switch for each digital output for manual override capability. Switches shall be mounted either within the controller's key-accessed enclosure, or externally mounted with each switch keyed to prevent unauthorized overrides. In addition, each switch position shall be supervised in order to inform the system that automatic control has been overridden.

   Each controller shall support its own real-time operating system. Provide a time clock with battery backup to allow for stand-alone operation in the event communication with its DDC Controller is lost and to insure protection during power outages.

   All programs shall be field-customized to meet the user's exact control strategy requirements.

   Programming of UC's shall utilize the same language and code as used by DDC Controllers to maximize system flexibility and ease of use. UC's that utilize a different control language or programming interface software shall not be acceptable and Standalone DDC Controllers shall be provided to meet the specified functionality.

   Each controller shall have connection provisions for a portable operator's terminal. This tool shall allow the user to display, generate or modify all point databases and operating programs.

   The terminal shall provide the user with the following functionality as a minimum:

- View and set date and time
- Modify and override time-of-day schedules
- View points and alarms
- Monitor points
- Command and modify setpoints

Should the system controller be unable to interface to a door-mounted terminal, provide a laptop or similar terminal at the controller, or provide a DDC Controller with a door-mounted or local terminal in lieu of the system controller in order to meet the specified minimum functionality.

b. TERMINAL EQUIPMENT CONTROLLERS
Provide for control of each piece of equipment, including, but not limited to, the following:

- Variable Air Volume (VAV) boxes
- Constant Air Volume (CAV) boxes
- Dual Duct Terminal Boxes
- Unit Conditioners
- Heat Pumps
- Unit Ventilators
- Water-side Controls, Valve positioners

The Terminal Equipment Controller (TEC) shall interface to the BAS on a LAN communications network originating at the Standalone DDC panel. An individual controller shall be provided for each terminal unit. The terminal controller must be listed by Underwriters Laboratory under UL 916 PAZX and UL 864 UDTZ.

Controllers shall include all point inputs and outputs necessary to perform the specified control sequences. Analog outputs shall be industry standard signals such as 24V floating control, 3-15 psi pneumatic, or 0-10vdc allowing for interface to a variety of modulating actuators.

All controller sequences and operation shall provide closed loop control of the intended application. Closing control loops over the FLN, BLN or MLN is not acceptable

For VAV boxes, the BAS contractor shall furnish the terminal controller (controller, damper motor, flow transducer) to the terminal unit manufacturer for factory mounting. Costs associated with factory mounting of terminal controller shall be covered by terminal unit manufacturer. The terminal box manufacturer shall provide an averaging air velocity sensor suitable for interfacing with the TEC's differential pressure transducer.

The controller shall include a differential pressure transducer that shall connect to the terminal unit manufacturer's standard averaging air velocity sensor to measure the average differential pressure in the duct. The controller shall convert this value to actual air flow. Single point air velocity sensing is not acceptable. The differential pressure transducer shall have a measurement range of 0 to 4000 fpm (0 to 20.4 m/s) and measurement accuracy of ±5% at 400 to 4000 fpm (2 to 20 m/s), insuring primary air flow conditions shall be controlled and maintained to within ±5% of setpoint at the specified parameters. The BAS contractor shall provide the velocity sensor if required to meet the specified functionality.

Each controller shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against drift over time. Calibration shall be accomplished by stroking the terminal unit damper actuator to a 0% position so that a 0 cfm air volume reading is sensed. The controller shall automatically accomplish this whenever the system mode switches from occupied to unoccupied or vice versa. Manual calibration may be accomplished by either commanding the actuator to 0% via the POT or by depressing the room sensor override switch. Calibration of the transducer at the controller location shall not be necessary.

Each TEC shall be accessible for purposes of control and monitoring from a central or remote operator's terminals as specified herein.

TEC damper actuator shall be of the 24 Vac floating point type. Upon power loss, the actuator maintains its current damper position. Position status is shown in percentage open notation.

TEC room temperature sensor shall come complete with a terminal jack and programmable override switch integral to the sensor assembly. The terminal jack shall be used to connect the portable operators terminal to control and monitor all hardware and software points associated with the terminal unit. A terminal jack may be alternatively located on a stainless steel wall plate mounted adjacent to the sensor. An override switch shall initiate override of the night setback or unoccupied mode to normal operation when activated. A thumbwheel-type temperature setpoint dial shall also be provided with 1 Deg F temperature increments. Override switch and temperature setpoint functions may be locked out, canceled or limited as to time or temperature via software.

TEC’s for VAV or CV applications shall be provided with integral differential pressure transducer capable of accepting an average air flow measurement signal from the terminal box averaging air velocity sensor. The value is converted through a square root function to average airflow by the TEC.

TEC control valve electronic actuators shall mount on the valve body and provide complete modulating control of the valve. Valve body shall separate from actuator for servicing without requiring any special tools or electrical connections. The actuator shall be of the floating control point type.

TEC wiring terminal bars are to be detachable type allowing quick serviceability of the electronic controller hardware without removal of the existing wiring.

FIELD DEVICES

1. TEMPERATURE SENSORS

All temperature sensors shall be solid state electronic, employing a resistance type output. Room and zone temperature sensors may be thermistor type. All duct sensors shall be rigid or flexible probe, averaging RTD-type sensors. All duct mixed air sensors shall be flexible averaging RTD-type sensors with sensor element length suitable for complete duct coverage. Pipe sensors shall be RTD-type. Provide outside air temperature sensors with watertight inlet fitting and sunlight shield. All single point sensors shall be accurate to a minimum of ± 0.5 degrees F at 77 degrees

F calibration point. Duct averaging sensors shall be accurate to a minimum of ± 1.0 degrees F.

2. CONTROL DAMPERS

Provide low leakage, galvanized steel control dampers with roll-formed steel frames and blades and oil-impregnated bronze bearings.

Leakage shall be no greater than 10 CFM per square foot at 4 in. W.C. with 20 in.-lbs. torque applied regardless of size.

Provide opposed blade type dampers unless indicated otherwise. All multi-section dampers shall be provided with factory linkage to allow for connection of actuator at one common point.

3. DAMPER ACTUATORS (ELECTRONIC)

Actuators shall be designed for mounting directly to the damper shaft without the need for connecting linkages.

All actuators having more than 100 in-lb torque output shall accept a 1” diameter shaft directly without the need for auxiliary adapters and shall have a self-centering damper shaft clamp that guarantees concentric alignment of the actuator’s output coupling with the damper shaft.

All actuators shall be designed to withstand a continuous stall condition throughout the full range of rotation without premature failure, or degradation in performance. The actuator shall resume normal operation once the stall condition has been eliminated.

All spring return actuators shall be capable of both clockwise and counterclockwise spring return fail-safe operation and shall use a continuously engaged mechanical return spring that returns the actuator to a fail-safe position in response to a loss of power.

Actuators shall provide a means of manually positioning the output coupling in the absence of power.

Actuators shall not require more than 10VA power draw at any time.

Modulating actuators shall be capable of accepting a 0-10Vdc, 4-20ma or floating point control signal and shall provide an easily readable high contrast position indicator.

All actuators shall be UL873 listed.

4. CONTROL VALVES

Modulating Valves 2" and Smaller: Bronze body and seat with stainless steel stem and screwed ends. ANSI Class 250 body rating. Suitable for fluid temperatures of up to 300 degrees F. Equal percentage flow characteristics capable of smooth operation at differential pressures present in system.

Modulating Valves 2-1/2" and Larger: Cast iron body with bronze trim and stainless steel stem and flanged ends. ANSI Class 125 body rating. Suitable for fluid temperatures of up to

300 degrees F. Equal percentage flow characteristics capable of smooth operation at differential pressures present in system.

Sizing: Modulating control valves shall be correctly selected for service and flow of system served.

5. VALVE ACTUATORS

All modulating valve actuators shall be 24vac electric motor type; floating point, 0-10Vdc, 0-16Vdc or other industry standard input signal type. Actuators shall function properly within the range of 85 to 110 percent of line voltage.

Provide actuators in sufficient size, quantity and type to match application.

Actuators shall be spring return as indicated by Normally Closed or Normally Open designation on drawings or in sequence of operation.

6. LOW TEMPERATURE DETECTION THERMOSTATS

Provide low temperature control thermostat, electric type manual reset, non-averaging 20 feet long sensing elements that switch whenever any 6 inch section or more of any portion senses a temperature as low as the thermostat setpoint as specified in sequences.

Provide with two sets of contacts, one for hardwired fan shutdown and one for remote monitoring.

7. DIFFERENTIAL PRESSURE SWITCHES

Provide air and liquid differential pressure switches for status of pumps and fans as called out in sequences and input/output summary.

Diaphragm-operated SPDT snap switch with ranges from .05" W.G to 12.0" W.G. for air. Airflow switch shall be Powers SW141 or approved equal.

8. CURRENT SENSING RELAYS

Provide current sensing relays for status of fans or pumps as called out in sequences or input/output summary. Provide with field adjustable current set point range.

9. DUCT STATIC OR VELOCITY PRESSURE TRANSMITTERS

Provide integral pressure transducer and transmitter in enclosure suitable for external duct mounting. 4-20ma output proportional to the input pressure span.

Transmitter range shall be selected so that the normal operating setpoint is midway between the upper and lower range of the transmitter.

Each transmitter shall have field adjustable span and zero adjustments for field calibration. Accuracy ± 1.0% of full scale. Linearity ± 0.1%.

Provide for sensing line blow-down and clean out without effecting system operation.

10. BUILDING STATIC PRESSURE TRANSMITTERS

Provide integral pressure transducer and transmitter in enclosure suitable for wall or panel mounting. 4-20ma output proportional to the input pressure span.

Transmitter range shall be selected so that the normal operating setpoint is midway between the upper and lower range of the transmitter. Transmitter range shall be unidirectional.

Each transmitter shall have field adjustable span and zero adjustments for field calibration. Accuracy ± 1.0% of full scale. Linearity ± 0.1%.

11. LIQUID OR STEAM PRESSURE TRANSMITTERS

Provide integral pressure transducer and transmitter in enclosure suitable for exposed mechanical room or panel mounting. 4-20ma output proportional to the input pressure span.

Internal components shall be selected appropriate for the sensed medium taking temperature, pressure, corrosive properties and medium consistency into account.

Transmitter range shall be selected so that the normal operating setpoint is midway between the upper and lower range of the transmitter. Transmitter shall be rated for a minimum of 125% of maximum expected system operating pressures.

For differential pressure sensing applications, provide transmitter unit with 3-valve manifold to allow unit to be serviced without draining system.

Each transmitter shall have field adjustable span and zero adjustments for field calibration. Accuracy ± 1.0% of full scale. Linearity ± 0.1%.

12. STEAM OR LIQUID METERS

Provide a 4-20ma transmitter output linearly scaled to the pressure being sensed. Transmitter range shall be selected so that the normal operating setpoint is midway between the upper and lower range of the transmitter. Infra-red transmitter.

Each transmitter shall have field adjustable span and zero adjustments for field calibration. Transmitter accuracy shall be ± 0.25% of calibrated span including the combined effects of linearity, hysteresis and repeatability. Units shall be provided with a watertight NEMA Type 4 electrical enclosure with ½" NPT conduit connection.

13. PRESSURE SAFETY SWITCHES

Provide static pressure high limit switches as required by sequence of operation to sensing duct over pressure condition. Provide with adjustable setpoint. Provide with spare contacts for monitoring by DDC system.

Switch shall be suitable for duct mounting.

14. CARBON DIOXIDE SENSOR

Provide Non-Dispersive Infra-Red (NDIR) carbon dioxide sensor suitable for room mounting. 4-20ma output signal corresponding to input CO2 concentration.

Range 0-2000 PPM. Accuracy ±3% of full scale. Repeatability ±1% of full scale.

Provide with a complete field calibration kit for initial startup including a CO2 canister.

15. CARBON MONOXIDE SENSOR

Provide single channel, solid-state sensor capable of generating a 4-20ma signal corresponding to carbon monoxide levels of 0-500 PPM. Calibrated for typical CO levels of 50-100 PPM.

Sensing element shall be rated for a minimum of 2 years of service and shall be completely field replaceable.

Suitable for temperature ranges of 32-120 degrees F. Accuracy ± 3% of full scale. repeatability ± 1 % of full scale.

16. REFRIGERANT DETECTOR

Provide self-contained CFC or HCFC as required refrigerant vapor detector capable of detecting hazardous gas levels. Provide with alarm contacts for 2 separate concentration levels as indicated. Self-contained unit shall also be provided with local audible and visual alarm indication based on preset alarm levels.

Provide QEL model QAS-10128 or approved equal.

17. DUCT AIRFLOW MEASURING STATIONS

Provide as indicated on floor plans for measuring air flow quantities through duct. Station shall consist of multiple insertion-type, Pitot tube probes designed to measure both the static and total pressures of the air in the duct and transmit a differential (velocity) pressure signal. Probes shall be installed across the entire width of the duct.

When more than one probe is required, provide 1/4” copper tube averaging manifolds for both sensing ports.

Accuracy ± 5%. Range 0-2500 FPM, minimum. Air Monitor Voluprobe/VS or approved equal.

18. HUMIDITY SENSORS

Combination sensor/transmitter measuring resistance change through bulk polymer sensor with accuracy at 77 degrees F of ± 2% RH between 20-95% RH including hysteresis, linearity and repeatability.

Output shall be 4-20mA, 2-wire, isolated loop powered, 0-100% linearly proportional.

Provide duct or outside air sensors complete with element guard and mounting plate.

19. DUCT SMOKE DETECTORS

Detectors shall be photoelectric or ionization type for sensing products of combustion within the airstream of ducted fan systems over 2000 cfm. Provide detector with sampling tube extending the width of the duct to provide a complete cross-sectional sampling. Visual indication of trouble or alarm condition shall be provided on the detector housing. An auxiliary set of contacts shall be provided for remote monitoring purposes and the alarm sequence shall comply with the project requirements.

20. INTERPOSING RELAYS

Track mounted SPDT relays (or as required) for all interposing applications.

IDEC or approved equal.

21. LEVEL SWITCHES

Provide single stage displacer-type level switch suitable for mounting at top of tank or sump. Displacer element shall be porcelain or stainless steel and shall slide up and down a stainless steel displacer cable as liquid level fluctuates. Displacer movement above or beyond designated level setpoint(s) shall actuate a pivoted magnet and trip an associated electric switch indicating a high or low level condition.

Provide NEMA 4 switch enclosure for mounting at top of level switch. Provide with flanged or threaded connection as appropriate.

Provide 2 sets of dry contacts within switching enclosure for remote level indication. For applications requiring switching of 120v motors, provide mercury switch suitable for application. Entire unit shall be FM approved.

23. DAMPER END SWITCHES
Not included

24. DIGITAL ENERGY MONITORS:

Provide three phase digital watt-meters with pre-wired CTs. All watt-meter electronics shall be housed within the CTs. CTs shall include sizes capable of mounting directly on a power bus. Diagnostics visible to the installing electrician (without a operator tool) shall indicate: proper operation, mis-wiring or low power-factor, device malfunction, and over-load condition. The meters shall include the following:

a. The device shall be UL Listed, and shall comply with ANSI C12.1 accuracy specification. The minimum CT/meter combined accuracy shall be no greater than 1% of reading over the range of 5% to 100% of rated load. The meter shall not require calibration
b. The wattmeter shall directly connect to power from 208 through 480 with no potential transformer. In-line fuses for each voltage tap phase shall be included.
c. The wattmeter CTs shall be split-core and at minimum be sized to accommodate loads ranging from 100 to 2400 Amps. The CTs shall be volt-signal type, and shall not require shorting blocks.
d. The wattmeter shall reside directly on the Floor Level Network along with other FLN devices. Data transferred shall include

- kW & kWH
- Consumption
- Demand
- Power Factor
- Current
- Voltage
- Apparent Power
- Reactive Power

WORKSTATION OPERATOR INTERFACE

Basic Interface Description

1. Operator workstation interface software shall minimize operator training through the use of English language prompting, 30 character English language point identification, on-line help, and industry standard PC application software. Interface software shall simultaneously communicate with up to 4 Building Level Networks and share data between any of the 4 networks. The software shall provide, as a minimum, the following functionality:

    a) Real-time graphical viewing and control of environment
    b) Scheduling and override of building operations
    c) Collection and analysis of historical data
    d) Point database editing, storage and downloading of controller databases.
    e) Alarm reporting, routing, messaging, and acknowledgment
    f) Display dynamic data trend plot.
        - Must be able to run multiple plots simultaneously
        - Each plot must be capable of supporting 10 pts/plot minimum
        - Must be able to command points directly off dynamic trend plot application.
    g) Definition and construction of dynamic color graphic displays.
    h) Program editing
    i) Transfer trend data to 3rd party software
    j) Scheduling reports
    k) Operator Activity Log
    l) Open communications via OPC Server
    m) Open communications via BACnet Client & Server

2. Provide a graphical user interface, which shall minimize the use of keyboard through the use of a mouse or similar pointing device and "point and click" approach to menu selection.

3. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. BAS software shall run on a Windows NT 32 bit operating. These Windows applications shall run simultaneously with the BAS software. The mouse or Alt-Tab keys shall be used to quickly select and switch between multiple applications. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BAS alarms and monitoring information.

a. Provide functionality such that any of the following may be performed simultaneously on-line, and in any combination, via user-sized windows. Operator shall be able to drag and drop information between applications, reducing the number of steps (i.e. Click on a point on the alarm screen and drag it to the dynamic trend graph application to initiate a dynamic trend).

1. Dynamic color graphics and graphic control

2. Alarm management, routing to designated locations, and customized messages

3. Year in advance event and report scheduling

4. Dynamic trend data definition and presentation

5. Graphic definition and construction

6. Program and point database editing on-line.

b. If the software is unable to display several different types of displays at the same time, the BAS contractor shall provide at least two operator workstations.

c. Report and alarm printing shall be accomplished via Windows Print Manager, allowing use of network printers.

4. Operator specific password access protection shall be provided to allow the user/manager to limit workstation control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (up to 999 user accounts shall be supported).

5. Reports shall be generated on demand or via pre-defined schedule and directed to either CRT displays, printers or disk. As a minimum, the system shall allow the user to easily obtain the following types of reports:

a. A general listing of all or selected points in the network
b. List of all points currently in alarm
c. List of all points currently in override status
d. List of all disabled points
e. List of all points currently locked out
f. List of user accounts and access levels
g. List all weekly schedules
h. List of holiday programming
i. List of limits and deadbands
j. Custom reports from 3rd party software
k. System diagnostic reports including, list of DDC panels on line and communicating, status of all DDC terminal unit device points

l. List of programs

6. Scheduling and override

Provide a calendar type format for simplification of time-of-day scheduling and overrides of building operations. Schedules reside in the PC workstation, DDC Controller, and HVAC Mechanical Equipment Controller to ensure time equipment scheduling when PC is off-line, PC is not required to execute time scheduling. Provide override access through menu selection or function key. Provide the following spreadsheet graphic types as a minimum:

a. Weekly schedules
b. Zone schedules, minimum of 200 unique zones
c. Scheduling for up to 365 days in advance
d. Schedule reports to print at PC.

7. Collection and Analysis of Historical Data

a. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard disk for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.

b. Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of at least six points. Provide additional functionality to allow predefined groups of up to 250 trended points to be easily transferred on-line to Microsoft Excel. DDC contractor shall provide custom designed spreadsheet reports for use by the owner to track energy usage and cost, equipment run times, equipment efficiency, and/or building environmental conditions. DDC contractor shall provide setup of custom reports including creation of data format templates for monthly or weekly reports.

c. Provide additional functionality that allows the user to view real-time trend data on trend graph displays. A minimum of ten points may be graphed, regardless of whether they have been predefined for trending. The dynamic graphs shall continuously update point values. At any time the user may redefine sampling times or range scales for any point. In addition, the user may pause the graph and take "snapshots" of screens to be stored on the workstation disk for future recall and analysis. Exact point values may be viewed and the graphs may be printed. A minimum of 8 true graphs shall run simultaneously. Operator shall be able to command points directly on the trend plot by double clicking on the point.

Dynamic Color Graphic Displays

1. Create color graphic floor plan displays and system schematics for each piece of mechanical equipment, including air handling units, chilled water systems and hot water boiler systems, and room level terminal units, shall be provided by the BAS contractor as indicated in the point I/O schedule of this specification to optimize system performance, analysis and speed alarm recognition.

2. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Graphics software shall permit the importing of Autocad or scanned pictures for use in the system.

3. Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention and without pre-defined screen refresh rates.

   a. Sizable analog bars shall be available for monitor and control of analog values; high and low alarm limit settings shall be displayed on the analog scale. The user shall be able to "click and drag" the pointer to change the setpoint.

   b. Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.

   c. Equipment state can be changed by clicking on the point block or graphic symbol and selecting the new state (on/off) or setpoint.

   d. State text for digital points can be defined up to eight characters.

4. Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable.

5. The windowing environment of the PC operator workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

6. Off the shelf graphic software, Microgafx Designer or Corel Draw software shall be provided to allow the user to add, modify or delete system graphic displays.

7. A clipart library of HVAC and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and laboratory symbols. The user shall have the ability to add custom symbols to the clipart library.

8. A dynamic display of the site specific architecture showing status of controllers, PC workstations and networks shall be provided.

System Configuration & Definition

1. Network wide control strategies shall not be restricted to a single DDC Controller or HVAC Mechanical Equipment controller, but shall be able to include data from

any and all other network panels to allow the development of Global control strategies.

2. Provide automatic backup and restore of all DDC controller and HVAC Mechanical Equipment controller databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate DDC Controller or HVAC Mechanical Equipment Controller. Changes made at the DDC Controllers or HVAC Mechanical Equipment Controllers shall be automatically uploaded to the workstation, ensuring system continuity.

3. System configuration, programming, editing, graphics generation shall be performed on-line. If programming and system back-up must be done with the PC workstation off-line, the BAS contractor shall provide at least 2 operator workstations.

Alarm Management

1. Alarm Routing shall allow the user to send alarm notification to selected printers or PC location based on time of day, alarm severity, or point type.

2. Alarm Notification shall be provided via two alarm icons, to distinguish between routine, maintenance type alarms and critical alarms. These alarm icons shall be displayed when user is working in other Windows programs. The BAS alarm display screen shall be displayed when the user clicks on the alarm icon.

3. Alarm Display shall list the alarms with highest priority at the top of the display. The alarm display shall provide selector buttons for display of the associated point graphic and message. The alarm display shall provide a mechanism for the operator to sort alarms.

4. Alarm messages shall be customizable for each point to display detailed instructions to the user regarding actions to take in the event of an alarm.

5. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. Any critical alarms shall have the capability of generating a user defined message and routing that message to any operator device or printer At no time shall the DDC controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

6. For projects with smoke control requirements, the DDC system shall be fully compliant with NFPA guidelines 92A and 92B for smoke control. System hardware shall be UL 864-UUKL listed for smoke control.

Workstation Communications

(Note: 1,1.a and 1.b are optional for use in dial-up applications**)**

1. Provide automatic dial-up communications for buildings as specified. Automatic dial-up communications shall include the following features as a minimum:

   a. Dial-Out

      1) Manual dial-out from the workstation to remote networks shall be accomplishable using only a mouse to select and request the desire remote connection.

   b. Dial-In

      1) Alarms shall automatically dial into the workstation for display at the terminal and for hard copy printout at the associated event printer.

      2) Alarms shall, at the operator's option, dial into a stand-alone modem-printer to provide for real-time alarm printouts even when the workstation is off-line (such as when it is being used to run operator-selected 3rd party software).

      3) Trend data shall be scheduled for automatic updating to the workstation at operator-selected times. The operator shall also have the option of manually collecting trend data at any time.

PORTABLE OPERATOR'S TERMINAL (POT)

Industry-standard, commercially available Portable Operator Terminals (POT's) with a LCD display and a full-featured keyboard. The POT shall be handheld and plug directly into all BLN & FLN Controller as described below. Provide a user-friendly, English language-prompted interface for quick access to system information, not codes requiring look-up charts.

Functionality of the portable operator's terminal connected at any Standalone DDC Controller:

1. Access all BLN & FLN Controllers on the network.

2. Backup and/or restore BLN Controller databases for all system panels, not just the Standalone DDC Controller interfaced to the POT.

3. Display all point, selected point and alarm point summaries.

4. Display trending and totalization information.
   Add, modify and/or delete any existing or new system point.
   Command, change setpoint, enable/disable any system point.
   Program and load custom control sequences as well as standard energy management programs.

5 Acknowledge alarms.

Functionality of the portable operator's terminal connected to any FLN Controller:

1. Provide connection capability at either the FLN Controller or a related room sensor to access controller information.
2. Provide status, setup and control reports.
3. Modify, select and store controller database.
4. Command, change setpoint, enable/disable any controller point.

Connection of a POT to a BLN or FLN Controller shall not interrupt nor interfere with normal network operation in any way, prevent alarms from being transmitted or preclude centrally-initiated commands and system modification.

Portable operator terminal access to controller shall be password-controlled. Password protection shall be configurable for each operator based on function, points (designating areas of the facility), and edit/view capability.

Section 3. Procedure for Proposal of an Alternate Product

The County is aware that changes in technology can produce improvements in products now is service. DPWT is responsible for keeping County building control systems standard in installation and consistent with current technology. Vendors or others may want to submit products they believe are suitable alternatives to the current standard. The following procedure is provided so those vendors of such products can present them to the County Review Committee for evaluation and possible inclusion in the County Standard.

At no cost to the County, vendors may:

A. Contact DPWT-DCD and ask for managers who manage the product to be submitted for evaluation.

B. Submit specifications to the manager on the product.

C. The manager will give the specifications to the HVAC Review Committee along with the vendor’s name and contact number.

D. A member of the Review Committee will be assigned to assess the product and establish a suitable test environment.

E. The vendor, with the Review Committee member, will produce a written test procedure. The test procedure will specify:

1. Identity of the product and purpose of the test.
2. An itemized parts list.
3. A drawing of the test installation.
4. A test beginning date and end date.
5. The removal procedure for the test product.

F. The vendor shall supply the material and labor necessary to complete the test installation and removal.

G. The County may assign an appropriate person or persons to assist with the test installation.

H. The Review committee member assigned to the test will produce a written evaluation of the test product.

End of Section

SECTION 23 08 00

TESTING, ADJUSTING, BALANCING

The following guidelines are used by the county for soliciting bids from TAB firms on specific projects. These guidelines are provided as reference materials and are to be included in the Contract Documents. These guidelines will be provided to Contractors upon request.

To provide for the necessary coordination assistance between the Contractor and the TAB firm, include Testing, Adjusting, and Balancing, in the contract documents. The section should be edited to accommodate the specifics of the project. Consult with the Project manager regarding specific items.

A. Scope

These standards and procedures apply to the testing, adjusting and balancing of all equipment and components to assure the optimum performance of mechanical systems.

Quality Assurance Qualifications

1. Balancing and testing of the Heating, Ventilation and Air Conditioning (HVAC) Systems will be performed by a qualified firm specializing in HVAC systems testing, adjusting, and balancing and noise level measurement. Systems shall be tested after installation and as part of commissioning.

2. Qualifications Requirements:

    a. Certified member of the Associated Air Balance Council (A.A.B.C.) or National Environmental Balancing Bureau (N.E.B.B.).

    b. Submit a current list of projects, including references and phone numbers, and name of principal technician.

All work shall proceed under the general direction of Project Manager which shall provide coordination between the Contractor, A/E, and Central Plant.

B. Design Criteria

Codes, Regulations and Standards

All work shall conform to the following Codes, Regulations, and Standards of latest issue.

1. Associated Air Balance Council (AABC), "National Standards for Field Management and Instrumentation Total System Balance," Volume One, No. 81266.

2. ASHRAE Handbook, 1987 HVAC Systems and Applications, Chapter 57.

3. AMCA Publication 203 Fan Application Manual, Part 3, Field Performance Measurement.

4. National Institute of Health (NIH)

5. Industrial Ventilation Guide, American Conference of Governmental Industrial Hygienist.

6. National Environmental Balancing Bureau (NEBB)

Design Review and Submittals

1. The Testing, Adjusting, and Balancing (TAB) firm shall prepare and submit, prior to any balancing work, a work schedule following but not limited to the one outlined in Execution.

2. All requirements for design review meetings and submittals shall be adhered to according to the Schedule of Work.

C. Balancing Reports

1. Report Submittals

   a. First submittal: Two (2) copies of rough draft report, to include narratives that describes (a) all problem areas that may require major construction or design changes and (b) the building control systems to demonstrate comprehension of the job system operation.

   b. Intermediate submittals: Three (3) copies of complete report for approval by theProject Manager and the Consultant A/E for Record.

   c. Final submittal: Three (3) copies of the approved report.

      1) Bind each copy of the manual as single volumes in 3 ring binders. Imprint bound edge of volumes with the name of the building and the words "Testing, Adjusting, and Balancing Report". Imprint front of the volume with the name of the building, project name, project number, Owner, General Contractor, Mechanical Subcontractor, Architect, Mechanical, Engineer, and the TAB firm.

2. The report shall include a narrative and the data necessary to describe the system(s), operating equipment, and how they function. Identify equipment using the construction drawing identifiers. Provide ventilation and heating hot water piping riser diagrams if either one is not already a part of the construction drawings. Include the following data:

   a. Fans:

      1) Installation data:
         a) Manufacturer and model

b) Size and type
c) Arrangement, discharge, class
d) Motor HP, voltage, hertz, frame, and full load amps
e) Identification data

2) Design data:
a) Total cfm (for exhaust hoods fan flow must agree with hood design requirement)
b) Static pressure (total)
c) Motor HP, rpm and amp
d) Fan rpm
e) System or service

3) Fan recorded/measured data:
a) Cfm
b) Static pressure
c) Rpm
d) Motor operating amp, volts
e) Motor operating bhp (calculated)
f) Drive sizes (sheaves, belts & shaft)
g) Fan curve cfm based on fan data
h) Date of readings

b. Duct Systems:

1) Duct cfm - mains:
a) Duct size (s)
b) Number of pressure readings
c) Tabulation of velocity measurements
d) Average velocity
e) Duct measured cfm (each)
f) Duct design cfm

c. Individual air terminals:

1) Supply, return, or exhaust terminal identification (room number, name location and number designation)

2) Manufacturer's catalog identification and type

3) Application factors (velocity, effective area, flow direction), etc.

4) Design and recorded velocities - fpm

5) Design and recorded quantities - cfm

d. Controllable air devices/boxes:

1) Identification (room or suite number and name)

2) Manufacturer's catalog identification and type

3) Applicable controller

4) Effective flow area

5) Maximum measured velocity or flow and static pressure

6) Minimum measured velocity or flow and static pressure

e. Fume Hoods:

1) Identification (room or suite number and name and number designation) and location

2) Manufacturer's name, model, or size, and type (i.e., fume, perchloric, walk-in, canopy, or bio-safety)

3) Inlet face area of hood with sash at maximum height (with sash stop released)

4) Design is inlet flow at 100 fpm through inlet face

f. Pumps:

1) Installation data:
   a) Manufacturer and model
   b) Size
   c) Type drive
   d) Motor HP, voltage, phase and full load amp
   e) Identification data

2) Design data:

   a) Gpm
   b) Head
   c) Rpm
   d) Bhp and amp

3) Recorded data:

   a) Discharge pressure (full-flow and no-flow)
   b) Suction pressure (full-flow and no-flow)
   c) Gpm from pump curve
   d) Operating head
   e) Operating gpm (from pump curves if no meter)
   f) No-load amps (where possible)

g) Full-flow amp
h) No-flow amp
i) Calculated Bhp
j) Seal water flow, gpm

g. Heat reclaim unit:

1) Design data and recorded data

a) Manufacture, model, and type
b) Size
c) Design flows, temperatures, and efficiencies
d) Air pressure drop across unit supply and exhaust
e) Entering and leaving temperatures
f) Calculated CFM through sections
g) Calculated heat gain or rejection and efficiency

h. Fan coil/Unit heater:

1) Design data and recorded data:

a) Mbh
b) Gpm
c) Entering and leaving water temperature
d) Entering and leaving supply air temperature
e) Supply air cfm
f) Exhaust air cfm
g) Water pressure drop
h) Identification data
i) Motor, hp, frame, rpm, amps, phases, and volts
j) Fan rpm, bhp, amps
k) System static pressure, in H2O

i. Fan Drives and Pump Impellers

1) Provide final drive size information and necessary pump impeller changes for each fan or pump.

a) Driven pulley pitch diameter, bushing and shaft size.
b) Belt size and quantity.
c) Drive pulley pitch diameter, bushing and shaft size.
d) Impeller diameter and type.

D. Execution

1. Schedule of Work

All preparations and execution of work shall proceed according to the following schedule to include, but not be limited to, the following items:

a. Provide a complete set of work sheets to specify each piece of equipment and show each terminal device.

b. Make a "first pass" through the entire system (approximately one month prior to beginning any work) to determine the critical path and to locate possible construction or design problems.

c. Following this inspection, the TAB firm shall:

   1) Immediately submit a report, if necessary, to the Project Manager of any construction or design deficiencies that could delay or affect balancing.

   2) Meet with The Project Manager to discuss the results and determine the scope of work to be completed by the Contractor and/or A/E.

d. Project Management will meet with Contractor and A/E to determine schedule to complete work and resolve problems.

e. A/E ensures that work is properly and sufficiently completed to the extent that testing, adjusting. and balancing shall continue uninterrupted to completion.

f. Meet with A/E to determine scope of work to be completed in "second pass."

g. Make additional pass through system and complete the majority of the balancing. The area should be ready for complete occupancy at the end of this phase of the work.

h. Provide three (3) copies of the rough draft of the report to the Project Manager, and the Consultant A/E. This should include the narrative that describes all problem areas that may require major construction or design changes.

i. Meet with Project Manager and Consultant A/E to discuss the report and determine the scope of work to complete the work.

j. Complete the field work so that the system is completely balanced and mark all dampers to show the final settings.

k. Complete the report and submit three (3) copies to the Project Manager and Consultant A/E for review.

l. Meet with Project Manager

19. 15990 -- Testing, Adjusting, Balancing **(IS THIS A REPEAT OF TEXT ABOVE?? A MISTAKE OR ARE WE GOING ON TO SOMETHING DIFFERENT THAN ABOVE??**

The following guidelines are used by the County for soliciting bids from TAB firms on specific projects. These guidelines are provided as reference materials and are to be included in the Contract Documents. These guidelines will be provided to Contractors upon request.

To provide for the necessary coordination assistance between the Contractor and the TAB firm, include Appendix E, Testing, Adjusting, and Balancing, in the contract documents. The appendix should be edited to accommodate the specifics of the project. Consult with the Project regarding specific items.

A. Scope

These standards and procedures apply to the testing, adjusting and balancing of all equipment and components to assure the optimum performance of mechanical systems.

Quality Assurance Qualifications

1. Balancing and testing of the Heating, Ventilation and Air Conditioning (HVAC) Systems will be performed by a qualified firm specializing in HVAC systems testing, adjusting, and balancing and noise level measurement. Systems shall be tested after installation and as part of commissioning.

2. Qualifications Requirements:

   a. Certified member of the Associated Air Balance Council (A.A.B.C.) or National Environmental Balancing Bureau (N.E.B.B.).

   b. Submit a current list of projects, including references and phone numbers, and name of principal technician.

All work shall proceed under the general direction of Project Management which shall provide coordination between the Contractor, A/E, and Central Plant.

B. Design Criteria

Codes, Regulations and Standards

All work shall conform to the following Codes, Regulations, and Standards of latest issue.

1. Associated Air Balance Council (AABC), "National Standards for Field Management and Instrumentation Total System Balance," Volume One, No. 81266.

2. ASHRAE Handbook, 1987 HVAC Systems and Applications, Chapter 57.

3. AMCA Publication 203 Fan Application Manual, Part 3, Field Performance Measurement.

4. National Institute of Health (NIH)

5. Industrial Ventilation Guide, American Conference of Governmental Industrial Hygienist.

6. National Environmental Balancing Bureau (NEBB)

Design Review and Submittals

1. The Testing, Adjusting, and Balancing (TAB) firm shall prepare and submit, prior to any balancing work, a work schedule following but not limited to the one outlined in Execution.

2. All requirements for design review meetings and submittals shall be adhered to according to the Schedule of Work.

C. Balancing Reports

1. Report Submittals

   a. First submittal: Two (2) copies of rough draft report, to include narratives that describes (a) all problem areas that may require major construction or design changes and (b) the building control systems to demonstrate comprehension of the job system operation.

   b. Intermediate submittals: Three (3) copies of complete report for approval by theProject Manager and the Consultant A/E for Record.

   c. Final submittal: Three (3) copies of the approved report.

      1) Bind each copy of the manual as single volumes in 3 ring binders. Imprint bound edge of volumes with the name of the building and the words "Testing, Adjusting, and Balancing Report". Imprint front of the volume with the name of the building, project name, project number, Owner, General Contractor, Mechanical Subcontractor, Architect, Mechanical, Engineer, and the TAB firm.

2. The report shall include a narrative and the data necessary to describe the system(s), operating equipment, and how they function. Identify equipment using the construction drawing identifiers. Provide ventilation and heating hot water piping riser diagrams if either one is not already a part of the construction drawings. Include the following data:

   a. Fans:

      1) Installation data:
         a) Manufacturer and model
         b) Size and type
         c) Arrangement, discharge, class
         d) Motor HP, voltage, hertz, frame, and full load amps

e) Identification data

2) Design data:
a) Total cfm (for exhaust hoods fan flow must agree with hood design requirement)
b) Static pressure (total)
c) Motor HP, rpm and amp
d) Fan rpm
e) System or service

3) Fan recorded/measured data:
a) Cfm
b) Static pressure
c) Rpm
d) Motor operating amp, volts
e) Motor operating bhp (calculated)
f) Drive sizes (sheaves, belts & shaft)
g) Fan curve cfm based on fan data
h) Date of readings

b. Duct Systems:

1) Duct cfm - mains:
a) Duct size (s)
b) Number of pressure readings
c) Tabulation of velocity measurements
d) Average velocity
e) Duct measured cfm (each)
f) Duct design cfm

c. Individual air terminals:

1) Supply, return, or exhaust terminal identification (room number, name location and number designation)

2) Manufacturer's catalog identification and type

3) Application factors (velocity, effective area, flow direction), etc.

4) Design and recorded velocities - fpm

5) Design and recorded quantities - cfm

d. Controllable air devices/boxes:

1) Identification (room or suite number and name)

2) Manufacturer's catalog identification and type

3) Applicable controller

4) Effective flow area

5) Maximum measured velocity or flow and static pressure

6) Minimum measured velocity or flow and static pressure

f. Fume Hoods:

1) Identification (room or suite number and name and number designation) and location

2) Manufacturer's name, model, or size, and type (i.e., fume, perchloric, walk-in, canopy, or bio-safety)

3) Inlet face area of hood with sash at maximum height (with sash stop released)

4) Design is inlet flow at 100 fpm through inlet face

f. Pumps:

1) Installation data:
   a) Manufacturer and model
   b) Size
   c) Type drive
   d) Motor HP, voltage, phase and full load amp
   e) Identification data

2) Design data:

   a) Gpm
   b) Head
   c) Rpm
   d) Bhp and amp

3) Recorded data:

   a) Discharge pressure (full-flow and no-flow)
   b) Suction pressure (full-flow and no-flow)
   c) Gpm from pump curve
   d) Operating head
   e) Operating gpm (from pump curves if no meter)
   f) No-load amps (where possible)
   g) Full-flow amp
   h) No-flow amp
   i) Calculated Bhp

j) Seal water flow, gpm

g. Heat reclaim unit:

1) Design data and recorded data

a) Manufacture, model, and type
b) Size
c) Design flows, temperatures, and efficiencies
d) Air pressure drop across unit supply and exhaust
e) Entering and leaving temperatures
f) Calculated CFM through sections
g) Calculated heat gain or rejection and efficiency

h. Fan coil/Unit heater:

1) Design data and recorded data:

a) Mbh
b) Gpm
c) Entering and leaving water temperature
d) Entering and leaving supply air temperature
e) Supply air cfm
f) Exhaust air cfm
g) Water pressure drop
h) Identification data
i) Motor, hp, frame, rpm, amps, phases, and volts
j) Fan rpm, bhp, amps
k) System static pressure, in H2O

i. Fan Drives and Pump Impellers

1) Provide final drive size information and necessary pump impeller changes for each fan or pump.

a) Driven pulley pitch diameter, bushing and shaft size.
b) Belt size and quantity.
c) Drive pulley pitch diameter, bushing and shaft size.
d) Impeller diameter and type.

D. <u>Execution</u>

1. Schedule of Work

All preparations and execution of work shall proceed according to the following schedule to include, but not be limited to, the following items:

a. Provide a complete set of work sheets to specify each piece of equipment and show each terminal device.

b. Make a "first pass" through the entire system (approximately one month prior to beginning any work) to determine the critical path and to locate possible construction or design problems.

c. Following this inspection, the TAB firm shall:

   1) Immediately submit a report, if necessary, to the Project Manager of any construction or design deficiencies that could delay or affect balancing.

   2) Meet with The Project Manager to discuss the results and determine the scope of work to be completed by the Contractor and/or A/E.

d. Project Management will meet with Contractor and A/E to determine schedule to complete work and resolve problems.

e. A/E ensures that work is properly and sufficiently completed to the extent that testing, adjusting. and balancing shall continue uninterrupted to completion.

f. Meet with A/E to determine scope of work to be completed in "second pass."

g. Make additional pass through system and complete the majority of the balancing. The area should be ready for complete occupancy at the end of this phase of the work.

h. Provide three (3) copies of the rough draft of the report to the Project Manager, and the Consultant A/E. This should include the narrative that describes all problem areas that may require major construction or design changes.

i. Meet with Project Manager and Consultant A/E to discuss the report and determine the scope of work to complete the work.

j. Complete the field work so that the system is completely balanced and mark all dampers to show the final settings.

k. Complete the report and submit three (3) copies to the Project Manager and Consultant A/E for review.

l. Meet with Project Managerand Consultant A/E for final review comments.

m. Complete the report and provide three (3) bound copies to Project Manager.

n. Final acceptance of the general construction contract shall occur when all testing, adjusting, and balancing work is completed.

2. Testing Equipment

   Instrumentation shall be provided by Contractor as necessary and appropriate to perform the work. The type and number of instruments utilized shall be determined by the type of systems involved and the number of personnel required to complete the work by the time stipulated. The instruments shall be recently factory calibrated and shall be used with the factory-determined application factors. This instrumentation shall include, as appropriate, but not be limited to the following, or approved equal:

   a. Ammeter, clamp-on type, Amprobe

   b. Anemometer, 4" Biram type

   c. Anemotherm, Anemostat Model 60

   d. Pitot tube and air velocity meter, Dwyer Model 400

   e. Pyrometer, contact type Alnor Type 4200

   f. Speed indicator, J.B. Biddle "Jagabi"

   g. Static pressure gauges, Dwyer "Magnehelic", 0 to 4" wg; 0-10" w.g.

   h. Velometer, Alnor Type 3002

   i. Terminal (cfm) flow measuring hood

3. General Testing, Adjustment, and Balancing Procedures

   a. Care shall be exercised while performing the work so as to avoid damaging the work of other trades, particularly paint and ceilings. Where damage is inevitable to gain access to the various devices, the Contractor shall be notified so that appropriate corrections can be made and proper accessibility provided. Damage incurred by the TAB firm shall be it's responsibility to correct.

   b. Records shall be maintained at all times which shall readily indicate all steps, adjustments, and intermediate and final readings. The records shall indicate on each trial whether a damper or balancing device was cut or opened. The records shall be maintained on reproduceable type forms which shall include measurement locations, design capacities, appropriate manufacturers' performance factors, and dates and names of personnel involved.

   c. Final settings shall be clearly marked on each balancing valve, quadrant, etc.

   d. Frequently work will have to be performed in areas that are partially or fully occupied, which may require the work to be accomplished during other than normal working hours. Such occupancy shall not be considered justification for any deviation for the requirements outlined herein or any extra payments.

Where overtime work is required for expeditious completion of the balancing work, payment of premium rates for such work shall not be allowed without specific approval of the Project Manager in writing, in advance.

e. System operation will be by the county Engineers to suit the requirements of the balancing work. System filters shall be new at start of testing, adjustment, and balancing work.

f. Resourcefulness is frequently required in order to properly balance some of the more complex and intricate systems. This may dictate the use of methods and techniques not herein before stated. Where "standard" balancing procedures cannot, due to physical conditions or other circumstances be employed, alternate methods shall be determined and approved by Project Managerand Consultant A/E.

4. Air System Procedures

a. Measure and adjust all ventilation openings on all systems to produce the air flow rates shown on the contract drawings. Air flow rates, as adjusted, shall be within a tolerance of plus or minus 5% from the design rates shown on the contract drawings. Where this is not possible or reasonable the reasons should be clearly documented in the final report. In addition to physical problems, energy consumption and noise reduction should be considered in recommending possible deviations.

b. When complete, at least one air path from each fan, or each high pressure mixing box, to an air outlet or inlet shall have all volume dampers wide open. This path shall be clearly identified. This is to ensure minimum static pressure buildup in the system as a result of balancing.

c. Determine the minimum operating static pressure required to deliver the required air volumes, for each inlet vane controlled fan or other automatic static pressure regulator, and note the setting adjacent to the regulator and on the record sheets.

d. The total air volume handled by each system shall be measured, and recorded, by readings taken at appropriate locations in the fan intake or discharge plenums. These measurements shall be compared with the design system volumetric rate and the individual inlet or outlet readings to correlate and substantiate the system measurements.

e. Determine drive ratio changes required in order to obtain the optimum operating fan speeds, review in detail with the Consultant A/E and the Project Manager, and recommend such changes in writing. Fan speed changes shall not be made without the approval of the Project Manager.

f. After final drive ratio changes have been completed, make a final set of readings, and adjustments if necessary to ensure the system balance. Record the final fan rpm, pulley sheave and belt sizes, and motor amperage.

5. Water System Procedures

a. Measure and adjust all radiation, coils, heat exchangers, etc., that constitute a part of the heating and/or cooling system, to produce the capacities shown on the contract drawings.

b. Flow rates may be determined by temperature differentials between the entering and leaving water conditions or by total energy transfer calculations involving air volumes, entering and leaving air temperatures, and entering and leaving water temperatures.

c. All measurements shall be made with the design air flow rates air entering temperatures, and flow water temperatures existing during the balancing process. If this is not possible, review with the Project Manager and Consultant A/E and agree on an alternate scheme, in writing.

d. Capacities, as adjusted, shall be within a tolerance of plus or minus 5% from the design ratings shown on the contract drawings or, when leaving water temperatures are used to indicate a balanced condition, within a tolerance of plus or minus 1^{o}F.

e. When complete, at least one path from the pump discharge to the pump intake, except for the balancing valve used to set the pump operating head, shall have all balancing valves wide open. This is to ensure minimum friction drop in the system as a result of balancing.

f. Using appropriately located flow meters or pressure gauges and the pump manufacturer's pump curves, set the operating pressure differential across the pumps to develop the correct flow rates.

Testing, Adjusting, and Balancing Specification

The following Guide Specification is intended to be modified and included into the Contract Documents. Items to be modified should be done in the consultation with the Project Manager and the Consultant A/E.

Part 1 - General

1.01 Scope

A. Contractor shall start-up and operate the mechanical systems, and assist the Testing, Adjusting, and Balancing (TAB) firm as required.

B. Owner shall contract for the TAB firm to perform the final testing, adjusting, and balancing of the following systems:

1. chilled water;
2. supply air;
3. return air;
4. exhaust air;
5. condenser water;
6. heat recovery;
7. air-cooled condensers; and
8. heating hot water.

C. Leak tests as specified elsewhere.

1.02 Start-up

A. Before starting the mechanical systems, provide a certificate stating that the systems are ready for start-up and the following conditions have been met:

1. safety controls installed and fully operational;
2. qualified personnel available to operate the systems;
3. permanent electrical connections made to all equipment;
4. chiller started up and adjusted by factory technicians;
5. clean air filters installed;
6. pump and fan drives properly aligned;
7. mechanical equipment rooms, including plenums, vacuum cleaned;
8. control devices calibrated, including air terminal unit volume controllers; and
9. verify that the minimum overload relay rating is not less than the full load current of each motor to allow the motor to be operated at full load current;
10. open fire dampers and volume dampers;
11. position manual valves for normal system operation.

Part 2 - Execution

2.01 Testing, Adjusting, and Balancing

A. Notify the Owner at least thirty (30) days before the balancing work can be started. Balancing shall not commence until all systems have been cleaned and treated and start-up requirements have been completed.

B. Contractor and its subcontractors shall coordinate its work with, and assist with, the Owner's TAB firm as required, to include, but not limited to:

1. Furnish ladders, scaffold, staging, and accessories as required; change fan drive, provide sheaves and pump-impellers as required; arrange for access to all dampers, valves, and balancing devices and operate equipment during time TAB work is being performed. Control contractor and sheet metal contractor shall be made available as their services are required.

2. Remove and replace ceiling tile as necessary. The extent of ceiling tile removal for access and the time schedule of removal and replacement shall be as directed by the TAB firm.

C. Work with the TAB firm to:

1. provide sufficient time for testing and balancing prior to substantial completion;
2. make corrections to achieve system balance without delay;
3. adjust fan drives, and provide sheaves and belts as directed by the TAB firm to achieve system balance;
4. maintain all systems in full operation during the complete testing and balancing period;
5. employ control technicians to make necessary adjustments to the control systems to facilitate the balancing process;
6. Check and realign any V-belt drives and/or shaft coupling drives if they have been adjusted during the balancing process; and
7. provide pump-impellers to achieve the specified flow rates.

D. Allowable deviation in the measured quantities shall not exceed plus/minus 5% of the design. Contractor shall correct any part of the air and water systems affecting balancing and/or temperature control.

End of Section

SECTION 23 20 00

Pumps

A. Scope

These standards and procedures apply to the selection and installation of pumps for hot water circulation, sump and steam condensate return systems. Not included are vacuum pumps, heat pumps, sewage lift stations, ejectors, air pumps, or piston pumps. Related sections include Fire Protection (15300) Plumbing (15400) and Central Cooling Water Systems (15535).

B. Design Criteria

Codes, Regulations and Standards

1. All work shall conform to the following codes, regulations and standards of latest issue:

2. The International Building Codes

3. Underwriters Laboratories Standards

4. NFPA 20 Standards

5. American Hydraulic Institute.

Design Review and Submittals

1. Design submittals of related systems shall include pump data showing impeller diameter and complete pump curves through full operating range
.
2. The schematic design and design development submittals shall include pump sizing calculations.

General Requirements

1. Pump selection shall be based on the highest efficiency nonproprietary products available.

2. Piping system design shall be based on ensuring lowest brake-horsepower per unit flow rate at maximum flow and head.

3. Pumps shall be located where easily accessible for service, yet isolated to prevent pumping or vibration source noise from disturbing the occupied area.

4. Stand-by pumps shall be provided only where a short duration shut-down for repairs and maintenance cannot be tolerated.

Specific Requirements

1. Pumps shall not operate at more than 1800 rpm.
2. Centrifugal type pumps should be selected so that shut-off head is not more than 25% greater than operating head.

3. The pump head shall be calculated and included in system design computations.

4. Where the pump inlet is above water supply level, both suction and total head shall be included in design computations.
5. Pump shall be designed to install on the concrete pad with vibration isolators.

Specific Requirements

1. Do not use “Or Equal” or “Equivalent” in the spacification. Specify three manufacturers’ names.

1. Pumps shall not operate at more than 1800 rpm.

2. Centrifugal type pumps should be selected so that shut-off head is not more than 25% greater than operating head.

3. The pump head shall be calculated and included in system design computations.

4. Where the pump inlet is above water supply level, both suction and total head shall be included in design computations.

5. "In-the-line" circulators shall only be used for extremely small capacity requirements. If used, they shall be located where they may be conveniently maintained. Isolation gate valves should be on each side of the pump.

6. Both suction and discharge lines of the pump shall be equipped with pressure gauges.

7. Discharge lines of the pump shall be equipped with thermometers.

9. Designer shall design the hot, chilled and condenser water circulating system with at least two identical pumps in sizes and capacities, one main and one stand-by. The pumps controlled shall be strategize to operate in cycle.

C. Products, Materials, and Equipment

1. The pump unit shall be a complete, integrated unit consisting of pump, motor, shaft, frame, and base; as manufactured and assembled at the factory.

2. Pumps shall be centrifugal, end suction type with vertically split casing.

3. Close coupled pumps shall be used for most applications unless the capacity and service justifies a frame-mounted type.

4. Chilled and hot water pumps shall be frame-mounted, not close coupled, so that the entire casing and connections may be completely insulated.

5. Mechanical seals shall be provided on all pumps.

6. Mechanical seals for hot water heating pumps shall be certified by the pump manufacturer to be suitable for the maximum expected water temperature and chemical treatment used.

7. Hot water pumps not designed for exposure to water containing ferrous oxides must be equipped with bypass connections to keep seals flushed.

8. Pump casings should have tappings for gauges which shall be equipped with pipe extensions and shut-off valves for gauge installations.

9. Large pumps should have an air cock in the casing.

10. Sump-type condensate pumps shall be vertical shaft type with the motor located above the sump; submersible pumps shall not be used.

11. Sump and condensate pumps shall be in duplex or simplex arrangement.

12. Condensate pumps should be floor mounted, cast iron type, and guaranteed for 210° F. water without flashing.

13. Hot well type condensate pumps shall have a cast iron or concrete sump.

14. The pumps shall be equipped with Variabl Frequency Drive (VFD).

D. Execution

1. Locate pumps in mechanical spaces with easy access whenever possible.

2. Floor mounted pumps shall be on concrete bases, four (4) inches minimum height, and grouted to the base.

3. Provide guards over shafts and couplings in accordance with WISHA/OSHA requirements.

4. Pumps shall be accessible for service and maintenance: with a minimum of 36 inches on two adjacent sides.

5. Each pump shall be isolated with full size gate valves and unions or flanges for easy removal for service, and hose fitted drain valves.

6. Pumps without gauge tappings shall be otherwise fitted with inlet and outlet gauges and shut-off cocks.

7. Provide balancing valve in the pump discharge piping so the design flow rate may be set.

8. Controls for condensate pumps shall provide for "lead-lag" start and shall automatically alternate the pumps on the "lead" start.

10. Provide all pumps with inlet strainers as part of the piping or pump inlet accessories.

11. Submit as-built drawings of systems with pump installations shown and maintenance/service manuals at job close out.

End of section

Kinetic Pump Types

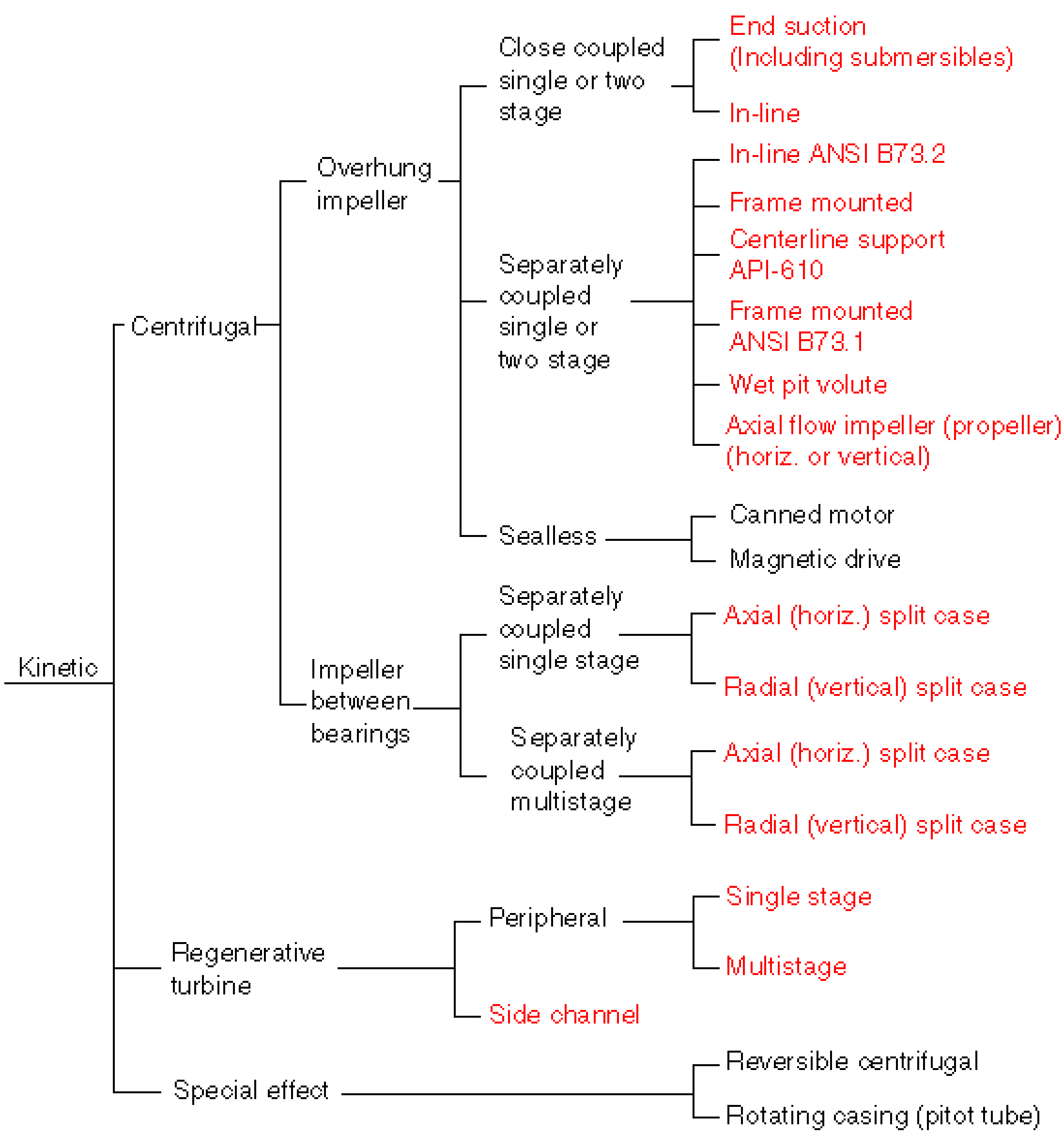


Figure 1.1 — Kinetic type pumps

Vertical Pump Types

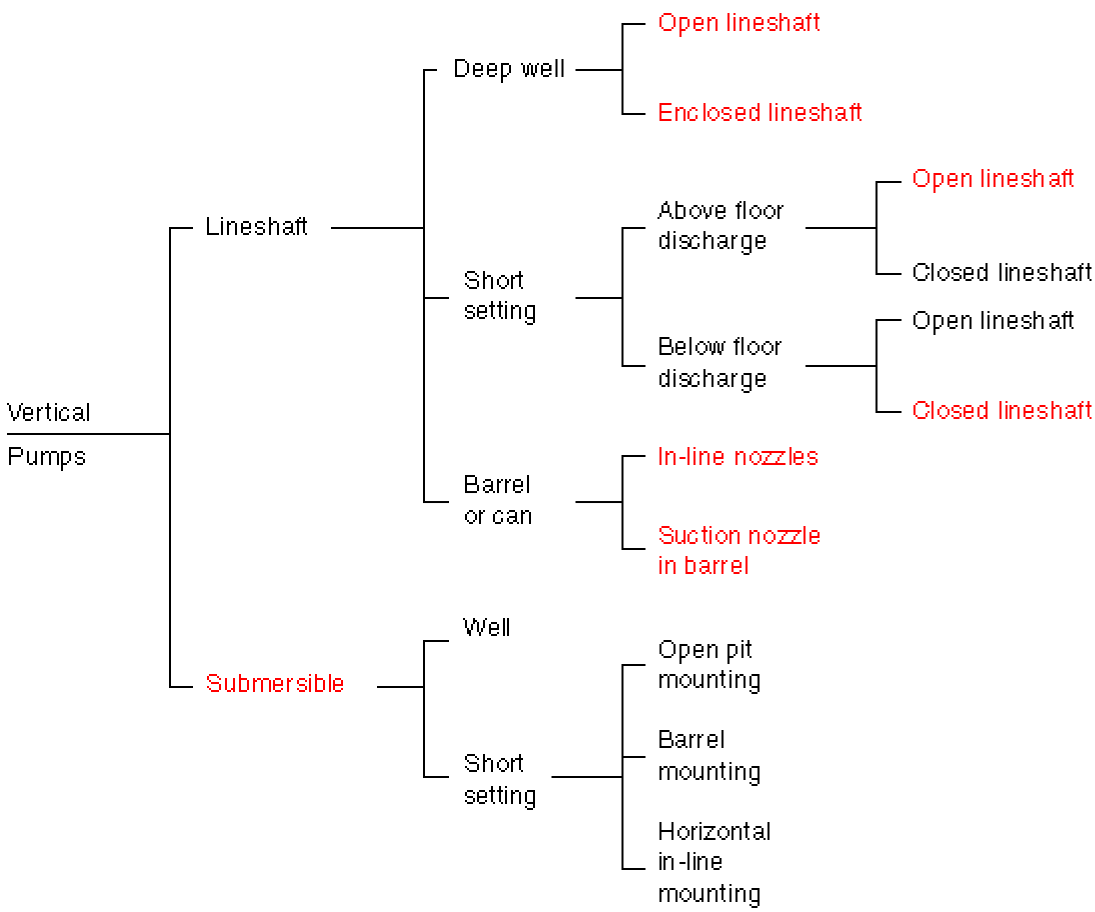


Figure 2.1 — Vertical pump types – single and multistage

Rotary Pump Types

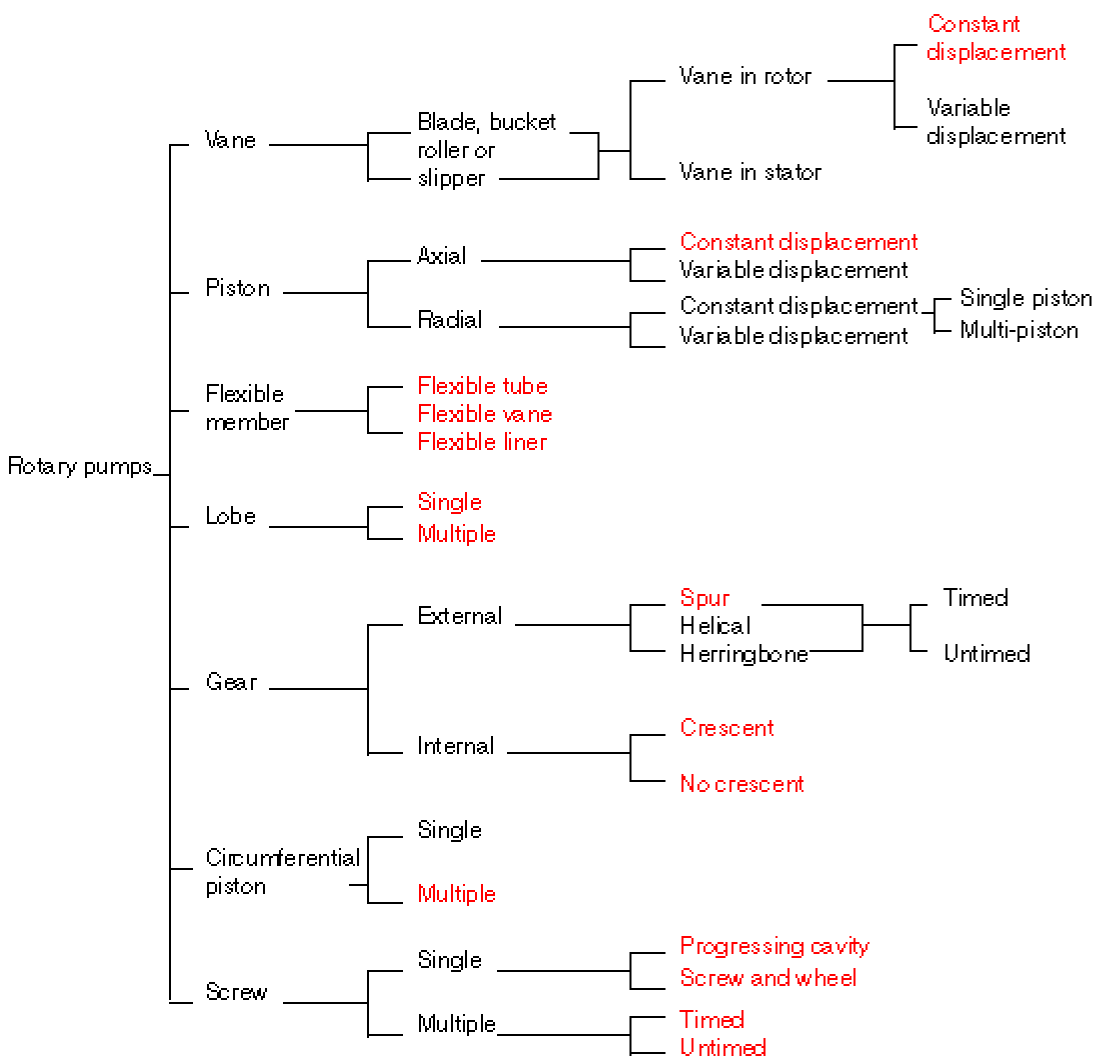


Figure 3.1 — Types of rotary pumps

SECTION 23 25 01

Energy Recovery

A. Scope

These requirements and recommendations apply to the incorporation of energy recovery into all building and system designs for new construction and remodel projects.

B. Design Criteria

Codes, Regulations, and Standards

1. Energy recovery systems are, for the most part, extensions of building heating, ventilating, and air conditioning systems. As such, codes, regulations, and standards shall apply as required in conformance with those sections of this document.

Design Review and Submittal

1. During the schematic design phase, the consultant shall investigate ways and systems to accomplish heat reclamation and make recommendations as to which system(s) shall be used. The presentation will include the estimated cost and payback period.

2. The schematic design submittal shall include the selected energy recovery systems with estimated cost and payback period. Details will include operation sequence, diagrams of systems and equipment lists.

3. The designer shall consider energy recovery system at the exhaust/relief air side where 100% outdoor air is warranted by code.

4. While specifying heat recovery unit the designer shall ensure low maintenance, minimal pressure drop,high life expectancy and efficiency.

5. While specifying the heat recovery unit for a chlorinated environment such as natatorium, the designer shall ensure the material of the heat exchanger plate and other metal surfaces that would come in contact with exhaust air shall be selected so that it elevates the integrity of the plate in chlorinated environment.

6. The designer shall specify the heat recovery unit that does have absolutetly no possibility of potential cross contamination.

General Requirements

1. Each scheme shall include calculations of all energy saved and all energy required to operate the system (parasitic energy). For these evaluations contact the Project Manager for current energy cost.

   Energy cost to operate heat pumps shall be based on electrical costs and manufacturers' published data.

D. Execution

1. All work shall be completed in accordance with the appropriate sections of this Manual. Once the heat recovery unit is installed, the system shall be tested and balanced as outlined in Section 15990 (Testing, Adjusting and Balancing). The consultant should review the report with the Project Manager to make sure that the system is operating in accordance with the manufacture's performance data..

End of section

SECTION 23 40 00

FUME HOOD EXHAUST SYSTEMS

A. Scope

The following are guidelines for designing and specifying fume hood exhaust systems for the County.

B. Requirements

1. Definitions

Access opening. That part of the fume hood through which work is performed: entrance or face opening.

Airfoil. Curved or angular member(s) at the fume hood entrance.

Air volume. Quantity of air, normally expressed in cubic feet per minute (cfm).

Auxiliary air. Supply or supplemental air delivered to a laboratory fume hood to reduce room air consumption.

Baffle. Panel located across the fume hood interior back which controls the pattern of air moving into and through the fume hood.

Biological safety cabinet. A ventilated HEPA filtered enclosure used to handle pathogenic micro-organisms. Provides personnel, environmental, and usually product protection. This enclosure is not a laboratory fume hood.

Blower. Air moving device sometimes called a fan consisting of a motor, impeller, and housing.

Bypass. Compensating opening that maintains a relatively constant volume exhaust through a fume hood regardless of sash position and that functions to limit the maximum face velocity as the sash is lowered.

Capture velocity. The air velocity at the hood face necessary to overcome opposing air currents and to contain contaminated air within the laboratory fume hood.

Counter top. Work surface resting on a base cabinet nominally three feet high.

Duct. Round, square, or rectangular tube used to enclose moving air.

Duct velocity. Speed of air moving in a duct, usually expressed in feet per minute (fpm).

Exhaust collar. Connection between exhaust duct and fume hood through which all exhaust air passes.

Face velocity. Speed of air moving into fume hood entrance or access opening, usually expressed in feet per minute (fpm).

Fume removal system. A combination of the laboratory fume hood and the exhaust system (duct and blower).

> NOTE: Room air, makeup air, auxiliary air (if used), and pollution abating devices (if used) are integral parts of a properly functioning system and should be considered when designing a fume removal system.

Glove box. Enclosure used to confine and contain hazardous materials with operator access by means of gloved portals or other limited openings; this enclosure is not a laboratory fume hood.

Imbalance. Condition in which the ratio of quantities of auxiliary air to room air is greater than the design maximum or lower than the design minimum.

Laboratory fume hood. A ventilated enclosed work space intended to capture, contain, and exhaust fumes, vapors, and particulate matter generated inside the enclosure. It consists basically of side, back, and top enclosure panels, a work surface or counter top, an access opening called the face, a sash, and an exhaust plenum equipped with a baffle system for the regulation of airflow distribution.

Laminar Airflow. Airflow in which the entire body of air within a confined area essentially moves with uniform velocity along parallel flow lines.

Laminar Flow Hood. A ventilated HEPA filtered enclosure which normally provides product protection only. Found in horizontal, vertical, vertical exhaust and biological safety models. These enclosures are not laboratory fume hoods.

Liner. Interior lining used for side, back, and top enclosure panels, exhaust plenum, and baffle system of a laboratory fume hood.

Lintel. Portion of laboratory fume hood front located directly above the access opening.

Manometer. Device used to measure air pressure differential, usually calibrated in inches of water.

Makeup air. Air needed to replace the air taken from the room by laboratory fume hood(s) and other air exhausting devices.

Negative air pressure. Air pressure lower than ambient. Negative with respect to: air pressure lower than that in adjacent rooms or areas.

Particulate matter. For this Standard, small, lightweight particles that will be airborne in low velocity air (approximately 50 fpm).

Petes plug. Fitting placed in duct to permit insertion of Pitot tube.

Pitot tube. Device used for measuring air velocity.

Plenum chamber. Chamber used to equalize air flow.

Positive air pressure. Air pressure higher than ambient. Positive with respect to air pressure higher than that in adjacent rooms or areas.

Room air. That portion of the exhaust air taken from the room.

Sash. Movable panel set in fume hood entrance, normally transparent.

Service fitting. Item of laboratory plumbing mounted on or fastened to laboratory furniture or fume hood intended to control the supply of piped gases and liquids for laboratory use.

Slot velocity. Speed of air moving through fume hood baffle openings.

Smoke bomb. Smoke producing device used to allow visual observation of air flow. May include materials such as dry ice in water.

Static pressure. Air pressure in laboratory fume hood or duct, usually expressed in inches of water.

Static pressure loss. Measurement of resistance created when air moves through a duct or hood, usually expressed in inches of water.

Superstructure. That portion of a laboratory fume hood that is supported by the work surface or countertop.

Threshold limit value (TLV). Time-weighted average concentration for a normal eight-hour work day and a forty-hour work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Tip speed. Speed of blower impeller end or tip.

Titanium tetrachloride. Chemical that generates white fumes used in testing laboratory fume hoods. CAUTION: THESE FUMES ARE TOXIC AND CORROSIVE.

Total pressure. Sum of velocity pressure and static pressure.

Transport velocity. Minimum speed of air required to support and carry materials in an air stream.

Velocity pressure. Pressure caused by moving air in a laboratory fume hood or duct, usually expressed in inches of water.

<u>Work area.</u> That part of the fume hood interior where apparatus is set up and fumes are generated. It is normally confined to an area six inches behind the plane of the sash to the face of the baffle, extending from the work surface to a plane parallel with the bottom edge of the sash when the sash is in the full open position.

<u>Work surface.</u> Counter top material area in laboratory fume hood where apparatus rests and where manipulations take place.

2. Fume Hood Terminology

Fume Hood types:

a. Airflow hood - a designation for an airflow fume hood having six (6) inches wide curved vertical facia panels to provide the maximum in streamlined entrance shapes around the hood face to enable air entering the hood to flow in smooth, uniform, unbroken pattern. This type of hood has a horizontal deflector vane and an automatic air bypass and is the most efficient hood available.

b. Auxiliary-air hood - a designation for an airflow fume hood which operates with 30-70 percent room air and 70-30 percent auxiliary air.

c. Bench hood - a common designation for hoods with working surface approximately 36 inches above floor level.

d. California hood - a common designation for a hood enclosed with glass on all four sides, with horizontal sliding sash on two sides (front and rear). The work surface is usually about 18 inches above the floor level.

e. Closed hood - the designation applied to fume hoods closed on all four sides, with sliding sash at the front of the hood.

f. Conventional hood - the usual designation applied to the older style square front hoods with offset interior ends and without the air bypass feature or curved shapes of any kind. These hoods are generally available in the following types: bench, walk-in, distillation, and perchloric acid.

g. Glove box - a complete enclosure requiring the use of gloves for access to the hood interior, rather than a sliding sash.

h. Walk-in hood - the designation applied to hoods which utilize a concrete floor as a work surface, or in which the built-in work surface rests directly on the floor. This type of hood is useful for bulky materials or large equipment which must be set into the hood. The hoods are available in airflow designs, and usually have a double sash, double hung.

i. Protective coatings - paint films or other materials applied to the interior of fume hoods, blowers, and exhaust ducts to provide corrosion protection. Protective coatings are many and varied, and usually some knowledge of the end use is necessary prior to a suitable factory recommendation.

j. Understructure - furniture cabinet base or leg and apron assembly that supports the fume hood superstructure.

3. Reference

NFPA No. 45 - 1975, Laboratories Using Chemicals

Industrial Ventilation, A Manual of Recommended Practice, A C GIH.

SAMA Std. for Laboratory Fume Hoods, SAMA LF7-1975.

ASHAE Handbook of Fundamentals 1972 edition.

Caplan, Knowlton J. and Gerhard W. Knutson. "Influence of room air supply on laboratory hoods." AIHA JOURNAL. 43:738-746, 1982.

Chamberlin, R.I. and J.B. Leahy. Laboratory Fume Hood Standards, Recommended for the U.S. Environmental Protection Agency. Contract No. 68-01-4661. January 15, 1978.

Keith Carlson, University of Minnesota. Personal Communication, June 21, 1982.

Harry Beaulieu, Boise State University. Personal Communication, June 21, 1983.

Richard Konzen, Texas A&M University, Personal Communication, June 21, 1983.

Thomas K. Wilkinson, National Institute of Health, Personal Communication.

C. Acceptable Types of Fume Hoods

Note: To the extent possible, this standard applies to existing installations.

1. Conditioned air locations: Laboratory hoods should be auxiliary air supplied hoods with a full-length overhead external supply source. The decision for auxiliary air supplied hoods will depend on the availability and final disposition of the conditioned air. No internally supplied hoods should be installed.

2. Balanced air locations: Laboratory hoods shall be bypass type hoods.

3. Special purpose hoods (radioactive, perchloric acid, pathogenic, etc.) shall be individually selected, or designed.

D. Hood Design

1. Face Velocities

a. Hood face velocity requirements for general lab use are listed in the following table.

DESIGN

Face Velocities fpm

Average	Minimum velocity at any location at the face
100 +/- 10%	80

Higher velocities may be achieved by lowering sash

Special Equipment and Uses

gloves boxes slot ventilation perchloric acid carcinogens pathogens radioisotopes	Consult Environmental Health and Safety for applications

See Section H - Chemical Use Factors.

2. Hood Design Characteristics

a. Each hood shall have a "picture frame" airfoil at the sides, top, and bottom approximately 6 inches wide.

b. Bottom airfoil shall have an air space between bottom airfoil and the hood bench top. Air space shall be unobstructed by brackets, or configurations which cause turbulence. Airfoils shall allow for inlet of air at bench level when the hood sash is closed. The outside leading edge of an airfoil sill shall be slightly below the hood bench level.

c. The hood bench shall be dished on all four sides to a depth of approximately one-half inch to contain spills inside hood. This depression (dish) should not be closer than six inches from the front lip of the hood bench top.

d. The hood interior end panels shall be flush with the entrance shape to prevent eddy currents and turbulence. There shall be no shelves or other obstacles within 18 inches of hood face.

e. The hood interior back panel shall contain three horizontal slots located at bench level, at the top, and at an intermediate position. The slots shall be able to be adjusted, either individually or in combination, to direct air flow within the hood.

f. Air velocity in the slots shall be equal to or less than the duct velocity range of 1000 to 1600 fpm and preferably less than 1500 fpm.

g. Sinks and service fittings shall be located at least six inches beyond the hood face.

h. A vertical sliding sash shall be provided for hoods unless otherwise specified.

i. The entry to the fume hood duct should be bell-shaped to provide as smooth a transition as possible.

j. All materials used in construction of fume hood shall be asbestos free. This includes but is not limited to materials used for interior end and back panels, baffles, the bench, cup sinks, gaskets for access panels and sash, insulation, and the bell-shaped duct entry transition assembly.

3. Specific Hood Design and Performance Requirements for Auxiliary Air Supply Hoods

a. Must meet face velocity requirements of general lab use hoods.

b. An auxiliary air plenum may be added to the fume hood. This chamber, when connected to a separate blower and air duct system, shall contain directional vanes and baffles such that the air stream is directed at the hood face and away, as much as possible, from the hood operator position. The auxiliary air shall be evenly distributed across the hood face at a uniform velocity. The supply velocity shall be such as to direct the supply stream across the full face opening. All of the supply air shall be captured and enter the hood before it is allowed to strike against the airfoil sill and thus be directed into the room. Hoods shall provide efficient fume removal when operating with 50 percent of the exhaust air requirements being auxiliary air and 50 percent room air, when auxiliary air is supplied at temperatures ranging from 70^{o} F to 90^{o} F. The flow of auxiliary air shall be confined to the area immediately in front of the hood, and shall be entrained in the flow of air entering the hood with a capture efficiency of at least 95 percent when operating with the sash up. Auxiliary air hoods shall be provided with a bypass to direct 100 percent of the auxiliary air into the hood when operating with the sash closed. With the sash lowered to three inches from full closed, the bypass shall limit the face velocity to not more than 3 TIMES nor less than 2 TIMES the average face velocity. When the sash is closed, a small amount of room air shall enter the hood under the airfoil sill. The hood sash shall operate smoothly and freely even when operated from one end of the sash and shall hold at any height. Failure to meet the performance requirements shall be cause for rejection of the equipment.

4. Specific Hood Design and Performance Requirements for "Bypass Hoods"

    a. Must meet face velocity requirements of general lab use hoods.

    b. General Design.

        1) An automatic air bypass shall be furnished for hoods with vertical sliding sash at the sash opening. This air bypass shall limit the maximum air velocity through the face of the hood, and provide a relatively constant volume of air through the hood (regardless of sash position) when hood exhaust blower is in operation. The hood air bypass shall not be dependent on mechanical or electrical linkage and shall be completely positive in operation. The air bypass shall be so designed to prevent hot gases, vapors or debris, generated by fire explosion within the hood, from being ejected through it directly at the operator. A design with the air bypass on top of the hood or with horizontal fixed front face louvers directed upward, with louver centerlines not more than one louver width apart is acceptable.

        The airflow fume hood, when properly installed in a laboratory and connected to an exhaust blower of the proper capacity, shall contain and remove fumes generated within the hood. The hood shall operate efficiently at the APPROPRIATE velocity. Hood design shall be such that it will exhaust light or heavy gases efficiently, when the hood is used for ordinary laboratory work in a room free from cross drafts, and without high thermal loads or other special conditions of this nature. Failure to meet the performance requirements shall be cause for rejection of the equipment.

5. Hood Utilities

    a. Controls for hood utilities shall be located outside the hood including any three-pronged receptacles for 110V power.

    b. Hood lighting shall be vapor-proof or explosion proof, depending upon the intended purpose of the hood.

    Light bulbs should preferably, be changed from outside the hood.

    c. Each sink or cup sink in a laboratory hood shall be individually trapped.

d. Hood electrical switches shall have indicator lights.

e. Indication lights shall be installed to indicate proper blower operation.

f. Fume hoods, if factory wired, must be U.L. (or equivalent) listed or wired upon installation by licensed construction electrical contractor.

6. Performance Evaluation

a. Two Petes plugs shall be installed in the exhaust duct at 90 degrees to each other around the circumference for the purpose of pitot tube insertion.

b. Performance evaluation shall be done by measuring hood face velocities and by measuring the terminal velocity of supply air. The supply air velocity should be no more than 1/2 to 2/3 of the face velocity.

c. In addition, smoke tubes or dry ice in water should be used to determine the extent to which the hood contains the contaminant and to check for reverse air flow and turbulence. Alternatively a solution of titanium tetrachloride may be painted on the walls and floor of the hood just inside the sash to provide the same information as obtained by use of the smoke tubes. For new hoods the vendor is responsible for performing the evaluation which is to be approved by the client.

d. The "OK" for general lab use may be withheld if in the judgment of the investigator, the hood does not meet certain physical requirements, e.g., lack of an air foil picture frame, lack of ventilated storage cabinet beneath the hood working surface, lack of air distribution slots at the rear of the hood.

7. The following manufacturers can meet these hoods design standards with certain models.

a. Kewaunee Scientific Equipment Corporation.

b. St. Charles Manufacturing Company

c. Taylor Division, American Desk Manufacturing Company

d. Hamilton Industries

For currently acceptable models offered by these manufacturers, see Section I - Acceptable Fume Hood Models.

E. <u>Hood Installation</u>

1. General

   Laboratory fume exhaust systems must be designed as complete operating units considering chemical use factors, room supply air, room configuration, hood type and location, exhaust fan, and ductwork.

2. Hood location and disturbances

   Cross drafts created by the room ventilation system, open windows, operable doors, personnel traffic, etc., can drastically disturb the flow of air entering the fume hood and cause a reverse flow of air out of the front of the fume hood. Room conditions such as these must be avoided by proper selection of ventilation delivery system, permanently locking windows, and locating hoods 10 feet or more away from doors. In no case should the velocity of cross drafts exceed 20 fpm or 20 percent of the hood face velocity adjacent to the hood.

   The velocity of supply air shall be no more than 1/2 to 2/3 the face velocity, i.e., 50 to 70 fpm measured at the operator location in front of the hood while the hood is off and the sash open. The velocity of supply air in hoods for which the fan cannot be turned off shall be as above but with the sash closed.

3. Noise

NOISE CRITERIA

SCALE SETTING	AVERAGE DECIBELS
A	62
C	79

Noise measurements to be made at an average distance of one foot from the fume hood with the sash fully open using a type 2 sound level meter per ANSI SI.4-1971 and an octave band filter for 31.5 to 4000 H.

Noise problems may be eliminated by considering several options:

a. Install larger slower-running fans.

b. Insure that fan discharge velocities remain within those indicated in the Table in paragraph F.4.d.

c. Install silencer in duct.

   Note: The NC50 curve is approx. equivalent to 59 dBA. The NC55 curve is approx. equivalent to 62 dBA. The NC60 curve is approx. equivalent to 67.5 dBA.

4. Makeup air - general laboratory

a. Air exhausted through laboratory fume hoods is not to be recirculated.

b. Positive pressure differentials shall be maintained between rooms to insure a positive air movement from clean to more contaminated areas. Therefore, air supply should exceed air exhausted to office or classroom space and air exhausted should exceed air supplied to laboratory space. Laboratory units in which flammable materials are stored or used must maintain air negative to corridors or adjacent spaces.

c. Supply may be controlled by automatic dampers that will open and close when the fume exhaust fan is turned from its full volume flow to 50% of full volume flow but at no time is the fan to be completely turned off.

5. Design for growth

When it is anticipated that hoods may be installed at a future date, minimum provisions should be made by setting aside a good location in the laboratory and adequate space shall be planned for all hood service and utility requirements.

6. Storage

a. Underhood storage units intended for chemical storage shall minimally contain: recessed flow, metal lining, liquid and gas-tight construction and ventilation flow from outside hood, through storage unit, to hood plenum chamber.

b. Underhood storage units intended for flammable liquids shall be ventilated and constructed to comply with the requirements of the Uniform Building Code.

F. <u>FAN AND DUCT DESIGN</u>

1. Exhaust Fans

a. Fans should be weather protected and installed near the building roof. Fan installation in fan room lofts, attics, or rooftop penthouses are preferred. Each fan should be, in any case, the last element of the system so that the ductwork through the building is under negative pressure. All fans should have a receptacle within 25'.

b. A means of ready access for fan maintenance should be provided.

c. Fans should be provided with:

1) outboard bearings

2) shaft seal
3) an access door
4) multiple 150 percent rated belts, or direct drive
5) fan system shall be chemical resistant throughout and shall have a non-sparking wheel
6) in designing for explosion and fire control, the fan shall be of the non-sparking construction and the V-belt drive shall be conductive.

d. Vibration isolators shall be used to mount fan. Flexible connection sections of ductwork, such as neoprene coated glass fiber cloth, shall be used between the fan and its intake duct when such material is compatible with hood chemical use factors.

e. Each exhaust fan assembly must be individually matched (DFM, SP, BHP, etc.) to each laboratory hood and duct system design.

f. Choice of fan type will be determined as follows:

1) Use straight-radial fans for systems handling moderate to heavy quantities of particulate matter in air.

2) Use backward-cuved fans for systems handling relatively clean (low particulate) air.

3) Axial fans may be used in a vertical mounting for systems requiring washdown as perchloric acid hoods.

g. The transition joint from duct to fan must be of a seamless constant diameter inert corrosion resistant material as approved by owner. The duct alignment must be within one half inch at the hood collar and fan.

2. Utility Cores

a. Adequate space and easy access shall be provided to facilitate inspection, repair, or replacement of exhaust ducts.

b. Utility cores may be central cores that are large enough to be entered; service cores that are accessible through removable panels opening into corridors; or concealed accessible chases located in outside walls.

3. Exhaust Duct Materials and Construction

a. Materials shall be non-combustible, inert to agents to be used, non-absorbent, and free of any organic impregnation.

b. All joints shall be made liquid and gas tight.

c. Smooth, non-porous lining surfaces shall be free of cracks, joints, or ledges.

d. Choice of duct material shall be one based on the compatibility with the materials handled in the hood. Basic characteristics of preferred hood and duct materials are as follows:

1) New installations shall be of 16 gauge (minimum thickness stainless steel. Stainless steels (subject to attack by acid and chloride compounds) vary with the chromium and nickel content of the alloy. Type 316L passive stainless with No. 2B finish shall be used for bacteriological, radiological, and perchloric acid hoods.

(Not suitable for hood handling concentrated H C1 and H S0 .) Joint construction for stainless steel shall be "butt" welded (use appropriate filler rod for type of stainless) and ground smooth. If welding is not absolutely possible, an alternate "owner prior approved" corrosion resistant (leak proof) joint may be used subject to passing a pressure test as described in 5) below. For high level radioactive hood exhaust systems where ducts must be dismantleable for decontamination, flanged neoprene gasket joints shall be used.

2) All stainless steel duct must be welded by a "certified " welder.

3) Glazed ceramic ducts and vitrified clay tile ducts are resistant to practically all corrosive agents (except hydrofluoric acid) and should be left in place in currently operating systems. However, if abandoned during remodel projects, they must be designated as "abandoned."

Existing fume hood ducts to be removed during demolition must be steam or hot water cleaned for 24 hours prior to handling and removal.

4) Maximum duct velocities, except for final discharge in 4.c below, shall not exceed those recommended for low velocity systems in the ASHRAE handbook.

5) Newly installed ducts are to be pressure tested such that the duct must hold pressure at two (2) inch water gauge for 24 hours. Owner must observe and approve the test.

4. Exhaust Stacks

a. Exhaust fumes shall be discharged through vertical stacks terminating above the wake cavity of the building or through shorter stacks with sufficient high velocity to project the discharge through the wake cavity into the non-turbulent air passing over the building.

b. Generally, for one or two story buildings, stacks extending at least 30 percent higher than the building height will provide satisfactory dispersal of fume hood exhaust.

c. Discharge shall be directed upward at a velocity of at least 3,000 fpm for stacks extending eight feet or more above the building. For shorter stacks, a vertical discharge velocity of at least 4,000 fpm is required to minimize chances of recirculation.

d. Exhaust stack velocities alluded to in c. above may be attained by restrictions at the top. However, duct and fan-outlet velocities should be as indicated in the following table:

	Recommended	Maximum
Main ducts	1000-1300 fpm	1100-1600 fpm
Fan discharge	1300-2000 fpm	1500-2200 fpm

e. Exhaust stacks should not have weather protection that requires the air to change direction or cause turbulence upon discharge, such as weather caps or louvers.

f. Exhaust stacks which allow for a vertical discharge, yet prevent rain from entering the exhaust system, shall be used.

g. To overcome aesthetic objection, it is important for the design team to plan for the release of contaminants in the concept stage of their design by incorporating an exhaust tower or a cluster of exhaust stacks as an architectural element of the building. Bunching of exhaust stacks has the added advantage of creating a mass of exhaust gases, which is much less readily deflected from upward vertical flow by wind gusts.

G. SPECIAL SYSTEMS

1. General

Hoods and devices handling materials classified as special shall be designed to suit such materials.

2. Perchloric Acid Fume Exhaust Systems

a. Perchloric acid deposits in hoods and ductwork are potentially explosive and, therefore, such systems must be considered to be hazardous.

b. Each perchloric acid hood shall be provided with a separate fume exhaust fan and must be totally independent from any other exhaust.

c. Preferable, perchloric acid hoods shall be located on the top floor to reduce to a minimum the extent of ductwork required.

d. The hoods must be specifically designed as perchloric acid hoods.

e. The ductwork must be welded (TIG process) type 316 stainless steel installed vertically from hood through fan to discharge with minimum (preferably no) elbows. All ductwork shall drain thoroughly.

f. Fans shall be located where a violent reaction will not harm adjacent equipment or personnel. Depending on the location, some type of protective screening may be desirable.

g. Fan casings and hood bottoms must be provided with continuous gravity drainage to the sanitary sewer.

h. The entire system, including duct fans and hood, must be provided with an internal washdown system. The system must be carefully designed and tested to provide as complete a washdown as possible. The interior of the ductwork can be sprayed by various methods which must be reviewed with the Project Manager prior to completion of the design. The washdown system shall be actuated by a manual valve located adjacent to the fume hood.

i. Perchloric acid is not to be used in hoods not specifically designated for this use. (The use of perchloric acid in hoods not designated for this use poses extreme problems for any subsequent hood and duct removal during renovation project.)

3. Special Systems

Each special system must be investigated and a design developed to meet the specific requirements to the approval of the Department of Environmental Health and Safety.

4. Filters

The Property Manager shall be consulted concerning proper filters, air cleaning devices, scrubbers, incinerators, ultraviolet lights, and other devices for special purpose hoods in which radioactive materials, pathogens, or carcinogens are to be used.

H. CHEMICAL USE FACTORS

1. It is emphasized that these listings are merely examples of toxic materials, they are not intended to be all inclusive.

2. Highly Toxic

Gases and vapors of substances with exposure limits below 1 ppm or dusts, fumes and mists of substances with exposure limits below 0.1 mg/M^3.

Examples: (not all inclusive)

I. Gases and Vapors	Dusts, Fumes, and Mists
Acrolein	Asbestos
Hydrazine and derivatives	Silica
Nitrated aromatics	
Metal carbonyls (Fe, NI, etc.)	
Hydrides	
Azides	
Alkyl mercury and lead compounds	
Boranes, Silanes	

3. Moderately Toxic

Gases and vapors of substances with exposure limits of 1 ppm and above or dusts, fumes, and mists of substances with exposure limits of 0.1 mg/M^3 and above.

Examples: (not all inclusive)

I. Gases and Vapors	II. Dusts, Fumes, and Mists
Benzene	Acrylamide
Cyanogen, Cyanogen Bromide	Acrylonitrile
Phosgene	Pyridine
Haloforms	Picric Acid
Dimethylformamide	Phenol
Butyl Mercaptan	Inorganic lead compounds
Ketones: MEK,MIBK,MBK	Malathion
Nitric Oxide	Parathion
Formaldehyde	Methyl Methacrylate
Alkanes (C to C)	Nicotine
Aniline	Dioxane
	Gluteraldehyde

4. Low Toxicity

Gases and vapors of substances with exposure limits above 100 ppm or dusts, fumes, and mists of substances with exposure limits above 15 mg/M^3.

Examples: (not all inclusive)

I. Gases and Vapors	II. Dusts, Fumes, and Mists
Freons	Corundum, Alundum
Alkanes (C_7 to C_n)	Emery
Ethanol	Fiberglass
Acetone	Limestone
Ethyl Ether	Mineral Wood Fiber
Methanol	Paper fiber
	Plaster of Paris

I. ACCEPTABLE FOR HOOD MODELS

1. Bypass Type Fume Hoods

Manufacturer	Models
Kewaunee Scientific Equipment	Airflow Supreme and Hoodair
St. Charles Manufacturing Co.	Aerostream Bench Vertical Company Sash Hood
Taylor Division, American Desk Manufacturing Co.	Type 200 (with fixed vanes)
Hamilton Industries	Safeair

End of section

SECTION 26 10 00
ELECTRICAL REQUIREMENTS

1. Service and Distribution (600 volt and below)

A. Scope

1. This section applies to the design of building secondary power service and distribution at 480Y/277 and 208Y/120 volts, from the secondary of the service transformer to the branch circuit outlets or utilization equipment.

2. Coordinate system design and equipment layout with Electrician.

3. Index

B. Short Circuit Study

1. The Consultant shall prepare a short circuit study at the design development phase, and evaluate potential coordination and interrupting capacity problems. The purpose of the initial study is to verify coordination of the proposed electrical equipment. It is possible that not all of the purchased protection equipment will be from the same manufacturer with the end result being unacceptable overlapping time current curves.

2. The initial study shall contain the fault and load current values listed at key points on the distribution system one-line diagram to illustrate the necessary equipment fault duty.

3. The consultant shall propose solutions to any problems, and demonstrate that coordination can be achieved with the proposed devices. Specify the electrical equipment with enough flexibility to allow field solutions on the installed system.

C. General Building Services and Distribution

1. Service and Distribution Methods

a. It is the objective of this design criteria to provide building service reliability commensurate with the needs of the facility's designed usage. Facility designed usage has been categorized into three (3) general normal power classes and three (3) general emergency power classes: See Section 16A03.

b. The County will participate in the selection of the building service configuration.

c. Normal Power
   (1) Provide main power and lighting distribution in new buildings and renovations at 480Y/277 volts, 3 phase, 4 wire solidly grounded. Serve convenience receptacles, special equipment and special lighting from a 208Y/120 volt, 3 phase, 4 wire solidly grounded system established by means of one or more dry-type transformers throughout the building.

   (2) In general, smaller (maximum 800A) conduit and cable risers are preferred over bus way risers for convenience in maintenance shut downs, and limiting disruptions during faults and repair.

d. Emergency Power
   Emergency lighting and power shall hook up to existing emergency power system or where none exists to the public and pathway lights.

   System Requirements will be decided on an individual building basis. The design team and the County Project Management Team, Operation, and Engineering Staff shall be included in the decision making process for each project.

2. Equipment Specifications
   a. All building services should be designed to limit the maximum available fault current to 50,000 amps or less.

   b. Select all equipment with full consideration for overcurrent protection, phase and ground fault selectivity (use zone-selective interlocking where beneficial), fault current interrupting, and fault closing capabilities, as well as current carrying capacity.

   c. Determine the requirements from the ultimate installed transformer capacity programmed for the building.

   d. Breakers and current limiting circuit breakers are preferred in lieu of fused switches and fused breakers.

   e. Each building shall have a main service switchboard(s) with main disconnect(s), tie breakers (where required), necessary feeder breakers, and metering. Unless otherwise directed, the application will be a 480/277 volt, 3 phase, 4 wire distribution system.

3. Electrical Rooms and Closets
   a. See Building Electrical Service Room Specification.

   b. Provide electrical rooms and closets on each floor. Size rooms with future panel and riser space. Accounted for in space provided.

   c. Distribution switchboards and panelboards, and dry transformers over 30kva, shall be in electrical rooms.

   d. Electrical closets may be used for floor branch panels and transformers 30kva and smaller, and riser panels not serving over three floors, to supplement electrical rooms. There shall be no storage in panel rooms.

4. Additional Considerations
   Secondary system design must give full consideration to future expansion, maintenance, and alterations by use of the following features:

   a. Switchboards and motor control centers located and arranged to permit installation of additional sections or cubicles.
   b. Spare full size breaker or space with hardware for maintenance backfeed operations.
   c. Panels with spare breakers, or space for additional breakers.
   d. Spare conduits or sleeves to minimize core drilling in the future.
   e. Surface raceways for multiple outlet areas.

D. <u>Switchboards</u>

1. General
   All switchgear should be reviewed before approval. Price listing of breakers listed and a physical sample should be available for inspection. The physical example can be an existing panel on site.

   Cutler Hammer is our preferred manufacturer because of readily available parts and a large inventory of spare breakers used for temporary panels.

   a. The switchboard should have an adequate number of spare feeder breakers, spaces for hardware for future feeder breakers, and provisions for adding vertical sections onto one end.
   b. Each of the circuit breakers should be provided with overcurrent and, as required, ground fault relay protection. A breaker tripping scheme should be specified that will not require an alternate source of control power. The settings for overcurrent and ground fault protective devices should be chosen to provide a completely selectively coordinated system.
   c. Provide Ground Fault Protection as Follows:
      (1) All services (unless programmed otherwise) shall be provided with GFP per NEC.
      (2) When ground fault protection is used on the main there should also be ground fault protection on the sub-feeders.

e. Provide status monitoring dry contacts on the following breakers for open, closed, and trip conditions for mains, ties and feeders for building services.

f. When viewing the switchboard from the front, specify:

(1) Phase relationship (A-B-C) shall be left-right, top-bottom, front-back.

(2) Low voltage switchgear connected to building power service transformers have their buses identified 1-2-3.

(3) Connections between the transformer low voltage terminals and the switchgear shall be as follows:
"X1" to "1" (Bus)
"X2" to "2" (Bus)
"X3" to "3" (Bus)
It is to be noted that transformer connections as indicated above will result in a rotation sequence at the low voltage switchgear of 1-2-3.)

g. Aluminum bus is allowed if insulated.

2. Switchboard Designations

The County has designated switchboards (400 amps and larger) into the three following types:

a. Type A:

(1) Bus 1600A and above, and all service switchboards.

(2) Similar to GE AKD-8, Siemens type R, or Square D Powerzone II; with hinged rear and front access panels for breaker and metering compartments.

(3) Insulated and isolated bus, with fully rated horizontal phase and neutral buses. Aluminum bus acceptable.

(4) Isolated compartments for all breakers.

(5) Draw-out air circuit breakers, 100% rated, stored energy opening and closing, with electronic static overcurrent, ground fault, current limiting fuses, and zone selective interlock protection. Integral current limiting fuses on tie and feeder breakers.

(6) Bus and connecting stubs for individual breakers sized for the full capacity of the breaker frame size and not for the trip setting of the overcurrent devices.

(7) 800 amp minimum breaker frame size.

b. Type B:

(1) Use GE "AV-3", square D or Siemens.

(2) Insulated and isolated continuous main bus and full neutral bus, also with hinged rear and front access panels for breaker and metering compartments in feeder compartments. Aluminum bus acceptable.

(3) Main and tie breakers draw-out air circuit breaker type, with stored energy opening and closing.

(4) Feeder breakers may be stationary mounted molded case type, with interchangeable thermo-magnetic trip units.
(5) Minimum size breaker 100A.

c. Type C:

(1) 401A through 800A.
(2) Use GE "AV-2" square D or Simiens, with group mounted feeders and individually mounted main. Copper busing. Hinged wiring compartment doors with captive screws.
(3) Molded case mains and feeders, except when serving service entrance.
(4) Wall mount panelboard construction with group mounted main permissible when not a service entrance. Copper busing.
(5) Provide door over circuit breaker handles.

3. Service Equipment

a. Service entrance label required for all building service switchboards, and all side load switchboards or panelboards of derived sources.
b. On services from a utility company, provide metering to suit their requirements.
c. Provide space for clamp-on type metering where service is subfed from other campus structure.

4. Additional Switchboard Specifications

a. Accessories such as breaker racking devices, integral extension rails, breaker lifting devices, and maintenance closing handles.
b. Shop drawings, wiring diagrams, maintenance manuals, and overcurrent device time-current characteristic curves.
c. Additional ground bus for 208Y/120 volt equipment.

E. Distribution Feeders
1. Equipment grounding conductors shall be included in all raceways. Isolated ground conductors on 208 volt systems shall be included in raceways when required and allowed by NEC 250-74 Exception 4 . Indicate on feeder schedules and circuiting.

2. Provide panel and feeder identification.

3. For wiring continuity, phase identify all feeder cables.

4. Consider the neutral as a current carrying conductor.

5. Specify circuit breaker lugs to match feeder size. Splitting single conductor to two smaller taps to accommodate parallel lugs on a breaker is not acceptable.

6. Switching mode power supplies can generate harmonic currents The harmful effect of these currents on distribution feeders and equipment must be considered in the design process.

F. Distribution Panels
1. Construct as non-service type B or C switchboards depending on size.
2. Copper busing only.
3. Provide additional isolated ground bar for 208Y/120 volt systems.
4. Derived source distribution panels shall have service entrance label.
5. Panel must have a main breaker.

G. Dry Type Transformers
1. Utilize as required to provide 208/120v, 3 phase, 4 wire service from the building 480 volt distribution system. Connect delta-wye.

2. Air cooled dry-type with steel housing enclosing all wiring and connections; have built-in vibration isolators.

3. Insulated/isolating type with class H insulation with an average temperature rise not to exceed 150C. based on a 40C. ambient temperature. Shielded type may be advisable for certain applications.

4. Six fully rated taps on the primary winding for each transformer: three 2-1/2 percent taps below normal and three 2-1/2 percent taps above normal.

5. Transformers shall be located to assure adequate ventilation. Provide heat gain calculations for space involved to verify adequate ventilation. Mechanical ventilation is probably necessary. Space away from walls at least as far as the width of the ventilation opening, or per U.L. listing.

6. Do not locate heat sensitive equipment or equipment requiring working clearance above transformers.

7. Dry transformers may be a source of noise, heat, and vibration problems. High quality equipment, special mounting arrangements, sound isolation, etc., may all need detailing in the specifications and on drawings. Suspended platform mountings for transformers must be coordinated with the structural engineer, as well as floor loadings. Wall mounted transformers shall be limited to 30 KVA and below.

8. A local primary side disconnect is not required if the transformer has a local secondary disconnecting means.

H. Branch Circuit Panelboards
1. Locate panels in electrical rooms, electrical closets, or utility hallways on each floor. Special rooms with highly concentrated loads should have separate panels. Panels should not be located in janitor closets or toilet room entries. As much as possible, locate panels near columns, on permanent corridor walls, or other permanent features, to reduce the chance of having to relocate panels on remodel projects.

2. Surface mounted panels are preferred to flush panels. Surface mount panels in utility spaces. In finished areas provide flush mount with full height access to ceiling for future

raceways. All flush panelboards shall have a minimum of (3) 3/4" conduits stubbed out above panel into accessible ceiling space.

3. Provide door-in-door construction with lockable metal latch fasteners on all doors. When more than one fastener is required on a door, provide single operator handle with multi-point fasteners. Locks shall be keyed alike and to match the existing standard keying system. Opening outer door should expose terminals and circuit breakers in a single operation.

4. Provide all 208Y/120 volt panels located in office areas with a dedicated, isolated, full size ground bus to serve future computer equipment, and a separate equipment grounding conductor bus. Provide terminals for a minimum of 50% of panel circuits on each bus. Connect to derived system ground. See "grounding" section.

5. Panels served by oversized feeders may require larger enclosures for bending space.

6. Circuit breaker type, equipped with "bolted-in" breaker units. Equipment must be provided with adequate interrupting capacity. Minimum interruption capacity for each panel shall be 10,000 AIC or as calculated, whichever is higher.

7. Panelboard designations shall be labeled on the front of the panel and on the directory to agree with as-built drawings.

8. Number panel circuits to correspond with the panel schedule. Each panel shall be provided with clear plastic covered typewritten circuit directory.

9. Provide copper busing.

I. <u>Branch Circuit Wiring</u>

1. Definitions
    a. Dedicated Circuit: A branch circuit with phase, neutral and ground conductor serving only designated loads. No other outlets to share neutral or phase conductors.
    b. Dedicated Outlet: A single outlet on dedicated branch circuit.
    c. Isolated Ground Circuit: An electrical branch circuit which includes a ground wire which is electrically insulated from all other electrically conductive items except at the point of origination of the circuit. It achieves a degree of freedom from interference. The ground is terminated at an isolated ground bus.
    d. Isolated Ground Bus: A ground bus which is electrically insulated from adjacent conductive surfaces and which is electrically connected to a selected reference point.

2. General
    a. Minimum conductor size shall be #12. Home runs greater than 75 feet to the first receptacle outlet shall be #10. Evaluate necessary longer runs and size to suit voltage drop limitations. As a rule keep 120 volt circuits to less than 75 feet, 277 volt circuits to less than 125 feet. Maximum branch circuit voltage drop to be 3%.

b. Original circuit loading shall not exceed 1,600 watts on 20 ampere, 120 volt circuits; 3,800 watts on 20 ampere, 277 volt circuits.
c. Common neutrals are permitted in a single conduit for two or three single phase circuits served from different phases when objectionable harmonic currents from fluorescent fixtures, electric discharge lighting, computers, etc. do not exist. The Contractor should be cautioned not to reconnect common neutral circuits to the same phase when balancing panel loading.
d. Office electrified or wired furniture partitions to have neutrals sized at 200%, or separate neutrals per circuit.
e. Microwave ovens, refrigerators, hot plates, water heaters to be on dedicated circuits, on normal power.
f. Each branch circuit raceway shall contain a green equipment grounding conductor in addition to the phase and neutral conductors. Indicate on branch circuits on plans, and size if other than #12.
g. Isolated ground circuits shall contain an additional grounding conductor.

3. Harmonic Currents: Switchmode power supplies, dimmers, variable frequency drives, etc., may create harmonic distortion and neutral current in excess of phase currents, provide properly sized lugs as required for larger conductors. As a guide, in lieu of specific data on equipment, use:
   a. Oversized (#10) neutral on 120 volt receptacle circuits sharing a neutral is the preferred design as this provides the least voltage drop; however, separate neutrals are required for dedicated circuits
   b. Double size neutral for 3 phase branch circuits.
   c. Disconnect panelboard and neutrals sized at 200% of phase conductor.
   d. If total panel load includes over 30% switchmode power supplies, derating of transformers, generators, and power supplies may be required, and other circuit adjustments necessary.

J. <u>Wiring Devices and Plates</u>

1. Use specification grade self-grounding devices in general; 20 amp for dedicated outlets. 15 amp for multiple outlets on 20 amp circuits acceptable. Hard ground pigtails are to be connected at all times. Do not rely on self-grounding feature.

2. AC only "quiet" type switches, 20 ampere rating, self grounding. White color for normal power. Interchangeable type devices may be used only for special applications when approved by the Architect. Locking switches - use Leulton (1201-2L).

3. Use neon or low voltage transformer-base types Pilot lights for long life and ruggedness.

4. Provide 120 volt convenience receptacles in janitor closets, toilet rooms, corridors, pipe tunnel and other special purposes spaces for maintenance department use. Receptacle locations in offices, classrooms, etc., shall be determined by the occupancy of the room. In corridors, receptacles for cleaning shall be provided at spacing not to exceed 50 feet near hallway intersection and rear entry vestibules on circuits separate from office circuits. Additionally provide janitorial receptacles in stairs at each floor landing. In general, each circuit's overcurrent device should be on the same floor as the outlets.

5. If emergency system exists in a particular building, provide at least one 120 volt convenience receptacle in each mechanical, electrical and communications room connected to the building standby emergency panel for emergency maintenance use, in addition to normal power receptacles.

6. Receptacle configuration shall conform to NEMA Standards.

7. Locate GFCI exterior weatherproof convenience receptacles adjacent to each entry way.

8. Provide ground fault circuit interrupter (GFCI) receptacles as dictated by good engineering practice. Use master/slave arrangement. Reset must be accessible by users.
   a. Follow NEC rules for residential use to determine need for GFCI in all areas.

9. Device Plates
   a. Stainless steel for devices in finished areas unless otherwise specified.
   b. Galvanized or cast to suit box when exposed wiring permitted.

K. <u>Grounding</u>
1. Proper grounding is a very important aspect of all electrical installation. The Specifications shall state, "all electric systems, components, and devices shall be properly grounded per National Electrical Code,".

2. A maximum resistance to ground of the grounding electrode system of two ohms shall be allowed.

3. In the following areas, comprehensive engineering design is required. For these installations, it is expected that the consultant will provide documents completely detailing all of the grounding requirements. Typical installations include, but are not limited to the following:
   a. Building services and grounding risers.
   b. Electrical vaults and substations.
      (1) Ground rod and mechanical system bonding details.
      (2) Adequacy of existing grounding in building remodels or renovations.
   c. Secondary distribution systems.
   d. Separately derived systems.
   e. Computer and communications rooms.
   f. Hazardous locations.
   g. Shop air and gas systems.
   h. Lightning protection per NFPA 78.

4. Details
   a. The consultant shall include the proposed grounding scheme and details with the design development submittal.
   b. Specify that paint between grounding lugs and enclosures is to be completely removed.
   c. Use multi-terminal lugs and ground bars to accommodate the number of ground conductors.

d. Bond structural steel column anchor bolts in footings to footing rebar for added lightning protection.
e. Equipment grounding conductors shall be provided for all raceways and should be so indicated in feeder schedules and branch circuiting representations. Bond to intermediate pull and junction boxes.
f. Specify exothermic welds for inaccessible connections, and for splices in grounding conductors.

L. Equipment and Conductor Load Calculations

1. Normal Power
   a. Lighting
      (1) NEC Table 220-3(b). Any VA excess over Energy code allowed VA may be considered spare capacity.
      (2) Demands in Table 220-11 not applicable.

   b. Other Loads: Use NEC 220-3(c).

2. Emergency Power Systems
   a. Lighting at 100% load.
   b. Receptacles and other loads per NEC.
   c. 100% coincident operating equipment.

3. Load Schedules
   Indicate panel demand loads on a drawing schedule.

4. Show Power
   100 amps or 60 amp. Use Hubbel (or Brown Bovery) pen and sleeve three-phase, 5-wire plugs (prefer Hubbel). Disconnects for 200-400 amp show power should be rated at 240 volts, fused and have multiple load lugs if backstage.

M. Equipment and Conductor Sizing

1. Service Switchboards
   Switchboards should be sized to handle full forced air cooled capacity of the service transformer as noted in 1603. One spare breaker of each frame size shall be provided with each draw-out switchgear lineup, with multiple tap C.T.'s. Where space only is indicated, provide all bussing and mounting hardware.

2. Distribution Feeders
   Distribution feeders serving several floors shall be sized with 25% spare capacity based on the calculated demand load for the feeder. The feeder capacity shall be based on the code allowable capacity of the cable and overcurrent protective device. 800A maximum riser feeder size. Multiple riser feeders shall be provided where additional capacity is needed.
   Need additional capacity for show power. Disconnects, plugs should be located for show power. Establish a pint sleeve plug (Hubbel or Asea Brown Bovery).

3. Distribution Switchboards and Panels

Size equipment and source feeders to carry the calculated demand load plus 25% spare ampacity. The switchboards and panels shall have 25% spare breaker space. Need larger load capacity for show power.

4. Transformers
Transformers shall be sized to carry the calculated demand load, with at least 25 percent of their capacity reserved or spare. The use of special transformers, or additional space capacity allowances may be necessary to compensate for excessive harmonic currents.

5. Branch Panels
Size panels and their source feeders serving mainly lighting and receptacle loads for their calculated demand load plus a minimum of 30 percent spare capacity for lighting and 40% for equipment and outlets. All lighting branch panels shall have 20% spare breaker space, and all receptacle and equipment branch panels shall have 25%. May need more for show power, with disconnect and plugs.

6. Branch Circuits
See paragraph J.2.b of this section and previous ones for loading calculations for branch circuits.

7. Remote Power Accommodations
(2) disconnects with plugs shall be supplied in the main electrical room of the building to accommodate remote power needs for show power. (One 200 amp 208V-3Ø disconnect and plug to be provided in each location.)
Buildings used by the public shall have at least one 60 amp three-phase, 5-wire Hubbel pen and sleeve plug at each entrance or side of building.

End of Section

SECTION 26 20 04
ELECTRICAL REQUIREMENTS

Motors and Controls

A. Scope

1. These standards and procedures apply to the selection and installation of motors and controls whether furnished under the electrical, mechanical, architectural, or other divisions of contract. Coordinate all requirements and references with other divisions.

2. Packaged equipment with prewired central panels shall have the same type of indicating lights, identification of wiring and components, and as necessary to comply with this section.

3. Index

B. Design Criteria

1. Design Review and Submittal

   a. The type of control for every motor must be identified in the specifications or on the drawings.

   b. Controls in motor control centers shown on electrical drawings must be verified by the mechanical engineer for compatibility with the control requirements.

2. Codes, Regulations, and Standards

   a. Motors and controls shall conform to N.E.M.A. standards for each specific purpose and application. Where applicable they should be installed following systems capability analysis including consideration of harmonic distortion.

   b. Conform to Seattle Energy Code.

3. General Requirements

   a. Motors and controls shall be manufactured by a reputable company recognized in its respective field. Preferred manufacturer for motor controls is Cutler Hammer.

   b. Identification.

c. Caution labels warning against frequent starting of motors may be necessary, or lockout controls with thermal sensor in motor windings.

d. As part of the as-built drawings, each motor shall have a control diagram indicating what devices are controlling it, where they are located, their identification name or number, and what they are supposed to do. Relationships between devices (priorities) and timed functions should be noted. The engineer shall provide specification wording and coordination with the work of other divisions to make certain the electrical contractor performs the work. Show typical diagrams on the drawings.

C. Specific Requirements

1. Motors

a. Motors shall be high efficiency energy conservative models, meeting the ASHRAE 90.1 requirements.

b. Voltage ratings for motors shall be as follows:

(1) Less than 1/2 horse power (hp): 120 volt, single phase if readily available.

(2) 1/2 hp and larger: continuous operation 460, 460/208, 3 phase. Connect to 480 volt source when available, 208 volt is acceptable for smaller motors where 480 volt is not available. For 1/2 HP sizes for intermittent light duty where energy consumption is minimal, such as sump pumps, door operators, unit heaters, etc., 120 volt operation may be used for first cost savings.

(3) Over 150 hp: coordinate with Operations.

c. Motor speeds shall be matched to the driven equipment. Heavy fan drive motors should be 1,200 rpm or less.

d. Motors must be rated for "continuous duty," and shall be oversized to avoid tripping.

e. Motors shall be open drip-proof construction. Totally enclosed or explosion-proof types shall be provided where conditions dictate. Aluminum components are not acceptable.

f. Motor bearings shall be sealed. Sleeve bearings will be permitted for fractional horse power motors and where specifically recommended by the equipment manufacturer as the better type of bearing for the application.

g. Vertical shaft motors for special application shall be equipped with suitable thrust bearings.

h. Fractional horse power motors for unit ventilators and similar applications should be carefully selected with respect to speed, load, and starting torque characteristics. Shaded pole-type motors are not acceptable.

i. Avoid exposing motors to the weather; install in penthouses or other suitable enclosures. Motors installed in equipment exposed to the weather shall be totally enclosed type, even though a weatherproof enclosure is provided.

j. Motors used in communication with variable frequency drives shall be matched for full operating range of that drive. Provide necessary isolation or conditioning such that harmonic distortion is addressed and will not be an issue for the power system associated.

2. Power Factor Correction

a. Induction motors rated 15 hp and over shall be equipped with capacitors for power factor correction to 0.95 minimum. Capacitors should have blown fuse indicator lights. Capacitors shall not be used with variable frequency drive applications.

b. Capacitors shall be connected downstream of motor overloads. A location near the motor and fed from the load side of the local disconnect is preferred. May be fed from starter "T" leads if no disconnect. Motor overload devices must be properly coordinated.

c. Capacitors shall be connected to correct power factor to 0.95 for motor control center buses serving more than 15 total horse power of small induction motors.

d. Verify and record power factor after building systems are operational and HVAC system balanced. Verify transform load and supply harmonic load analyses.

e. Capacitor not required for motors controlled by variable frequency drives.

3. Motor Controls

a. All motors must be provided with proper motor starting and overload protection devices. Overload protections shall be provided in all three phases for three phase motors; in all "hot" legs for single phase motors.

b. Combination circuit breaker starters are preferred over separate components. Fusible switch types are generally not allowed. Motor control centers shall be used in lieu of distribution panels and separate starters in mechanical rooms and other multi-motor installations.

c. Determine short circuit rating by calculations, with consideration given to future system changes.

d. Motor controls shall be provided as follows:

(1) Manual starters (non-magnetic type): for single phase motors which do not require remote or automatic control.

(2) Magnetic Starters

(a) All motor starters shall have selector switch "Hands-Off-Automatic" controls with magnetic starters: for all three phase and single phase motors.

(b) Automatic control requirements shall be coordinated with other equipment operations, automatic control by the temperature regulation system, float controls, central supervisory controls, etc.

(c) Leave the automatic position open for motors without an automatic control.

(3) The manual position shall never have any automatic controls except for safety and equipment overload protection. The automatic position shall be used for any automatic control including freeze stats, load shed, smoke control, remote manual control, and process control. The automatic and manual positions shall have status contacts wired to the starter control terminal strip for smoke control fans and other critical motors.

(4) Only intermittent, task oriented motor starters shall have locally mounted "start-stop" push-button control (in addition to the starter HOA). If safety is a concern, local emergency stop buttons shall be provided.

e. Full voltage starters shall normally be used. Reduced voltage starters must be used in case of motors over 60 hp, limited power supply, or unusual load characteristics.

f. Large compressor-type equipment must have automatic controls to "unload" the machine during start-up.

(1) Utilize autotransformer type unless variable speed required by process or energy code.

g. Variable frequency drive (VFD) specifications:

GENERIC AC MOTOR SPECIFICATIONS

Nema B
Class B or better insulation; F preferred
1.15 Service Factor
1,750 rpm preferred for inverter service
Winding thermostat for best protection
Enclosure, oversized 120-150 % - Nema 4 enclosure

Designate an acceptable efficiency range

GENERIC AC DRIVE SPECIFICATIONS

Constant voltage dc bus with mov on input rectifier

Voltage	Rated +10%, -6% (or 10%)
Min. power factor	95%
Harmonic content	95%
Allowable temperature rise	Not less than 40 degrees C
Altitude, standard	3300 ft.
Humidity	5 to 95%, non condensing
Vibration	!.0 G
Output power	Pulse width modulated
Enclosure	To suit ambient
Ride through on power drop	3 Hz minimum
Readouts	Frequency, Current, Fault

h. Controls exposed to weather or severe moisture conditions shall have N.E.M.A. type 4 enclosures. This includes area where storm water or chemical pipes are located. Type 3 enclosures are not acceptable.

i. Push-buttons, selector switches, pilot lights, etc., shall be heavy duty "oil-tight" devices.

(1) Control and pilot light circuits shall operate at 120 volts. 480-volt starters shall have internal control transformers. Motor control centers may utilize a common control transformer if each unit is separately protected by a control circuit fuse or breaker.

(2) Every control and remote push-button shall have an "on" pilot light.

(a) Red "on" pilot light and "off" push button.

(b) Green "off" pilot light and "on" push button.

j. Coordinate locations of remote and central control and annunciation panels with Plant Engineering.

k. Lockout safety disconnect switches shall be provided in sight of motors. Disconnects shall be horsepower rated, number of poles required and shall have lock-open features.

l. Motor controls not located in motor control centers shall be located adjacent to the motor served; either wall mounted or mounted on an angle iron frame or framing channel supported from the structure.

m. Motor shall have sealed bearings.

n. All VFD (variable frequency drives) must have bypasses and be oversized by 120-150%. All drives shall have harmonic distortion conditioning. Allon Bradley preferred, Graham acceptable. VFDs shall shut off at 50 Hz to prevent problems.

4. Motor Control Centers

a. Provide motor control centers in mechanical rooms and other "multi-motor" locations.

b. Foregoing requirements for motor controls shall apply to controls in motor control centers.

c. Motor control centers shall be standard manufacturer design and construction to permit ready installation, removal, or replacement of standard components.

d. Construction shall be N.E.M.A. Class I or II, Type B with unit terminal strips only.

e. Vertical wiring spaces shall be accessible from the front without opening individual control units, with hinged cover and captive screws.

f. Units shall be located so as not to be subjected to high ambient temperatures, and not be in close proximity to radiant heat source.

g. Starter units shall be minimum N.E.M.A. size 1 for uniformity and maximum interchangeability and shall be the circuit breaker combination type.

5. Motor Starter Stations

a. Locally mounted motor starters shall be NEMA 1 enclosures for general use and NEMA 4 for damp and wet areas.

b. The foregoing requirements for motor controls shall apply to controls in motor starter stations.

c. Starters shall be minimum NEMA size required for service.

End of Section

SECTION 27 00 00

Enterprise Cabling Requirements and Standards

Requirements:

All cable installations and equipment provided must conform to industry standards set forth in the Commercial Building Telecommunications Wiring Standard (TIA/EIA 568-A.) and the Commercial Telecommunications Pathway and Spaces (TIA/EIA 569-A). All fiber optic installations must conform to the Telecommunications System Bulletin for Centralized Optical Fiber Cabling Guidelines (TIA/EIA TSB -72)
All cable runs when completed, must be tested end-to-end and certified using industry standard test equipment and practices (e.g. Microtest Penta Scanner or equivalent, and OTDR). Test results must be provided to the Montgomery County Government's point of contact within 10 days of completion of work. All cables should be identified according to established DTS labeling schemes as well as adherence to the Building Infrastructure Administration Standard (TIA/EIA 606).

Contractor Qualifications:

A qualified Cabling Contractor should be familiar with both fiber-optic and copper cabling systems. He should be experienced in wiring both rough-in and termination The Cable Contractor must have a minimum of five years experience in the data/voice cabling field on projects of similar scope and size. A reference list of no less than five customers is required. The reference should include the name of the company where the work was done and a point of contact with phone number at the reference site.

All work in conjunction with the installation shall be in accordance with good engineering practices. The installation shall be in accordance with the latest requirements of the national Electrical Code, State and local codes, ordinances and regulations of any governing body having jurisdiction.

The Contractor shall submit to the Architect for approval, prior to the installation of any part of the system, engineering drawings of the system showing the interconnections of all equipment and cables. Specification sheets covering all component parts of the system shall be submitted along with engineering drawings. The system and equipment as shown on the engineering drawings and specification sheets shall meet all items of specifications.

The contractor must be a certified installer on infrastructure components being provided and show proof thereof.

The contractor must be an authorized reseller of the networking and infrastructure components quoted and show proof thereof.

A registered communications distribution designer (RCDD) will supervise work during all phases of the installation. An RCDD must be on-site and available to technicians and installers any time work is being performed.

Test Procedures:
Data and Voice test should be satisfactorily performed and quality control and installation standards adhered to by the Cabling Contractor-with the specified documentation provided prior to the cabling system installation project sign-off. All test, quality control, and installation standards implementation results should be delivered in machine-readable form compatible with the Windows operating system environment. Hard copy test, quality control, and installation standards implementation results should also be provided in the form generated by the test equipment or contractor produced with text file.

Provide full testing and documentation to satisfy Category 5E specifications. Test should be performed from the horizontal cable 110 field to the faceplate jack for all drop cables. Transmission performance data shall meet TIA/EIA 568-A-5 100% Category 5E or 6E cabling.

Specific Installation Instructions:
NOTE: Category 5E or 6E will be used for all data and voice cabling unless otherwise noted.

All voice cabling will be terminated at the MDF/IDF using ‘110 hardware’ and at the information outlet on RJ-45 Category 5E or 6E outlets.
All data cabling will be terminated in the telecom closet on Category 5E or 6E patch panels and at the information outlet on RJ-45 Category 5E or 6E outlets.
All cabling installed in the riser and horizontal distribution shall meet or exceed all local fire codes.

Completion Criteria:
Contractor’s work shall be considered complete after the following conditions have been met:

Cable installation is complete and all cable runs have been tested and determined to be installed according to specifications.
Test data has been presented to Owner (DTS).
All hardware has been installed and the system tested.
All ceiling panels, covers, etc...removed during construction have been replaced
All labeling specified in the Contract Documents has been completed.
All scrap materials, boxes and other construction debris resulting from the installation have been removed from the site.
One set of marked drawings and specifications is to be returned to the Owner (DTS) at completion of the work.
The Owner (DTS) and project designer have inspected and accepted the installation.

Installation and Connection:

The minimum bend radius of a cable must never be exceeded. For high-performance UTP cable, the bend radius will not be less than eight times the outside diameter of the cable. For Category 5E cable, the cable may not be bent beyond 1.25”.

Do not kink the cable. Kinking the cable jacket changes the shape of the core, moves the pairs and distorts cable symmetry. This type of damage can be permanent, despite efforts to work out the kinks.

Cables should be well supported to prevent excessive hanging load and weight strain against objects. Correcting cable tension to lighten the load after it has been stressed may not reverse the damage of overloading.

Do not over-cinch cable. Over-cinching can cause compression of the cable jacket, deforming the cable and causing the same effects as over-bending and kinking the cable. Cable ties or cords must never be tightened to the point that strain is placed on the jacket.

Cable bundles must be installed carefully. Cables inside the bundle can be damaged as easily as cables on the outside. Examine bundles to ensure that their weight is not causing additional compression on the cable jackets.

No UTP cable shall have any splices or repair of damaged insulation.

No UTP cable shall exceed the distance of 90 meters (295 feet) from the service drop wiring closet, as stated in the EIA/TIA 568 document regarding horizontal wiring.

All cabling installed in the riser and horizontal distribution shall meet or exceed all local fire codes.

The Contractor will be responsible for cleanup of all facilities and buildings related to the cabling system installation project, during and at completion. The work site and adjacent area should be left in the same condition or cleaner than when starting a shift. This must be done on daily basis.

The Contractor should protect building equipment, exterior and interior, in the immediate and adjacent work areas. The contractor should protect building finishes and services not affected by the modifications.

Utilize brindle eye type cable supports for all cable runs not installed in raceway or cable tray system. “J” hooks are not permitted.

Contractor shall provide all plywood backboards indicated to be installed for voice and data wiring. Backboards shall be ¾” void free plywood painted with two (2) coats of fire retardant paint, color to match wall finish. Size and quantity of plywood backboards shall be noted on drawings.

Labeling:
The installers should label all wires in the cabling system according to a logical and clear code. If possible, they should incorporate any existing building space designations into the code. They should place this code on the physical cabling system in three places: on both ends of each wire and somewhere in the base plate box to which the wire is connected

Each cable run will be labeled at both ends with corresponding drop number. Labeling shall be with snap-on wire markers as manufactured by LEM.

All cable outlets and termination panels/bays or blocks will be appropriately labeled to match the cable using the following labeling scheme:
Room number
(dash)
Face plate number
D or V (for data or voice)
Outlet number on the plate in sequence
Example 150-2D3 would represent the third data outlet on the second plate in Room 150

Acceptance:
Acceptance should begin at the completion of the cutover and could continue for a period of 5 to 10 working days prior to signing. The warranty should begin immediately upon signing of acceptance.

Acceptance criteria should include 100 percent of all circuits installed. All circuits should pass specified performance tests and be duly documented and recorded in a project history file.

Warranty:
All cabling labor is to be warranted for one (1) year and all cabling material is to be warranted for 1-year or the manufacturer’s warranty, which ever is longer. All manufacturer warranties on materials are to be fully extended to the Montgomery County Government.

Minimum Standard for telecommunications/data/wiring closets and related infrastructure requirements:

The telecommunications closet must be a dedicated, lockable room used exclusively for data and telecommunications functions
In a multi-floor facility, where possible telecommunications closets should be stacked on top of each other, preferably near the building core or center to minimize the maximum cable run and these should have two (2) dedicated 4-inch trade size conduit permitting cable passage between the closets
In a multi-floor facility, when it is not possible to stack the closets, adjoining floor closets should be interconnected by a minimum of two (2) 4-inch trade size conduit or an equivalent pathway between each as mentioned above

Multiple closets on the same floor should be interconnected by a minimum of one 4-inch trade size conduit or equivalent pathway in each direction.
The telecommunications closet must support a minimum floor loading of 50lbs per square foot.

The minimum acceptable room size is 6 feet by 9 feet. This 54 square foot minimum requirement can effectively serve 15,000 square feet of usable floor space. As the usable floor space increases, so should the size of the closet at the rate of 9 square feet per 5,000 square feet of usable floor space. A maximum 20,000 square feet of usable space would require a minimum closet size of 6 feet by 12 feet.

Minimum of four dedicated 120V 30Amp AC duplex dedicated and grounded electrical outlets receptacles. If power conditioning, emergency generator and/or UPS protection are available in the facility, all telecommunications and MAN/LAN switching equipment should be sourced from this system.

It is possible that amperage and receptacle type may change as site requirements become better known. Every effort will be made to insure that electrical requirements are communicated to the design team as the project matures and requirements become better known.

Additional convenience duplex outlets shall be placed at (six feet) intervals around the perimeter (six inches) above the floor

Overhead lighting should be appropriate for the room size.

A minimum of a 6 AWG ground conductor from the main building grounding electrode and power neutral should be provided. It should also be terminated on a copper ground bar properly installed in the room.

HVAC requirements to maintain temperature that is between 65 and 75 degrees Fahrenheit year round.

The walls should be lined with ¾ - inch, 4-foot by 8-foot fire-resistant plywood attached to the wall-framing members or mechanically attached to the masonry walls. All surfaces are to be painted with fire-resistant paint.

Doorways should be a minimum of 36 inches wide by 6 feet, 8 inches high.

SPECIFIC WIRING GUIDANCE

General Planning Guidance for MCG Work Areas

General guidelines concerning the number of communication outlets by room type are outlined below. Specific requirements for each room and each project shall be coordinated with the using agency at the onset of design for the project. The architect/engineer is cautioned that the Building Program also includes requirements, but may not be all inclusive regarding communication facilities. Therefore, the project architect/engineer must work very closely with appropriate Using Agency and Voice/Data/Communications personnel during initial planning to assure total coordination and minimize the need for revisions or changes at the second or design development document submittal stage.

For each type of work area listed in this section, the end user shall consult with the Department of Technology Services to help determine the specific configuration necessary to meet work area requirements. Also, the use of a Multi-Use Telecommunications Outlet Assembly (MUTOA) and multi-use cabling is encouraged wherever it is possible to consolidate data and voice wiring into one location. In each case, for each communication outlet identified, the defined configuration is two CAT6 runs per outlet and one fiber per outlet.

Administrative Offices, Clerical/Staff Offices, Secretary/ Administrative Assistant Offices and Cubicles

Two duplex data communications outlets (jacks), on opposing walls, for offices with fixed walls of 100square feet or more are required. One additional duplex data outlet for each additional 100 square feet of office space or each additional occupant is strongly recommended. For offices designed with modular furniture, each cubicle or workstation will be provided with one duplex communication outlet per designated occupant. Additionally, a set of station wires (one voice and one data) will be installed as a spare to each cluster of six (6) office cubicles.

Training Rooms/Lecture Halls/Auditoriums

In training rooms, lecture halls and auditoriums, four communication outlets (one on each wall) are required. The need for a cable TV outlet will be considered during the planning process. The cable TV outlet is not intended to solve all audio/video needs in classrooms, lecture halls and auditoriums. Classrooms may be designed to be subdivided, by adding or removing walls, in the future. If this is a design consideration, the number and location of communication outlets will be adjusted accordingly (e.g. at least one duplex jack in every potential subdivision).

The recommended location for additional outlets is as follows:

- Chalkboard area
- Projection booth/rear wall
- Lectern area
- Remaining sides

Laboratories/Testing Facilities

As a minimum, install one single wall phone outlet and one duplex data communication outlet. Since laboratory and test facility requirements are diverse, coordinate with the end user and Technology Services at the onset of design for renovation and new construction projects, and prior to the initiation of work orders, contracts, or other installation action for other types of projects.

Specialty Offices/Multi-Purpose Rooms
One duplex communication outlet is recommended for every 75 square feet of space. Above 200 square feet one duplex data/voice communication outlet on each wall is recommended.

Sleeping Facilities
Install one voice jack per room, one data jack per resident, and one cable TV outlet in each room.

Libraries
Libraries will be wired in accordance with the size of the room and need for communication. A minimum of one (1) duplex data/voice communication outlet is recommended in every room.

Conference Rooms
Install one duplex data/voice communication and one cable TV outlet in each room. Rooms with more than 500 square feet should have two duplex communication outlets. Rooms over 500 square feet that may be considered "muster" or emergency work areas should have at least eight duplex communication outlets.

Rooms over 500 square feet, with a high potential use for any training opportunities should have at least two duplex communication outlets at the room ends and a duplex communication jack every 10 feet on side walls with at least one duplex communication jack AND electrical duplex jack located just below ceiling height near the primary entrance / exit.

Storage Areas
One wall-phone communication outlet for each room over 500 square feet and one additional phone outlet for each additional 2000 square feet are required.

Comfort Rooms
Install one duplex data/voice communication and one cable TV outlet for each occupant.

Other Room Configurations
Any additional room configurations should be identified during the design stage of any new or renovation planning and have wiring configuration and communication jacks documented specifically.

End of Section

SECTION 28 00 00
FIREALARM & SECURITY SYSTEM

1. SYSTEM DESCRIPTION:

Fire Alarm System shall be a Microprocessor based system with both manual and automatic alarm initiation. The system must have the capability for intelligent fire detection, analog addressable smoke detector, and automatic alarm verification for alarm initiated by certain smoke detector zones. It shall have Emergency Voice Alarm Communication System with all requirements to complete, coordinated and establish an acceptable level performance and includes features, which are necessary for operational sequence for all projects.

The system shall have the capabilities to supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble alert and alarm mode or condition. The system shall be capable to interface with emergency voice communication system and transmitting a prerecorded voice message to all outgoing devices. In addition it shall be capable of storing and verifying all analog and binary I/O control activation.

The system include all necessary properly labeled wiring, cabinets, pull boxes, mounting boxes, alarm initiating devices, voice evacuation equipment's, control panels, auxiliary control devices, annunciators, power supplies, communicator for remote notification and all other accessories items required for complete operating system even if each item is not specifically mentioned or described. The system shall include all necessary hardware and software to integrate with Direct Digital Control (DDC) system. The DDC system shall communicate with security/access management equipment to provide display alarm activity, acknowledge alarms, set/reset output points, issue overrides commands, unlock/lock doors, set time/date and executes all system events.

All system hardware and software programming tools shall be intelligent to modify including addition and deletion of devices, circuit zones system operation and custom label change for devices or zones and document. System shall place no limit on the type or extent of software modifications on site. Modification of software shall not require power to be down or loss of the system protection while modification is being mode.

Fire alarm system shall be compatible with County's energy management system (EMS). County must have the capability to monitor fire alarm and security system remotely through management system software and network. Fire alarm and security system should also be sending signals to county security office. All work of fire alarm and security system shall comply with ruling of the latest edition of all local and state code, local fire marshal requirements, ADA, The National Fire Alarm code NFPA 72, The National Electrical Code NFPA 70, and the requirement of The Local power Company unless otherwise approved by the manufacturer.

1.1 GENERAL REQUIREMENTS:

1. A fire alarm must have two sources of electrical power: A power supplies provided for control units, circuit interfaces, or other equipment essential to system operation, located remote from the main control unit, must also have a primary and secondary power supply.
2. Fire alarm circuits must have battery and voltage drop calculation.
3. All systems are required to have maintenance and testing agreement.
4. The relay used to initiate control of fire safety function be located within 3 feet of the control device.
5. Mounting manual fire alarm box shall be mounted at each exit on each floor. The operable part of each manual fire alarm box shall be not less than 3 '/2 feet and not more than 4 %2 feet above floor level.
6. Travel distance to nearest fire alarm box not to exceed 200 feet.
7. Graphic annunciators mast consist of a floor plan of the protected building or facility with a lamps mounted into the display to pictorially display the location of zone or of an initiating device.
8. Switches for fan or damper control or for speaker circuit control must be integrated into the graphic announciators.
9. All fire alarm and process monitoring alarm supervisory system should be electrically supervised so the occurrence of single open or single ground fault condition of its installation wiring is indicated by a distinctive trouble signal.
10. All fire alarm/security systems are to be provided with a separate and independent source of emergency stand by power.
11. Fire alarm control (FAC) power supply shall have a continuous rating adequate to power all zones of functions indefinitely in full alarm condition.
12. Switching to emergency standby power during alarm shall not cause signal drop out.
13. System trouble signal shall be annunciated at the control center by means of audible and visible indication.
14. All equipment's shall be new and shall be bear the manufacturer's name and trade name.
15. Acceptable manufacturers shall be Pyrotronics only. No substitution is allowed.
16. Panel board shall not be installed where it will be exposed to ambient temperatures above 40 Celsius (104 Fahrenheit) degree, dust, abnormal vibration, mechanical shock, unless specified by the manufacturer.
17. All installation shall be following the manufacturer instructions and labels
18. Panelbord-loading shall be determined during design phase to Inured from prevent harmonic cause in the electrical system, which may result in overheating condition.
19. All junction box covers shall be stenciled for distinct identification.
20. All conduits, device mounting boxes, junction boxes and panels shall be securely fastened with appropriate fitting to insure positive ground and connections throughout the entire system.

1.1A <u>WIRING REQUIREMENTS:</u>

1. All wiring shall be installed in metal conduit or surface metal raceway. Only copper conductors wire must be used for fire alarm system wiring. Conduit shall be 3/4" (inches) minimum.
2. Signaling lines circuit shall be minimum solid copper No. 18 AWG.
3. Notification appliances circuit shall be minimum solid copper No. 14 AWG.
4. All other wiring shall be solid copper No. 14 AWG with minimum of 600 Volt THHT insulation except as specifically noted.
5. Every conductor must be installed for 300 volts.
6. All circuits must be monitored for reliability and must be identified at terminal and junction locations.
7. Power-limited fire alarm conductors shall not be strapped, taped, or attached by any means to the exterior of any conduit or other raceway as a means of support

1.1B <u>DETECTORS REQUIREMENTS:</u>

1. All detectors shall be located at the highest point on the ceiling or slab such that indicator lamps are visible from the floor below, or from the nearest equipment aisle, or from the doorway entering the room, as applicable

1.1C SMOKE DETECTORS REQUIREMENTS

1. Smoke detectors shall note be located within 3 feet of or in the direct air stream from supply air diffusers.
2. Smoke detectors must be powered separately from the signaling system for the sole function of stopping fans shall not required standby power.
3. The maximum sensitivity for smoke detectors must be at 3% feet.
4. Beam detectors are required in atrium in lies of installing spot type detector on the ceiling S
5. Smoke detectors must be the plug-in type, with a separate base to facilitate replacement and maintenance.
6. Open area type smoke detectors mounted within 12 feet of a working surface shall have their built-in locking device activated to prevent unauthorized removal.
7. Open area smoke detectors should not be within 3 feet of an air supply (All works shall coordinate with Mechanical Specification).
8. Smoke detectors are not permitted to be installed until all construction activity is completed. During renovation work, if smoke detectors are present, they must be replaced with heat detectors.

1.1D HEAT DETECTORS REQUIREMENTS

1. Heat detector should be positioned on the ceiling not less than 4" (inches). From the side wall neither less than 4" (inches) or more than 12" (inches).
2. Heat detectors are required in rooms or areas where unwanted or unintentional alarm are possible due to humidity, temperature, exhaust or other problem.
3. Temperature rating of heat detectors should be indicated on the plan of specification.

1.1E DUCT DETECTORS RQUIREMENTS:

1. Duct detectors are required in the supply and return sides of any AHU over 15,000 CFM capacity and in the supply side of any AHU between 2,000 and 15,000 CFM.
2. HVAC ducts, Lighting fixtures, and other factors affecting airflow must be considered in establishing the exact location of the detectors.

1.1F AUDIBLE & VISUAL SIGNALS REQUIREMENTS:

1. Strobe spacing requirements between devices must be not exceed 100'.
2. Visible alarm notification devices must be integrated into the building or facility fire alarm system.
    a. Light must be white Xenon Strobe.
    b. Maximum pulse duration 0.2 second
    c. All devices minimum 75 candela.
    d. Flash rate minimum 1 Hz and maximum 3 Hz.
    e. Flash rate 1-2 flashes per second
3. Visible alarm notification devices must have the following photometries and location features:
    a. 80" above floor or 6" below ceiling whichever is lower.
    b. No places in any room more than 50' from any appliances. In large rooms appliances may be 100' centers around perimeter.
    c. At a minimum, visible appliances required restroorns, general areas (meeting rooms), and hallways.
    d. Minimum 15 candela in non-sleeping areas.
    e. Minimum 110 candela in sleeping areas.
    f. Minimum 177 candela if combined with a single station smoke detector.
    g. When using wall mounted strobes install:
        i. 1 strobes, or 2 strobes on opposite walls.
        ii. In rooms 80'x80' or greater, where more than strobes are in any field of view, space a minimum of 55' apart.
        iii. Synchronize if more than 2 strobes.
    h. If a room configuration is not square, the square room size that will entirely encompass the room or subdivide into multiple squares shall be used.
    i. Strobe viewing position shall be no more than 15' from end of corridor with spacing no more than 100' apart.
    j. When there are interruptions in the viewing path, each area must be considered a separate corridor.
4. Audible signal for the public mode of operation should have a sound output level of no less than 75dBA at 10' (feet) with duration of at least 60 seconds.
5. Audible signal output for Mechanical equipment rooms is recommended 85dBA.
6. Audible signal output for private mode shall have a sound level of not less than 45dBA at 10' (feet) or more than 120dBA at the minimum hearing distance from the audible appliance with duration of at least 60 seconds.
7. Audible signal in sleeping areas shall have at least 70dBA at 10' with duration of at lest 60 seconds.

8. Visual signals shall be mounted 80" (inches) above the finished floor or 6"(inches) below the finished ceiling whichever is lower.
9. Visible signals must be the strobe (flash discharge) type, with a minimum intensity of 75 candela.

End of Section

SECTION 32 90 00
PLANTS and LAWN

1. TREE RELOCATION

Tree to be relocated must be healthy, have aesthetic value, and be of suitable size, as determined by the County.

The County will conduct a pre-construction tree inventory. The tree inventory will determine the following information about each tree within the proposed construction limits: exact location, species, d.b.h., relative health, appraised value, maintenance needs, and any other special tree concerns.

Tree will be moved to an appropriate site taking in such considerations as the tree's health and other requirements such as: similarities in sun exposure from old site to new site, aesthetic attributes of the tree and suitability to the site, soil and drainage compatibility.

County or Landscape Architect shall be responsible for siting and layout of tree locations. Contractor will obtain approval from Landscape Architect before planting.

Contracted tree transplanter will be responsible for location of all utilities including over head wiring and the repair of the utilities if damaged.

Contracted tree transplanter shall be responsible for the complete process of the transplanting from ground breaking to staking including all labor.

1) Site Preparation:

    a) See Specifications in Site Preparation section

2) Digging of Trees:

    a) New planting hole will be dug before tree to be removed is dug. Sides of new hole shall be scarified.

    b) Dig only when soil is moist. Ball and burlap rootball if transported off site or stored.

    c) A mechanical digger will be allowed provided ball-size is as specified and machine can be used without damage to existing tree. Any other digging method used must be approved by the Certified Arborist and Landscape Architect. If trees are replanted immediately there is no need to ball and burlap rootball.

    d) If a mechanical digger other than a tree spade is being used, roots up to and including ¾" shall be cut by hand pruners and roots over ¾" shall be cut by a hand saw. Do not chop, tug, mutilate or otherwise destroy roots. Protect exposed roots at all times from desiccation by wind, sun, freezing, or other adverse environmental conditions.

    e) Ball sizes as follows: for each one inch of tree caliper measured 12 inches above ground line, the ball diameter shall be 10" with a minimum size being 18" diameter.

Rootball depth as follows:

Rootball Size	Ball Depth
and smaller……….	.2/3 rootball diameter
to 48"……………….	.5/8 rootball diameter
and larger…………	3 feet deep

f) Prior to digging of trees, apply WILT-PRUF to the drip point at the recommended rate if deemed necessary by the Landscape Architect or the County Landscape Staff.

g) After trees are removed, fill resultant holes to grade with surplus soil. Do not leave open holes.

3) Procedure for Moving Trees:

a) Transport trees to final locations with care. Tie back branches and protect bark with burlap to prevent damage from chafing by ropes or wires. Do not drag along ground. Keep rootball moist.

b) Plants shall be moved and transported by an experienced operator as approved by the County Landscape Staff.

4) Planting of Relocated Trees:

a) Plant to a depth so that the finished grade level of the tree, after settlement, will be the same that at which the tree was grown.

b) Do not pull burlap out from under balls. Remove burlap from top and sides of rootball if it will not affect the integrity of the rootball. Cleanly cut off all broken or frayed roots.

c) Backfill with native soil excavated from pits. Soil shall be backfilled in layers of not more than six inches and each layer thoroughly compacted by hand and water, and free of voids before next layer if put in place.

d) Work the backfill soil around and beneath the ball leaving no air pockets. Continue adding and tamping the soil until the hole is half full. Add water to partially fill the hole. Let the water soak into the soil and finish backfilling and create a watering well with backfill around perimeter of rootball.

e) Trees shall be staked immediately after planting as recommended in the National Arborist Association Standards for Pruning and Guying of Shade Trees. See staking standards.

f) Wire on cables shall be flagged with plastic pipe cover and surveyor's tape immediately after installation.

g) Cover entire surface of pit with two inch layer of mulch within two days of planting. Keep mulch 3" to 6" away from trunk.

h) Upon completion of planting, water thoroughly. Apply water slowly so as to penetrate the entire root system and at a rate which will prevent saturation of the soil.

5) Maintenance:

a) Maintenance shall begin immediately after each tree is planted. Trees shall be watered, mulched, weeded, pruned, sprayed and fertilized as needed. Settled trees shall be reset to proper grade and position and watering well restored.

b) Tighten guys and cables as necessary. Staking to be adjusted as necessary.

c) Spray as necessary to control insects, fungus, and other diseases. All pesticide applications shall be submitted to the
d) County for approval prior to implementation.
e) Notify the County of signs of nutrient deficiency and submit recommended program of fertilization.

f) Maintenance of relocated trees shall occur for one year after provisional acceptance.

6) Guarantee:

a) Guarantee of relocated trees shall occur for one year after provisional acceptance.

b) All trees shall remain in a plumb upright position. Contractor shall periodically inspect and maintain the guying system on trees, including safety flagging on cables.

c) Relocated trees that are seriously damaged, die, or decline during transport, transplant, shall be replaced with trees of the same species and equal size.

d) These damaged and destroyed trees shall be removed from the site, the stumps grubbed and the ground surface repaired with all costs borne by the Contractor.

e) The County will be reimbursed for the appraised value or cost of cure for trees damaged, killed or that show signs of significant decline within a three year period after the completion of construction. If the County is deprived of the use and/or enjoyment of the property during the time of restoring the property to near its former condition, the property County may be entitled to additional compensation as determined by negotiation or appropriate legal action.

2. TREE PROTECTION GUIDELINES

1) The County or a Certified Consulting Arborist is to review all aspects pertaining to the preservation of trees. If a Certified Consulting Arborist is to be contracted, this Arborist is to be mutually agreed on by the Contractor and by the County.

2) The Arborist will conduct a pre-construction tree inventory. The tree inventory will determine the following information about each tree within the proposed construction limits: exact location, species, d.b.h., relative health, appraised value, maintenance needs, and any other special tree concerns.

3) The Arborist is to over-see any pre-construction pruning. Trees with large dead branches should be pruned to make the construction site safe for all personnel. Some trees may require lower branch pruning to allow for the operation of construction equipment. Prohibiting the use of large dump trucks

may be necessary in certain segments of the construction area. Pruning is to be performed by trained personnel under the supervision of the Arborist.

4) All contractors and sub-contractors, including all personnel, will be made aware that the trees are valuable and need to be protected. The general contractor is ultimately responsible for the protection and value of the trees.

5) The Arborist is to determine the tree protection zone(s). Chain link protection fencing at least 6' tall is to be constructed 360* around each tree or groups of trees. Single-strand wires, rope or plastic flagging is not considered an acceptable barrier. If chain link fencing is not an appropriate material, only the Arborist may approve an alternate material. Chain link fencing should have some type of screening material for aesthetics and debris retention purposes. Tree protection zones may be established by the dripline or branch spread for small trees. For larger spreading trees, a one foot radius for each inch of tree diameter. Leaving the fence open on one side, moving the fence limits, or temporarily removing the fence and working around the tree is unacceptable.

6) The Arborist is to oversee any pre-construction root pruning. Prevention of tree root damage by construction equipment is a priority. To prevent roots being ripped by equipment excavating and/or grading, the roots are to be pruned 6" -12" closer to the tree than the construction limit. The Arborist may need to specify the use of equipment manufactured by the arboricultural industry for root pruning.

7) Construction materials or stockpiling fill are not to be stored over root zone area at any time. Parking of vehicles or construction equipment is not permitted over root zone area. Where installation of utilities is to disturb root system, auguring is to be done as recommended by the Arborist. The Arborist will determine if severing roots close to the trunk will make the tree subject to windthrow hazard.

8) Provisions are to be made to water designated trees during periods of drought. Periods of drought are defined as a time when there is less than one inch of rainfall during any 30 day period. Trees should be watered at a rate of 50 gallons per inch diameter. Application should be made so that the water slowly soaks into the ground and does not run off.

9) Trees that are to be preserved should be maintained during the year preceding construction to promote optimum health.

10) When backfilling, subsoil and fill material is unsuitable for root growth. All construction debris is to be removed and backfilled with clean topsoil as specified in soil section specifications. Mulch is to be applied within two days of backfilling. Two inches of mulch is recommended, keeping mulch 3" away from trunk and a minimum diameter of four feet. Backfill is to be replaced at the original root crown level. Grade changes may be recommended by the Arborist only.

11) If trees are damaged, killed, or show signs of significant decline within a three year period after the completion of construction, the County will be reimbursed for the appraised value or cost of cure for the trees.

12) If the County is deprived of the use and/or enjoyment to the property during the time of restoring the property to near its former condition, the property County may be entitled to additional compensation as determined by negotiation or appropriate legal action.

3. PRUNING SPECIFICATIONS

1) All work shall be done in a professional manner under the direction of the Project Manager and shall conform to all state and federal laws and regulations.

2) The Certified Arborist shall be bonded and licensed with the State of Washington and subscribe to ISA standards and ANSI Z133.1.1979 unless otherwise stated.

3) The Certified Arborist shall furnish all labor, materials and equipment needed.

4) No spurs or irons are to be used climbing unless the tree is to be removed.

5) All cuts shall be made clean with pruner or saw at nodes or crotches beyond the collar and BBR while exercising caution not to bruise or tear bark.

6) Tools and equipment shall be maintained and operated in a safe professional manner; those used on infected trees will be disinfected to prevent translocation of disease.

7) While maintaining the shape of the tree within the aesthetic balance of the landscape, dead and competing branches shall be removed. Diseased wood is to be removed as appropriate.

8) All debris resulting from pruning shall be removed from the site. The area beneath each tree shall be swept clean before moving to the next tree.

9) The Certified Arborist shall be responsible for any damage incurred to County property by the pruning operation.

10) Warning devices, barricades, cones, ground personnel and other necessary precautions shall be taken by the Certified Arborist to provide for the protection and safety of persons and vehicles in the area.

11) Authorization, supervision and inspection of the work will be provided through the County. The Certified Arborist shall conform to the standards, techniques and judgment of the County. The Certified Arborist reserves the right to refuse circumstances considered unsafe.

4. SITE PREPARATION

1) Drainage Requirements For All Plantings:
   a) Ensure that all areas are free draining prior to planting. Excavate pits to test for drainage. Fill with water. If pit drains clear of water within 2 hours, it is acceptable to follow the planting details on plans. If pits are not free draining, submit method of drainage for review.

2) Grading:
   a) Grade sub-surface to achieve a uniform surface relative to the finish grade, or as indicated in the details.

b) It shall be the General Contractor's responsibility prior to any landscape work to do all cutting and filling necessary to provide a proper subgrade, removing from site, all general debris, woody material, roots, concrete, and stones larger than 1-1/2" diameter.

c) Establish survey grids in field corresponding to drawings and indicate required depth of cut or fill. Grade to uniform levels or slopes between points where grades are noted on drawings. The Landscape Architect or Engineer shall have final approval of rough grades and may supervise revision in the field.

3) Soil Preparation For Shrub beds:
   a) Excavate and remove 12" below grade and then prepare existing soil. Rip, disc, scarify, or till subgrade to a depth of six inches. Use heavy mechanical equipment if required to attain full six inch depth. Heavy equipment use to be approved by the Landscape Architect or the County Landscape Staff. Fourteen inches of planting soil shall be thoroughly mixed into the tilled subgrade. Remove from site, all general debris, woody material, roots, concrete, and stones larger than 1-1/2" diameter within 6" of the surface. Use additional planting soil and to bring the elevation of the finished elevations noted on the plans.

4) Soil Preparation For Lawns:
   a) Prepare existing soil. Rip, disc, scarify, or till lawn areas to a depth of six inches. Use heavy mechanical equipment if required to attain full six inch depth. Heavy equipment use to be approved by the Landscape Architect or the County Landscape Staff. Six inches of turf mix (see soil specs) shall be applied on top of the tilled subgrade. Remove from site, all general debris, woody material, roots, concrete, and stones larger than 1" diameter within 6" of the surface.

5) Finish Grading:
   a) The Landscape Contractor shall be responsible for bringing lawn and planted areas to finish grades as indicated on drawings. Remove all concrete, rocks, rubble, roots and debris larger than 1-1/2" on a side from within 6" of the surface.

6) The finish grade for lawns shall be flush with curbs, paved areas, site furniture, or other site transitions.

5. SOILS

1) Before delivery of soil, the contractor must furnish the Landscape Architect or County with a written report from a recognized, certified soil laboratory. The report shall include soil analysis and recommendations for amendments suitable for ornamental landscape and/or turf areas. The contractor will coordinate with the Landscape Architect or County in meeting optimal levels of soil nutrition for healthy plant growth. This will include a pathological report to identify pests detrimental to the health of the plants. The report will include: fungus/bacterial disease identification; nematode count/soil; soil/water fungi detection or other tests as directed by the Landscape Architect and the County. These tests will be required if the soil has not been sterilized. The contractor will be required to amend the soil on site as directed by the Landscape Architect or the County at the cost of the contractor.

2) The soil is to be delivered to the work site only when it is not saturated, muddy or frozen.

3) Topsoil for Lawns:
   a) Lawn area to be sand based, from standard washed builders sand, containing 10% - 15% organic matter from compost.

   b) Total nitrogen 0.25% minimum

   c) pH range 5.5 - 7.5.

4) Planting Soil:
   a) Shall be a mixture of 50% compost and 50% builders sand (washed) by volume. Any other soil mixture must be approved by the County.

5) Compost:
   a) Compost shall be a well decomposed, humus-like material derived from the decomposition of organic matter. The compost shall have an earthy odor, shall be free of viable weed seeds and other plant propagules (weed seed test sample to be taken from 2" to 8" below the surface of the pile), shall have a moisture content such that there is no visible free water or dust produced when handling the material, and shall be free of manufactured inerts.

   b) In addition, compost shall have the following physical characteristics:
      i) Equal parts of three types of perennial rye grass
      ii) Shall be screened using a sieve no finer than 7/16" and no greater than ¾".
      iii) Shall pass a standard cress test for seed germination (90% germination compared to standard).
      iv) Shall have a pH from 5.5 to 7.5.
      v) Shall have a maximum electrical conductivity of 5.0 mmhos/cm.
      vi) Shall have a maximum carbon to nitrogen ration of 40:1.
      vii) Shall be certified by the Process to Further Reduce Pathogens (PFRP) guideline for hot composting as established by the United States Environmental Protection Agency.
      viii) Shall be produced at a permitted solid waste composting facility (Health permit, DOE storm water permit, PSAPCA facility and equipment registration.
   c) Acceptable product is Cedar Grove "Pure Compost" or approved equal.

<u>6. LAWN</u>

1) Examination of Site:
   a) Prior to installation of lawn, verify the location of all electrical lines, utilities, and drainage systems. Take precaution not to disturb or damage sub-surface elements. Contractor shall make repairs to damaged utilities and site elements at own expense.

2) Installation:

   a) Notify the Landscape Architect of all subsurface drainage or soil conditions detrimental to growth or survival of lawn.
   b) All lawns must have automated irrigation (see Irrigation Section for Specifications).

3) Preparation of Seeding Surface:

a) Prior to final grading and raking of seeded surface ensure that soil profile is free draining, dry, and that the subgrade has been compacted to 85% to ensure that no soil settling will occur.
b) After completing soil preparation measures as found in Site Preparation and Soils Specification, rake out entire area to be seeded with lightweight grade rakes and remove all raked debris. Approved mechanical raking methods may be utilized prior to hand raking but not as a substitute. Ensure that all debris is removed as specified and that the surface is smooth, free draining, contains no low or high spots, and follows the described or illustrated contours on the grading
c) Rake fertilizer into surface. Apply fertilizer at rates determined by laboratory soil analysis.
d) Compact surface with a manual or mechanical roller in two directions at right angles to each other. Sprinkle seeded surface prior to each rolling. Roller to be minimum 3'0" width steel drum specifically for the purpose of rolling lawn areas.
e) Finish grade shall be flush with curbs, paved areas, site furniture, or other site transitions

4) Seeding for General Lawns:
   a) Seed lawn areas at the rate of six pounds per 1,000 square feet.
   b) Sow half of seed at right angles to the first sowing. Lightly rake to cover seed and compact by rolling. Water as required to maintain moist soil to a depth of at least four inches
   c) Apply fertilizer at rates determined by laboratory soil analysis.
   d) Produce a close stand of grass within 60 days after seeding. Approximately 21 days after germination, the soil shall be retested by the same soil laboratory and amendments applied as recommended. Reseed barren areas as originally specified.

5) Recommended Grass seed mix: Certified quality seed shall meet the following
   a) 100% perennial rye grass - 3 way blend
      i) Equal parts of three types of perennial rye grass
      ii) 0% weed seeds
   b) 90 -95% germination rate
   c) inert matter not to exceed 1.5%

6) Example of grass seed mix:

	REQUESTED	*KIND*	*PURE SEED IN MIX*	*GERM*	*ORIGIN*
a).	34.00%	AFFINITY PER. RYEGRASS	33.72%	92.00%	OR.
b).	33.00%	SECRETARIAT PER. RYEGRASS	32.46%	92.00%	OR.
c).	33.00%	NIGHTHAWK PER. RYEGRASS	32.64%	92.00%	OR.

OTHER CROP SEED: 0.05 INERT MATTER: 1.17% WEEDS: 0.00%
BAG WEIGHT: 50 LBS NET DATE OF TEST: 01/01/97
NOXIOUS: NONE FOUND
AMS 690

7) Hydroseeding:
   1) Notify the Landscape Architect and County not less than 24 hours in advance of seeding operation for approval of grade before seeding.
   2) Accomplish seeding with a hydroseeder that utilizes water as the carrying agent, and maintains a continuous agitator action that keeps seed and fertilizer mixed in uniform distribution until pumped from tank. Maintain pump pressure for a continuous nonfluctuating system stream of solution.
   3) Apply seed, fertilizer and mulch at the following rates:
   4) Seed - 240 pounds per acre

5) Fertilizer as directed by Landscape Architect or County as determined from soil analysis.
6) Mulch (Silva-Fiber) - 1,000 pounds per acre. Dyed green to facilitate inspection of placement.
7) Produce a close stand of grass within 60 days after seeding. Approximately 21 days after germination, re-fertilize as determined by second soil test. Re-seed barren areas as originally specified.

8) Fertilizer:
   a) Fertilization of turf and planting areas shall be determined from soil analysis from a recognized, certified laboratory according to specific plant needs.

   b) A “typical” turf area should be fertilized with a product that includes a variety of major nutrient sources; slow release (70-75%) nitrogen and micronutrients necessary for good plant health.

   c) Apply fertilizer to dry turf and water lightly after application. Avoid mowing soon after application to prevent particle pick up damage.

   d) Seasonal adjustments shall be made to fertilizer nutrient ratios under direction of the County Landscape Staff.

9) Maintenance and Protection of Seeded Areas:

   a) Protect against harm from wind, trespassing and damage. Provide safeguards and protection to insure the lawn area is not damaged prior to approval and opening to public. Provide continuous plastic web fencing (or other enclosure as approved by County) at lawn perimeter with stakes at 6’-0” o.c. minimum. Maintain fence/enclosure in place until second lawn mowing. Replace damaged portions of lawn immediately.
   b) Lawn areas shall be maintained by Contractor until accepted by County. Maintenance shall consist of: Mowing, reseeding - consistent with original seed blend, weeding, fertilization, repair of erosion damage, and other operations necessary for proper maintenance of the project. Mowing shall occur on a regular basis, as proscribed by County, by Contractor until final acceptance by County. If Contractor fails to do so, mowing will be done by County and charged to Contractor. If final acceptance is delayed, Contractor shall be responsible for additional mowing required for upkeep and maintenance of the site as determined by the County.
   c) After 90 days, apply fertilizer at rates determined by laboratory analysis.
   d) Mow and edge lawn at 1-1/2” each time grass has grown to a 2 inch height until final acceptance.
   e) Arrange watering schedule with the County Landscape Staff.

10) Inspection And Acceptance Of Lawns:
   a) Request for Inspection: Notify the Landscape Architect or the County Landscape Staff at least three days before anticipated inspection.
   b) Acceptance of Work: Upon completion of all repairs, the Landscape Architect shall verify provisional acceptance of lawns to the County Landscape Staff. Physical completion of lawns shall constitute the beginning of the guarantee period.

11) Guarantee Period And Final Acceptance:
   a) Duration of Guarantee:
      i) Lawns shall be guaranteed for a period of one year from the date of Physical Completion to be in good, healthy, and flourishing condition. Replace defective materials noted and upon

completion of replacements, final acceptance will be verified in writing by the Landscape Architect with approval from the County Landscape Staff.

7. MULCH

1) Choice of type of mulch to be determined by the County Landscape Staff.

2) All mulch shall be applied to new shrub beds to a uniform depth of two inches.

3) All mulch shall be applied three inches from tree and shrub trunks.

4) Acceptable mulch products:
   a) Bark - shall consist of fir and or hemlock, shall be of a medium fine texture (=1 ¾"), the moisture content shall not exceed 22%, it shall not contain weed seeds or sawdust, resin, tannin, wood fiber or other compounds detrimental to plant life.
   b) Gro-Co - a composted organic material composed of fir/hemlock sawdust and biosolids. Distributed by Sawdust Supply.
   c) Steer-Co - a composted organic material composed of sawdust and composted steer manure. Distributed by Sawdust Supply.
   d) Cedar Grove Compost - well decomposed humus -like material derived from the decomposition of organic matter.

8. PLANT SPECIFICATIONS

1) Select trees and plants that are appropriate to the site. Price includes delivery to site. Avoid trees having aggressive root structures that may damage adjacent structures. Avoid trees near pedestrian areas that provide a winter haven for nuisance urban birds.

2) Examination:

   a) Inspection of plant material at the supplier's nursery site may be made prior to award of the purchase contract. Upon award, the Landscape Architect or the County Landscape Staff will inspect identified plant material to confirm quality and quantity offered. Supplier will notify County immediately if the condition of plant material fails as a result of infestation, fire, flood, drought or other circumstance which has compromised the quality of the plant material ordered. The Landscape Architect or the County Staff may inspect the material 10 days prior to delivery to confirm that plants selected meet the quantities and quality standards established. Plant lots must be clearly segregated from stock and have full identification tags including botanical name and certification of size and condition at times of inspection.
   b) Upon the determination of the County, one sample of each specified plant may be required to be provided to the County to assure acceptable quality standards. All plants delivered shall meet the size, quality and character of the representative material as established by the County.
   c) If proof is provided that any plant specified is not available, a proposal may be considered for the use of the nearest equivalent size and variety with a corresponding adjustment in the Contract price. This provision shall not relieve the supplier of obtaining the specified materials in advance.

3) Quality Assurance:

a) Supplier shall comply with sizing and grading standards of the American Association of Nurserymen ANSI Z60.1 and the American Joint Committee on Horticultural Nomenclature.
b) Plants shall be nursery grown in climatic conditions similar to Seattle.
c) Plants must be typical of their species, variety and cultivar with standard, well developed branching and a vigorous fibrous root system.
d) Plants shall be of premium quality, free of weeds, pests, diseases, injury, or general defects.
e) Pruning wounds with a diameter of more than one inch must show vigorous callus on all edges. Trees shall not be pruned within six months prior to delivery.
f) Balled and burlapped plants shall be provided with a firm rootball per AAN Standards. Ball with firm, natural balls of soil, wrap firmly with biodegradable burlap and secure for shipment.
g) Containerized grown stock shall be grown a minimum of six months in the finished container. Root bound material is not acceptable.
h) Native material shall be nursery grown for a minimum of two years.
i) Plant material furnished shall be at the size specified, larger material is acceptable at no additional cost upon approval of the County. Larger plants shall not be cut back to meet size requirements.
j) Shipment:
k) Plants shall be dug, loaded and transported with care to insure protection against injury. Plants shall not be stacked to result in damage to tissue or held in shipment for a period detrimental to plant health.
l) Plants shall be provided cover in shipment to prevent wind burn or whipping. Antidescicants are recommended for plants in leaf but they shall not supplant enclosed cover for shipment.
m) Stock shall be handled by rootball or container only, not the trunks, stems or tops of plants.
n) Inspection certificates required by law shall accompany each shipment.
o) Plants damaged by the supplier during delivery shall be rejected.

4) Approval:
   a) Plants delivered to the site which are not those previously approved by a the Project Manager, that are without labels, that are not certified to have met the conditions and specifications addressed above shall be rejected.
   b) Plants may be rejected at any time prior to planting if they are found to be deficient in meeting the specifications. Rejected plants shall be removed and replaced immediately from the site by the supplier. The County may assess a penalty of 25% against the price of rejected plant material which cannot be replaced in a timely manner. This requirement stems from the light construction schedule and the programs developed to celebrate and promote the completed project.

9. PLANT INSTALLATION

1) General:
   a) All imported plants shall be installed immediately upon their delivery to the project site.

   b) If planting is delayed more than 24 hours after delivery, set balled and burlapped plants on the ground, well protected with soil or wet bark. Adequately cover all roots of bare root material with soil or wet bark. Protect rootballs from freezing, sun, drying winds or mechanical damage. Water as necessary until planted. Do not heel in plants for more than one week.

2) Requirements:

a) Contractor shall furnish imported plant materials, move and/or remove on-site plants specified, and install all plant materials indicated on the drawings, provide maintenance and care of plant material, cleanup, and provide guarantee per specifications.
b) All plant material shall be transported to planting locations with care to prevent damage. Branches shall be tied back, as necessary, and bark protected with burlap from chafing by ropes at all times. No plant material shall be dragged along the ground without proper protection of the root and branches.
c) The specified materials shall be installed in accordance with the arrangements shown on the drawings. Planting of trees and shrubs shall be accomplished after all major grading has been completed. The landscape contractor shall be responsible for bringing lawn and planted areas to finished grades. Remove all concrete, rubble, roots, debris, and rocks larger than two inches.

3) Project/Site Conditions:
a) Bareroot Stock: Plant bareroot stock from October to February only under approval by the Landscape Architect or the County Landscape Staff.
b) Balled and Burlapped Stock: Plant during periods that are normal for work, as determined by season, weather conditions and accepted practice.
c) Do not plant when ground is frozen or excessively wet.

d) All plants shall be placed to bear the same relation to finished grade, after settlement, as originally borne to natural grade.

e) Notify the Landscape Architect and the County Landscape Staff, in writing, immediately of all subsurface drainage or soil conditions that Contractor considers detrimental to growth or survival of plant materials.

4) Planting Bed Preparation And Soil Installation:
a) New Installation : Prepare soil for beds per Soils and Site Preparation Specifications. Native soil shall be used where possible. If native soil is not acceptable per the Landscape Architect or the County Landscape Staff, then an Imported soil, per specifications in Soils, may be used. It should be incorporated a minimum of 6 inches into the existing substrate. Do not allow any ponds to form in beds. Remove surplus excavated material from site.
b) Existing Planting Beds with Partial Plant Replacement : Remove plants shown for removal. Add imported soil at this area, at depressions and low areas to raise grade to paving level, sloping areas to drain. Incorporate imported soil to a minimum depth of 6”.

5) Tree And Shrub Installation:
a) Locations of all trees and shrubs shall be inspected and accepted by the Landscape Architect or the County Landscape Staff prior to planting. Indicate the location of each tree with a two inch square by two foot long wood stake or wire stake with flag. Place containerized or balled and burlapped shrubs in proposed locations for observations by the Landscape Architect or the County Landscape Staff prior to planting. Begin planting after approval of locations by the Landscape Architect or the County Landscape Staff.
b) Procedure for planting:
i) Apply (6-10-8) fertilizer to backfill at one pound per inch caliper of tree.
ii) Trees and plants shall be planted in holes twice the diameter of the rootball.
iii) Add native soil to bottom of plant pit and tamp firmly to prevent settlement. Place plant in pit and remove binding of upper one-third of balled and burlapped stock and remove a minimum

of upper one-third of burlap. Care should be taken to remove excess soil to expose the crown of the tree or shrub.

iv) Fill planting pit to two-thirds depth and tamp with foot. Flood holes with sufficient water
v) After surplus water drains off, fill hole to finish grade with backfill. Form soil basin around each tree. Tamp soil firmly and add bark mulch, per mulch specifications. Stake trees and shrubs that may blow over.
vi) Remove all plant tags and flags after installation

6) Groundcover Installation:
   a) Place containerized plants in proposed locations for observation by the Landscape Architect or the County Landscape Staff prior to planting. An area of approximately 1,000 square feet should be laid out showing a typical configuration. Begin planting after approval of locations by the Landscape Architect or the County Landscape Staff.
   b) Clean ground cover areas of all extraneous material.
   c) Mulch after planting as per mulch specifications.
   d) Remove all plant tags and flags after installation

7) Disposal Of Waste Materials:
   a) Remove all plastic labels, materials, and synthetic burlap from planting pit, after plant is in place. Remove waste materials from site.

End of Section

SECTION 32 90 01

Site landscaping work

1. Purpose

The purpose of these guidelines is to call attention to various Specification items that will require proper paraphrasing, when applicable. Specification standards have been developed for certain portions of the work and shall be incorporated into the contract specifications, verbatim, when applicable, except indexing. The guidelines and standards of all Specification Divisions, except Division 1, shall utilize the CSI Three Part Specification System.

a) The methods and procedure for compaction operations shall be set forth in the Specifications in specific detail.

b) The words "satisfactory disposal" of all materials to be removed for the proper execution of the work shall be defined in the Specifications.

c) Where a site development contract precedes a building project on the same site, the engineering and surveying work shall be included in the site contract with the following additional requirements:

(1) The General Contractor shall be responsible for, and pay for costs incurred and shall obtain a final topographic and location survey immediately after completion of the Site Work.

(2) The work shall be performed in accordance with the Professional Practice of Surveying and Mapping within Civil Engineering as published by the American Congress on Surveying and Mapping, by a Land Surveyor or a Civil Engineer registered in the State of Maryland.

(3) The Designer shall include a complete description of the survey work to be accomplished by the General Contractor.

(4) Record Drawings for the Site Work shall be maintained during construction by a Registered Surveyor or Engineer in the employ of the General Contractor. Drawings shall be maintained and finalized as required in DIVISION 1, General Requirements.

(5) At the completion of the contract, the Registered Surveyor or Engineer shall submit the General Contractor for processing to the County, a complete reproducible set of Record Drawings showing all conditions, together with his registration seal and signature.

d) Landscape: This part is divided into two sections:

1. <u>Soft Landscape Items</u> which includes plant material, ground cover, shrubs, and trees.

2. <u>Hard Landscape Items</u> which includes parking lots, curbs, gutters, site furnishings, etc.

SECTION 1. SOFT LANDSCAPE ITEMS

<u>General</u>: In the selection of plant material, consideration should be given to the very cold winters experienced in recent years. Many plant materials, particularly broadleaf evergreens, died during the winter months. We are recognizing a significant climate shift, so that plant materials indigenous to zones to the north of us, say Pennsylvania, are preferable to those previously identified as suited to the Maryland - Virginia zone.

<u>Grasses</u>: The following grasses are favored:

K-31 Tall Fescue - heavy traffic areas
Perennial Ryegrass - heavy traffic areas
Ben-sun A-34 Bluegrass - general lawn areas
Red Fescue (Creeping) - general lawn areas
Bentgrass (colonial or Creeping) - general lawn areas
K-31 Tall Fescue or Perennial Ryegrass should also be used near outdoor swimming pools where chlorine may be present.
New sod should be fertilized with low nitrogen fertilizer to ensure a well established root system.
Hydroseeding can be used, except on steep slopes and drainage swells where sod is more appropriate.

<u>Slopes and Grass</u>: A 2% slope in a grass area is optimum. Avoid slopes less than 2%. The maximum grass slope that can be maintained safely and efficiently is 30%. Slopes over 30% should be terraced, covered with rip-rap, or treated in a manner to facilitate maintenance and provide safe pedestrian access and avoid erosion.

<u>Ground Covers</u>: The selection of ground covers should take into account the likely pedestrian traffic in the area. Plant materials easily crushed by foot traffic should not be used where pedestrians may be tempted to short-cut across plant beds. Favored ground covers are:

Japanese Spurge (Pachysandra Terminatis) - areas of light foot traffic

Blue Rug Juniper (Juniperus Horizontalis) - areas of both light and heavy foot traffic

Crown Vetch (Coronilla Varia) - on slopes

Parking Lot Screens: All planting in a parking lot should be placed least 6'-0" from the face of a curb or curb stop, otherwise the material will be damaged by cars. In all instances the applicable zoning code should be checked and complied with for screening of parking areas.

Favored Screen Material:

Buckhorn (Rhamnus Cathartica)
Canadian Hemlock (Tsuga Canadensis)
Yews (Taxus)
Arborvitae (Thuja)
English Laurel (Laurocerasus Officinalis)
Buford Holly)Ilex Cornuta Bufordi)
Winged Eunonymus (Eunonymus Alatus)

Avoid Legustrom as it does not survive winters.

The parking lot screens are most effective when they are installed 18" high minimum and 2'-0" maximum spacing. (Check local zoning codes)

In plant areas within parking lots, if less than 3 ft. is provided from curb to curb for plant material, use either concrete or sod. The space is too small for screen planting, ground cover, shrubs or tress. Provide at least 160 sq. ft./tree.

Avoid ivy of all types, as it serves to collect trash, and does not look good until well established.

Shrubs: The following is a list of shrubs that have been found to thrive and survive around County buildings:

Japanese Holly (Ilex Convexa)
Buford Holly (Ilex Cornuta Bufordi)
Winged Burning Bush (Eunonymus Altaus)
Golden Bell Forsythia (Forsythia Intermedia)
Sweet Pepper Bush (Clethra Alnifolia)
Leather Leaf Viburnum (Viburnum Rhytido Phylum)
Wright Viburnum (Viburnum Wright)
Arrowood Viburnum (Viburnum Dentatum)
Saving Juniper (Juniperus Sabina)
Pfitzer Juniper (Juniperus Chinensis Pfitzer Iana)
Vase Juniper (Juniperus Communis Depressa)
Azaleas - Various types and colors - Hardy northern variety only.
Rhododendrons - Various colors - in locations protected from high winds.

Avoid placing shrubs and ground cover under large overhangs where they are cut off from rainfall. Avoid shrubs and trees w/poisonous berries.

Evergreens: The following evergreens are recommended:

Douglas Fir (Pseudotsuga Taxifolia)
Norway Spruce (Picea Abies)
Colorado Blue Spruce (Picea Pungens Koster)
White Pine (Pinus Strobus)
Scotch Pine (Pinus Sylvertris)
Austrian Pine (Pinus Nigra)
American Hemlock (Tsuga Canadensis)
Pyramidal Arborvitae (Thuja Occidentalis Pyramidalis)

Avoid broad leaf evergreens such as Magnolias because they suffer severely from windburn in winter months.

Ornamental and Shade Trees: The following are recommended:

Crimson King Maple (Acer Platanoides Schwedleri)
Sugar Maple (Acer Saccharum)
Norway Maple (Acer Plantanoides Columnare)
Japanese Red Maple (Acer Palmatum Atropurvureum)
Green Ash (Fraxinus Pennsylvanica Lanceolata)
Redmond Linden (Tilia Euclora Redmon)
American Linden (Tilia Americana)
Russian Olive (Elaeagnus Augustifolia)
American Holly (Ilex Opaca)
Big Leaf Holly (Ilex Crenata Latifolia)
English Holly (Ilex Aquifolium)
Honey Locust (Gleditsia Triacanthus Inermis)
River Birch

Avoid Clump Birches.

Flowering Trees: The following flowering trees are favored:

Kwazan Cherry (Prunus Kwanzan)
Mount Fugi Cherry (Prunus Serrulata)
Yoshino Cherry (Prunus Yeddensis)
Weeping Cherry (Prunus Subhirtella Pendula)
Red Bud (Cercis Canadensis)
Ruby Tree (Prunus Cerasifera Pissardi)
Rose of Sharon (Hibiscus Syriacus)
Golden Raintree (Koelreteria Paniculata)
Washington Hawthorn (Crathegus Phaenopyrum)

Avoid flowering crab apple trees because of the need for pruning, problems with tent caterpillars, and Japanese beetles. Do not place Hawthorn on sites used by children or near pedestrians.

Street Trees: The following street trees are favored:

Red Oak (Quercus Borealis)
London Plane Tree (Platanus Acerfolia)
Bradford Pear
Sweetgum (Liquidambar Styraciflua)

Preservation of Existing Trees: Very often extreme measures are made to preserve large existing trees, particularly in parking lot areas. Our experience has been that many of these trees survive no more than three years and must be removed.

If any of the following changes are likely to occur around an existing tree, the probability that it will survive is limited:

1. Change of grade around base of tree.
2. Reduction of root system by more than 30%.
3. Impervious surface, such as paving, within drip line of tree.
4. Compaction of earth within drip line of tree during construction by construction vehicles.
5. Trees not pruned if root system is reduced up to 30%.

The designer should work to preserve clumps of trees rather than individual specimens, where possible.

In-Lawn Plantings:

Trees should be planted in shrub areas wherever practical. If trees must be planted in lawns they should be located at least 8 feet from any walls, fence or other obstruction. Lawn trees should be provided with 24" of bare sod free soil beyond and around a full circle of the tree. Avoid tree planting which creates lawn areas less than 30 inches wide. Where this condition occurs substitute mulch for sod. When planting groves of 3 or more trees provide a continuous mulched area between the trees to facilitate mowing.

Chemical Run-Off:

Salts and other chemicals are frequently used for snow and ice removal on parking lots, driveways and sidewalks. Site development should be designed so that this run-off does not contaminate shrubs and trees. Consideration should be given to piping run-off from parking lots, driveways and sidewalks directly to storm water management systems. The use of swells or french drains should be considered to prevent chemical run-off problems in planted areas.

SECTION 2. HARD LANDSCAPE ITEMS

Pavers: Do not use loose laid brick pavers. All pavers should be laid over a concrete slab and all joints should be grouted.

Sidewalks: Sidewalks to the entrance of buildings should be at least 6'-0" wide to permit three persons to walk abreast. Locate sidewalks where people are likely to walk, design with the flow. Provide radii at intersections so that grass at corners is not worn down. Avoid acute angles in layout when possible. An exposed aggregate finish is preferred over a smooth concrete finish.

Wheel Stops: Avoid using wood railroad ties for wheel stops. When possible use standard curb and gutter instead of concrete wheel stops. Wheel stops interfere with snow removal. Use wheel stops to prevent cars damaging transformers and on grade mechanical equipment adjacent to parking lots. However, it is preferable that equipment is set back at least 6'-0" from curb face to eliminate need for the wheel stops.

Decorative Stone: Under overhang areas around buildings use pavers or decorative stone instead of plant material. Plant material paving in these locations receive poor light and little rain water. The decorative stone should be small in size so that it does not become a problem in high vandalism areas.

Bicycle Racks: Bicycle racks should be of simple design and easily repaired. Painted bicycle racks constructed of round pipe are preferred. The racks should be bolted to a concrete slab and located close to the front entrance door - in view of building staff.

Railings: Railings on exterior steps should be aluminum. The use of aluminum is very important near swimming pools and other damp situations. Drain plugs should be provided on vertical supports.

Benches: Wood benches should be sealed - avoid varnish on exterior benches.

Fencing: In public areas wood slate fencing should be used. Use of chain link fencing should be limited as far as practical and used only when security or safety or protected of equipment considerations apply.

Retainage/Cribbage: Use new pressure treated wood or composite stone systems. Do not use railroad ties.

Curbs: Use concrete curbs, do not use rolled asphalt curbs. In large grass area, provide curb cut for lawn mowing equipment.

Flagpoles: In general, each building should have a single, free-standing flagpole near the main entrance. The flagpole should be equipped to fly two flags, one above the other. A spotlight must light the flags.

Building Identification Signs: Names of buildings or street numbers shall be metal letters attached to the building wall.

[Note to Designer: Fill in extra payment costs for additional excavation, rock excavation and additional gravel borrow after approval from the County.]

a) Additional Excavation

(1) Excavation, other than excavation of rock as herein defined, below the bottom grades for work indicated, if ordered to be removed by the Designer with the prior written approval of the County, because of "Differing Site Conditions", will be paid for, in addition to the lump sum contract price at the following rates:

(a) For the first 8 feet below specified elevation $_______ per cubic yard, measured in place.

(b) For depths of more than 8 feet below specified elevation, compensation will be made at the rate of $------- per cubic yard, measured in place.

(c) The payment under the above paragraphs shall cover all costs relating to such extra excavation, including sheeting, shoring, pumping, disposal of surplus or unsuitable material, filling, backfilling, compacting with suitable material as specified by the engineer, overhead, superintendence, profit, and all related costs as prescribed under the CONTRACT AND GENERAL CONDITIONS.

(d) If additional depths of excavation are required to obtain suitable bearing as a result of Contractor's failure to protect excavation from surface water and the elements, or provide adequate pumping, then such additional work shall be at Contractor's expense.

b) Rock Excavation

(1) Excavation of rock in excess of one cubic yard, if ordering in writing by the Designer with the prior written approval of the County, will be paid for in addition to the contract price at the rate of $_______ per cubic yard in opencut, and $_______ per cubic yard in trenches, and $------- per cubic yard where blasting is required all measured in place anywhere within the contract limits as defined on the drawings or any duly authorized modifications. The payment shall cover all costs relating to such ledge excavation, including blasting, removal and satisfactory disposal of the excavated material, overhead, superintendence, profit, and all related costs as prescribed under the CONTRACT AND GENERAL CONDITIONS.

c) Additional Gravel Borrow

(1) The General Contractor shall provide additional gravel borrow when such is not available on the site for any unanticipated filling or backfilling requirements, if ordered in writing by the Designer with the prior approval of the County.

(2) Payment for additional gravel borrow will be made in addition to the contract price at the rate $_______ per cubic yard, measured in place, which shall include all costs relating to the furnishing, installing, compacting, overhead, superintendence and profit.

d) Definitions

(1) General (mass) rock excavation is defined as removal and disposal of materials and obstructions encountered that can not be dislodged and excavated with modern,

track mounted, heavy duty excavating equipment without drilling or ripping. Rock excavation equipment is defined as Caterpillar Model 210 HP flywheel power and developing minimum of 45,000 pound breakout force (measured in accordance with SAE J732).

(a) Typical of material classified as rock are boulders 1/2 cubic yard or more in volume, solid rock, rock ledges, and rock-hard cementatious aggregate deposits.

(2) Trench rock excavation is defined as removal and disposal of materials and obstructions encountered that can not be excavated with a track-mounted power excavator, equivalent Caterpillar Model No. 215C LC, and rated at not less than 115 HP flywheel power and 32,000 pound drawbar pull and equipped with a short stick and a 42" wide, short tip radius rock bucket at 0.81 cubic yard (heaped) capacity.

(a) Trenches in excess of 10 feet wide and pits in excess of 30 feet in either length or width are classified as general excavation.

(3) The word "trench" shall mean excavations having vertical sides whose depths exceed their width, for pipes such as drain, sewer, water and gas pipes, electric and steam conduits and foundations.

(4) Compaction shall mean the tamping and rolling of all fill and backfill placed in uniform horizontal layers not exceeding six inches in thickness. Water shall be added in such amounts as necessary to obtain required compaction to a density of not less than 95 percent as determined by ASTM Designation D-698, Method C.

(5) Gravel borrow shall consist of inert material that is hard durable stone and coarse sand, free from loam and clay, surface coatings, and deleterious materials, uniformly graded and containing no stone having any dimension greater than four (4) inches. Gradation shall be determined in accordance with ASTM Designation D422.

End of section

Definition of Terms

The following are abbreviations and terms frequently used in the DM text.

Consultant – A licensed registered architect or engineer or an authorized member of a licensed consulting firm or organization retained by the Owner.

Owner – The Montgomery County Maryland-Division of Capital Development-DCD, acting through Department of Public Works and Transportation- DPWT.

Project Manager – An individual authorized by the DCD as defined in the Agreement.

County – The Montgomery County Maryland, Division of Capital Development-DCD.

Abbreviations

ADA	Americans with Disabilities Act
CCAP	Construction Contract Agreed Price
CSI	Construction Specifications Institute
CD	Construction Documents
DBDC	Division of Building Design and Construction
DD	Design Development
DPWT	Department of Public Works and Transportation
DO	Division of Operations
DM	Manual for Planning, Design, and Construction of Sustainable Buildings
DPS	Department of Permitting Services
DEP	Department of Environmental Protection
DGS	Department of General Services
MCG	Montgomery County Government
M-NCPPC	Maryland National Park and Planning Commission
OSP	Office of Special Projects
POR	Program OF Requirements
SD	Schematic Design, Standards Drawing

End of Appendix

PROJECT MANUAL
FOR
NAME OF PROJECT

Project Address
Montgomery County, Maryland

IFB No. xxxxxxxxx

Volume 1 of x
Bidding and Contracting Requirements
And Division 1

Owner/Manager:
Office of Special projects
Department of General Services
110 Monroe Street
Rockville, Maryland 20850

Tenant/User Agency
Department of xxxxxxxx:

Architects: Architect
Civil Engineer: Civil Engineer
Structural Engineer: Structural Engineer
Mechanical Engineer: Mechanical Engineer

2”
1”
3”
1”

Montgomery County Maryland
Isiah Leggett, County Executive

Name of the Project
Department of Recreation

1”
1”
1”
1”
1”
1”

County Council

Council member name	Council member name
Council member name	Council member name
Council member name	Council member name
Council member name	Council member name
Council member name	

4’-0”

1”
2”
2”
1”

Manager:
Department of General services
Office of Special Projects
240-777-6126

1”
1”
1”

Architect:
Xxxxxxxx
xxxxxxxxx

Contractor:
xxxxxxx
xxxxxxxx
xxxxxxxxxx

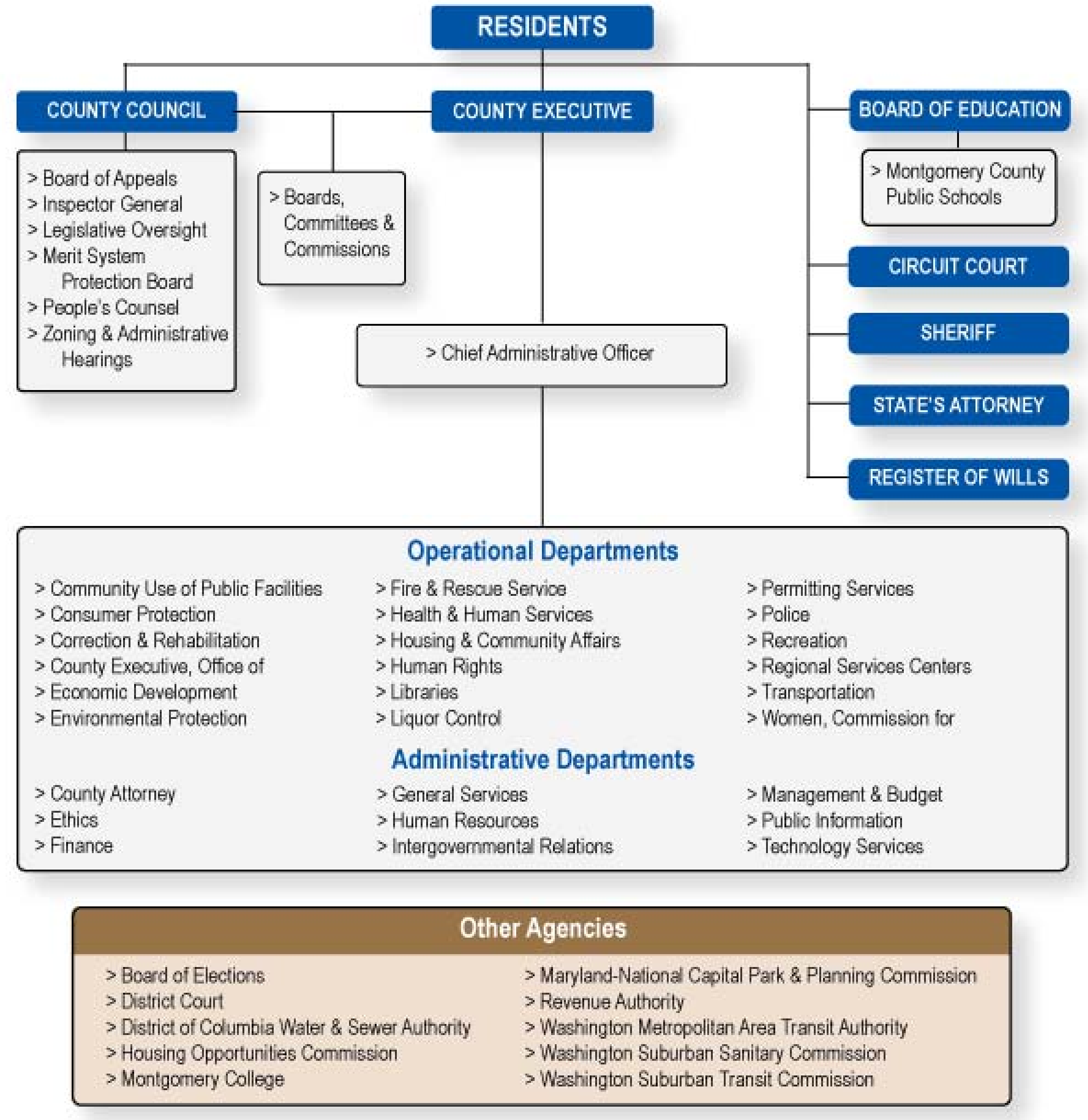
8’-0”

White text on blue background

Commissioning Checklists and Tests files are in a separate binder.
Electronic versions are located in directories with the same names.

End of Appendix

Montgomery County Organization Chart



Program of Requirements – POR
for

Project Name

Department of Name

July 2010

Montgomery County Maryland
Department of General Services (DGS)
Office of Special Projects
101 Monroe Street
Rockville, Maryland 20850

Note:

This template is for both NEW Construction as well as Facility Renovation.
Delete the last chapter 4. If this a New Constrution POR
Keep the format and numbering system
If an item does not apply, keep the numbering system and noted as “Not Applicable”, “Not Investigated”, “Not Available”, and so on.
Delete this and other orange texts.

Project Name Renovation
Program of requirements

Prepared by:

Name
XYZ Architects Inc
Project manager name, Project Manager, DGS

SIGNATURE PAGE

Approved: ______________________________ ______________

Joseph Beach, Director — Date
Office of Management and Budget

Approved: ______________________________ ______________

David E. Dise, Director — Date
Department of General Services

Approved: ______________________________ ______________

Catherine Matthews, Director — Date
Upcounty Regional Service Center
Debra J. Snead, Director
Bethesda-Chevy Chase Reginal Service Center
Anise K. Brown, Director
Eastern Montgomery Reginal Service Center
Gary Stith, Director
Silver Spring Reginal Service Center
Natalie Cantor, Director
Mid-County Reginal Service Center

Approved: ______________________________ ______________

Ernest Lunsford, Chief — Date
Division of Building Design and Construction
Department of General Services

Hamid Omidvar, Chief
Office of Special Projects
Department of General Services

Approved: ______________________________ ______________

E. Steven Emmanuel, Director — Date
Department of Technology Services

Approved: ______________________________ ______________

Max Stuckey, Chief — Date
Enterprise Telecommunications Division
Department of Technology Services

Approved: ______________________________ ______________

Thomas W. Carr, Jr., Chief Date
Montgomery County Fire and Rescue Service
J. Thomas Manger, Chief
Department of Police
Corinne Stevens, Chief Operating Officer
Department of Health and Human Services
Arthur M. Wallenstein, Director
Department of Correction and Rehabilitatiion
Gabriel Albornoz, Director
Department of Recreation
Parker Hamilton, Director
Department of Public Libararies

TABLE OF CONTENTS

1. Facility Requirements

1.1. Statement of needs for the facility

In this part you explain the justification for the new facility or need for renovation of the facility. Reference must be given to the agency's Strategic Facility Planning or MNCPP-C Master plan.

1.2. Historical background of the project

In this part you explain the historical background of since when this facility has been in need of repair. Also if the building is historical the writer must explain the historical background and characteristics related to this issue.

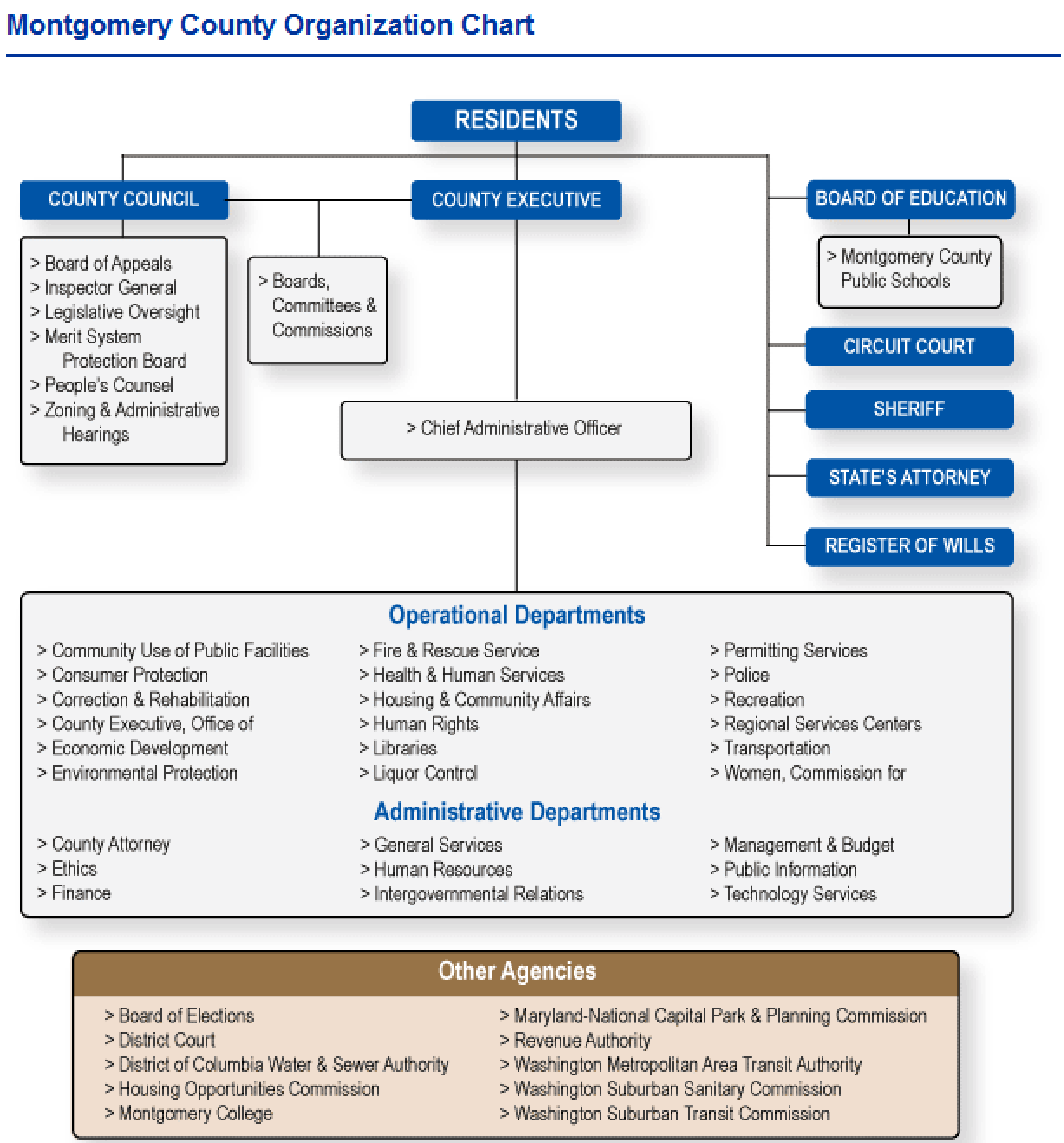
1.3. Department or Agency mission

In this part the writer explains the general mission statement of the agency or the department. The goal is to relate the importance of the operation of this building in the context of the overall department's mission.

1.4. Organization charts

1.4.1. Montgomery County Organization chart

Here we show the overall County organization chart. The goal is to show where the responsible department or agency is related to the County. Provide a brief explanation here.

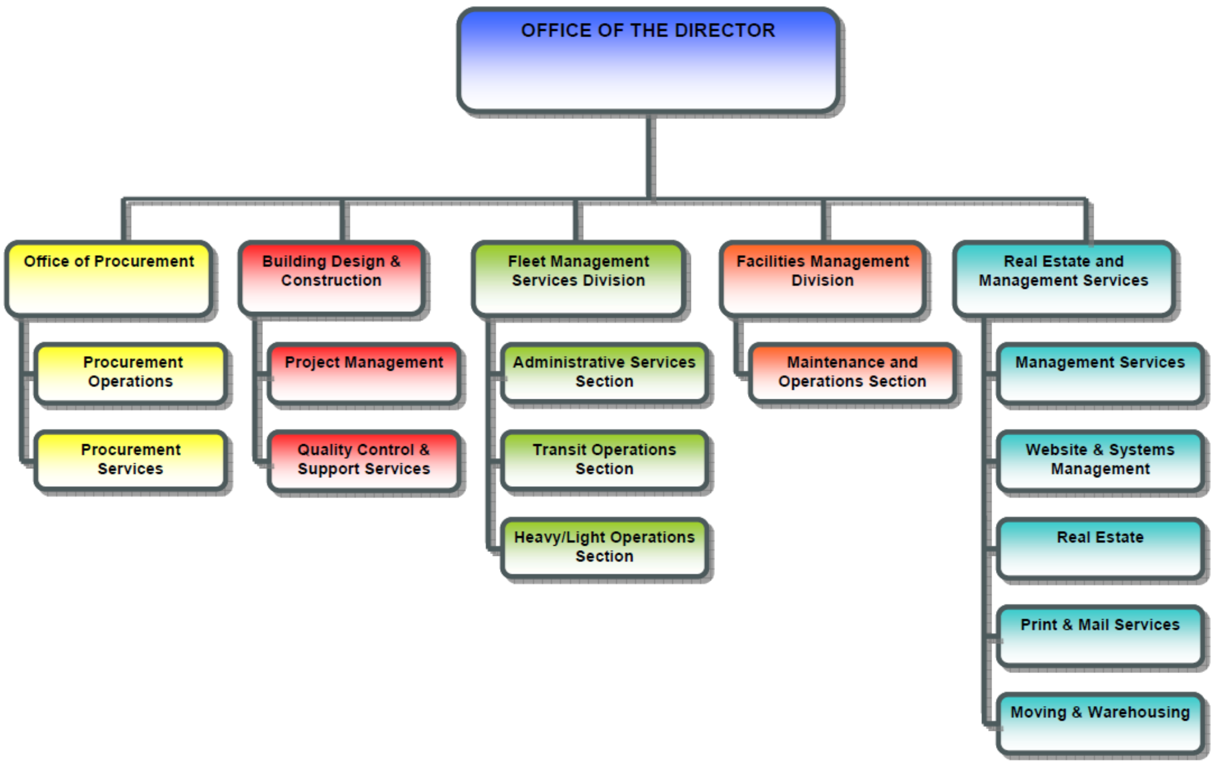


1.4.2. Agency organization chart

Explain the organization of the department or the agency here. Goal is to show the relationship of various divisions and sections and also to show where this facility or the group that uses this facility is locate in the overall department. Provide a brief explanation here.

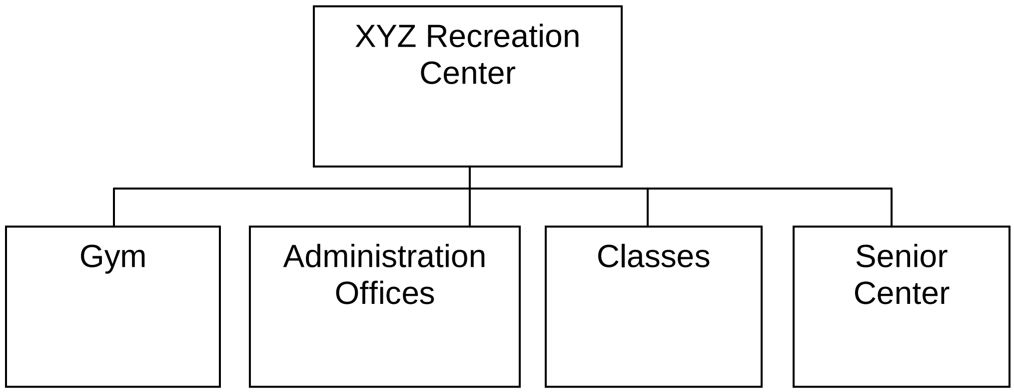
Example:

MONTGOMERY COUNTY DEPARTMENT OF GENERAL SERVICES



1.4.3. Facility organization chart

Explain the organization of the facility or the group that is operating the facility. Goal is to show the relationship of various groups in the building. Provide a brief explanation here.



1.5. Mission Statement of the facility

In this part explain the overall mission of the building, or the agency who is occupying the facility.

1.6. Building operation hours

Building operation hours must be explained here. Hours of operation must include weekdays and weekends, as well as delivery and loading dock operation. If there are other functions on the site such as athletic fields, their hours of operation must be described as well.

1.7. Site requirements and characteristics

In this part explain all charactricstics of the site. Either the site is selected which in that case these characteristics are of an actual site that must be visited and verified or the site is not selected which in that case many of the following chractrisctics are unknown and many are what the department wishes or requires to be.

If site is not selected the fact must be mentioned.

1.7.1. Site requirements

Arial 10 Black

1.7.2. Vehicular access

Arial 10 Black

1.7.3. Pedestrian safety

Arial 10 Black

1.7.4. Parking spaces and basis of calculation

Arial 10 Black

1.7.5. Drop-off

Arial 10 Black

1.7.6. Functional areas (athletic fields, storage sheds)

Arial 10 Black

1.7.7. Lighting (Perimeter lighting requirements to include parking lights)

Arial 10 Black

1.7.8. Signing

Arial 10 Black

1.7.9. Outdoor furniture and equipment

Arial 10 Black

1.7.10. Fencing

Arial 10 Black

1.7.11. Security

Arial 10 Black

1.7.12. Site characteristics

Arial 10 Black

1.7.13. Topography
Arial 10 Black

1.7.14. Geotechnical information
Arial 10 Black

1.7.15. Unsuitable soil
Arial 10 Black

1.7.16. Wetland and streams
Arial 10 Black

1.7.17. Wooded areas
Arial 10 Black

1.7.18. Historical aspects
Arial 10 Black

1.7.19. Availability of utilities and name of companies
Arial 10 Black

1.7.20. Availability of fiber optic line
Arial 10 Black

1.7.21. Easements and ROW
Arial 10 Black

1.7.22. Other aspects of the site
Arial 10 Black

1.8. Summary List of staff in the facility

After creating the chart in Excel.
Copy in Excel, in Word Edit “paste special” as “Microsoft Office Excel Worksheet Object”.

Damscus Library

Data date: 12/23/2007

				Staff Number			
No.	**Position**	**Grade**	**FT/PT**	Current	2010	2015	2020
1	OSC	19	FT	6	8	10	12
2	OSC	21	PT	3	4	5	5
3	Supervisor	21	FT	3	4	5	5
4	Section Chief	MLS3	FT	2	2	2	2
5	Division Chief	MLS2	FT	1	1	1	1
6	Copy area			1	1	1	1
7	Filie area						
8							
9							
10							
11							
12							
13							
14							
15							
	Total			**16**	**20**	**24**	**26**

1.9. Space Standard

Use County Space Standards to create this table
After creating the chart in Excel
Copy in Excel, in Word Edit "paste special" as "Microsoft Office Excel Worksheet Object".

			Space Standard Size		
No.	**Position**	**Grade**	**Length**	**Width**	**Area**
1	OSC	19	8	8	64
2	Supervisor	21	8	10	80
3	Section Chief	MLS3	10	12	120
4	Division Chief	MLS2	12	16	192
5					
6					
7					
8	Print Room		12	16	192
9					
10					
11					
12					
13					
14					
15					

1.10. Space Requirements

Use County Space Standards to create this table
After creating the chart in Excel
Copy in Excel, in Word Edit “paste special” as “Microsoft Office Excel Worksheet Object”.

Division of Accounting

Data date: 12/23/2007

No.	Position	Grade	FT/PT	Space Cat.	Programable size L	Programable size W	Programable size Area	Space Type	Staff Number Current	Staff Number 2010	Staff Number 2015	Staff Number 2020	Space Size Current	Space Size 2010	Space Size 2015	Space Size 2020
1	OSC	19	FT	OO	8	8	64	O1	6	8	10	12	384	512	640	768
2	OSC	21	PT	OC	8	10	80	O2	3	4	5	5	240	320	400	400
3	Supervisor	21	FT	OC	8	10	80	O3	3	4	5	5	240	320	400	400
4	Section Chief	MLS3	FT	OC	10	12	120	O4	2	2	2	2	240	240	240	240
5	Division Chief	MLS2	FT	OC	12	16	192	O5	1	1	1	1	192	192	192	192
6	Copy area			SC	8	8	64	S1	1	1	1	1	64	64	64	64
7	Filie area			SO			-	S2					-	-	-	-
8							-						-	-	-	-
9							-						-	-	-	-
10							-						-	-	-	-
11							-						-	-	-	-
12							-						-	-	-	-
13							-						-	-	-	-
14							-						-	-	-	-
15							-						-	-	-	-
	Total						**600**		**16**	**20**	**24**	**26**	**1,360**	**1,648**	**1,936**	**2,064**

1.11. Adjacency requirement chart for the facility

Use County Space Standards to create this table
After creating the chart in Excel.
Copy in Excel, in Word Edit “paste special” as “Microsoft Office Excel Worksheet Object”.

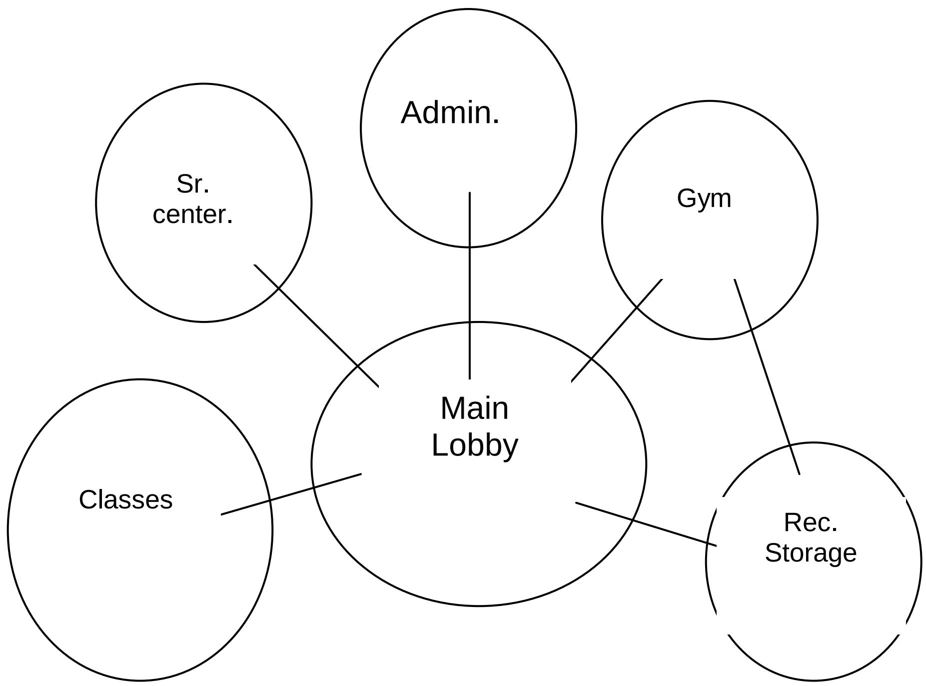
Damascus Library

Group 1							
Group 2	1						
Group 3	2	2					
Group 4	3	1	0				
Group 5	2	2	3	3			
Group 6	1	1	3	2	0		
Main Lobby	1	2	2	3	1	2	
List of spaces	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Main Lobby

Must be adjacent	3
Adjacency is prefared	2
No relationship	1
Must not be adjacent	0

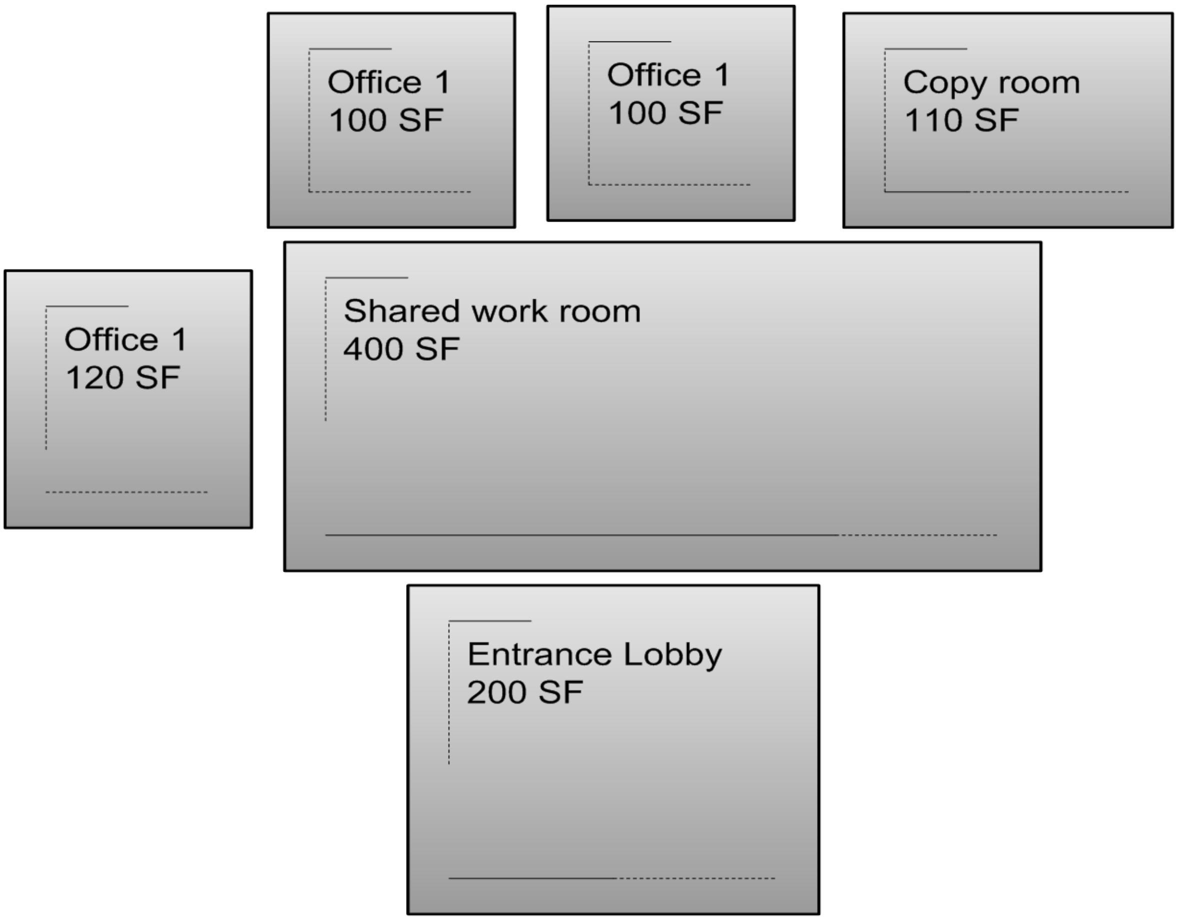
1.12. Adjacency diagram (bubble diagram) for the facility

Showing various spaces in a buble form to communicate the overall adjacencies.



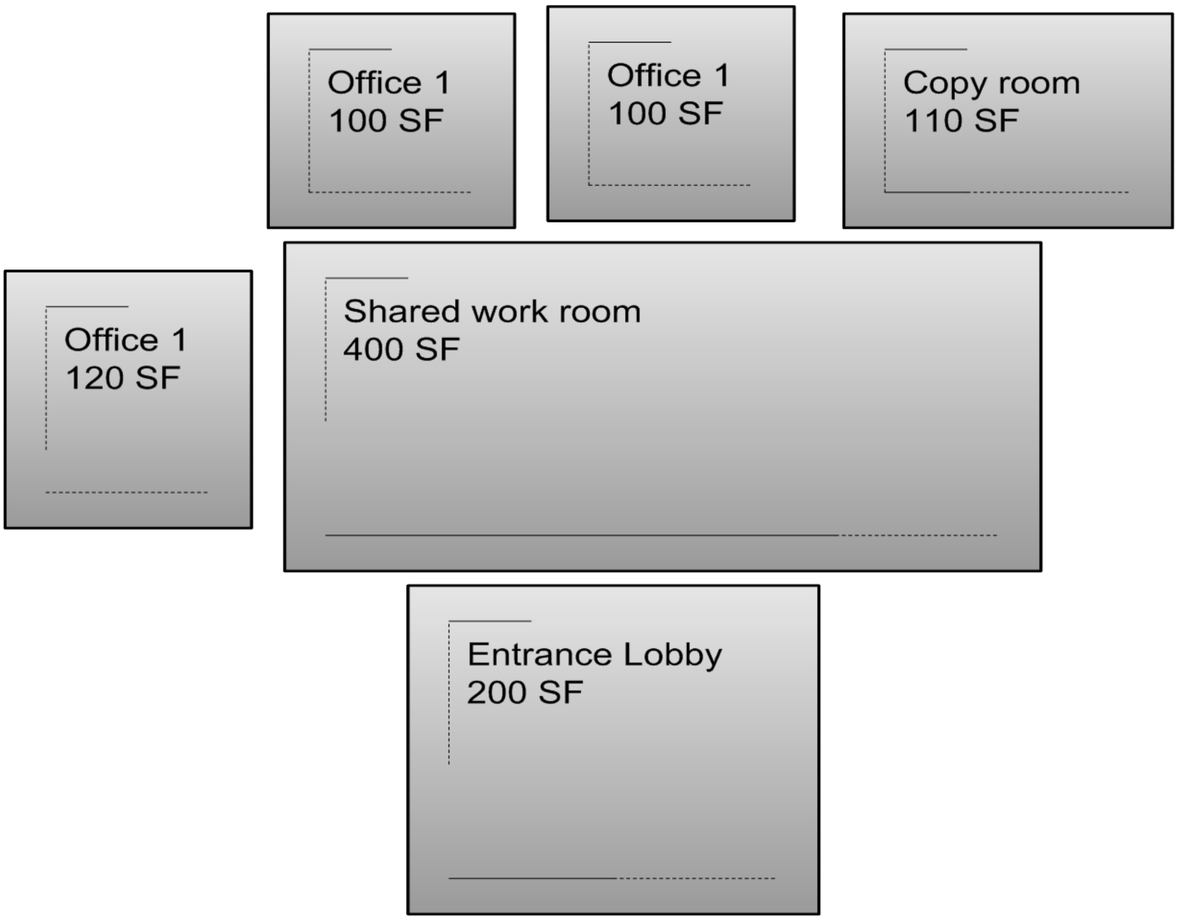
1.13. Scaled Relationship Adjacency Diagram for the facility

Showing various spaces in a rectangle form with the name of space and size of space shown. If multi story each level should have separate diagram.



1.14. Scaled Relationship Adjacency Diagram for Floors

Showing various spaces in a rectangle form with the name of space and size of space shown. If multi story each level should have separate diagram.



1.15. General building design requirements (exceptions to the standards)

Use County Space Standards to create this table
After creating the chart in Excel.
Copy in Excel, in Word Edit “paste special” as “Microsoft Office Excel Worksheet Object”.

1.15.1. Building shell (Structural system, steel, concrete, wood, etc.)
1.15.2. Building envelop facades (All glass, brick, Stone, Etc.)
1.15.3. Building roof (high slope or low, metal or build up, etc.)
1.15.4. Code and design standards compliance
1.15.5. Green building/sustainability goals
1.15.6. HVAC
1.15.7. Electrical
1.15.8. Plumbing
1.15.9. IT/telecommunications
1.15.10. Fire protection
1.15.11. Acoustics
1.15.12. Lighting
1.15.13. Security/access

Building Security needs must be coordinated with the Operations

1.15.14. Signage/graphics/way finders
1.15.15. Other requirements

Explain any other requirements that are specific to this project and there is no other place to mention it.

1.16. Tabulated table of all furniture requirements to include:

This chart is the summary of all non-computer equipment for the entire facility and not space by space.

Damascus Library
Furniture List - Summary
Data date: 12/23/2007

		Quantity			Size in inches					
No.	**List of items**	**New**	**Existing**	**Refurbish**	**W**	**L**	**D**	**H**		
1	Table	12	24		36	72		31		
2	Conference table	2			48	84		31		
3	Task Chair	24			20		19	17		
4	Credenza		12		72		20	32		
5	Guest chair									
6	Marker board									
7	Display board									
8	Projection screen non-electrical									
9	Shelf									
10	Shelf									
11	Shelf									
12	Bookcase									
13	Lateral file cabinet									
	Vertical file cabinet									
	Drawing file cabinet									
	pedestale									

1.17. Tabulated table of all equipment requirements

This chart is the summary of all non-computer equipment for the entire facility and not space by space.

Damascus Library
General Equipment List - Summary
Data date: 12/23/2007

		Quantity		Size in inches			Energy data			
No.	**List of items**	**New**	**Existing**	**W**	**H**	**D**	**Watts**			
1	Copy Machiene	12	24	V	V	V	200			
2	Fax	2		10	18	19	100			
3	Printer large format	24		9	3	8	200			
4	Printer personal		12				150			
5	Papare cutter						0			
6	Post stamper						5			
7	Sherreder						50			
8	Toaster						400			
9	Refregerator						100			
10	Microvawe oven						400			
11	Coffe maker connected to water									
12	Coffe maker									
13	Wall Clocks									

1.18. Summary table of computer equipment

This chart is the summary of all computer equipment for the entire facility and not space by space.

Damascus Library
Computer Equipment List - Summary
Data date: 12/23/2007

		Quantity		Size in inches			Energy data			
No.	**List of items**	**New**	**Existing**	**W**	**H**	**D**	**Watts**			
1	PC	12	24	V	V	V	200			
2	Server PC	2		10	18	19	400			
3	Wireless router	24		9	3	8	8			

1.19. Tabulated table of all telephone equipment requirements

This chart is the summary of all computer equipment for the entire facility and not space by space.

Damascus Library
Telephone Equipment List - Summar
Data date: 12/23/2007

		Quantity		Size in inches			Energy data			
No.	**List of items**	**New**	**Existing**	**W**	**H**	**D**	**Watts**			
1	Telephine set	12	24							
2	Analog telephone	2		10	18	19	400			
3	TTY	24		9	3	8	8			

1.20. Code and regulations requirements

The panning, design and construction of all new facilities must comply with all appliocable local, state, and federal codes and regulations.

Montgomery County Maryland requires that all facilities must be planned, designed and constructed to be be ceryified as LEED Silver rating by USGBC or equalant.

Consultants must also design all facilities to comply with the latest version of the “Montgomery County Manual for Planning, Design, and Construction of Sustainable Buildings” published by the Department of General Services (DGS), Division of Building Design and Construction (DBD&C).

1.21. Other requirements

2. Group Requirements

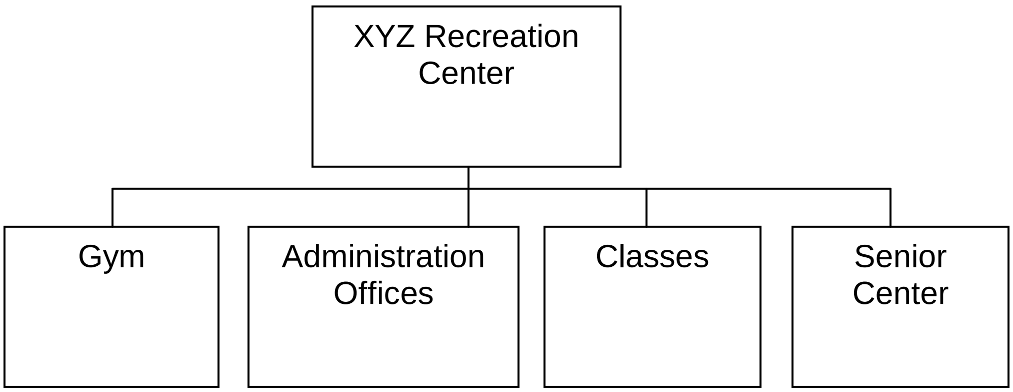
2.1. Group 1

2.1.1. Mission

Explain mission of this group in text format as introduction.

2.1.2. Organization Chart for Group 1

After creating the chart in Excel
Use County Space Standards to create this table
Copy in Excel, in Word Edit “paste special” as “Microsoft Office Excel Worksheet Object”
For each group provide one chart



2.1.3. List of staff and Space Requirements by group

After creating the chart in Excel
Use County Space Standards to create this table
Copy in Excel, in Word Edit “paste special” as “Microsoft Office Excel Worksheet Object”
For each group provide one chart.

Division of Accounting
Data date: 12/23/2007

				Space	Programable size			Space	Staff Number				Space Size			
No.	**Position**	**Grade**	**FT/PT**	**Cat.**	**L**	**W**	**Area**	**Type**	Curren	2010	2015	2020	Current	2010	2015	2020
1	OSC	19	FT	OO	8	8	64	O1	6	8	10	12	384	512	640	768
2	OSC	21	PT	OC	8	10	80	O2	3	4	5	5	240	320	400	400
3	Supervisor	21	FT	OC	8	10	80	O3	3	4	5	5	240	320	400	400
4	Section Chief	MLS3	FT	OC	10	12	120	O4	2	2	2	2	240	240	240	240
5	Division Chief	MLS2	FT	OC	12	16	192	O5	1	1	1	1	192	192	192	192
6	Copy area			SC	8	8	64	S1	1	1	1	1	64	64	64	64
7	Filie area			SO			-	S2					-	-	-	-
8							-						-	-	-	-
9							-						-	-	-	-
10							-						-	-	-	-
11							-						-	-	-	-
12							-						-	-	-	-
13							-						-	-	-	-
14							-						-	-	-	-
15							-						-	-	-	-
	Total						**600**		**16**	**20**	**24**	**26**	**1,360**	**1,648**	**1,936**	**2,064**

2.1.4. Adjacency requirement chart for the facility

Use County Space Standards to create this table
After creating the chart in Excel.
Copy in Excel, in Word Edit "paste special" as "Microsoft Office Excel Worksheet Object".

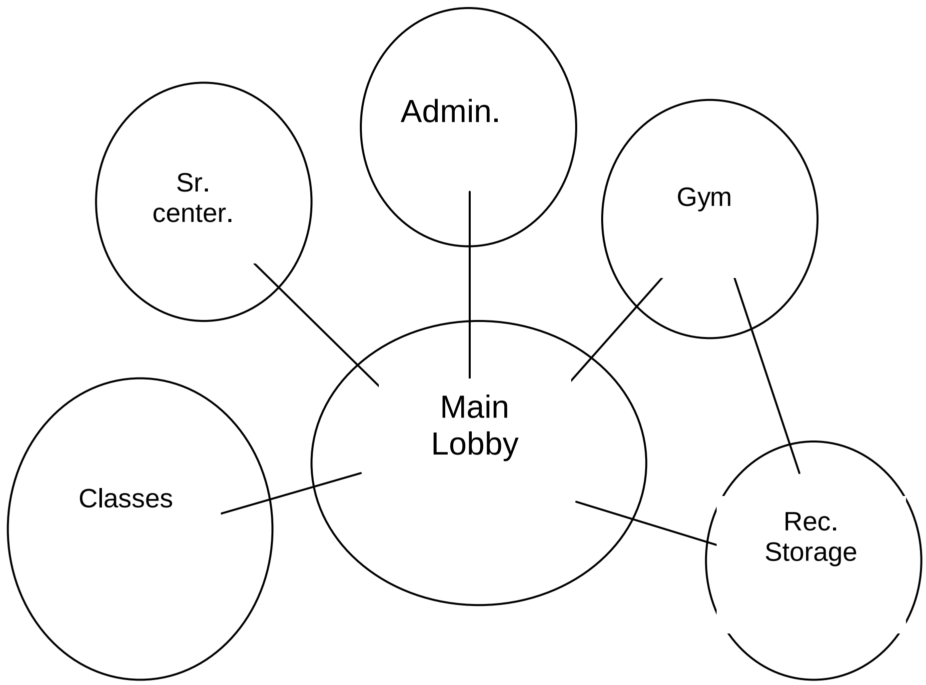
Damascus Library

Group 1							
Group 2	1						
Group 3	2	2					
Group 4	3	1	0				
Group 5	2	2	3	3			
Group 6	1	1	3	2	0		
Main Lobby	1	2	2	3	1	2	
List of spaces	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Main Lobby

Must be adjacent	3
Adjacency is prefared	2
No relationship	1
Must not be adjacent	0

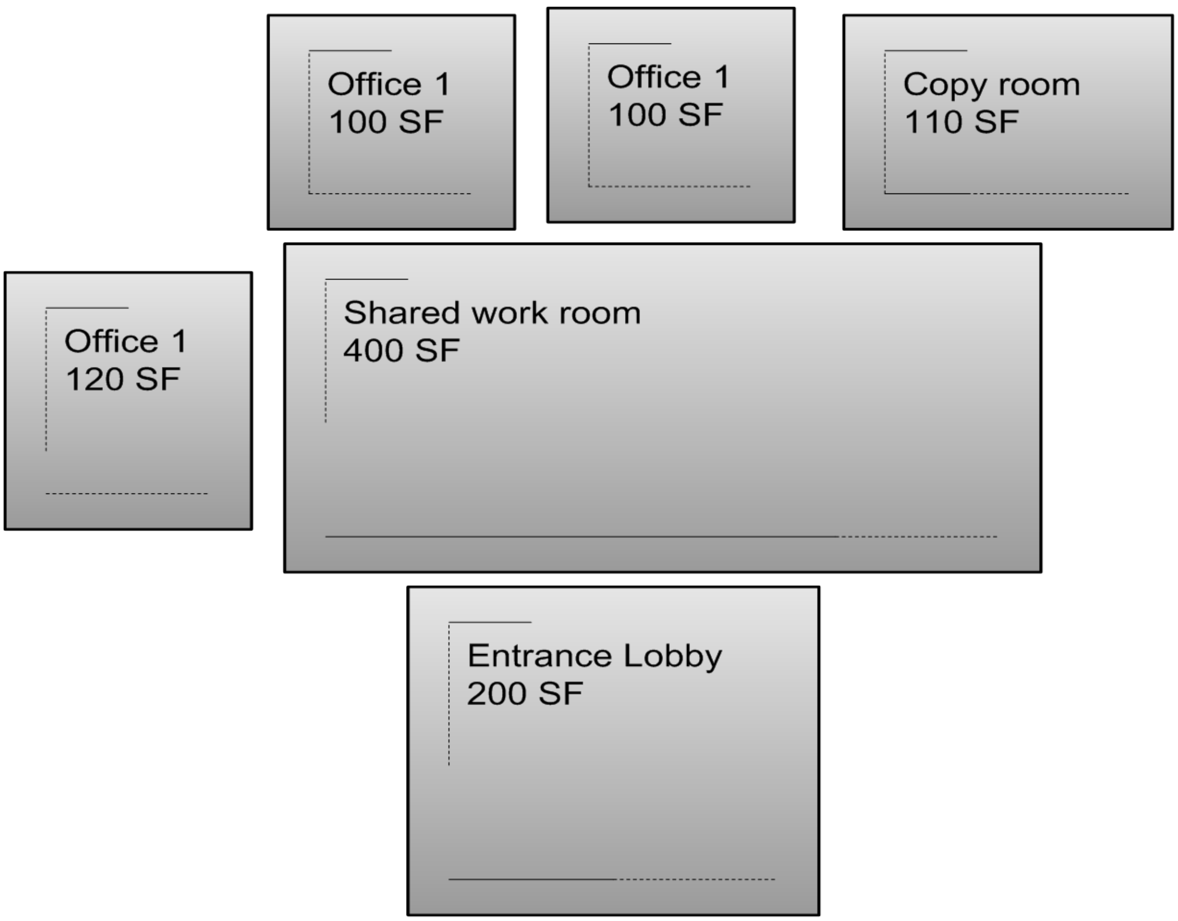
2.1.5. Buble Adjacency Diagram for the Group 1

Showing various spaces in a buble form to communicate the overall adjacencies.



2.1.6. Scaled Relationship Adjacency Diagram for the Group 1

Showing various spaces in a rectangle form with the name of space and size of space shown. If multi story each level should have separate diagram.



Note: USE FORMAT FOR GROUP1 AND ADD OTHER GROUPS THAT OCCUPY THE FACILITY. THE LOGIC IS TO IDENTIFY THE FACILITY IN A HORACHICAL AND FORMAT STARTING FROM THE TOP ORGANIZATIONAL LEVEL TO THE SMALLEST LEVEL.

Group Numbering system will logically continue with 2.2, 2.3 and so on.

3. Space Requirements

Note to editor: Following space tables must have the same components. If one is edited to add new columns or rows, all tables must be edited as well. Best practice is to edit the template in Excel and then cut and paste them as instructed before.

3.1. Conference Room

Space name:	**Conferenece room**
Occupant:	NA
Number of occupants	12
Program Size (WxL, SF)	16x20=320
Wall Finish	Paint
Floor Finish	Carpet
Ceiling type	Suspended acoustical tiles
Ceiling Height	9 ft
Furniture	1-table, 12-chairs, 1-credenza, 1-display board, 2-Marker boards,
Equipment	
Computer	
Telephone	1- telephone
Audio/video	1-microphone/speaker set 1-video projector ceiling mounted
HVAC	
Electrical	If possible a floor outlet under the table
Lighting	Dimable lights and standard fluorescent lights
Security	Vision panel by the door
Door hardware	Passage set
IAQ Requirements	

Add typical fllor layout for each room either at the bottom of the sheet or on a separate sheet after this page (this would be typical for all following Space Standard Sheets

3.2. Loading dock

Space name:	**Loading dock**
Occupant:	NA
Number of occupants	12
Program Size (WxL, SF)	16x20=320
Wall Finish	Paint
Floor Finish	Carpet
Ceiling type	Suspended acoustical tiles
Ceiling Height	9 ft
Furniture	1-table, 12-chairs, 1-credenza, 1-display board, 2-Marker boards,
Equipment	
Computer	
Telephone	1- telephone
Audio/video	1-microphone/speaker set 1-video projector ceiling mounted
HVAC	
Electrical	If possible a floor outlet under the table
Lighting	Dimable lights and standard fluorescent lights
Security	Vision panel by the door
Door hardware	Passage set
IAQ Requirements	

3.3. Room Building lobby

Space name:	**Building lobby**
Occupant:	NA
Number of occupants	12
Program Size (WxL, SF)	16x20=320
Wall Finish	Paint
Floor Finish	Carpet
Ceiling type	Suspended acoustical tiles
Ceiling Height	9 ft
Furniture	1-table, 12-chairs, 1-credenza, 1-display board, 2-Marker boards,
Equipment	
Computer	
Telephone	1- telephone
Audio/video	1-microphone/speaker set 1-video projector ceiling mounted
HVAC	
Electrical	If possible a floor outlet under the table
Lighting	Dimable lights and standard fluorescent lights
Security	Vision panel by the door
Door hardware	Passage set
IAQ Requirements	

3.4. Storage

Space name:	**Storage**
Occupant:	NA
Number of occupants	12
Program Size (WxL, SF)	16x20=320
Wall Finish	Paint
Floor Finish	Carpet
Ceiling type	Suspended acoustical tiles
Ceiling Height	9 ft
Furniture	1-table, 12-chairs, 1-credenza, 1-display board, 2-Marker boards,
Equipment	
Computer	
Telephone	1- telephone
Audio/video	1-microphone/speaker set 1-video projector ceiling mounted
HVAC	
Electrical	If possible a floor outlet under the table
Lighting	Dimable lights and standard fluorescent lights
Security	Vision panel by the door
Door hardware	Passage set
IAQ Requirements	

3.5. Janitorial spaces

Space name:	**Janitorial spaces**
Occupant:	NA
Number of occupants	12
Program Size (WxL, SF)	16x20=320
Wall Finish	Paint
Floor Finish	Carpet
Ceiling type	Suspended acoustical tiles
Ceiling Height	9 ft
Furniture	1-table, 12-chairs, 1-credenza, 1-display board, 2-Marker boards,
Equipment	
Computer	
Telephone	1- telephone
Audio/video	1-microphone/speaker set 1-video projector ceiling mounted
HVAC	
Electrical	If possible a floor outlet under the table
Lighting	Dimable lights and standard fluorescent lights
Security	Vision panel by the door
Door hardware	Passage set
IAQ Requirements	

3.6. Closets

Space name:	**Closets**
Occupant:	NA
Number of occupants	12
Program Size (WxL, SF)	16x20=320
Wall Finish	Paint
Floor Finish	Carpet
Ceiling type	Suspended acoustical tiles
Ceiling Height	9 ft
Furniture	1-table, 12-chairs, 1-credenza, 1-display board, 2-Marker boards,
Equipment	
Computer	
Telephone	1- telephone
Audio/video	1-microphone/speaker set 1-video projector ceiling mounted
HVAC	
Electrical	If possible a floor outlet under the table
Lighting	Dimable lights and standard fluorescent lights
Security	Vision panel by the door
Door hardware	Passage set
IAQ Requirements	

3.7. Electrical rooms

Space name:	**Electrical rooms**
Occupant:	NA
Number of occupants	12
Program Size (WxL, SF)	16x20=320
Wall Finish	Paint
Floor Finish	Carpet
Ceiling type	Suspended acoustical tiles
Ceiling Height	9 ft
Furniture	1-table, 12-chairs, 1-credenza, 1-display board, 2-Marker boards,
Equipment	
Computer	
Telephone	1- telephone
Audio/video	1-microphone/speaker set 1-video projector ceiling mounted
HVAC	
Electrical	If possible a floor outlet under the table
Lighting	Dimable lights and standard fluorescent lights
Security	Vision panel by the door
Door hardware	Passage set
IAQ Requirements	

3.8. Mechanical rooms

Space name:	**Mechanical rooms**
Occupant:	NA
Number of occupants	12
Program Size (WxL, SF)	16x20=320
Wall Finish	Paint
Floor Finish	Carpet
Ceiling type	Suspended acoustical tiles
Ceiling Height	9 ft
Furniture	1-table, 12-chairs, 1-credenza, 1-display board, 2-Marker boards,
Equipment	
Computer	
Telephone	1- telephone
Audio/video	1-microphone/speaker set 1-video projector ceiling mounted
HVAC	
Electrical	If possible a floor outlet under the table
Lighting	Dimable lights and standard fluorescent lights
Security	Vision panel by the door
Door hardware	Passage set
IAQ Requirements	

3.9. Trash collection area

Space name:	**Trash collection area**
Occupant:	NA
Number of occupants	12
Program Size (WxL, SF)	16x20=320
Wall Finish	Paint
Floor Finish	Carpet
Ceiling type	Suspended acoustical tiles
Ceiling Height	9 ft
Furniture	1-table, 12-chairs, 1-credenza, 1-display board, 2-Marker boards,
Equipment	
Computer	
Telephone	1- telephone
Audio/video	1-microphone/speaker set 1-video projector ceiling mounted
HVAC	
Electrical	If possible a floor outlet under the table
Lighting	Dimable lights and standard fluorescent lights
Security	Vision panel by the door
Door hardware	Passage set
IAQ Requirements	

4. Existing Building Assessment

4.1. Building Data

Building name:
Address:
Zoning Classification:
Use Group:
Occupant load:
Purpose of study:
Net usable floor area in square feet:
Gross floor area in square feet:
Building age/date constructed:
Codes in force when constructed/renovated:
Number of stories:
Height from level of Fire Department access:
Architect Name:
Engineers Name(s):
Dates of field survey/inspection:
Date of report preparation:

4.2. Architectural Systems

Provide a general description of the building structure. Consultant will study and assess the conditions of architectural elements and their major components including, but not limited to, the following. Include photographs as appropriate.
DO NOT DELETE any of the categories.
If not applicable, write NOT APPLICABLE and
if not verified write NOT VERIFIED.

4.2.1. Roof

4.2.1.1. Type of roof
4.2.1.1.1. Life expectancy of this type
4.2.1.1.2. Remaining life
4.2.1.2. Approximate date last replaced
4.2.1.3. Presence of skylights and/or hatches
4.2.1.4. Condition of skylights and/or hatches
4.2.1.5. Present Conditions
4.2.1.5.1. Current slope and drainage characteristics, making special note of ponding water conditions.
4.2.1.5.2. Current drainage methods noting storm drain piping, gutters, and scuppers both primary and secondary/emergency.
4.2.1.5.3. Current height relationships of walls, MEP penetrations, windows, etc. versus industry/County standards for noted applications.
4.2.1.5.4. Current sheet metal flashing and membrane flashing types, gauges, and characteristics.
4.2.1.5.5. Complaints and nature of complaints
4.2.1.5.6. R values of the existing roof
4.2.1.5.7. Indicate all deficiencies in roofing system in terms of type of system, system age, energy conservation, code-related issues, maintenance procedures, slope, drainage, and summary of repair costs over the last 5 years.
4.2.1.5.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of the roofing system including but not limited to drainage, slope, height adjustments and modifications, insulation, flashing types/adjustments, and membrane for its intended use.

4.2.2. Foundation / Waterproofing

4.2.2.1. Type of wall and membrane system
4.2.2.1.1. Life expectancy of this type
4.2.2.1.2. Remaining Life
4.2.2.2. Approximate date last replaced
4.2.2.3. Present Conditions
4.2.2.3.1. Current perimeter drainage characteristics, making special note of ponding and water infiltration locations
4.2.2.3.2. Current drainage methods noting storm drain piping, gutters, and scuppers both primary and secondary/emergency
4.2.2.3.3. Cracks or points of moisture infiltration
4.2.2.3.4. Current height relationships of walls, MEP penetrations, windows, etc. versus industry/County standards for noted applications
4.2.2.3.5. Current sheet metal flashing and membrane flashing types, gauges, and characteristics
4.2.2.3.6. Complaints and nature of complaints
4.2.2.3.7. R-values
4.2.2.3.8. Indicate all deficiencies in foundation/waterproofing system in terms of type of system, system age, energy conservation, code-related issues, maintenance procedures, drainage, and summary of repair costs over the last 5 years.

4.2.2.4. Provide recommendations for rehabilitation, remediation, upgrading or repair of the foundation/waterproofing system including but not limited to drainage, perimeter slope, height adjustments and modifications, insulation, flashing types/adjustments, and membrane for their intended use.

4.2.3. Perimeter Skin

4.2.3.1. Type of construction/materials
4.2.3.2. R-values
4.2.3.3. Condition and quantity of caulking, mortar, and/or grout
4.2.3.4. Condition of exterior finish surface (brick, block, metal, wood, etc.)
4.2.3.5. Approximate date and extent of last paint/point/caulk work
4.2.3.6. Provide recommendations for rehabilitation, remediation, upgrading or repair of the perimeter skin for its intended use.

4.2.4. Exterior Glazing

4.2.4.1. Glazing area (sq. ft.)
4.2.4.2. Number and size of windows
4.2.4.3. Type of windows (operable / non-operable)
4.2.4.4. Frame system (wood, aluminum, mullionless) and finish
4.2.4.5. Condition of windows
4.2.4.6. Condition of glazing tape/gaskets/caulk
4.2.4.7. Single pane/insulating glazing
4.2.4.8. Appearance of glazing (tinted and/or reflective coating)
4.2.4.9. Age of windows
4.2.4.10. Approximate date last replaced/repaired
4.2.4.11. Indicate all deficiencies in window system in terms of type of system, age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of to match with existing type etc.
4.2.4.12. Provide recommendations for rehabilitation, remediation, upgrading or repair of exterior glazing for its intended use.

4.2.5. Interior Partitions

4.2.5.1. Condition of drywall (to be submitted on a space-by-space basis as applicable)
4.2.5.2. Extent and type(s) of finish surface materials (paint, wall covering, wood pane, /masonry, tile, stone, etc.)
4.2.5.3. Type of paint (i.e. lead, oil-based, water-based, polymer)
4.2.5.4. Condition of finish surface materials
4.2.5.5. Approximate date and extent of last paint/point up/caulk work
4.2.5.6. Indoor air quality issue due to paint
4.2.5.7. Indicate all partition deficiencies in terms of: type of walls, age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, etc.
4.2.5.8. Determine fire rating of all partitions and review above-ceiling condition of same to identify any breaches in separation assembly due to post-construction penetrations.
4.2.5.9. Provide recommendations for rehabilitation, remediation, upgrading or repair of the interior partitions for their intended use.

4.2.6. Interior Glazing

4.2.6.1. Window configuration (sidelight, transom, frameless panels, etc.)
4.2.6.2. Glazing area (sq. ft.)
4.2.6.3. Number of windows/panels

4.2.6.4. Type of windows (operable / non operable)
4.2.6.5. Type of glazing (acid etched, clear or colored, patterned, decorative, tempered, laminated, etc.)
4.2.6.6. Glazing dimensions (including thickness)
4.2.6.7. Frame system (wood, aluminum, mullionless) and finish
4.2.6.8. Condition of windows (frames and glazing)
4.2.6.9. Condition of glazing tape/gaskets/caulk
4.2.6.10. Provide recommendations for rehabilitation, remediation, upgrading or repair of interior glazing for its intended use.

4.2.7. Doors / Entranceways (exterior and interior)
4.2.7.1. Type of doors and locations
4.2.7.2. Size, quantity and configuration
4.2.7.3. Frame material
4.2.7.4. R-values (include assessment of weatherstripping,, threshold, door bottom, etc)
4.2.7.5. Glass door (sq. ft.)
4.2.7.6. Hardware components and door operation
4.2.7.7. ADA compliance
4.2.7.8. Vestibules (if any)
4.2.7.9. Type of vestibules (pressurized / non-pressurized)
4.2.7.10. Floor surface characteristics (grade changes, material change, etc.)
4.2.7.11. Age of doors
4.2.7.12. Condition of doors
4.2.7.13. Approximate date last replaced
4.2.7.14. Approximate date last painted
4.2.7.15. Indicate all deficiencies in doors and entranceway in terms of ADA requirements, size, type of system, age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years,, availability of to match with existing etc.
4.2.7.16. Review all openings in fire-rated partitions to determine that assembly has code-compliant labels and hardware (applies to opening assemblies that have been modified since initial construction).
4.2.7.17. Provide recommendations for rehabilitation, remediation, upgrading or repair of the doors/entranceways for their intended use.

4.2.8. Ceilings & Soffits (interior and exterior)
4.2.8.1. Total ceiling/soffit area (sq. ft.)
4.2.8.2. Type and locations (suspension system and tile/panel spec/material)
4.2.8.3. Ceiling/soffit area (sq. ft.) Type A
4.2.8.4. Ceiling area (sq. ft.) Type B
4.2.8.5. Ceiling area (sq. ft.) Type C
4.2.8.6. Acoustical properties
4.2.8.6.1. Type A
4.2.8.6.2. Type B
4.2.8.6.3. Type C
4.2.8.7. Ceiling/soffit height and locations
4.2.8.8. Ceiling/soffit transitions
4.2.8.9. Condition of ceiling
4.2.8.9.1. Type A
4.2.8.9.2. Type B
4.2.8.9.3. Type C
4.2.8.10. Approximate date last replaced
4.2.8.11. Condition of paint and approximate date last painted

4.2.8.12. Indicate all deficiencies in ceiling/soffit system(s) in terms of type of system, age, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, etc.
4.2.8.13. Provide recommendations for rehabilitation, remediation, upgrading or repair of the ceiling/soffit system(s) for their intended use.

4.2.9. Flooring
4.2.9.1. Total floor area (sq. ft.)
4.2.9.2. Floor substrate (concrete slab on grade, raised access floor, etc.)
4.2.9.3. Type(s) of finish (carpet, vinyl tile, rubber, cork, porcelain tile, quarry tile, thickset stone, etc)
4.2.9.4. Flooring area (type-by-type in sq. ft.)
4.2.9.5. Condition of carpet
4.2.9.6. Condition of tile and/or other finishes
4.2.9.7. Approximate date last replaced (carpet? tile? others?)
4.2.9.8. Indoor air quality issue due to condition of carpet/tile/others
4.2.9.9. Indicate all deficiencies in flooring materials in terms of wear, age, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of to match with existing.
4.2.9.10. Provide recommendations for rehabilitation, remediation, upgrading or repair of the flooring materials for their intended use.

4.2.10. Stairs & Ramps
4.2.10.1. Location and quantity of stairs
4.2.10.2. Width of stairs
4.2.10.3. Landing dimensions
4.2.10.4. Riser height
4.2.10.5. Condition of finishes
4.2.10.6. ADA compliance
4.2.10.7. Provide recommendations for rehabilitation, remediation, upgrading or repair of the stairs and ramps for their intended use.

4.2.11. Elevator / Escalator Systems
4.2.11.1. Description of the existing elevator/escalator system
4.2.11.1.1. Type of the existing elevator equipment (traction/hydraulic)
4.2.11.1.2. Number of elevator cab(s) / escalator(s)
4.2.11.1.3. Size of elevator cab(s) / escalator(s)
4.2.11.1.4. Capacity of elevator cab(s)
4.2.11.1.5. Age of the existing system
4.2.11.2. Appropriate and effectiveness of the existing system with building functions
4.2.11.3. Condition of the system
4.2.11.4. Condition of the equipment
4.2.11.5. Condition of the cab / door / side panel / handrail finishes
4.2.11.6. Elevator / escalator control system and its effectiveness
4.2.11.7. ADA compliance
4.2.11.8. Approximate date last replaced
4.2.11.9. Life expectancy
4.2.11.10. Safety issues
4.2.11.11. Indicate all deficiencies in the existing elevator / escalator system in terms of capacity, equipment size and installation, type of system, ADA requirements, age, energy conservation, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.2.11.12. Provide recommendations for rehabilitation, remediation, upgrading or repair of the elevator(s) / escalator(s) for their intended use.

4.2.12. Potential Environmental & Hazardous Materials

4.2.12.1. Investigate for the presence of asbestos and/or lead etc.

4.2.12.1.1. Indicate suspicion of asbestos and/or lead containing products, mercury, PCBs etc. and recommend professional investigation.

4.2.12.1.2. Asbestos in roofing, roof flashing, duct wrap, pipe insulation, flooring lead paint and coatings and other building components.

4.2.12.1.3. Mercury in lamps (light bulb) and thermostat.

4.2.12.1.4. PCBs in light fixtures and ballasts

4.2.12.2. Investigate for the presence of mold, mildew, fungus, bacterial compounds or rot, radon gas etc.

4.2.12.2.1. Indicate suspicion of a mold, mildew, fungus, bacterial compounds or rot, radon gas, and recommend professional investigation.

4.3. Structural System

Consultant will study and assess the conditions which include, but are not limited to the following structural criteria and elements. Include photographs as appropriate.

4.3.1. General Criteria

4.3.1.1. Adequacy

4.3.1.1.1. Gather design criteria and the applicable codes of the existing building.

4.3.1.1.2. Consideration shall be given to investigate the adequacy of the structure for future functions to be performed, the loads imposed by equipment, occupants and their activities, life expectancy and cost of material to match with existing material for repair work.

4.3.1.2. Evaluate the possibilities of alterations, maintenance costs, and ease of demolition during future construction.

4.3.1.3. Stability

4.3.1.3.1. Overall structure stability shall be investigated to confirm the recognized engineering principles. Stability shall provide resistance against lateral loads and gravity loads etc.

4.3.1.4. Fire Resistance

4.3.1.4.1. Fire resistance rating of all structural members shall be investigated for future function to be performed.

4.3.1.5. Security

4.3.1.5.1. Structure specific security criteria shall be investigated for future function to be performed. The risk assessment shall consider risk factors, severity level etc.

4.3.1.6. Material Strength

4.3.1.6.1. Exploratory field work and testing is required in the absence of original contract documents, or when information is required to define in-place construction. Materials such as concrete, steel, masonry and wood etc.

4.3.1.7. Provide recommendations for rehabilitation, remediation, upgrading or repair of general structural criteria for the structures intended use.

4.3.2. Roof

4.3.2.1. Ponding of water on roof

4.3.2.2. Clogging of scuppers and other overflow mechanisms

4.3.2.3. Adequacy of roof top unit /skylight/hatch support framing

4.3.2.4. Exposed steel above roof to be galvanized

4.3.2.5. Joist bridging

4.3.2.6. Vertical /horizontal bridging of trusses

4.3.2.7. Roof framing member (beams, girders, slab etc.) conditions such as cracks, spalling, excessive deflection etc.
4.3.2.8. Expansion joint locations and condition
4.3.2.9. Beam/truss bearing conditions
4.3.2.10. Water leakage
4.3.2.11. Vibration due to roof mounted equipments
4.3.2.12. Provide recommendations for rehabilitation, remediation, upgrading or repair of the structural roof for its intended use.

4.3.3. Floors

4.3.3.1. Floor framing member (beams, girders, slab etc.) condition such as crack, spalling, and excessive deformation of framing members.
4.3.3.2. Severity of cracks on floor
4.3.3.3. Beam/truss/joist bearing conditions
4.3.3.4. Floor opening framing members
4.3.3.5. Equipment pads size and condition
4.3.3.6. Vibration due to floor mounted equipments
4.3.3.7. Wheel loads on floors
4.3.3.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of the floors for their intended use.

4.3.4. Foundation & Foundation Drainage System

4.3.4.1. Effects on the foundation from adjoining property, buildings and facilities must be examined.
4.3.4.2. Proper drainage of water from the building
4.3.4.3. Water seepage through basement walls.
4.3.4.4. Cracks on floor due to differential settlement of footings
4.3.4.5. Frost depth
4.3.4.6. Provide recommendations for rehabilitation, remediation, upgrading or repair of the foundation for its intended use.

4.3.5. Walls

4.3.5.1. Variations of hydrostatic pressure and surcharge on retaining walls
4.3.5.2. Back fill material and water proofing of retaining walls
4.3.5.3. Blocked weep Holes
4.3.5.4. Cracks on exterior walls due to lack of control joints and concentrated loads
4.3.5.5. Provide recommendations for rehabilitation, remediation, upgrading or repair of structural walls for their intended use.

4.4. Mechanical Systems

Consultant will study and assess mechanical systems and their major components including, but not limited to, the following. Include photographs as appropriate.

4.4.1. Heating System

4.4.1.1. Description of the existing heating system
4.4.1.2. Heating plants
4.4.1.3. Boiler(s) (year, make, model, capacity, gas fired / electric / oil fired)
4.4.1.4. Type of systems (two pipe / four pipe)
4.4.1.5. Piping Arrangement (single loop / primary or secondary loop)
4.4.1.6. Return (direct / reverse)
4.4.1.7. Circulating Pumps (year, make, model, capacity, HP, GPM, /head)
4.4.1.8. Piping
4.4.1.9. Pipe insulation

4.4.1.10. Valves
4.4.1.11. Expansion tank (year, make, model, size)
4.4.1.12. Air separator (year, make, model, size)
4.4.1.13. Other type(s) of heating systems
4.4.1.14. Radiant heating
4.4.1.15. Under-floor heating
4.4.1.16. Indicate all deficiencies in heating system in terms of equipment size, equipment installation, water distribution, type of system, system age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.4.1.17. Provide recommendations for rehabilitation, remediation, upgrading or repair of heating system(s) for their intended use.

4.4.2. Air Conditioning System

4.4.2.1. Description of the existing air conditioning system
4.4.2.2. Chilled water plant
4.4.2.3. Air cooled / water cooled (year, make, model, capacity)
4.4.2.4. Type of chiller (centrifugal / reciprocating / screw / scroll etc.) (year, make, model, capacity)
4.4.2.5. Piping Arrangement
4.4.2.5.1. Single loop / primary or secondary loop
4.4.2.5.2. Return (direct / reverse)
4.4.2.6. Cooling tower (year, make, model, capacity)
4.4.2.7. DX system (year, make, model, capacity)
4.4.2.8. Self-contained unit (year, make, model, capacity)
4.4.2.9. Location of all units
4.4.2.10. Type of systems (two pipe / four pipe)
4.4.2.11. Circulating pumps (year, make, model, capacity, HP, GPM/head)
4.4.2.12. Piping
4.4.2.13. Pipe insulation
4.4.2.14. Valves
4.4.2.15. Expansion tank (year, make, model, size)
4.4.2.16. Air separator (year, make, model, size)
4.4.2.17. Indicate all deficiencies in cooling system in terms of equipment size, equipment installation, water distribution, type of system, system age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.4.2.18. Provide recommendations for rehabilitation, remediation, upgrading or repair of air conditioning system for its intended use.

4.4.3. Air Distribution System

4.4.3.1. Description of the existing air distribution system
4.4.3.2. Type of system (constant volume / VAV / VVT)
4.4.3.3. VAV / VVT (fan power / non fan power)
4.4.3.4. Total number of VAV / VVT boxes
4.4.3.5. VAV / VVT (year, make, model, capacity)
4.4.3.6. Floor-wise air distribution arrangement (for multi-storied buildings)
4.4.3.7. Zone-wise air distribution arrangement (for single / two storied buildings)
4.4.3.8. Identify all air handlers with corresponding serving areas
4.4.3.9. Type and condition of diffusers
4.4.3.10. Type and condition of return air grilles
4.4.3.11. Type of duct (round / rectangular / oval)
4.4.3.12. Insulation type and condition

4.4.3.13. Type of return air system (ducted / ceiling plenum)
4.4.3.14. Assess indoor air quality
4.4.3.15. Record all complaints from building occupants / building engineer
4.4.3.15.1. Frequency of complaints
4.4.3.15.2. Severity of complaints
4.4.3.16. Indicate all deficiencies in air distribution system in terms of equipment size, equipment installation, air flow (CFM) through the terminal units, type of system, system age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.4.3.17. Provide recommendations for rehabilitation, remediation, upgrading or repair of air distribution system for its intended use.

4.4.4. Make up / Fresh Air Intake System
4.4.4.1. Description of the existing make up/fresh air intake system
4.4.4.2. Make up / fresh air intake fan (year, make, model, capacity)
4.4.4.3. Age of the fan
4.4.4.4. Approximate date last replaced
4.4.4.5. Condition of fan(s)
4.4.4.6. Intake damper size/type
4.4.4.7. Any issues regarding damper location(s) in terms of indoor air quality and/or other concerns
4.4.4.8. Indicate all deficiencies in make-up/fresh air intake system in terms of equipment size, equipment installation, air flow (CFM), type of system, system age, energy conservation, code-related issues, IAQ issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.4.4.9. Provide recommendations for rehabilitation, remediation, upgrading or repair of make-up / fresh air intake system for its intended use.

4.4.5. Exhaust / Relief Air System
4.4.5.1. Description of the existing exhaust / relief air system
4.4.5.2. Exhaust air fan(s) (year, make, model, capacity)
4.4.5.3. Relief air fan(s) (year, make, model, capacity)
4.4.5.4. Age of the fan(s)
4.4.5.5. Approximate date last replaced
4.4.5.6. Condition of fan(s)
4.4.5.7. Damper size / type
4.4.5.8. Any issues regarding exhaust and relief air damper locations in terms of indoor air quality and/or other concerns
4.4.5.9. Indicate all deficiencies in exhaust / relief air system in terms of equipment size, equipment installation, air flow (CFM), type of system, system age, energy conservation, code-related issues, IAQ issues, other concern, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.4.5.10. Provide recommendations for rehabilitation, remediation, upgrading or repair of exhaust / relief air system for its intended use.

4.4.6. Water Distribution System (chilled, hot, condenser etc.)
4.4.6.1. Description of the existing water distribution system
4.4.6.2. Type of system (two pipe / four pipe)
4.4.6.3. Return (direct / reverse)
4.4.6.4. Loop (single vs. primary and secondary)
4.4.6.5. Pipe material
4.4.6.6. Condition of piping in the space
4.4.6.7. Condition of insulation

4.4.6.8. Condition of valves
4.4.6.9. Life expectancy and age of piping systems
4.4.6.10. Approximate date last replaced
4.4.6.11. Report any issue regarding pipe supports
4.4.6.12. Record all complaints from building occupants/building engineer in terms of leakage
4.4.6.12.1. Frequency of complaints
4.4.6.12.2. Severity of complaint
4.4.6.13. Indicate all deficiencies in water distribution system in terms of pipe size, installation, water flow (CFM) through the terminal units, type of system, system age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.4.6.14. Provide recommendations for rehabilitation, remediation, upgrading or repair of water distribution system for its intended use.

4.4.7. Automatic Temperature / Humidity Control System

4.4.7.1. Description of the existing automatic temperature / humidity control system
4.4.7.2. Type of system (electric / pneumatic / DDC etc.)
4.4.7.3. Age of the system
4.4.7.4. Approximate date last replaced
4.4.7.5. Life expectancy of the system
4.4.7.6. Condition of all components
4.4.7.7. Effectiveness and appropriateness of the system
4.4.7.8. Energy conservation issues with existing system
4.4.7.9. Record all complaints from building occupants / building engineer in terms of temperature, humidity, IAQ, etc.
4.4.7.9.1. Frequency and nature of complaints
4.4.7.9.2. Severity of complaints
4.4.7.10. Indicate all deficiencies in the existing control system in terms of effectiveness, appropriateness, installation, system age, energy conservation, IAQ issue(s), code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.4.7.11. Provide recommendations for rehabilitation, remediation, upgrading or repair of automatic temperature / humidity control system for its intended use.

4.4.8. Plumbing System

4.4.8.1. Description of the existing plumbing system
4.4.8.2. Domestic water heating plant
4.4.8.3. Boiler(s) / water heater (year, make, model, capacity, gas fired / electric / oil fired)
4.4.8.4. Piping arrangement (single loop / primary or secondary loop)
4.4.8.5. DWH circulating pumps (year, make, model, capacity, HP, GPM/head)
4.4.8.6. Piping
4.4.8.7. Pipe insulation
4.4.8.8. Valves
4.4.8.9. Age of the existing DWH system
4.4.8.10. Condition of the system
4.4.8.11. Approximate date last replaced
4.4.8.12. Life expectancy
4.4.8.13. Type of plumbing fixtures
4.4.8.14. Age of plumbing fixtures
4.4.8.15. Condition of plumbing fixtures
4.4.8.16. ADA compliance

4.4.8.17. Indicate all deficiencies in plumbing system in terms of equipment size, equipment installation, water distribution, type of system, system age, energy conservation, water temperature control, code-related issues, ADA issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.

4.4.8.18. Provide recommendations for rehabilitation, remediation, upgrading or repair of plumbing system for its intended use.

4.5. Electrical Systems

Consultant will study and assess electrical systems and their major components including, but not limited to, the following. Include photographs as appropriate.

4.5.1. Primary Electrical System

4.5.1.1. Description of the existing electrical system
4.5.1.1.1. Electrical power provider (PEPCO / Allegheny Power, etc.)
4.5.1.1.2. Electric panels (year, make, model, capacity)
4.5.1.1.3. MCCs (year, make, model, capacity)
4.5.1.1.4. Age of the existing system
4.5.1.1.5. Condition of the system
4.5.1.1.6. Approximate date last replaced
4.5.1.1.7. Life expectancy
4.5.1.2. Type of wires (aluminum / copper / other)
4.5.1.2.1. Age of the existing wires
4.5.1.2.2. Condition of existing wires
4.5.1.2.3. Approximate date last replaced
4.5.1.2.4. Life expectancy of existing wires
4.5.1.3. Grounding
4.5.1.3.1. Type(s) (standard building / isolated)
4.5.1.4. Distribution
4.5.1.4.1. Type(s) (ductbank, conduit, cable tray, etc)
4.5.1.5. Transformer(s)
4.5.1.5.1. Xyz
4.5.1.6. Indicate all deficiencies in primary electrical system in terms of equipment/components size, capacity, equipment installation, distribution, type of system, system age, energy conservation, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.5.1.7. Provide recommendations for rehabilitation, remediation, upgrading or repair of primary electrical system for its intended use.

4.5.2. Emergency Power System

4.5.2.1. Emergency Generator
4.5.2.1.1. Description (year, make, model, output relative to building loads, redundancy)
4.5.2.1.2. Fuel storage tank (year, make, model, capacity)
4.5.2.1.3. Age of the existing system
4.5.2.1.4. Condition of the system
4.5.2.1.5. Load shed sequence
4.5.2.1.6. Approximate date last replaced
4.5.2.1.7. Life expectancy
4.5.2.1.8. Conduits (concealed / exposed)
4.5.2.2. Uninterrupted Power System
4.5.2.2.1. xyz
4.5.2.3. Automatic Transfer Switch (ATS) (year, make, model, capacity)
4.5.2.3.1. Age of the existing ATS

4.5.2.3.2. Condition of ATS
4.5.2.3.3. Approximate date last replaced
4.5.2.3.4. Life expectancy of ATS
4.5.2.3.5. Condition of the conduits
4.5.2.4. Indicate all deficiencies in emergency power system in terms of equipment/components size, capacity, equipment installation, distribution, type of system, system age, energy conservation, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.5.2.5. Provide recommendations for rehabilitation, remediation, upgrading or repair of emergency power system for its intended use.

4.5.3. Lighting Systems
4.5.3.1. Description of the existing lighting systems
4.5.3.2. Type of light fixtures (year, make, model)
4.5.3.3. Number of fixtures per floor (for various types)
4.5.3.4. Age of the existing fixtures
4.5.3.5. Condition of the fixtures
4.5.3.6. Lighting control system description and locations
4.5.3.7. Approximate date last replaced
4.5.3.8. Life expectancy
4.5.3.9. Energy efficiency of the fixtures
4.5.3.10. Indicate all deficiencies in lighting system in terms of component size, capacity, fixture installation, illumination (foot candles), switching distribution, type of system, age, energy conservation, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.5.3.11. Provide recommendations for rehabilitation, remediation, upgrading or repair of lighting system for its intended use.

4.6. Fire Prevention Systems

Consultant will study and assess the condition of the fire prevention system and its major components including, but not limited to, the following. Include photographs as appropriate.

4.6.1. Fire Alarm System
4.6.1.1. Type of existing fire alarm system
4.6.1.2. Age of the existing system
4.6.1.3. Appropriate and effectiveness of the existing system with building functions
4.6.1.4. Condition of the system
4.6.1.5. Approximate date last replaced
4.6.1.6. Life expectancy
4.6.1.7. Location of pull stations and appropriateness
4.6.1.8. Location of the enunciator and appropriateness
4.6.1.9. Locations of egresses and appropriateness
4.6.1.10. Indicate all deficiencies in the existing fire alarm system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures, and summary of repair costs over the last 5 years, availability of spare parts etc.
4.6.1.11. Provide recommendations for rehabilitation, remediation, upgrading or repair of fire alarm system for its intended use.

4.6.2. Sprinkler System
4.6.2.1. Type of the existing system (dry / wet / other)
4.6.2.2. Age of the existing system

4.6.2.3. Appropriate and effectiveness of the existing system with building functions
4.6.2.4. Condition of the system
4.6.2.5. Approximate date last replaced
4.6.2.6. Life expectancy
4.6.2.7. Indicate all deficiencies in the existing sprinkler system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.6.2.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of sprinkler system for its intended use.

4.7. Communications

Consultant will study and assess communications systems including, but not limited to, the following. Include photographs as appropriate.

4.7.1. Telephone System
4.7.1.1. Description of the existing telephone system
4.7.1.2. Age of the existing system
4.7.1.3. Appropriate and effectiveness of the existing system with building functions
4.7.1.4. Condition of the system
4.7.1.5. Approximate date last replaced
4.7.1.6. Life expectancy
4.7.1.7. Indicate all deficiencies in the existing telephone system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.7.1.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of telephone system for its intended use.

4.7.2. Network System
4.7.2.1. Description of the existing network system
4.7.2.2. Age of the existing system
4.7.2.3. Appropriate and effectiveness of the existing system with building functions
4.7.2.4. Condition of the system
4.7.2.5. Approximate date last replaced
4.7.2.6. Life expectancy
4.7.2.7. Indicate all deficiencies in the existing network system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.7.2.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of network system for its intended use.

4.7.3. Optic Fiber
4.7.3.1. Description of existing optic fiber
4.7.3.2. Age of the existing lines
4.7.3.3. Appropriate and effectiveness of the existing lines with building functions
4.7.3.4. Condition of the lines
4.7.3.5. Approximate date last replaced
4.7.3.6. Life expectancy
4.7.3.7. Indicate all deficiencies in the existing optic fiber lines in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance

issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.

4.7.3.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of optic fiber system for its intended use.

4.7.4. Cabling Plant

4.7.4.1. Description of the existing cabling plant

4.7.4.2. Age of the existing cabling plant

4.7.4.3. Appropriate and effectiveness of the existing cabling plant with building functions

4.7.4.4. Condition of the cabling plant

4.7.4.5. Approximate date last replaced

4.7.4.6. Life expectancy

4.7.4.7. Indicate all deficiencies in the existing cabling plant in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.

4.7.4.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of cabling plant for its intended use.

4.7.5. Satellite / Cable TV

4.7.5.1. Description of existing satellite / cable TV

4.7.5.2. Age of the existing equipment

4.7.5.3. Appropriate and effectiveness of the existing equipment with building functions

4.7.5.4. Condition of the equipment

4.7.5.5. Approximate date last replaced

4.7.5.6. Life expectancy

4.7.5.7. Indicate all deficiencies in existing satellite / cable TV in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.

4.7.5.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of satellite / cable TV for its intended use.

4.7.6. Radio System

4.7.6.1. Description of the existing radio system

4.7.6.2. Age of the existing system

4.7.6.3. Appropriate and effectiveness of the existing system with building functions

4.7.6.4. Condition of the system

4.7.6.5. Approximate date last replaced

4.7.6.6. Life expectancy

4.7.6.7. Indicate all deficiencies in the existing radio system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.

4.7.6.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of radio system for its intended use.

4.8. Site Conditions

Consultant will study and assess site conditions including, but not limited to, the following. Include photographs as appropriate.

4.8.1. Parking Lot / Garage
4.8.1.1. Description of the existing parking lot / garage
4.8.1.1.1. Total area (sq. ft.)
4.8.1.1.2. Total number of parking spaces including handicap spaces
4.8.1.1.3. Size, type and proximity to entrance of handicap spaces
4.8.1.2. Condition of the parking lot / garage
4.8.1.3. Approximate date last repaired / resurfaced
4.8.1.4. Vehicular circulation issues
4.8.1.5. Pedestrian circulation issues
4.8.1.6. Signage issues
4.8.1.7. Appropriate number of spaces to the building occupant / patron load
4.8.1.8. Code related issues in terms of handicap spaces and access to building
4.8.1.9. ADA compliance
4.8.1.10. Security / controlled access system (type, location, effectiveness, issues)
4.8.1.11. Parking attendant structure
4.8.1.12. Indicate all deficiencies in the existing parking lot / garage in terms of ADA requirements, age of the surfaces, code-related issues, vehicular circulation issues, pedestrian circulation issues, signage, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
4.8.1.13. Provide recommendations for rehabilitation, remediation, upgrading or repair of parking lot / garage for its intended use.

4.8.2. Parking Lot / Site Lighting System(s)
4.8.2.1. Description of the existing parking lot / garage lighting
4.8.2.2. Condition and type of parking lot / garage lighting fixtures
4.8.2.3. Approximate date parking lot/garage lighting system was last upgraded
4.8.2.4. Level and direction of illumination (LEED compliance)
4.8.2.5. Description of the existing site / entry lighting
4.8.2.6. Condition and type of site/entry lighting fixtures
4.8.2.7. Approximate date site/entry lighting system was last upgraded
4.8.2.8. Level and direction of illumination (LEED compliance)
4.8.2.9. Indicate all deficiencies in the existing parking lot / garage and site / entry lighting systems in terms of ADA requirements, age, energy conservation issues, code-related issues, illumination issues, LEED compliance, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
4.8.2.10. Provide recommendations for rehabilitation, remediation, upgrading or repair of parking lot / site lighting systems for their intended use.

4.8.3. Sidewalks & Curb Cuts
4.8.3.1. Location and description of sidewalk(s) and curb cut(s)
4.8.3.2. Material and condition of sidewalk(s) and curb cut(s)
4.8.3.3. Length and width of sidewalk (in ft.) and curb cut(s)
4.8.3.4. Approximate date the existing sidewalk(s) and curb cut(s) were last repaired / resurfaced
4.8.3.5. Circulation issues
4.8.3.6. Indicate all deficiencies in the existing sidewalk(s) and curb cut(s) in terms of ADA requirements, age of the surfaces, code-related issues, vehicular circulation issues, pedestrian circulation issues, signage, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
4.8.3.7. Provide recommendations for rehabilitation, remediation, upgrading or repair of sidewalk(s) and curb cut(s) for their intended use.

4.8.4. Stairs & Ramps

4.8.4.1. Location and quantity of stairs
4.8.4.2. Width of stairs
4.8.4.3. Landing dimensions
4.8.4.4. Riser height
4.8.4.5. Condition of surfaces
4.8.4.6. ADA compliance
4.8.4.7. Provide recommendations for rehabilitation, remediation, upgrading or repair of the stairs and ramps for their intended use.

4.8.5. Storm Water Management

4.8.5.1. Condition of existing system
4.8.5.2. DPS requirements
4.8.5.3. Upgrading requirements
4.8.5.4. Indicate all deficiencies in the existing storm water management system, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
4.8.5.5. Provide recommendations for rehabilitation, remediation, upgrading or repair of storm water management system for its intended use.

4.8.6. Retention Facilities

4.8.6.1. Xyz

4.8.7. Access from Public Transportation

4.8.7.1. Description of existing access from public transportation
4.8.7.2. Condition of structures and surfaces along path of travel
4.8.7.3. ADA compliance
4.8.7.4. Indicate all deficiencies in the existing access from public transportation in terms of ADA requirements, code-related issues, illumination issues, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
4.8.7.5. Provide recommendations for rehabilitation, remediation, upgrading or repair of access from public transportation.

4.8.8. Utility Locations & Terminations

4.8.8.1. Xyz

4.9. Special Areas

Consultant will study and assess the condition of special areas including, but not limited to, the following. Include photographs as appropriate.

4.9.1. Kitchens & Pantries

4.9.1.1. Description of the existing spaces (size, location, equipment, fixtures, millwork, finishes, colors, etc.)
4.9.1.2. Age and condition of the existing equipment, fixtures, millwork, finishes, etc.
4.9.1.3. ADA compliance
4.9.1.4. Appropriate and effectiveness of the existing facility / components with building functions
4.9.1.5. Indicate all deficiencies in the existing kitchens and pantries in terms of capacity, energy conservation, ADA compliance, code-related issues, maintenance issues, etc.
4.9.1.6. Provide recommendations for rehabilitation, remediation, upgrading or repair of kitchens and pantries for their intended use.

4.9.2. Fitness & Locker Rooms

4.9.2.1. Description of the existing spaces (size, location, equipment, lockers, fixtures, toilet / shower partitions and accessories, millwork, finishes, colors, etc.)
4.9.2.2. Age and condition of the existing equipment, lockers, fixtures, toilet / shower partitions and accessories, millwork, finishes, etc.
4.9.2.3. ADA compliance
4.9.2.4. Appropriate and effectiveness of the existing facility / components with building functions
4.9.2.5. Indicate all deficiencies in the existing fitness and locker rooms in terms of capacity, ADA compliance, code-related issues, maintenance issues, etc.
4.9.2.6. Provide recommendations for rehabilitation, remediation, upgrading or repair of fitness and locker rooms for their intended use.

4.9.3. Restrooms
4.9.3.1. Description of the existing spaces (size, location, fixtures, toilet partitions and accessories, millwork, finishes, colors, etc.)
4.9.3.2. Age and condition of the existing fixtures, toilet partitions and accessories, millwork, finishes, etc.
4.9.3.3. ADA compliance
4.9.3.4. Appropriate and effectiveness of the existing restrooms with building functions
4.9.3.5. Indicate all deficiencies in the existing restrooms in terms of capacity, ADA compliance, code-related issues, maintenance issues, etc.
4.9.3.6. Provide recommendations for rehabilitation, remediation, upgrading or repair of restrooms for their intended use.

4.10. Miscellaneous Systems & Equipment

Consultant will study and assess the condition of miscellaneous systems and equipment including, but not limited to, the following. Include photographs as appropriate.

4.10.1. Security System & Equipment
4.10.1.1. Description of the existing security system and equipment
4.10.1.2. Age of the existing security system and equipment
4.10.1.3. Appropriate and effectiveness of the existing security system and equipment with building functions
4.10.1.4. Condition of the security system and equipment
4.10.1.5. Approximate date last replaced
4.10.1.6. Life expectancy
4.10.1.7. Indicate all deficiencies in the existing security system and equipment in terms of component size, capacity, installation, type of system, age, effectiveness, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.10.1.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of security system and equipment for their intended use.

4.10.2. Furniture
4.10.2.1. Description of the existing furniture (general, systems and custom)
4.10.2.2. Age of the existing furniture
4.10.2.3. Appropriate and effectiveness of the existing furniture with building and occupant functions
4.10.2.4. Condition of the furniture
4.10.2.5. Approximate date last replaced
4.10.2.6. Life expectancy
4.10.2.7. Indicate all deficiencies in the existing furniture in terms of size, condition, installation, type of system, age, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.

4.10.2.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of furniture for its intended use.

4.10.3. Audiovisual Systems & Equipment

4.10.3.1. Description of the existing audiovisual systems and equipment
4.10.3.2. Age of the existing audiovisual systems and equipment
4.10.3.3. Appropriate and effectiveness of the existing audiovisual systems and equipment with occupant requirements
4.10.3.4. Condition of the audiovisual systems and equipment
4.10.3.5. Approximate date last replaced
4.10.3.6. Life expectancy
4.10.3.7. Indicate all deficiencies in the existing audiovisual systems and equipment in terms of component characteristics, installation, type of system, age, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.10.3.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of audiovisual systems and equipment for their intended use.

4.10.4. Food Service Equipment

4.10.4.1. Description of the existing food service equipment
4.10.4.2. Age of the existing food service equipment
4.10.4.3. Appropriate and effectiveness of existing food service equipment with building functions
4.10.4.4. Condition of the food service equipment
4.10.4.5. Approximate date last replaced
4.10.4.6. Life expectancy
4.10.4.7. Indicate all deficiencies in the existing food service equipment in terms of equipment size, capacity, installation, type, age, energy conservation, condition, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.10.4.8. Provide recommendations for rehabilitation, remediation, upgrading or repair of food service equipment for its intended use.

4.10.5. Medical Equipment

4.10.5.1. Description of the existing medical equipment
4.10.5.2. Age of the existing medical equipment
4.10.5.3. Appropriate and effectiveness of the existing medical equipment with building functions
4.10.5.4. Condition of the medical equipment
4.10.5.5. ADA compliance
4.10.5.6. Approximate date last replaced
4.10.5.7. Life expectancy
4.10.5.8. Indicate all deficiencies in existing medical equipment in terms of equipment size, capacity, installation, type, age, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.10.5.9. Provide recommendations for rehabilitation, remediation, upgrading or repair of medical equipment for its intended use.

4.10.6. Signage

4.10.6.1. Description of existing signage (exterior, building-mounted, directional, room (permanent and otherwise), building directory, workstation, etc.)
4.10.6.2. Age of existing signage components
4.10.6.3. Sizes of existing signage components

4.10.6.4. Materials / finishes of existing signage components
4.10.6.5. Locations of existing signage components
4.10.6.6. Appropriate and effectiveness of existing signage with building functions
4.10.6.7. Condition of signage
4.10.6.8. Life expectancy (illuminated type)
4.10.6.9. ADA compliance (Braille, raised letters, mounting height and location, etc.)
4.10.6.10. Indicate all deficiencies in existing signage in terms of size, installation, type of system, age, energy conservation (illuminated type), code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
4.10.6.11. Provide recommendations for rehabilitation, remediation, upgrading or repair of signage for its intended use.

4.11. Phasing Plan

4.11.1. Recommended Phasing Scenario(s)

4.11.1.1. Consultant shall provide one or more recommended phasing plans /scenarios. Scenarios shall:
4.11.1.1.1. Identify impact on the functions of the building
4.11.1.1.2. Identify if building renovation can be accomplished without shutting down operations
4.11.1.1.3. Identify if building renovation can only be accomplished by shutting down entire operation
4.11.1.1.4. Include estimated amount of space that must be vacant during the course of work if applicable
4.11.1.1.5. Identify if computer, electrical or mechanical rooms will be affected and if so, strategy for eliminating or reducing impact on building occupants
4.11.1.1.6. Identify to what extent surrounding property will be needed for construction staging
4.11.1.1.7. Identify if underground utility or other work will impact public access to building

4.11.2. Duration of Phases

4.11.2.1. Provide sequence of phases
4.11.2.2. Provide construction time frames for each phase

4.11.3. Impact on Building Occupants and Surrounding Area

4.11.3.1. In conjunction with recommended phasing scenarios, provide:
4.11.3.1.1. Strategies for temporary relocation of personnel work spaces
4.11.3.1.2. Strategies for temporary relocation of building amenities (cafeteria, fitness rooms, copy center, etc.)
4.11.3.1.3. Identify noise, vibration and/or odor creating operations, define level of anticipated disruption, and make recommendations for mitigating impact on building occupants
4.11.3.1.4. Identify potential disruption on surrounding area and make recommendations for mitigating impact.

4.12. Indirect Costs

Consultant shall discuss indirect costs which include, but are not limited to the following:

4.12.1.1. Moving
4.12.1.2. Temporary heating / air conditioning / ventilation
4.12.1.3. Temporary supply of domestic water (hot and cold)
4.12.1.4. Temporary power
4.12.1.5. Temporary parking spaces
4.12.1.6. Weekends / non regular hour construction work
4.12.1.7. Noise control
4.12.1.8. Smoke / welding fumes control
4.12.1.9. Dust control

4.12.1.10. Special rigging with street closure (helicopter / large crane)

4.12.1.11. Necessary duct modification / replacement / new installation above the existing ceiling, if the ceiling / lighting systems are in appropriate condition, add the tasks for removing and reinstalling the ceiling and lighting system as indirect cost elements.

4.12.1.12. Necessary pipe modification / replacement / new installation above the existing ceiling, if the ceiling / lighting systems are in appropriate condition, add the tasks for removing and reinstalling the ceiling and lighting system as indirect cost elements.

4.13. Space measurement summary

Consultant must verify the existing building spaces and fill the following charts. If building is one floor only Total Building Chart (the last one) must be filled, otherwise for the first floor use the Ground Floor Chart and for typical floors use the Typical Floor Chart.

4.13.1. Floor: Typical Floor

No.	Space category	Area SF	Multiplier	Formula for area
A	**Programmable Area**	**10,983**	**1.00**	**Total from Space Tabulation Charts**
B	Internal walls	1,296	0.12	
C	Assignable Area	12,279	1.12	A+B
d1	Internal corridors	1,858	0.17	
d2	Non-programmable areas	80	0.01	
D	Internal circulation	1,938	0.18	d1+d2
E1	Net Usable Area	12,839	1.17	A+d1
E2	Usable Area	14,217	1.30	C+D
f1	Lobby	399		
f2	Mech. room	0		
f3	Equipment room	0		
f4	Mail room	0		
f5	Telephone/IT room	0		
F	Building Common area	399	0.04	Σf
g1	Janitor’s closet	20		
g2	Elect. & Tel. room	90		
g3	Mech. room	90		
g4	Rest room	493		
g5	Corridors	1,845		
G	Floor Common Area	2,538	.23	Σg
h1	Shafts	78		
h2	Elevator banks	267		
h3	Stairs	391		
H	Major Vertical Penetrations	736	0.07	Σh
I	Rentable Area	17,154	1.56	E2+F+G
J	Gross Measured Area	17,890	1.63	I+H
K	Exterior walls	486	0.04	
L	Gross Building Area	18,595	1.67	J+K

4.13.2. Floor: Ground Floor

No.	Space category	Area SF	Multiplier	Formula for area
A	**Programmable Area**	**10,351**	**1.00**	**Total from Space Tabulation Charts**
B	Internal walls	931	0.09	
C	Assignable Area	11,282	1.09	A+B
d1	Internal corridors	1,858	0.18	
d2	Non-programmable areas	80	0.01	
D	Internal circulation	1,938	0.19	d1+d2
E1	Net Usable Area	12,210	1.18	A+d1
E2	Usable Area	13,220	1.28	C+D
f1	Lobby	1,197		
f2	Mech. room	199		
f3	Equipment room	0		
f4	Mail room	0		
f5	Telephone/IT room	0		
F	Building Common area	1,396	0.13	Σf
g1	Janitor’s closet	20		
g2	Elect. & Tel. room	90		
g3	Mech. room	90		
g4	Rest room	493		
g5	Corridors	1,845		
G	Floor Common Area	2,538	.24	Σg
h1	Shafts	78		
h2	Elevator banks	267		
h3	Stairs	391		
H	Major Vertical Penetrations	736	0.07	Σh
I	Rentable Area	17,154	1.66	E2+F+G
J	Gross Measured Area	17,890	1.73	I+H
K	Exterior walls	486	0.04	
L	Gross Building Area	18,595	1.79	J+K

4.13.3. Floor: Total Building

No.	Space category	Area SF	Multiplier	Formula for area
A	**Programmable Area**	**43,300**	**1.00**	**Total from Space Tabulation Charts**
B	Internal walls	4,820	0.11	
C	Assignable Area	48,120	1.11	A+B
d1	Internal corridors	7,433	0.17	
d2	Non-programmable areas	320	0.01	
D	Internal circulation	7,753	0.19	d1+d2
E1	Net Usable Area	50,733	1.18	A+d1
E2	Usable Area	55,873	1.30	C+D
f1	Lobby			
f2	Mech. room			
f3	Equipment room			
f4	Mail room			
f5	Telephone/IT room			
F	Building Common area	2,593	0.06	Σf
g1	Janitor's closet			
g2	Elect. & Tel. room			
g3	Mech. room			
g4	Rest room			
g5	Corridors			
G	Floor Common Area	10,150	.23	Σg
h1	Shafts			
h2	Elevator banks			
h3	Stairs			
H	Major Vertical Penetrations	2,943	0.07	Σh
I	Rentable Area	68,616	1.59	E2+F+G
J	Gross Measured Area	71,559	1.66	I+H
K	Exterior walls	1,732	0.04	
L	Gross Building Area	73500	1.79	J+K

5. Apendecis

Documentation
References (current codes, industry standards, manufacturer's literature, etc.)
Engineering and other calculations
Photographs (if not included in the applicable sections above)
Interviewee comments/complaints
Research materials

This page must always be an even number to be the back cover sheet

Project Name Renovation

Program of Requirements
Department of Name

Montgomery County Maryland
Department of General Services (DGS)
Office of Special Projects
or
Division of Building Design and Construction (DBD&C)
101 Monroe Street
Rockville, Maryland 20850

BUILDING CONDITION ASSESSMENT

FOR

Project Name

Date mm.dd.yyyy

Department of General Services
101 Monroe Street
Rockville, Maryland 20850

INTRODUCTION

The purpose of this document is to provide specific guidelines to the consultants who are in contractual agreement with the County for rendering services. This document, in its entirety, shall define the facility condition assessment services to be provided under the contract for aforementioned services. The format of the consultant's inspection and study report shall be in compliance with this document.

The survey is to be performed on a space-by-space or room-by-room basis where appropriate. All systems are to be evaluated in accordance with current construction and accessibility codes. Recommendations are to include LEED-compliant options for consideration.

EXECUTIVE SUMMARY

Provide executive summary of the report with detailed description and recommendation in bullet form for various systems of the building. Systems include, but are not limited to, the following:

A. Architectural Systems
   1. Roof
   2. Foundation / waterproofing
   3. Perimeter skin
   4. Exterior glazing
   5. Interior partitions
   6. Interior glazing
   7. Doors / entranceways
   8. Ceilings & soffits
   9. Flooring
   10. Stairs & ramps
   11. Elevator / escalator systems
   12. Potential environmental & hazardous materials

B. Structural System
   1. General criteria
   2. Roof
   3. Floors
   4. Foundation & foundation drainage system
   5. Walls

C. Mechanical Systems
   1. Heating system
   2. Air conditioning system
   3. Air distribution system
   4. Make up / fresh air intake system
   5. Exhaust / relief air system
   6. Water distribution system
   7. Automatic temperature / humidity control system
   8. Plumbing system

D. Electrical Systems
1. **Primary electrical system**
2. **Emergency power system**
3. **Lighting systems**

E. Fire Prevention Systems
1. **Fire alarm system**
2. **Sprinkler system**

F. Communications
1. **Telephone system**
2. **Network system**
3. **Optic fiber**
4. **Cabling plant**
5. **Satellite / cable TV**
6. **Radio system**

G. Site Conditions
1. **Parking lot / garage**
2. **Parking lot / site lighting system(s)**
3. **Sidewalks & curb cuts**
4. **Stairs & ramps**
5. **Storm water management**
6. **Retention facilities**
7. **Access from public transportation**
8. **Utility locations & terminations**

H. Special Areas
1. **Kitchens & pantries**
2. **Fitness & locker rooms**
3. **Restrooms**

I. Miscellaneous Systems & Equipment
1. **Security system & equipment**
2. **Furniture**
3. **Audiovisual systems & equipment**
4. **Food service equipment**
5. **Medical equipment**
6. **Signage**

J. Phasing plan
1. **Recommended phasing scenario(s)**
2. **Duration of phases**
3. **Impact on building occupants and surrounding area**

K. Indirect costs

TEXT

Building Data

Building name:
Location:
Zoning Classification:

Use Group:
Occupant load:
Purpose of study:
Net usable floor area in square feet:
Gross floor area in square feet:
Building age/date constructed:
Codes in force when constructed/renovated:
Number of stories:
Height from level of Fire Department access:
Architect Name:
Engineers Name(s):
Dates of field survey/inspection:
Date of report preparation:

A. Architectural Systems

Provide a general description of the building structure. Consultant will study and assess the conditions of architectural elements and their major components including, but not limited to, the following. Include photographs as appropriate.

1. Roof

a. Type of roof
    - Life expectancy of this type
    - Remaining life

b. Approximate date last replaced

c. Presence of skylights and/or hatches

d. Condition of skylights and/or hatches

e. Present Conditions
    - Current slope and drainage characteristics, making special note of ponding water conditions.
    - Current drainage methods noting storm drain piping, gutters, and scuppers both primary and secondary/emergency.
    - Current height relationships of walls, MEP penetrations, windows, etc. versus industry/County standards for noted applications.
    - Current sheet metal flashing and membrane flashing types, gauges, and characteristics.
    - Complaints and nature of complaints
    - R values of the existing roof
    - Indicate all deficiencies in roofing system in terms of type of system, system age, energy conservation, code-related issues, maintenance procedures, slope, drainage, and summary of repair costs over the last 5 years.

f. Provide recommendations for rehabilitation, remediation, upgrading or repair of the roofing system including but not limited to drainage, slope, height adjustments and modifications, insulation, flashing types/adjustments, and membrane for its intended use.

2. Foundation / Waterproofing

a. Type of wall and membrane system
    - Life expectancy of this type
    - Remaining Life

b. Approximate date last replaced

c. Present Conditions

- Current perimeter drainage characteristics, making special note of ponding and water infiltration locations
- Current drainage methods noting storm drain piping, gutters, and scuppers both primary and secondary/emergency
- Cracks or points of moisture infiltration
- Current height relationships of walls, MEP penetrations, windows, etc. versus industry/County standards for noted applications
- Current sheet metal flashing and membrane flashing types, gauges, and characteristics
- Complaints and nature of complaints
- R-values
- Indicate all deficiencies in foundation/waterproofing system in terms of type of system, system age, energy conservation, code-related issues, maintenance procedures, drainage, and summary of repair costs over the last 5 years.

d. Provide recommendations for rehabilitation, remediation, upgrading or repair of the foundation/waterproofing system including but not limited to drainage, perimeter slope, height adjustments and modifications, insulation, flashing types/adjustments, and membrane for their intended use.

3. **Perimeter Skin**

a. Type of construction/materials
b. R-values
c. Condition and quantity of caulking, mortar, and/or grout
d. Condition of exterior finish surface (brick, block, metal, wood, etc.)
e. Approximate date and extent of last paint/point/caulk work
f. Provide recommendations for rehabilitation, remediation, upgrading or repair of the perimeter skin for its intended use.

4. **Exterior Glazing**

a. Glazing area (sq. ft.)
b. Number and size of windows
c. Type of windows (operable / non-operable)
d. Frame system (wood, aluminum, mullionless) and finish
e. Condition of windows
f. Condition of glazing tape/gaskets/caulk
g. Single pane/insulating glazing
h. Appearance of glazing (tinted and/or reflective coating)
i. Age of windows
j. Approximate date last replaced/repaired
k. Indicate all deficiencies in window system in terms of type of system, age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of to match with existing type etc.
l. Provide recommendations for rehabilitation, remediation, upgrading or repair of exterior glazing for its intended use.

5. **Interior Partitions**

a. Condition of drywall (to be submitted on a space-by-space basis as applicable)
b. Extent and type(s) of finish surface materials (paint, wall covering, wood pane, /masonry, tile, stone, etc.)
c. Type of paint (i.e. lead, oil-based, water-based, polymer)
d. Condition of finish surface materials
e. Approximate date and extent of last paint/point up/caulk work
f. Indoor air quality issue due to paint

g. Indicate all partition deficiencies in terms of: type of walls, age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, etc.
h. Determine fire rating of all partitions and review above-ceiling condition of same to identify any breaches in separation assembly due to post-construction penetrations.
i. Provide recommendations for rehabilitation, remediation, upgrading or repair of the interior partitions for their intended use.

6. **Interior Glazing**
   a. Window configuration (sidelight, transom, frameless panels, etc.)
   b. Glazing area (sq. ft.)
   c. Number of windows/panels
   d. Type of windows (operable / non operable)
   e. Type of glazing (acid etched, clear or colored, patterned, decorative, tempered, laminated, etc.)
   f. Glazing dimensions (including thickness)
   g. Frame system (wood, aluminum, mullionless) and finish
   h. Condition of windows (frames and glazing)
   i. Condition of glazing tape/gaskets/caulk
   j. Provide recommendations for rehabilitation, remediation, upgrading or repair of interior glazing for its intended use.

7. **Doors / Entranceways (exterior and interior)**
   a. Type of doors and locations
   b. Size, quantity and configuration
   c. Frame material
   d. R-values (include assessment of weatherstripping,, threshold, door bottom, etc)
   e. Glass door (sq. ft.)
   f. Hardware components and door operation
   g. ADA compliance
   h. Vestibules (if any)
   i. Type of vestibules (pressurized / non-pressurized)
   j. Floor surface characteristics (grade changes, material change, etc.)
   k. Age of doors
   l. Condition of doors
   m. Approximate date last replaced
   n. Approximate date last painted
   o. Indicate all deficiencies in doors and entranceway in terms of ADA requirements, size, type of system, age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years,, availability of to match with existing etc.
   p. Review all openings in fire-rated partitions to determine that assembly has code-compliant labels and hardware (applies to opening assemblies that have been modified since initial construction).
   q. Provide recommendations for rehabilitation, remediation, upgrading or repair of the doors/entranceways for their intended use.

8. **Ceilings & Soffits (interior and exterior)**
   a. Total ceiling/soffit area (sq. ft.)
   b. Type and locations (suspension system and tile/panel spec/material)
   c. Ceiling/soffit area (sq. ft.) Type A
   d. Ceiling area (sq. ft.) Type B
   e. Ceiling area (sq. ft.) Type C
   f. Acoustical properties

- Type A
- Type B
- Type C

g. Ceiling/soffit height and locations
h. Ceiling/soffit transitions
i. Condition of ceiling
   - Type A
   - Type B
   - Type C

j. Approximate date last replaced
k. Condition of paint and approximate date last painted
l. Indicate all deficiencies in ceiling/soffit system(s) in terms of type of system, age, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, etc.
m. Provide recommendations for rehabilitation, remediation, upgrading or repair of the ceiling/soffit system(s) for their intended use.

9. <u>Flooring</u>

a. Total floor area (sq. ft.)
b. Floor substrate (concrete slab on grade, raised access floor, etc.)
c. Type(s) of finish (carpet, vinyl tile, rubber, cork, porcelain tile, quarry tile, thickset stone, etc)
d. Flooring area (type-by-type in sq. ft.)
e. Condition of carpet
f. Condition of tile and/or other finishes
g. Approximate date last replaced (carpet? tile? others?)
h. Indoor air quality issue due to condition of carpet/tile/others
i. Indicate all deficiencies in flooring materials in terms of wear, age, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of to match with existing.
j. Provide recommendations for rehabilitation, remediation, upgrading or repair of the flooring materials for their intended use.

10. <u>Stairs & Ramps</u>

a. Location and quantity of stairs
b. Width of stairs
c. Landing dimensions
d. Riser height
e. Condition of finishes
f. ADA compliance
g. Provide recommendations for rehabilitation, remediation, upgrading or repair of the stairs and ramps for their intended use.

11. <u>Elevator / Escalator Systems</u>

a. Description of the existing elevator/escalator system
   - Type of the existing elevator equipment (traction/hydraulic)
   - Number of elevator cab(s) / escalator(s)
   - Size of elevator cab(s) / escalator(s)
   - Capacity of elevator cab(s)
   - Age of the existing system

b. Appropriate and effectiveness of the existing system with building functions
c. Condition of the system
d. Condition of the equipment

e. Condition of the cab / door / side panel / handrail finishes
f. Elevator / escalator control system and its effectiveness
g. ADA compliance
h. Approximate date last replaced
i. Life expectancy
j. Safety issues
k. Indicate all deficiencies in the existing elevator / escalator system in terms of capacity, equipment size and installation, type of system, ADA requirements, age, energy conservation, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
l. Provide recommendations for rehabilitation, remediation, upgrading or repair of the elevator(s) / escalator(s) for their intended use.

12. <u>Potential Environmental & Hazardous Materials</u>

a. Investigate for the presence of asbestos and/or lead etc.
   - Indicate suspicion of asbestos and/or lead containing products, mercury, PCBs etc. and recommend professional investigation.
   - Asbestos in roofing, roof flashing, duct wrap, pipe insulation, flooring lead paint and coatings and other building components.
   - Mercury in lamps (light bulb) and thermostat.
   - PCBs in light fixtures and ballasts

b. Investigate for the presence of mold, mildew, fungus, bacterial compounds or rot, radon gas etc.
   - Indicate suspicion of a mold, mildew, fungus, bacterial compounds or rot, radon gas, and recommend professional investigation.

B. <u>Structural System</u>

Consultant will study and assess the conditions which include, but are not limited to the following structural criteria and elements. Include photographs as appropriate.

1. <u>General Criteria</u>

a. Adequacy
   - Gather design criteria and the applicable codes of the existing building.
   - Consideration shall be given to investigate the adequacy of the structure for future functions to be performed, the loads imposed by equipment, occupants and their activities, life expectancy and cost of material to match with existing material for repair work.
b. Evaluate the possibilities of alterations, maintenance costs, and ease of demolition during future construction.
c. Stability
   - Overall structure stability shall be investigated to confirm the recognized engineering principles. Stability shall provide resistance against lateral loads and gravity loads etc.
d. Fire Resistance
   - Fire resistance rating of all structural members shall be investigated for future function to be performed.
e. Security
   - Structure specific security criteria shall be investigated for future function to be performed. The risk assessment shall consider risk factors, severity level etc.
f. Material Strength

- Exploratory field work and testing is required in the absence of original contract documents, or when information is required to define in-place construction. Materials such as concrete, steel, masonry and wood etc.

g. Provide recommendations for rehabilitation, remediation, upgrading or repair of general structural criteria for the structures intended use.

2. <u>Roof</u>

a. Ponding of water on roof
b. Clogging of scuppers and other overflow mechanisms
c. Adequacy of roof top unit /skylight/hatch support framing
d. Exposed steel above roof to be galvanized
e. Joist bridging
f. Vertical /horizontal bridging of trusses
g. Roof framing member (beams, girders, slab etc.) conditions such as cracks, spalling, excessive deflection etc.
h. Expansion joint locations and condition
i. Beam/truss bearing conditions
j. Water leakage
k. Vibration due to roof mounted equipments
l. Provide recommendations for rehabilitation, remediation, upgrading or repair of the structural roof for its intended use.

3. <u>Floors</u>

a. Floor framing member (beams, girders, slab etc.) condition such as crack, spalling, and excessive deformation of framing members.
b. Severity of cracks on floor
c. Beam/truss/joist bearing conditions
d. Floor opening framing members
e. Equipment pads size and condition
f. Vibration due to floor mounted equipments
g. Wheel loads on floors
h. Provide recommendations for rehabilitation, remediation, upgrading or repair of the floors for their intended use.

4. <u>Foundation & Foundation Drainage System</u>

a. Effects on the foundation from adjoining property, buildings and facilities must be examined.
b. Proper drainage of water from the building
c. Water seepage through basement walls.
d. Cracks on floor due to differential settlement of footings
e. Frost depth
f. Provide recommendations for rehabilitation, remediation, upgrading or repair of the foundation for its intended use.

5. <u>Walls</u>

a. Variations of hydrostatic pressure and surcharge on retaining walls
b. Back fill material and water proofing of retaining walls
c. Blocked weep Holes
d. Cracks on exterior walls due to lack of control joints and concentrated loads
e. Provide recommendations for rehabilitation, remediation, upgrading or repair of structural walls for their intended use.

C. <u>Mechanical Systems</u>

Consultant will study and assess mechanical systems and their major components including, but not limited to, the following. Include photographs as appropriate.

1. **Heating System**
    a. Description of the existing heating system
    b. Heating plants
    c. Boiler(s) (year, make, model, capacity, gas fired / electric / oil fired)
    d. Type of systems (two pipe / four pipe)
    e. Piping Arrangement (single loop / primary or secondary loop)
    f. Return (direct / reverse)
    g. Circulating Pumps (year, make, model, capacity, HP, GPM, /head)
    h. Piping
    i. Pipe insulation
    j. Valves
    k. Expansion tank (year, make, model, size)
    l. Air separator (year, make, model, size)
    m. Other type(s) of heating systems
    n. Radiant heating
    o. Under-floor heating
    p. Indicate all deficiencies in heating system in terms of equipment size, equipment installation, water distribution, type of system, system age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
    q. Provide recommendations for rehabilitation, remediation, upgrading or repair of heating system(s) for their intended use.

2. **Air Conditioning System**
    a. Description of the existing air conditioning system
    b. Chilled water plant
    c. Air cooled / water cooled (year, make, model, capacity)
    d. Type of chiller (centrifugal / reciprocating / screw / scroll etc.) (year, make, model, capacity)
    e. Piping Arrangement
        - Single loop / primary or secondary loop
        - Return (direct / reverse)
    f. Cooling tower (year, make, model, capacity)
    g. DX system (year, make, model, capacity)
    h. Self-contained unit (year, make, model, capacity)
    i. Location of all units
    j. Type of systems (two pipe / four pipe)
    k. Circulating pumps (year, make, model, capacity, HP, GPM/head)
    l. Piping
    m. Pipe insulation
    n. Valves
    o. Expansion tank (year, make, model, size)
    p. Air separator (year, make, model, size)
    q. Indicate all deficiencies in cooling system in terms of equipment size, equipment installation, water distribution, type of system, system age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
    r. Provide recommendations for rehabilitation, remediation, upgrading or repair of air conditioning system for its intended use.

3. **Air Distribution System**

a. Description of the existing air distribution system
b. Type of system (constant volume / VAV / VVT)
c. VAV / VVT (fan power / non fan power)
d. Total number of VAV / VVT boxes
e. VAV / VVT (year, make, model, capacity)
f. Floor-wise air distribution arrangement (for multi-storied buildings)
g. Zone-wise air distribution arrangement (for single / two storied buildings)
h. Identify all air handlers with corresponding serving areas
i. Type and condition of diffusers
j. Type and condition of return air grilles
k. Type of duct (round / rectangular / oval)
l. Insulation type and condition
m. Type of return air system (ducted / ceiling plenum)
n. Assess indoor air quality
o. Record all complaints from building occupants / building engineer
   - Frequency of complaints
   - Severity of complaints
p. Indicate all deficiencies in air distribution system in terms of equipment size, equipment installation, air flow (CFM) through the terminal units, type of system, system age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
q. Provide recommendations for rehabilitation, remediation, upgrading or repair of air distribution system for its intended use.

4. Make up / Fresh Air Intake System

a. Description of the existing make up/fresh air intake system
b. Make up / fresh air intake fan (year, make, model, capacity)
c. Age of the fan
d. Approximate date last replaced
e. Condition of fan(s)
f. Intake damper size/type
g. Any issues regarding damper location(s) in terms of indoor air quality and/or other concerns
h. Indicate all deficiencies in make-up/fresh air intake system in terms of equipment size, equipment installation, air flow (CFM), type of system, system age, energy conservation, code-related issues, IAQ issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
i. Provide recommendations for rehabilitation, remediation, upgrading or repair of make-up / fresh air intake system for its intended use.

5. Exhaust / Relief Air System

a. Description of the existing exhaust / relief air system
b. Exhaust air fan(s) (year, make, model, capacity)
c. Relief air fan(s) (year, make, model, capacity)
d. Age of the fan(s)
e. Approximate date last replaced
f. Condition of fan(s)
g. Damper size / type
h. Any issues regarding exhaust and relief air damper locations in terms of indoor air quality and/or other concerns
i. Indicate all deficiencies in exhaust / relief air system in terms of equipment size, equipment installation, air flow (CFM), type of system, system age, energy conservation, code-related issues, IAQ issues, other concern, maintenance

procedures and summary of repair costs over the last 5 years, availability of spare parts etc.

j. Provide recommendations for rehabilitation, remediation, upgrading or repair of exhaust / relief air system for its intended use.

6. **Water Distribution System (chilled, hot, condenser etc.)**
   a. Description of the existing water distribution system
   b. Type of system (two pipe / four pipe)
   c. Return (direct / reverse)
   d. Loop (single vs. primary and secondary)
   e. Pipe material
   f. Condition of piping in the space
   g. Condition of insulation
   h. Condition of valves
   i. Life expectancy and age of piping systems
   j. Approximate date last replaced
   k. Report any issue regarding pipe supports
   l. Record all complaints from building occupants/building engineer in terms of leakage
      - Frequency of complaints
      - Severity of complaint
   m. Indicate all deficiencies in water distribution system in terms of pipe size, installation, water flow (CFM) through the terminal units, type of system, system age, energy conservation, code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
   n. Provide recommendations for rehabilitation, remediation, upgrading or repair of water distribution system for its intended use.

7. **Automatic Temperature / Humidity Control System**
   a. Description of the existing automatic temperature / humidity control system
   b. Type of system (electric / pneumatic / DDC etc.)
   c. Age of the system
   d. Approximate date last replaced
   e. Life expectancy of the system
   f. Condition of all components
   g. Effectiveness and appropriateness of the system
   h. Energy conservation issues with existing system
   i. Record all complaints from building occupants / building engineer in terms of temperature, humidity, IAQ, etc.
      - Frequency and nature of complaints
      - Severity of complaints
   j. Indicate all deficiencies in the existing control system in terms of effectiveness, appropriateness, installation, system age, energy conservation, IAQ issue(s), code-related issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
   k. Provide recommendations for rehabilitation, remediation, upgrading or repair of automatic temperature / humidity control system for its intended use.

8. **Plumbing System**
   a. Description of the existing plumbing system
   b. Domestic water heating plant
   c. Boiler(s) / water heater (year, make, model, capacity, gas fired / electric / oil fired)
   d. Piping arrangement (single loop / primary or secondary loop)
   e. DWH circulating pumps (year, make, model, capacity, HP, GPM/head)
   f. Piping

g. Pipe insulation
h. Valves
i. Age of the existing DWH system
j. Condition of the system
k. Approximate date last replaced
l. Life expectancy
m. Type of plumbing fixtures
n. Age of plumbing fixtures
o. Condition of plumbing fixtures
p. ADA compliance
q. Indicate all deficiencies in plumbing system in terms of equipment size, equipment installation, water distribution, type of system, system age, energy conservation, water temperature control, code-related issues, ADA issues, maintenance procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
r. Provide recommendations for rehabilitation, remediation, upgrading or repair of plumbing system for its intended use.

D. **<u>Electrical Systems</u>**

Consultant will study and assess electrical systems and their major components including, but not limited to, the following. Include photographs as appropriate.

1. **<u>Primary Electrical System</u>**
   a. Description of the existing electrical system
      - Electrical power provider (PEPCO / Allegheny Power, etc.)
      - Electric panels (year, make, model, capacity)
      - MCCs (year, make, model, capacity)
      - Age of the existing system
      - Condition of the system
      - Approximate date last replaced
      - Life expectancy
   b. Type of wires (aluminum / copper / other)
      - Age of the existing wires
      - Condition of existing wires
      - Approximate date last replaced
      - Life expectancy of existing wires
   c. Grounding
      - Type(s) (standard building / isolated)
   d. Distribution
      - Type(s) (ductbank, conduit, cable tray, etc)
   e. Transformer(s)
      - Xyz
   f. Indicate all deficiencies in primary electrical system in terms of equipment/components size, capacity, equipment installation, distribution, type of system, system age, energy conservation, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
   g. Provide recommendations for rehabilitation, remediation, upgrading or repair of primary electrical system for its intended use.

2. **<u>Emergency Power System</u>**
   a. Emergency Generator
      - Description (year, make, model, output relative to building loads, redundancy)

- Fuel storage tank (year, make, model, capacity)
- Age of the existing system
- Condition of the system
- Load shed sequence
- Approximate date last replaced
- Life expectancy
- Conduits (concealed / exposed)

b. Uninterrupted Power System
- Description (year, make, model, capacity)
- Age of the existing system
- Condition of the system
- Approximate date last replaced
- Life expectancy

c. Automatic Transfer Switch (ATS) (year, make, model, capacity)
- Age of the existing ATS
- Condition of ATS
- Approximate date last replaced
- Life expectancy of ATS
- Condition of the conduits

d. Indicate all deficiencies in emergency power system in terms of equipment/components size, capacity, equipment installation, distribution, type of system, system age, energy conservation, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years, availability of spare parts etc.

e. Provide recommendations for rehabilitation, remediation, upgrading or repair of emergency power system for its intended use.

3. <u>Lighting Systems</u>

a. Description of the existing lighting systems
b. Type of light fixtures (year, make, model)
c. Number of fixtures per floor (for various types)
d. Age of the existing fixtures
e. Condition of the fixtures
f. Lighting control system description and locations
g. Approximate date last replaced
h. Life expectancy
i. Energy efficiency of the fixtures
j. Indicate all deficiencies in lighting system in terms of component size, capacity, fixture installation, illumination (foot candles), switching distribution, type of system, age, energy conservation, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
k. Provide recommendations for rehabilitation, remediation, upgrading or repair of lighting system for its intended use.

E. <u>Fire Prevention Systems</u>

Consultant will study and assess the condition of the fire prevention system and its major components including, but not limited to, the following. Include photographs as appropriate.

1. <u>Fire Alarm System</u>

a. Type of existing fire alarm system
b. Age of the existing system
c. Appropriate and effectiveness of the existing system with building functions

d. Condition of the system
e. Approximate date last replaced
f. Life expectancy
g. Location of pull stations and appropriateness
h. Location of the enunciator and appropriateness
i. Locations of egresses and appropriateness
j. Indicate all deficiencies in the existing fire alarm system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures, and summary of repair costs over the last 5 years, availability of spare parts etc.
k. Provide recommendations for rehabilitation, remediation, upgrading or repair of fire alarm system for its intended use.

2. Sprinkler System

a. Type of the existing system (dry / wet / other)
b. Age of the existing system
c. Appropriate and effectiveness of the existing system with building functions
d. Condition of the system
e. Approximate date last replaced
f. Life expectancy
g. Indicate all deficiencies in the existing sprinkler system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
h. Provide recommendations for rehabilitation, remediation, upgrading or repair of sprinkler system for its intended use.

F. Communications

Consultant will study and assess communications systems including, but not limited to the following. Include photographs as appropriate.

1. Telephone System

a. Description of the existing telephone system
b. Age of the existing system
c. Appropriate and effectiveness of the existing system with building functions
d. Condition of the system
e. Approximate date last replaced
f. Life expectancy
g. Indicate all deficiencies in the existing telephone system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
h. Provide recommendations for rehabilitation, remediation, upgrading or repair of telephone system for its intended use.

2. Network System

a. Description of the existing network system
b. Age of the existing system
c. Appropriate and effectiveness of the existing system with building functions
d. Condition of the system
e. Approximate date last replaced
f. Life expectancy
g. Indicate all deficiencies in the existing network system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues,

maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.

h. Provide recommendations for rehabilitation, remediation, upgrading or repair of network system for its intended use.

3. **Optic Fiber**
   a. Description of existing optic fiber
   b. Age of the existing lines
   c. Appropriate and effectiveness of the existing lines with building functions
   d. Condition of the lines
   e. Approximate date last replaced
   f. Life expectancy
   g. Indicate all deficiencies in the existing optic fiber lines in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
   h. Provide recommendations for rehabilitation, remediation, upgrading or repair of optic fiber system for its intended use.

4. **Cabling Plant**
   a. Description of the existing cabling plant
   b. Age of the existing cabling plant
   c. Appropriate and effectiveness of the existing cabling plant with building functions
   d. Condition of the cabling plant
   e. Approximate date last replaced
   f. Life expectancy
   g. Indicate all deficiencies in the existing cabling plant in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
   h. Provide recommendations for rehabilitation, remediation, upgrading or repair of cabling plant for its intended use.

5. **Satellite / Cable TV**
   a. Description of existing satellite / cable TV
   b. Age of the existing equipment
   c. Appropriate and effectiveness of the existing equipment with building functions
   d. Condition of the equipment
   e. Approximate date last replaced
   f. Life expectancy
   g. Indicate all deficiencies in existing satellite / cable TV in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
   h. Provide recommendations for rehabilitation, remediation, upgrading or repair of satellite / cable TV for its intended use.

6. **Radio System**
   a. Description of the existing radio system
   b. Age of the existing system
   c. Appropriate and effectiveness of the existing system with building functions
   d. Condition of the system
   e. Approximate date last replaced
   f. Life expectancy

g. Indicate all deficiencies in the existing radio system in terms of component size, capacity, installation, type of system, age, energy conservation, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
h. Provide recommendations for rehabilitation, remediation, upgrading or repair of radio system for its intended use.

G. <u>Site Conditions</u>
Consultant will study and assess site conditions including, but not limited to, the following. Include photographs as appropriate.

1. <u>Parking Lot / Garage</u>
a. Description of the existing parking lot / garage
   - Total area (sq. ft.)
   - Total number of parking spaces including handicap spaces
   - Size, type and proximity to entrance of handicap spaces
b. Condition of the parking lot / garage
c. Approximate date last repaired / resurfaced
d. Vehicular circulation issues
e. Pedestrian circulation issues
f. Signage issues
g. Appropriate number of spaces to the building occupant / patron load
h. Code related issues in terms of handicap spaces and access to building
i. ADA compliance
j. Security / controlled access system (type, location, effectiveness, issues)
k. Parking attendant structure
l. Indicate all deficiencies in the existing parking lot / garage in terms of ADA requirements, age of the surfaces, code-related issues, vehicular circulation issues, pedestrian circulation issues, signage, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
m. Provide recommendations for rehabilitation, remediation, upgrading or repair of parking lot / garage for its intended use.

2. <u>Parking Lot / Site Lighting System(s)</u>
a. Description of the existing parking lot / garage lighting
b. Condition and type of parking lot / garage lighting fixtures
c. Approximate date parking lot/garage lighting system was last upgraded
d. Level and direction of illumination (LEED compliance)
e. Description of the existing site / entry lighting
f. Condition and type of site/entry lighting fixtures
g. Approximate date site/entry lighting system was last upgraded
h. Level and direction of illumination (LEED compliance)
i. Indicate all deficiencies in the existing parking lot / garage and site / entry lighting systems in terms of ADA requirements, age, energy conservation issues, code-related issues, illumination issues, LEED compliance, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
j. Provide recommendations for rehabilitation, remediation, upgrading or repair of parking lot / site lighting systems for their intended use.

3. <u>Sidewalks & Curb Cuts</u>
a. Location and description of sidewalk(s) and curb cut(s)
b. Material and condition of sidewalk(s) and curb cut(s)
c. Length and width of sidewalk (in ft.) and curb cut(s)

d. Approximate date the existing sidewalk(s) and curb cut(s) were last repaired / resurfaced
e. Circulation issues
f. Indicate all deficiencies in the existing sidewalk(s) and curb cut(s) in terms of ADA requirements, age of the surfaces, code-related issues, vehicular circulation issues, pedestrian circulation issues, signage, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
g. Provide recommendations for rehabilitation, remediation, upgrading or repair of sidewalk(s) and curb cut(s) for their intended use.

4. <u>Stairs & Ramps</u>

a. Location and quantity of stairs
b. Width of stairs
c. Landing dimensions
d. Riser height
e. Condition of surfaces
f. ADA compliance
g. Provide recommendations for rehabilitation, remediation, upgrading or repair of the stairs and ramps for their intended use.

5. **<u>Storm Water Management</u>**

a. Condition of existing system
b. DPS and other agency requirements
c. Upgrading requirements
d. Indicate all deficiencies in the existing storm water management system, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
e. Provide recommendations for rehabilitation, remediation, upgrading or repair of storm water management system for its intended use.

6. <u>Retention Facilities</u>

a. Condition of existing facility
b. Recent maintenance report
c. DPS and other agency requirements
d. Indicate all deficiencies in the existing facility, code-related issues, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
e. Provide recommendations for rehabilitation, remediation, upgrading or repair of retention facility for its intended use.

7. <u>Access from Public Transportation</u>

a. Description of existing access from public transportation
b. Condition of structures and surfaces along path of travel
c. ADA compliance
d. Indicate all deficiencies in the existing access from public transportation in terms of ADA requirements, code-related issues, illumination issues, maintenance issues and procedures and summary of repair costs over the last 5 years etc.
e. Provide recommendations for rehabilitation, remediation, upgrading or repair of access from public transportation.

8. <u>Utility Locations & Terminations</u>

a. Identify locations of all utilities servicing site along with all components and terminations
b. Identify updated requirements that will result in modifications to existing service
c. Confirm easement locations

H. Special Areas
Consultant will study and assess the condition of special areas including, but not limited to, the following. Include photographs as appropriate.

1. Kitchens & Pantries
a. Description of the existing spaces (size, location, equipment, fixtures, millwork, finishes, colors, etc.)
b. Age and condition of the existing equipment, fixtures, millwork, finishes, etc.
c. ADA compliance
d. Appropriate and effectiveness of the existing facility / components with building functions
e. Indicate all deficiencies in the existing kitchens and pantries in terms of capacity, energy conservation, ADA compliance, code-related issues, maintenance issues, etc.
f. Provide recommendations for rehabilitation, remediation, upgrading or repair of kitchens and pantries for their intended use.

2. Fitness & Locker Rooms
a. Description of the existing spaces (size, location, equipment, lockers, fixtures, toilet / shower partitions and accessories, millwork, finishes, colors, etc.)
b. Age and condition of the existing equipment, lockers, fixtures, toilet / shower partitions and accessories, millwork, finishes, etc.
c. ADA compliance
d. Appropriate and effectiveness of the existing facility / components with building functions
e. Indicate all deficiencies in the existing fitness and locker rooms in terms of capacity, ADA compliance, code-related issues, maintenance issues, etc.
f. Provide recommendations for rehabilitation, remediation, upgrading or repair of fitness and locker rooms for their intended use.

3. Restrooms
a. Description of the existing spaces (size, location, fixtures, toilet partitions and accessories, millwork, finishes, colors, etc.)
b. Age and condition of the existing fixtures, toilet partitions and accessories, millwork, finishes, etc.
c. ADA compliance
d. Appropriate and effectiveness of the existing restrooms with building functions
e. Indicate all deficiencies in the existing restrooms in terms of capacity, ADA compliance, code-related issues, maintenance issues, etc.
f. Provide recommendations for rehabilitation, remediation, upgrading or repair of restrooms for their intended use.

I. Miscellaneous Systems & Equipment
Consultant will study and assess the condition of miscellaneous systems and equipment including, but not limited to, the following. Include photographs as appropriate.

1. Security System & Equipment
a. Description of the existing security system and equipment
b. Age of the existing security system and equipment
c. Appropriate and effectiveness of the existing security system and equipment with building functions
d. Condition of the security system and equipment
e. Approximate date last replaced

f. Life expectancy
g. Indicate all deficiencies in the existing security system and equipment in terms of component size, capacity, installation, type of system, age, effectiveness, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
h. Provide recommendations for rehabilitation, remediation, upgrading or repair of security system and equipment for their intended use.

2. Furniture

a. Description of the existing furniture (general, systems and custom)
b. Age of the existing furniture
c. Appropriate and effectiveness of the existing furniture with building and occupant functions
d. Condition of the furniture
e. Approximate date last replaced
f. Life expectancy
g. Indicate all deficiencies in the existing furniture in terms of size, condition, installation, type of system, age, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
h. Provide recommendations for rehabilitation, remediation, upgrading or repair of furniture for its intended use.

3. Audiovisual Systems & Equipment

a. Description of the existing audiovisual systems and equipment
b. Age of the existing audiovisual systems and equipment
c. Appropriate and effectiveness of the existing audiovisual systems and equipment with occupant requirements
d. Condition of the audiovisual systems and equipment
e. Approximate date last replaced
f. Life expectancy
g. Indicate all deficiencies in the existing audiovisual systems and equipment in terms of component characteristics, installation, type of system, age, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
h. Provide recommendations for rehabilitation, remediation, upgrading or repair of audiovisual systems and equipment for their intended use.

4. Food Service Equipment

a. Description of the existing food service equipment
b. Age of the existing food service equipment
c. Appropriate and effectiveness of existing food service equipment with building functions
d. Condition of the food service equipment
e. Approximate date last replaced
f. Life expectancy
g. Indicate all deficiencies in the existing food service equipment in terms of equipment size, capacity, installation, type, age, energy conservation, condition, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
h. Provide recommendations for rehabilitation, remediation, upgrading or repair of food service equipment for its intended use.

5. Medical Equipment

a. Description of the existing medical equipment

b. Age of the existing medical equipment
c. Appropriate and effectiveness of the existing medical equipment with building functions
d. Condition of the medical equipment
e. ADA compliance
f. Approximate date last replaced
g. Life expectancy
h. Indicate all deficiencies in existing medical equipment in terms of equipment size, capacity, installation, type, age, code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
i. Provide recommendations for rehabilitation, remediation, upgrading or repair of medical equipment for its intended use.

6. Signage

a. Description of existing signage (exterior, building-mounted, directional, room (permanent and otherwise), building directory, workstation, etc.)
b. Age of existing signage components
c. Sizes of existing signage components
d. Materials / finishes of existing signage components
e. Locations of existing signage components
f. Appropriate and effectiveness of existing signage with building functions
g. Condition of signage
h. Life expectancy (illuminated type)
i. ADA compliance (Braille, raised letters, mounting height and location, etc.)
j. Indicate all deficiencies in existing signage in terms of size, installation, type of system, age, energy conservation (illuminated type), code-related issues, maintenance issues, procedures and summary of repair costs over the last 5 years, availability of spare parts etc.
k. Provide recommendations for rehabilitation, remediation, upgrading or repair of signage for its intended use.

J. Phasing Plan

1. Recommended Phasing Scenario(s)

a. Consultant shall provide one or more recommended phasing plans /scenarios. Scenarios shall:
   - Identify impact on the functions of the building
   - Identify if building renovation can be accomplished without shutting down operations
   - Identify if building renovation can only be accomplished by shutting down entire operation
   - Include estimated amount of space that must be vacant during the course of work if applicable
   - Identify if computer, electrical or mechanical rooms will be affected and if so, strategy for eliminating or reducing impact on building occupants
   - Identify to what extent surrounding property will be needed for construction staging
   - Identify if underground utility or other work will impact public access to building

2. Duration of Phases

a. Provide sequence of phases
b. Provide construction time frames for each phase

3. **Impact on Building Occupants and Surrounding Area**
   a. In conjunction with recommended phasing scenarios, provide:
      - Strategies for temporary relocation of personnel work spaces
      - Strategies for temporary relocation of building amenities (cafeteria, fitness rooms, copy center, etc.)
      - Identify noise, vibration and/or odor creating operations, define level of anticipated disruption, and make recommendations for mitigating impact on building occupants
      - Identify potential disruption on surrounding area and make recommendations for mitigating impact.

K. Indirect Costs

1. Consultant shall discuss indirect costs which include, but are not limited to the following:
   a. Moving
   b. Temporary heating / air conditioning / ventilation
   c. Temporary supply of domestic water (hot and cold)
   d. Temporary power
   e. Temporary parking spaces
   f. Weekends / non regular hour construction work
   g. Noise control
   h. Smoke / welding fumes control
   i. Dust control
   j. Special rigging with street closure (helicopter / large crane)
   k. Necessary duct modification / replacement / new installation above the existing ceiling, if the ceiling / lighting systems are in appropriate condition, add the tasks for removing and reinstalling the ceiling and lighting system as indirect cost elements.
   l. Necessary pipe modification / replacement / new installation above the existing ceiling, if the ceiling / lighting systems are in appropriate condition, add the tasks for removing and reinstalling the ceiling and lighting system as indirect cost elements.

APPENDICES

Documentation
References (current codes, industry standards, manufacturer's literature, etc.)
Engineering and other calculations
Photographs (if not included in the applicable sections above)
Interviewee comments/complaints
Research materials

1 2 3 4 5 6 7 8 9 10

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1 2 3 4 5 6 7 8 9 10

CLIENT:

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MONTGOMERY COUNTY
MARYLAND

DEPARTMENT OF GENERAL SERVICES
OFFICE OF PLANNING &
DEVELOPMENT
101 MONROE STREET
ROCKVILLE, MARYLAND 20850

PROJECT:

PROJECT NAME
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REGISTRATION:

NO.	DATE	ISSUE DESCRIPTION
1	01-01-2008	SCHEMATIC DESIGN

PROJECT NO: XXXX-XXXX
DRAWN BY: XXXX
CHECKED BY: XXXX

KEY PLAN:

N

SHEET TITLE:

XXXX
XXXX
XXXX
XXXX

SHEET NUMBER:

A-000

Original drawing is 30" x 42". Scale entities accordingly if reduced

Department of Technology Services
Radio Communication Services Section

Station Alerting
and
Public Address (SA/PA) System

for Fire/Rescue Stations

RCS Document 0601
Revision 1
August 18, 2006

Prepared by:

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This specification and standard is adopted and promulgated this date. It supersedes and replaces RCS Document 0401, which was promulgated to limited distribution on December 3. 2004.

Gene Cummins
Chief, Radio Communications Services Section
Department of Technology Services
Montgomery County

August 18, 2006

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Table of Contents

Section 1
General System Description

It is the jointly adopted goal of the Montgomery County Fire and Rescue Service and the Department of Technology Services to adopt and maintain a set of technical and operational standards for the alerting systems and public address systems in Montgomery County's fire and rescue stations. This document provides a specification which sets forth these technical and operational standards.

Strictly speaking, the Fire Station Alerting system has four primary components: the ECC, the two station radio transceivers, and the remote terminal unit. Each of these will be described in further detail. The public address system could be considered technically to be a separate system, but it functions with the station alerting system so integrally that, for purposes of this specification, it will be considered as the fifth primary component. This specification will discuss an integrated Station Alerting/Public Address system, which will be referred to by the acronym, the *SA/PA System*.

The first component of the SA/PA System is the Public Safety Communications Center (PSCC). This document does not specify the functional aspects of the PSCC, but only addresses those portions of the station alerting system located within the fire-rescue stations themselves. It is important to consider the PSCC in this discussion, however, since this is the origin of the station alerting signals.

The second and third components are the 800 MegaHertz (MHz) trunked radio transceivers at the station. The first transceiver receives and decodes the data signals transmitted by radio from the PSCC. This also provides data signals to perform other automated functions, such as triggering the tone generators which create the alert sounds that are heard throughout the station for the various types of alerts. A second transceiver provides the fire dispatch audio (the verbal messages) to alert the personnel in the station. There are two transceivers in each fire-rescue station.

A third radio, typically but not necessarily, a receive-only scanner, will provide a second source of audio to be amplified and sent to loudspeakers throughout the station via a separate secondary audio distribution system. This secondary system gives station personnel the opportunity and the means to listen to other communications, such as a fireground talkgroup, or other communications of interest. This secondary audio system is collocated with, but is not part of, the Fire Station Alerting system. It is part of the SA/PA system, inasmuch as it is a public address system.

The fourth component of the Fire Station Alerting system is the Remote Terminal Unit. Technically termed the Motorola Systems Control and Data/Remote Terminal Unit (MOSCAD/RTU), this component will commonly be referred to as, simply, the "RTU." There is one RTU in each fire-rescue station. It both receives and transmits. It receives signals from the first trunked radio transceiver, decodes the signals, and provides relay closures (switching) to activate lights, doors, and other alarm-related functions within the station. It also generates the alarm sounds to be distributed throughout the station by the public address amplifier. The RTU also receives information from various sensors in the station (e.g., smoke detectors, emergency generator status and control panels, etc.) and encodes and transmits signals back to the PSCC**,** via radio, about conditions in the station. In this way the PSCC dispatcher personnel can monitor certain functions within the stations.

The fifth component is the two public address system (also called the "audio systems"). The public address systems are comprised of high quality audio amplifiers, audio system wiring, volume controls, loudspeakers, and related components. Most MCFRS fire stations were built with only one public address system, but since the implementation of the 800 MHz trunked radio system, a requirement has been determined for a second audio channel. Therefore new fire stations are now being built and older stations may be retrofitted to have two public address systems.

The audio heard by personnel in the stations, consisting of the primary ("7A") dispatcher's voice, will hereafter be referred to as Fire Dispatch Audio.

The audible alerting sounds, which are generated within the station's RTU and amplified and distributed within the station by the primary public address system, will hereafter be referred to as alerting audio.

With reference to the main system and secondary system, the term "main system" shall refer to the Fire Station Alerting system, which is used to supply the alert sounds and the main fire dispatch audio throughout the station. The term "secondary system" shall refer to the secondary audio system, which is used to distribute audio from a scanner radio or other secondary audio source device.

The following sections of this specification document will define the standard system for all fire-rescue stations within the Montgomery County Fire and Rescue Service.

Section 2
Audio, Lighting, and Signaling Systems

This section will describe general aspects and functionality of the audio system, its inputs and its outputs.

AUDIO AMPLIFIER SYSTEM(S)

The audio amplifier system(s) shall have a 70-volt nominal distribution voltage. All equipment shall be exactly according to this specification and, unless specifically stated otherwise, no other equipment is to be substituted without the approval of the Section Chief, Radio Communications Services, Department of Technology Services.

Separate speaker wiring runs will be required for different areas or zones of the station. Wiring runs for separate areas can share a common conduit, but are not to be electrically interconnected. Speaker wiring for all areas/zones shall be home runs all the way back to the demarc. (The demarc or demarcation point is defined as the wiring connection panel co-located with the SA/PA equipment cabinet.) These different areas will hereafter be referred to as speaker zones. While fire-rescue stations differ in style and construction, the speaker zones have been designated so as to apply to any station, regardless of layout. Care and attention must be exercised before, during, and after installation of the speaker wiring to ensure a reliable system, conforming exactly to this specification.

Audio equipment is specified in Section 4; requirements for wiring, cabling, and conduit are specified in Section 5.

The following is a list of speaker zones for wiring to be provided within the fire-rescue station. Not all stations will have all zones, but where these listed areas exist, each shall be provided with its own wiring as a separate zone, and they shall be numbered according to this listing:

Zone 1	Apparatus bays (engine rooms)
Zone 2	Administrative areas (regardless of floor location)
Zone 3	Exterior speakers (outdoors)
Zone 4	General Areas, Floor 1
Zone 5	General Areas, Floor 2
Zone 6	General Areas, Floor 3 Note: General areas are defined to include hallways and corridors, exercise and similar activity rooms, day rooms, lounges, kitchens, etc.
Zone 7	Fire (suppression) dormitories (male/female, as applicable)
Zone 8	EMS dormitories (male/female, as applicable)
Zone 9	Duty Officer dormitory and/or office
Zone 10	Basement and/or workshops

Zone 11 Outbuildings (optional)
Zone 12 Large ballrooms or conference centers (optional)
Zone 13 Station Watch Office

The alerting audio and fire dispatch audio will be provided to all areas of the fire/rescue station, including administrative areas and workshop areas, and also including significant outbuildings. Ballrooms, conference centers, and facilities typically made available to the general public or outside users may or may not be wired, at the discretion of the local fire-rescue department. If wired, a switch may be used to disable alerting in these areas.

LOCAL ALARM FEEDS TO ECC/PSCC

The MOSCAD RTU provides a means of connecting a variety of switches or sensors, such as alarms and equipment status indicators or monitors to a display system, which can be remotely monitored at the Emergency Communications Center (ECC). The MOSCAD RTU used in Montgomery County's fire-rescue stations is designed with an input module to connect to various in-house contact points, to monitor equipment and activity within the fire-rescue station and to report that activity back to the ECC. Also within the RTU are two output modules, each with 8 outputs. These are "dry contact outputs" (also called switch or relay closures) which can trigger lighting or other controls, and the tone generators which create the various alert sounds that are heard throughout the station. The input module and both output modules are controlled by a CPU (central processor unit) module.

MOSCAD INPUTS

The MOSCAD digital input module has a total capacity of 16 inputs. Thirteen inputs may be connected, if desired and if contacts are available within the station. Two will be spares. The remaining input, digital input #16, is an internal tamper switch on the RTU door and will be connected by Radio Shop personnel. The thirteen inputs, if used, may be connected in the demarc cabinet, terminal block TBE, using contacts 20 through 32. See Drawing 6.

Digital inputs 1 and 2 will monitor activity within the fire alarm control panel.

Digital inputs 3, 4, 5, 6, 12, and 13 will be initiated in-house by manual pushbuttons located in the Watch Office Console.

Digital inputs 7, 8, 9, and 10 will monitor the activity and status of the station's emergency generator.

The complete list of input and output functions is in Tables 1 and 2 below.

Table 1. MOSCAD Digital Inputs

Digital Input	Function	Comments
1	Smoke Detector	Smoke detector activation at station
2	Sprinkler	Sprinkler system activation at station
3	Manual Act., Fire	Manual activation of “Fire” sequence
4	Manual Act., BLS	Manual Activation of “BLS” sequence
5	Manual Act., ALS	Manual Activation of “ALS” sequence
6	Manual Act., Duty	Manual Activation of “Duty” sequence
7	Station Gen. Input 1	Commercial AC power failure
8	Station Gen. Input 2	Generator running
9	Station Gen. Input 3	Generator on-line
10	Station Gen. Input 4	Generator failure
11	Spare: Future use	Spare for future use
12	Manual Act. Squad	Manual activation of “Squad” sequence
13	Manual Reset	Manual reset of RTU and all relays
14	Spare: Future use	Spare for future use
15	Spare: Future use	Spare for future use
16	Tamper Switch	RTU Tamper Switch

Table 2. MOSCAD Digital Outputs

Digital Output	Function	Comments	Duration (secs)
1-1	General area lights	Closed = ON, Open = OFF	60
1-2	Amplifier	Closed = ON, Open = OFF	60
1-3	Alert, Fire	Momentary closure for “Fire” calls	3
1-4	Alert, BLS	Momentary closure for “BLS” calls	3
1-5	Alert, ALS	Momentary closure for “ALS” calls	3
1-6	Alert, Duty	Momentary closure for “Duty” calls	3
1-7	Alert, CAD Down	Momentary closure when CAD is down	3
1-8	Alert, Squad	Momentary closure for “Squad” calls	3
2-1	Tone, Fire	Tone activation for “Fire” calls	3
2-2	Tone, BLS	Tone activation for “BLS” calls	3
2-3	Tone, ALS	Tone activation for “ALS” calls	3
2-4	Tone, Duty	Tone activation for “Duty” calls	3
2-5	Tone, CAD down	Tone activation for “Squad” calls	3
2-6	Fire dorm lights	Closed = ON, Open = OFF	60
2-7	EMS dorm lights	Closed = ON, Open = OFF	60
2-8	Duty dorm lights	Closed = ON, Open = OFF	60

CUSTOM ACCESSORIES

While not specifically addressed in this publication as a standard, an individual fire/rescue station may elect to connect external devices such as lighting controls or External Sirens to the SA/PA System. These external devices are not part of the SA/PA System itself. They are not intended to be part of this specification. This specification, however, does govern their connection to the SA/PA System, if such devices are used. **Except for a house siren in stations which use them, no audible warning or alert devices such as horns, bells, buzzers, or any other sound-producing devices, are to be connected to the SA/PA System, directly or indirectly.**

HOUSE SIREN

If a house siren is used, a relay to activate it may be connected in the external devices terminal box referred to as the demarc, to terminal block TBA, terminals 9 &10. See Drawing 3.

HOUSE LIGHTING

If automatic control of house lighting is used, relays to activate the various lighting circuits may be connected in the demarc terminal box to terminal strip TBA, terminals as follows: (See Drawing 3.)

Terminals 1 & 2 for engine bays and/or general station lighting
Terminals 3 & 4 for suppression bunk room
Terminals 5 & 6 for EMS bunk room
Terminals 7 & 8 for duty officer bunk room

TRAFFIC LIGHTS

If traffic lights are to be controlled automatically by signals associated with the fire station alerting (i.e., by the SA/PA system), relays to activate them may be connected in the demarc terminal box to terminal strip TBA, to terminals as follows: (See Drawing 3.)

Terminals 11 & 12 for traffic light #1
Terminals 13 & 14 for traffic light #2

The SA/PA System will provide 24 volts AC to activate the above listed relays. The maximum load that may be connected to these terminals is 2 amperes AC.

Section 3
Equipment

SYSTEM EQUIPMENT

The following equipment is considered to comprise the SA/PA System:

800 MHz trunked radio voice transceiver
800 MHz trunked radio MOSCAD transceiver
800 MHz MOSCAD RTU (remote terminal unit)
Antennas and antenna cables
Uninterruptible power supply (UPS) system
Tone generators
Audio amplifiers
Loudspeakers
Relay/power supply controls
Wiring and conduits
Equipment cabinet
Secondary radio

A block diagram of the SA/PA system is shown in Drawing 1.

The transceivers, remote terminal units, UPS, tone generators, amplifiers, relays, and their associated circuitry are to be mounted in a standard electronic equipment cabinet within the fire-rescue station.

The antenna cables connect the antennas, which are generally mounted on the roof of the station or an adjacent tall structure, to the equipment mounted in the equipment cabinet.

The equipment cabinet is to be installed in a space to which access is restricted. Station personnel are not to have access to the space. If this is not possible, the equipment cabinet must be designed and installed such that station personnel do not have access to the equipment mounted within the cabinet. There can be no exceptions to this restriction.

The 800 MHz trunked radio transceivers and the MOSCAD RTU's, provided by Motorola under a Montgomery County contract, are generally installed by a local Motorola field service organization or by the technicians of the Radio Communications Services (RCS) Section of DTS.

The antennas and cabling may also be provided and installed by Motorola and/or its field service organization or by RCS. For audio and control cables, conduit or wiring raceways will be required (see section 5). The antenna cables will often be of a semi-rigid type (such as Andrew LDF4-50A *Heliax*). Any conduit, cable trays, or raceways for antenna cables must accommodate, at a minimum, two runs of semi-rigid 1/2-inch diameter antenna cable with a minimum 2-foot bending radius. These conduits, cable trays, or raceways may be provided and installed by any qualified contractor. Flexible coaxial jumpers may be used at the equipment cabinet's antenna inputs to facilitate movement without damaging the cables.

A UPS system shall be installed inside the equipment cabinet to provide uninterrupted power during emergency generator starting and stopping and during power transfers between the emergency generator and the local power utility. This equipment provides power for the radio transceivers, the RTU, the audio amplifier, and peripheral equipment such as power supplies and controls. This UPS shall provide a minimum of 2000 VA *(volt-amps)* and have a run time of not less than 5 minutes at full load.

The audio amplifier(s) shall be rack mounted with the appropriate mounting kit. One perforated rack spacer plate at least 1 inch high shall be installed above and another below the amplifier, to ensure adequate ventilation for the amplifier.

Several special-purpose control circuits will be mounted in a sliding drawer, 5½ inches high. These will provide for such functions as a time clock for the turning off of the outdoor paging speakers at night, internal station lighting relays, and power supplies. (This drawer will be referred to as the *Control Shelf* in the future.)

SECONDARY RADIO

The secondary radio shall be a Uniden model BC785D, model BCD-996T, or equivalent trunk-tracking scanning receiver. However, the technology of these radios changes rapidly, so the substitution of an equivalent or better model scanning radio is permitted, with the approval of the Chief of the Radio Communications Services Section of the Department of Technology Services.

MOUNTING RACKS & CABINETS

The equipment described above is to be housed in a 19" EIA standard electronic equipment rack cabinet, fully accessible from both the front and rear. This cabinet shall have and will be installed so as to provide adequate ventilation for all equipment mounted within. The doors shall be able to swing open to no less 90 degrees to provide100% outward travel of internal shelf sliders. This cabinet must also have lockable solid front and rear doors. (This requirement may be dispensed with if the cabinet is located in a room or space within the station, to which station personnel do not have access.) The cabinet may be permanently mounted, floor standing, or mounted on wheels. Any component not available in a 19" direct-mount configuration can be installed on a 19" shelf.

If a rack on wheels is used, all cables into and out of the cabinet must have a minimum 40-inch service loop. In this case, to provide strain relief for all cables, an umbilical support cord, made of steel wire rope of at least 1/8" diameter and of length at least 4 inches shorter than the shortest cable service loop, is to be installed between the cabinet and an adjacent wall. If cable entry is made from the above, there will be a minimum 4-foot service loop of semi-rigid 2" flexible conduit (Greenfield or equivalent). Extreme care must be taken not to crimp or to bend to an unacceptably small radius any semi-rigid antenna cables.

DEMARCATION BOX (DEMARC)

The demarcation box (demarc) is a County-supplied medium Type 1 enclosure, with a key lock, and with a number of terminal blocks mounted inside. (See Drawing 10.) The dimensions of the cabinet are nominally 30" high by 24" wide by 8 ½ " deep. The demarc box is to be mounted to a plywood sheet of not less than ¾ inch thickness, which shall, in turn, be mounted to a masonry or drywall surface. It is to be securely mounted or anchored so as to support its nominal weight of 52 pounds, plus the weights of the conduits which terminate at the box. The mounting height shall be such that the bottom of the cabinet is 44 to 48 inches above the floor. The left hand opening door must be able to swing open to no less than 90 degrees, in order to ensure access to the internal panel and the terminal blocks.

All wires and cables entering the demarc cabinet shall be in conduit.

CENTRAL ELECTRONICS CABINET

The cabinet housing the transceivers, remote terminal units, tone generators, amplifiers, relays and associated circuitry shall be a standard electronic equipment cabinet. The cabinet is referred to as the Central Electronics Cabinet. A single conduit of 2-inch diameter EMT or flexible Greenfield-type conduit shall interconnect this cabinet and the demarc cabinet. If the cabinet is mounted on wheels, a minimum of four feet of the total conduit run must be the flexible type of conduit. When installed in its normal, permanent location, the location shall be such that the front and rear doors can be opened to at least 90 degrees, and the internal, sliding shelves must have sufficient room to slide 100% of their depth out of the cabinet for service.

ELECTRICAL REQUIREMENTS

A dedicated 20-amp 120-volt single-phase AC circuit shall be provided for this equipment and terminated in a quad or double-duplex receptacle. Receptacles shall be red in color. These receptacles shall be powered from a panel which provides power from the station’s emergency generator in case of a commercial power failure. The panel designation and circuit number must be shown clearly on a plate mounted in a conspicuous place at or near the equipment cabinet with an adhesive label. No marker or handwritten labels are permitted. The feed panel directory must list “Station Communications System” as the load being served.

The cabinet shall be grounded by a stranded copper green-insulated conductor, no smaller than #6 AWG and terminated to the building’s grounding system, in conformance with the National Electrical Code, Article 250-50, and Motorola’s R-56 grounding standard. Single hole mechanical lugs are acceptable for this purpose.

Section 4
Public Address Audio Subsystem Equipment

The following equipment is to be used in the public address portion of the SA/PA system. Only where specifically noted are substitutions allowed.

Equipment type	Manufacturer	Model
Audio amplifiers	Peavey	PZS 140
Interior speakers	Atlas Soundolier	HD-70W or VP-14
Exterior speakers	Atlas Soundolier	AP-15T
Volume controls	Atlas Soundolier	AT 10-PA or AT 35-PA (See below)
Back boxes for interior speakers	Atlas Soundolier	95-8

Enclosures and back boxes for indoor speakers, when used above a suspended ceiling, shall be supported by either an all-thread steel rod of at least 3/16" diameter or by a hanger wire suspended from a solid connection to a structural ceiling. If mounted in a fire-resistant partition, wall, or ceiling, an enclosure site-built with fire-rated drywall is required.

When the total connected wattage of any group of parallel-wired speakers that will be controlled by a single volume control does not exceed 10 watts, a model AT 10-PA volume control may be used. When the total connect wattage exceeds 10 watts but does not exceed 35 watts, a model AT 35-PA volume control will be used. This pertains to both indoor and outdoor speakers. Drawing 11 provides details of speaker wiring.

When the station is alerted, the main system will send 24 VDC over the white and green pair of the 4-conductor cable to each volume control. A relay within the volume control will automatically bypass the selected level setting and will provide full volume for the timed duration of 60 seconds. After that time, the volume control will revert to the normal level set by the volume control knob.

The secondary audio system will be a more basic public address audio system, with the levels being controlled by individual volume controls. The secondary audio system will be a duplicate of the main system (identical wiring, identical materials, identical installation practices) except that automatic step-up for alerting will not be used.

Both the primary system and secondary system exterior (outdoor) speakers are to be clock controlled, to silence them during a night-time period to be specified at each station. This will help prevent complaints at those stations located in proximity to residential neighborhoods.

All speakers are similarly connected, as shown in Drawing 11.

Section 5
Wiring, Cables, and Conduits

All wire shall be installed exactly in accordance with this specification and, unless specifically stated otherwise, no other type of wire is to be substituted. All wiring associated with the primary fire station alerting and secondary audio systems, including speaker, control, and alarm wiring shall be installed in metallic conduit only. Acceptable types and sizes of conduit are specified below.

INSIDE SPEAKERS

For interior wiring, EMT (electrical metallic tubing) conduit or FMC (flexible metallic conduit) may be used. Conduit sizes will be determined according to the paragraph on conduit capacities, below. Wiremold-type surface-mounted conduit may be used in the rehabilitation of older construction stations in interior areas normally visible to personnel (i.e., not in utility areas, above ceilings, or in other normally unseen areas, or on the exterior of a building). Surface mounted conduits may only be used with prior approval by the Montgomery County project manager supervising the construction project.

Note 1: No PVC conduit is permitted.

Note 2: No ½ EMT/Conduit used shall contain more than 1 speaker wire.

Note 3: No Wiremold type or other surface mount conduit may be used in new construction.

OUTSIDE SPEAKERS

For outdoor wiring, Liquidtite metallic conduit, EMT, or Rigid pipe may be used. Conduit sizes will be determined according to the paragraph on conduit capacities, below.

Note 1: No PVC conduit may be used in any SA/PA installation.

Note 2: No ½-inch EMT conduit shall contain more than 1 speaker cable. No other wires may be run in ½-inch EMT conduit.

Note 3: No Wiremold surface-mount conduit is permitted to be used in new construction.

CONDUIT CAPACITIES

Conduits may contain not more than the following quantities of cable, in any combinations of Belden type 8770 or type 9402:

Conduit size	Max. number of cables
½”	1
¾”	2
1”	3
1½”	6
2”	12

ANTENNA CONDUITS

A minimum 2-inch EMT conduit per cable is required for a single antenna cable. A 4-inch EMT conduit may be used to accommodate up to 3 one-half-inch antenna cables. Any 90-degree bends must be at a minimum two-foot bending radius. After any combination of 2 bends of 90 degrees, a minimum of a 24” by 24” by 6” pull box must be installed.

Note 1: All conduits shall be installed in the building as to minimize the number of bends to 4 or fewer per cable run.

Note 2: All conduit runs shall be planned and installed so as to minimize overall length.

Note 3: All conduit runs with pull boxes shall have nylon nipples installed in the pull boxes and at each end to minimize damage to the antenna cables during installation.

Note 4: All conduits shall have nylon pull string(s) installed within them.

Note 5: All antenna cables installed within the conduits shall be treated as a coiled soft copper pipe and shall be rolled off the coil or spool with great care so as to prevent kinking or crimping of the coaxial cable.

Note 6: Conduits installed outdoors shall bear the same identification Markings as indoor conduits.

Note 7: All conduit shall be installed in accordance with the current version of the National Electrical Code.

Only the following cable types are to be used:

AUDIO SYSTEM WIRING

A separate 4-conductor cable, Belden type 9402 must be run from the demarc enclosure to the volume controls of each zone as listed in Section 4. The 3-conductor cable which connects the volume controls to the speakers is to be Belden type 8770. No substitutions are permitted.

Each speaker zone, from volume control to demarc box	Belden type 9402
From volume control to speaker(s)	Belden type 8770
From Watch Office Console to demarc box	Belden type 8762

ALARM SENSOR WIRING

Digital inputs 1 & 2 from demarc box to fire alarm control panel	Belden type 6342UE (Substitution of exact equivalent Is permitted)
Digital inputs 7, 8, 9, & 10 from demarc box to generator transfer switch.	Belden 6345UE (Substitution of exact equivalent Is permitted)
Digital inputs 3, 4, 5, 6, 12 & 13 from demarc box to watch office desk-top console	Alpha 5060/20C

AUXILIARY LIGHTING WIRING

From demarc box to traffic light relay(s)	Alpha 5052C
From demarc box to lighting relays (to control dormitory lights, apparatus room lights, etc.)	Alpha 5052C

CONDUIT LABELING

All conduits feeding speakers, controls, or alarm points pertaining to station alerting shall be identified and clearly marked as specified below. All EMT conduit and FMC conduit shall be marked above ceilings every 15 feet or in each room. In any room within the station, the conduit marker must be visible above the ceiling at any point. In apparatus bays, conduits will be marked at least every 25 feet. All conduits shall be marked before and after any wall or floor penetrations. All conduits shall be marked starting at 8 feet above finished floors.

Marking will be by means of a Setmark Pipe Marker, catalog number M4068, size 10 (available from Seton at 800- 243-6624). The color is to be yellow with black letters. (yellow field, black letters/characters).

These are pre-tensioned markers that simply snap around conduits. These pipe markers will also snap around cables and bundles.

Labels shall read as follows:

"STA ALERTING/PA SYS" for the primary fire station alerting audio system.
"SEC/PA SYS" for the secondary audio system

CABLE LABELING

Alarm sensor cables shall be installed and labeled so as to be easily distinguished from audio cables. Alarm sensor wiring from the demarc box to the fire alarm control panel shall be marked "DI – 1", on both ends, 2" from the end of the cable. Alarm sensor wiring from the County demarc box to the generator transfer switch shall be marked "DI- 7", "DI-8", "DI-9", or "DI-10", as appropriate, on both ends, 2" from the end of the cable.

Alarm sensor wiring from the County demarc box to the watch office console shall be marked "Watch Office Console" on both ends, 2" from each end.

All speaker zone wiring must be labeled by zone in the County demarc box, between 2" and 8" from the end of each pair of wires.

All desktop console wiring must be labeled, both at the console and at the demarc box, between 2" and 8" from the end of each pair of wires. Microphone and scanner shielded audio cable must be labeled in the watch office and in the demarc box, between 2" and 8" from the end of each wire.

All antenna cables shall be marked at each end.

SHIELDS

The shields of all shielded cable(s) shall be insulated at each device, volume control, speaker, junction box, or cabinet. Suitable means of insulating shields are heat-shrinkable tubing or other approved, flexible, electrically insulating plastic tubing sleeved over all shields. Individual insulation of two-, three-, or four-shielded conductors within a junction box is necessary, even if all shields are to be combined. Heat-shrink tubing must also be installed at the point where the outer jacket ends and the newly cover shield begins, for no less than 1". See Drawing 13

SECONDARY RADIO ANTENNA CONDUIT

A 1-inch minimum diameter EMT conduit shall be installed from the roof to a point under the watch office counter, to terminate near the location of the desk-top console. It shall contain at least one nylon pull string.

WATCH OFFICE CONSOLE CONDUIT

A 1-inch minimum diameter EMT conduit shall be installed from a point under the watch office counter (near the secondary radio antenna conduit, described above) to the demarc cabinet. Installed in this conduit shall be one Belden type 8762 cable, with a service loop of ten foot length under the counter. In addition to this cable, the conduit shall contain a minimum of one nylon pull string.

TRAFFIC LIGHTS

If traffic signals are controlled from the fire station, a 1-inch minimum diameter EMT conduit shall be installed from the State or County traffic signal relay to the demarc cabinet. In this conduit a single Alpha type 5052C cable (2-conductor cable) shall be installed. In addition to this cable, the conduit shall contain a minimum of one nylon pull string. A 24 volt AC relay, with an activation current of not more than 2 amps, shall be provided and installed at a location to be determined by the Montgomery County project manager supervising the construction project.

BUNK ROOM LIGHTS

If the station bunk room(s) has or have or will have lighting to be activated when the station receives an alert, the following specifications apply to each applicable lighting circuit. The lights shall be activated by means of a 24-volt AC relay, whose coil shall draw not more than 2 amps. The pair of wires to activate the relay shall be contained in a 1-inch minimum diameter EMT conduit, which shall also contain a minimum of one nylon pull string. If more than one lighting circuit is to be controlled from a single contact pair in the demarc cabinet, the sum of the activation currents for those lighting circuit relays shall not total more than 2 amps.

GENERAL LIGHTING

Where applicable, all engine rooms (apparatus bays), hallways and common areas, and other areas of the station where automatic control of lighting by the alerting system is deemed appropriate, control wiring and conduits shall be installed and connected following the same specifications as given above, for bunk room lights.

LOUDSPEAKERS

All ceiling-mounted loudspeakers shall be installed in drop ceiling tiles, where drop ceilings exist, and installed as specified in Sections 3 and 4. Drop ceiling mounted speakers shall be neatly installed in ceiling tiles with a metal speaker can on the top side of the ceiling tile. The speaker shall be fed by flexible (Greenfield) electro metallic tubing conduit of at least a 3 foot length, connected to a ceiling-mounted type 1900 junction box. The speaker back can shall be secured by means of a hanger wire, minimum 14-guage, from the suspension tab of the can to a solid structure above.

VOLUME CONTROLS

All volume controls shall be installed in deep, type 1900 or type 11B boxes with 1-inch knock-outs. These boxes shall each be fed with two one-inch EMT conduits. These boxes shall be supplied with Raco type 778 (or equivalent) two-device raised mud rings.

All wall-mounted volume controls shall be mounted at the standard height of a normal wall-mounted light switch. They shall be installed immediately to the left of the room’s light switch, as you enter a room where the light switch is to the right side of the doorway, as you enter. They shall be installed immediately to the right of the room’s light switch, as you enter a room where the light switch is to the left side of the doorway, as you enter. If it is impractical to locate the volume control in this location, the Montgomery County project manager in charge of the work may approve an alternate location. Such approval shall be in writing.

All volume controls shall be fed by conduit of minimum diameter of one inch, the other end of which shall connect to the demarc cabinet.

APPARATUS BAY/ENGINE ROOM SPEAKERS

Apparatus bays shall have a minimum of two speakers. In most situations four to six speakers will be required. The exact number of speakers required will be dictated by the floor area, the height of the space, and other environmental factors. The determination of the number of speakers required will be made by a contractor experienced in the placement of loudspeakers in apparatus rooms of fire/rescue stations, and will be approved by the Montgomery County project manager supervising the construction project.

EXTERIOR SPEAKERS

All horn-mounted speakers on the exterior of a building shall be mounted a minimum of 8 feet off the ground. Speakers shall be mounted to a blank two-gang cover plate and attached to a two-gang box, either externally mounted or counter-sunk in the outside wall of the building. This box is to be fed by 1-inch diameter conduit from the volume control.

SHIELDS AND GROUNDS

All speaker wires and cables shall be shielded as follows.

Cables from the demarc to volume controls: the outer jackets and shields shall be stripped back a minimum of 6 inches from the end of the cable. All bare shields shall be insulated to within ½ inch of the end of the conductor.

In the wiring of the SA/PA system, shields ARE NOT TO BE CONSIDERED AS GROUND CONDUCTORS. They are to be considered as conductors that are used to reduce excess cross-talk due to inductance between adjacent or parallel lines in the same pipe or when bunched together in the same confined space (such as conduits and cabinets).

In the cables from the demarc to the volume control and from the volume control to the speakers, the shields shall be treated as shown in Drawing 11. The shields are to be kept insulated from the metallic conduit or box. A service loop of approximately 8” is to be provided. At the speaker end of a single cable from a volume control to a single speaker, the shield is to be trimmed back, cut off to a length of approximately 12 inches, and insulated. In the case where there is a second cable being fed in parallel from that speaker’s enclosure, the shield will not be cut off. Instead it is to be trimmed as above, connected to the shield of the 2-conductor cable feeding the next speaker, etc. At the end or last speaker, the shield is to be trimmed back, cut off, and insulated as described above. A service loop of approximately 12 inches shall be left in the speaker enclosures.

Only shrink tubing of the proper size is to be used for insulating the shields. The use of electrical or other tape is not permitted.

Section 6
Watch Office Console

The watch office console is a custom-built device which permits the fire rescue personnel to initiate an in-house fire/EMS dispatch alarm. If, for example, a citizen walks into the fire-rescue station and needs emergency assistance, personnel within the station can manually initiate a local emergency alarm. They can also make a local announcement of the nature of the situation.

The console will provide a series of pushbuttons as shown in Drawing 12. These pushbuttons will provide the capability of manually initiating the following alarm sequences:

Fire
BLS (Basic Life Support)
ALS (Advanced Life Support)
Duty Officer

The console will also provide two buttons which can be connected to control up to two traffic light signals, independent of each other.

The pushbuttons of the Watch Office Console are color-coded, for ease of identification and use, as follows:

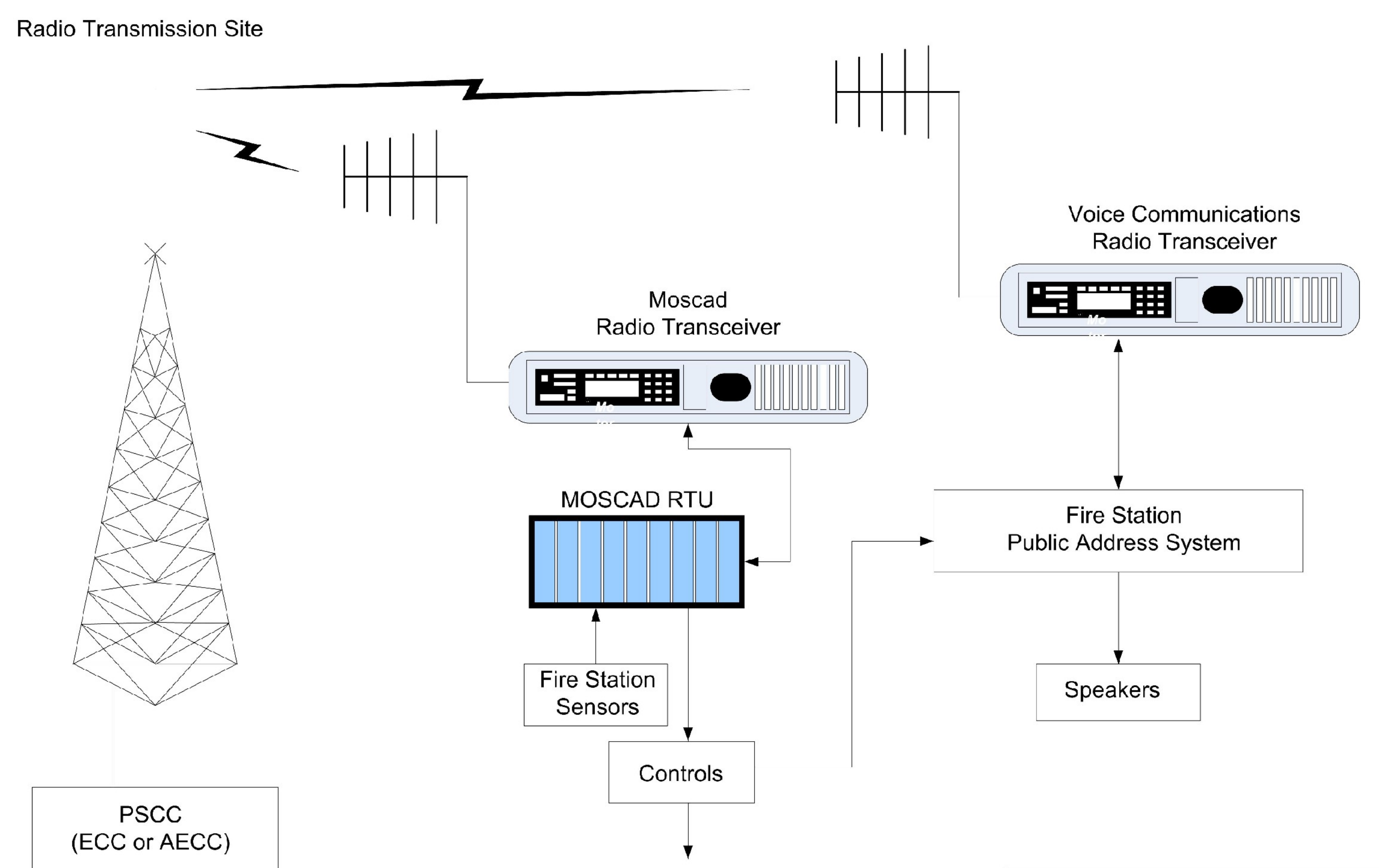
Fire	Red
BLS	Blue
ALS	Yellow
Duty officer	White
Traffic control(s)	Black

Along with the manual pushbuttons, a voice handset is to provide a means to make voice announcements over the SAPA system. This handset shall employ a push-to-talk (PTT) switch to disable this microphone when not in use. An additional relay disables the watch office speaker zone, thus preventing audio feedback during a local announcement.

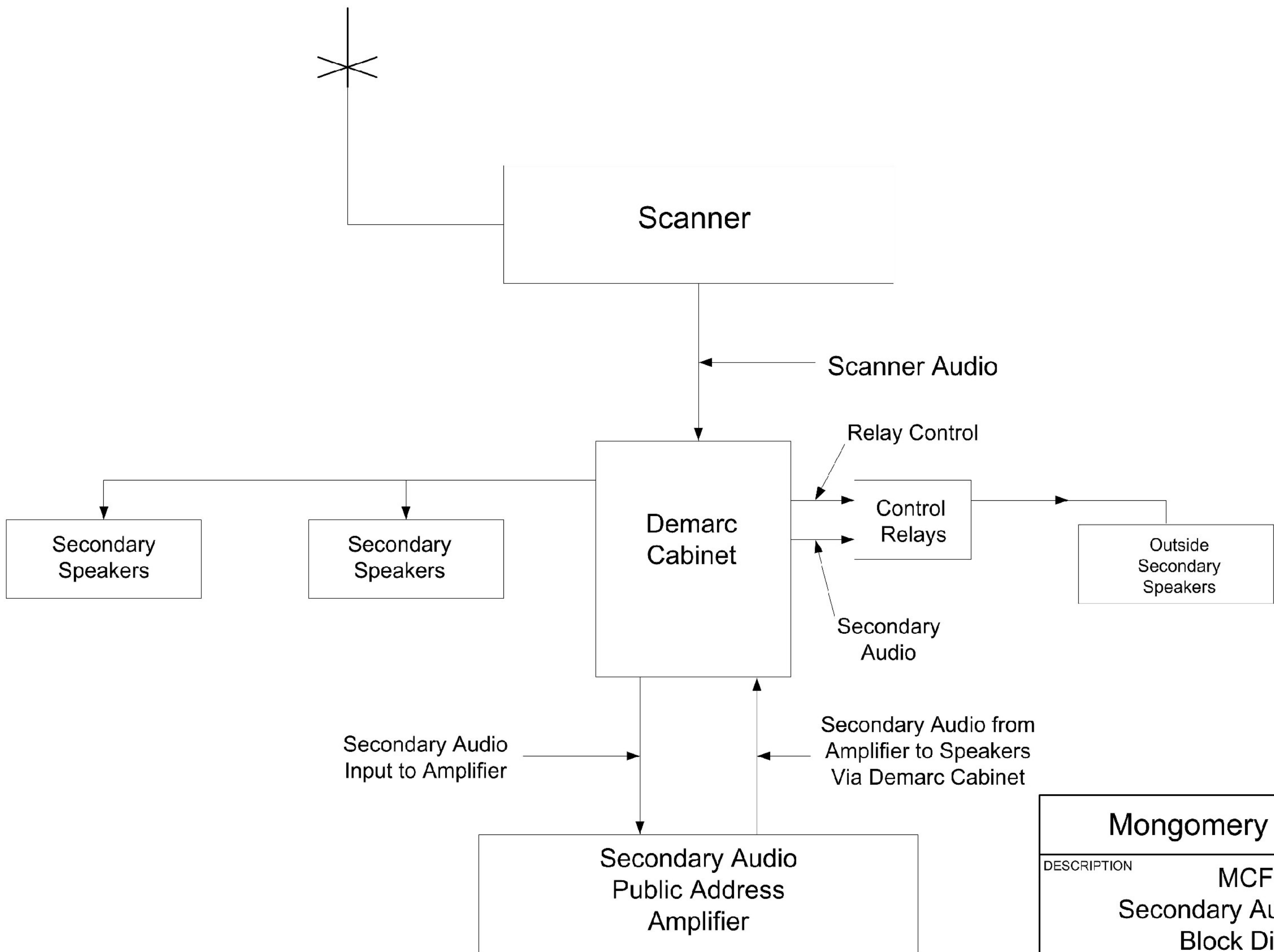
The Watch Office Console sends voice audio via a 4 pin Amphenol connector, part number 206060-1, and a 2-conductor shielded microphone cable, Belden part number 8762, via the demarc cabinet to the PA amplifier located within the Central Electronics Cabinet. The Watch Office Console also sends receives 24 volts DC, and then sends switched 24 volts DC from its PTT and function buttons, via an Amphenol 24-pin connector, part number 206837-1, and a 20-conductor cable, Alpha part number 5060/20C, back via the demarc cabinet to the Central Electronics Cabinet.

The cables described above are to be installed in a conduit of not less than 2 inches diameter EMT. The conduits shall be run from a point under the counter or desk in the watch office to the demarc cabinet. The wires of this cable will be terminated on terminal block TBE inside the demarc cabinet. (See: Drawing 6.) Under the watch office counter/desk, there shall be a service loop of not less 10 feet of both the microphone and control cables.

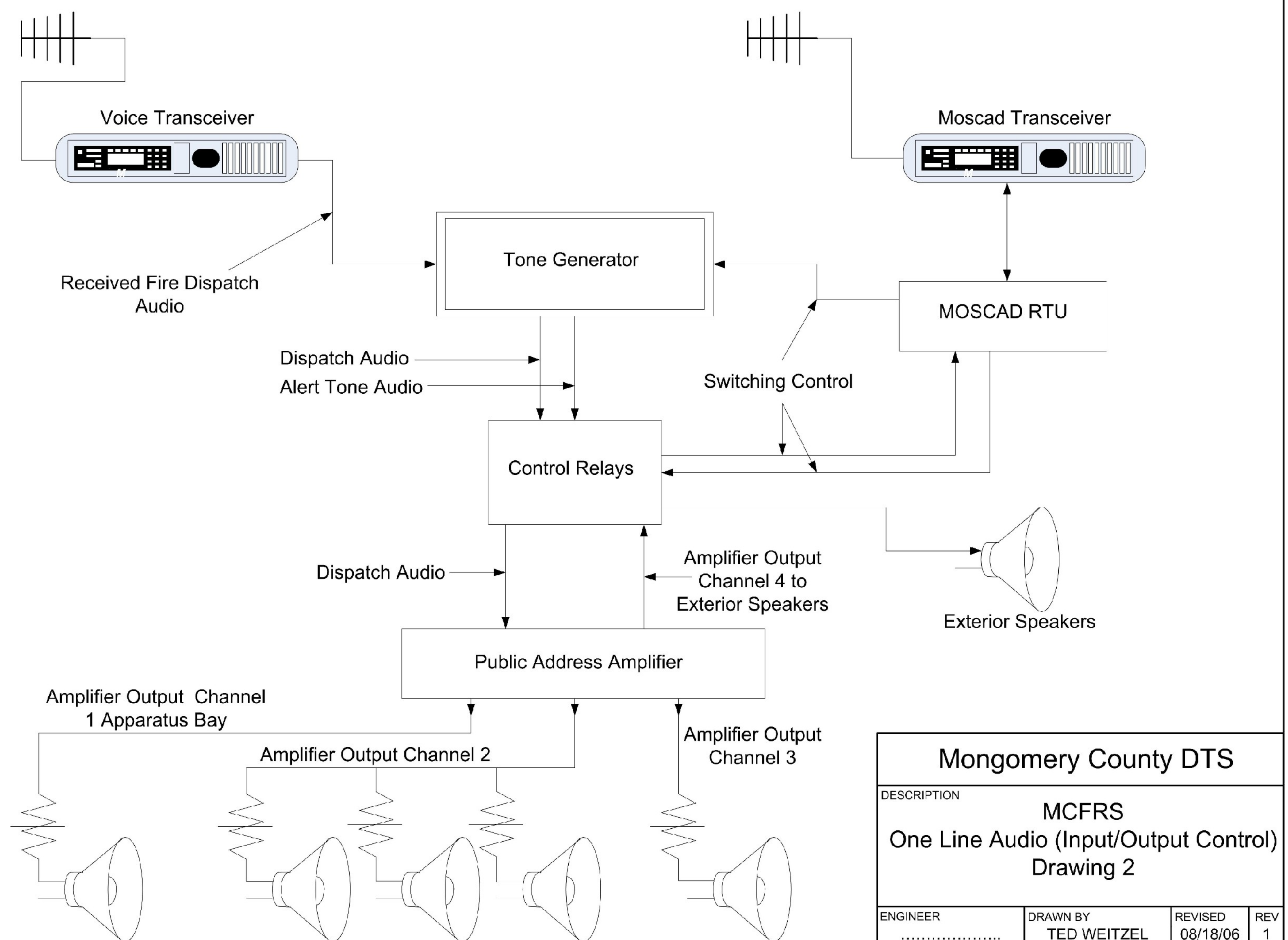
Section 7
Drawings



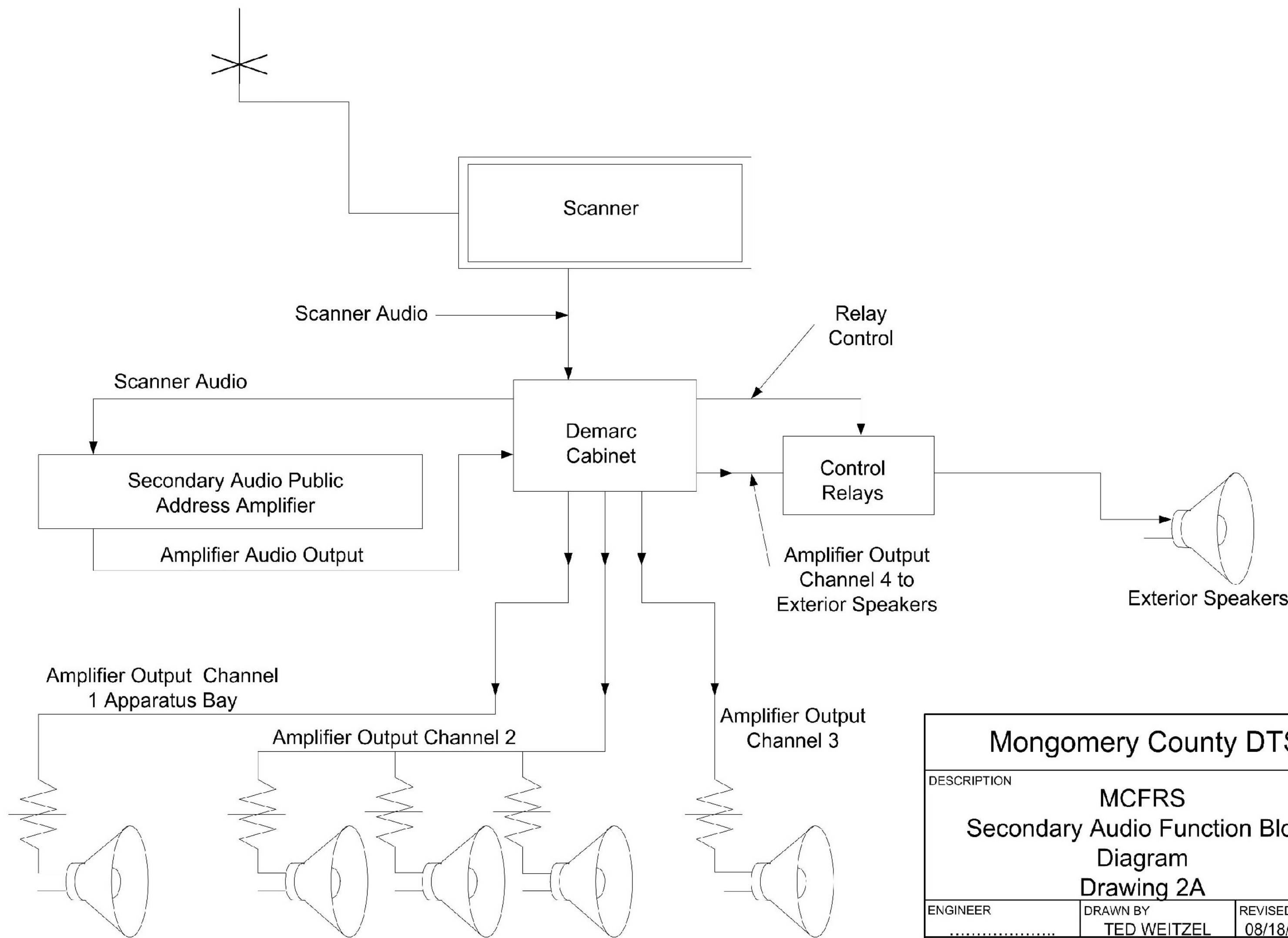
Montgomery County DTS			
DESCRIPTION MCFRS Functional Block Diagram of Fire Station Alerting and Public Address System Drawing 1			
ENGINEER	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 1
FILENAME MONTGOMERY COUNTY DRAWING 1.VSD		SCALE NONE	SIZE A



Mongomery County DTS			
DESCRIPTION MCFRS Secondary Audio System Block Diagram Drawing 1A			
ENGINEER	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV A
FILENAME MONTGOMERY COUNTY DRAWING 1A.VSD		SCALE NONE	SIZE A

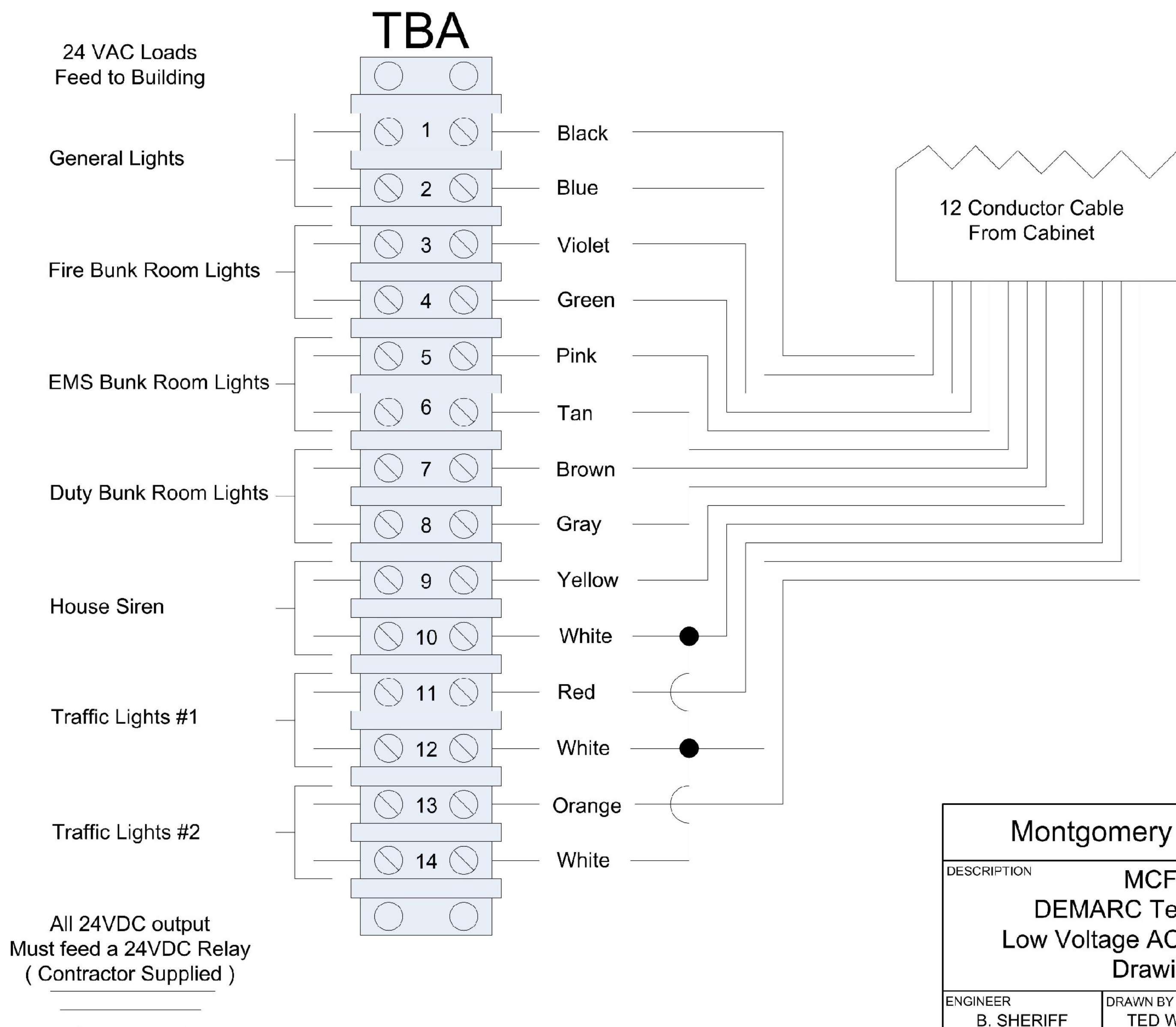


Mongomery County DTS			
DESCRIPTION MCFRS One Line Audio (Input/Output Control) Drawing 2			
ENGINEER	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 1
FILENAME MONTGOMERY COUNTY DRAWING 2.VSD		SCALE NONE	SIZE A

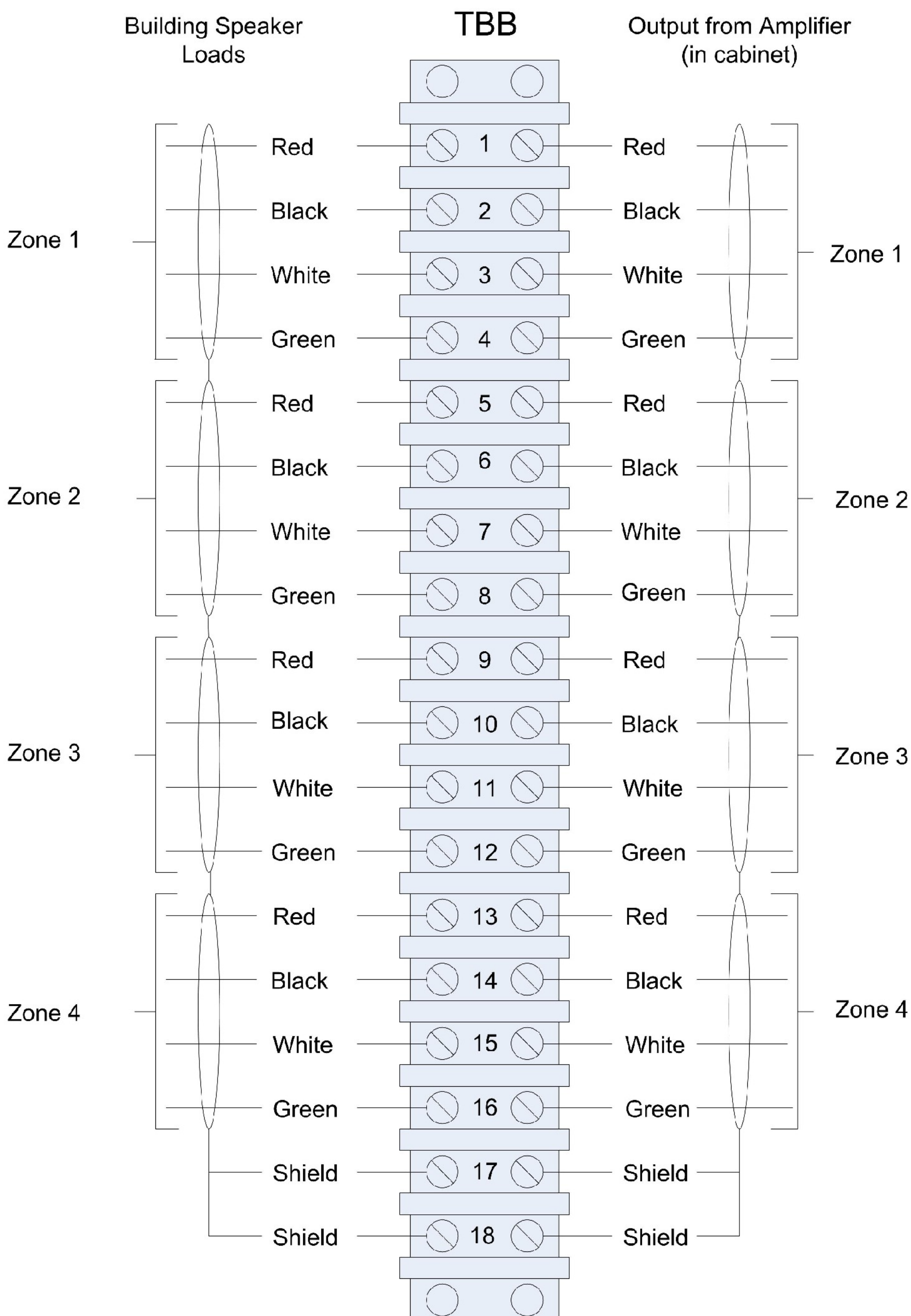


Mongomery County DTS

DESCRIPTION MCFRS Secondary Audio Function Block Diagram Drawing 2A			
ENGINEER	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 1
FILENAME MONTGOMERY COUNTY DRAWING 2A.VSD		SCALE NONE	SIZE A



Montgomery County DTS			
DESCRIPTION MCFRS DEMARC Terminal TBA Low Voltage AC Relay Output Drawing 3			
ENGINEER B. SHERIFF	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 1
FILENAME MONTGOMERY COUNTY DRAWING 3.VSD		SCALE NONE	SIZE A

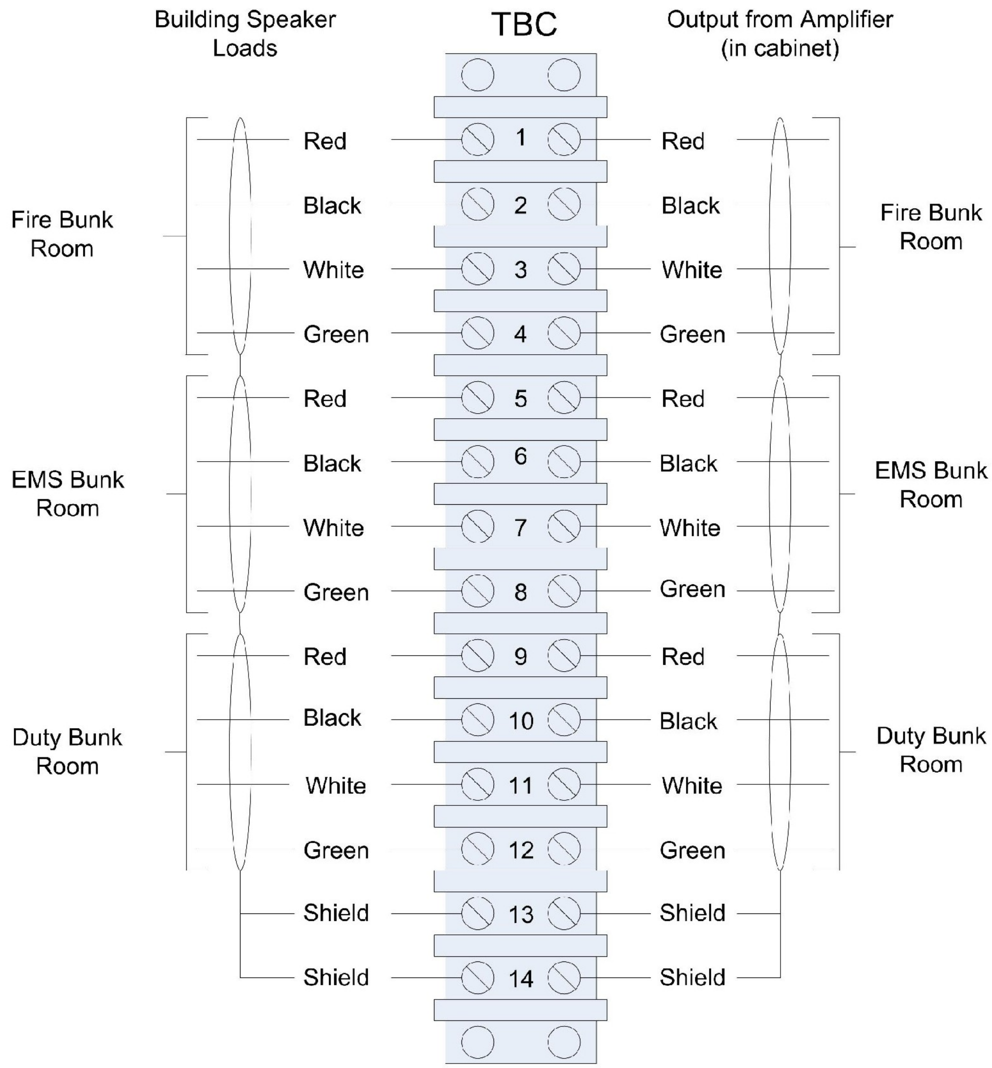


Note 1: All shields are to be Insulated

Note 2: Zone 4 to be used for Outside Speakers Only!!

Volume Control
- 70 volt line — Red + / Black - — Feed from Amp. — TBB
- Relay — White + / Green - — Feed from Shelf — TBB

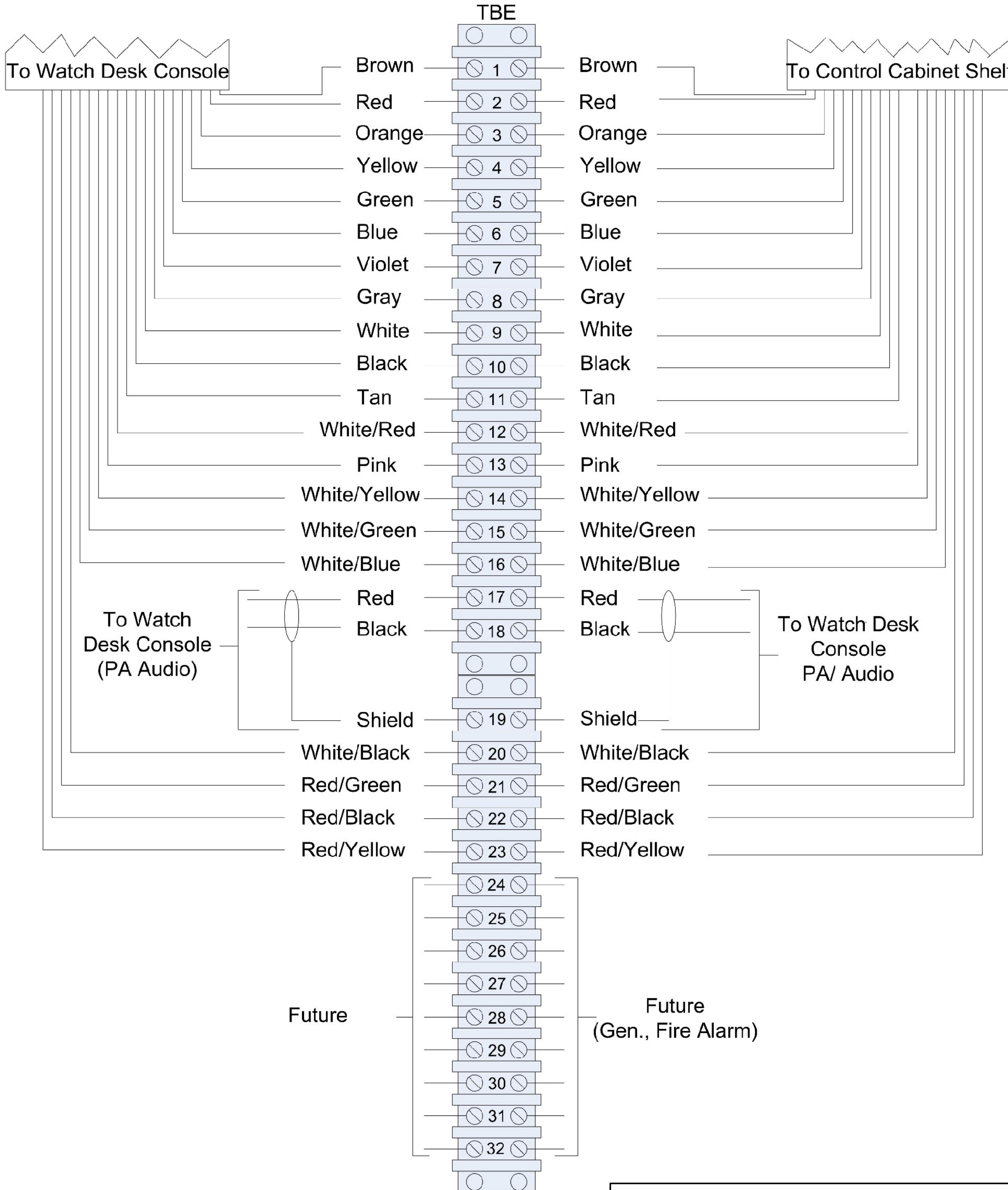
Montgomery County DTS			
DESCRIPTION: MCFRS DEMARC Terminal TBB Fire Station Alerting Speaker Zones 1- 4 Drawing 4			
ENGINEER: B. SHERIFF	DRAWN BY: TED WEITZEL	REVISED: 08/18/06	REV: 1
FILENAME: Montgomery County Drawing 4		SCALE: NONE	SIZE: A



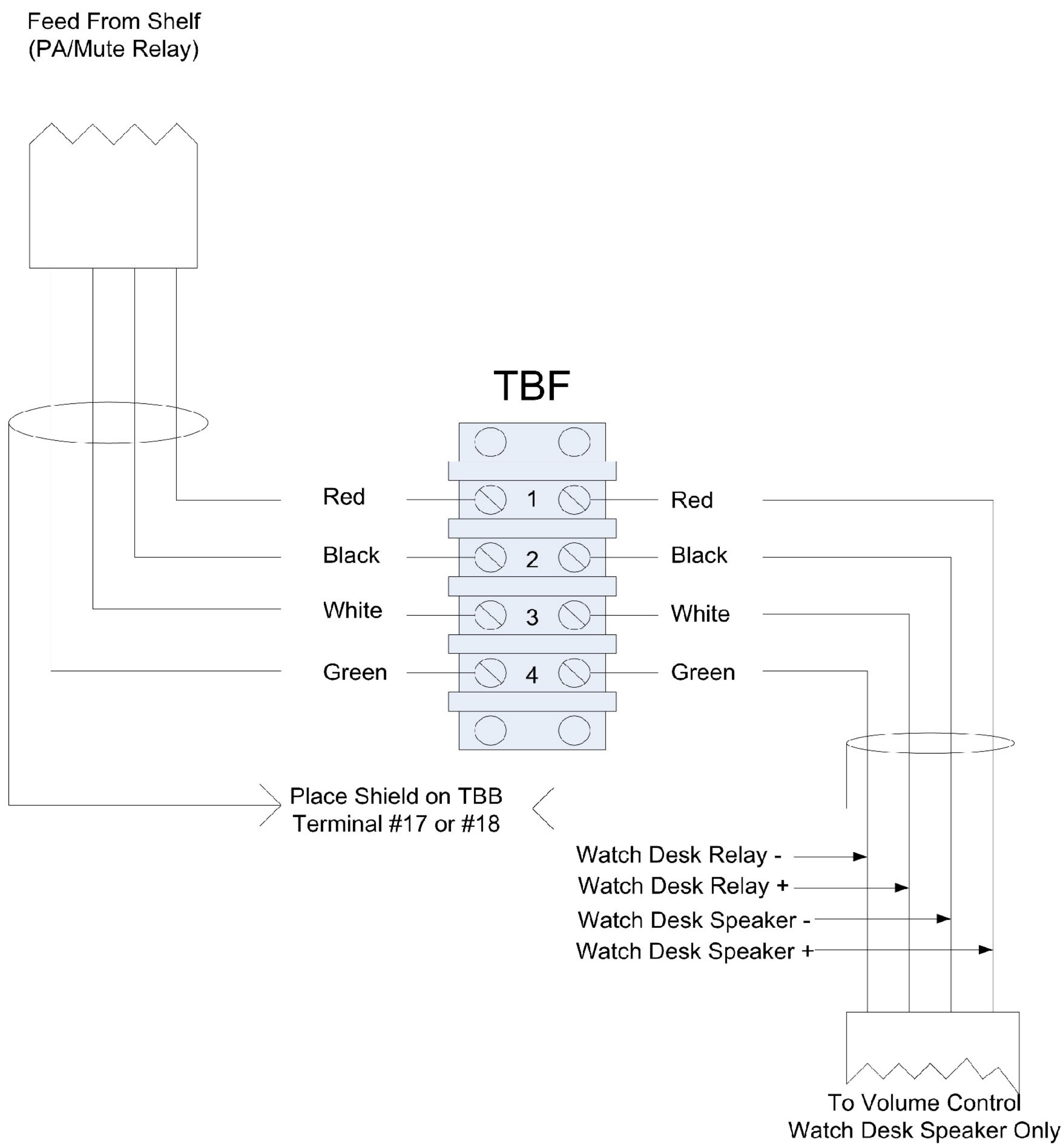
Note 1: All shields are to be Insulated

Note 2: The above speaker feeds are to be used when there are separate bunk rooms.

Montgomery County DTS			
DESCRIPTION MCFRS DEMARC Terminal TBC Fire Station Alerting Bunk Room Speakers Drawing 5			
ENGINEER B. SHERIFF	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 1
FILENAME Montgomery County Drawing 5		SCALE NONE	SIZE A



Montgomery County DTS			
DESCRIPTION MCFRS DEMARC Terminal TBE Watch Office Console/ Moscad Digital Inputs Drawing 6			
ENGINEER B. SHERIFF	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 1
FILENAME Montgomery County Drawing 6		SCALE NONE	SIZE A

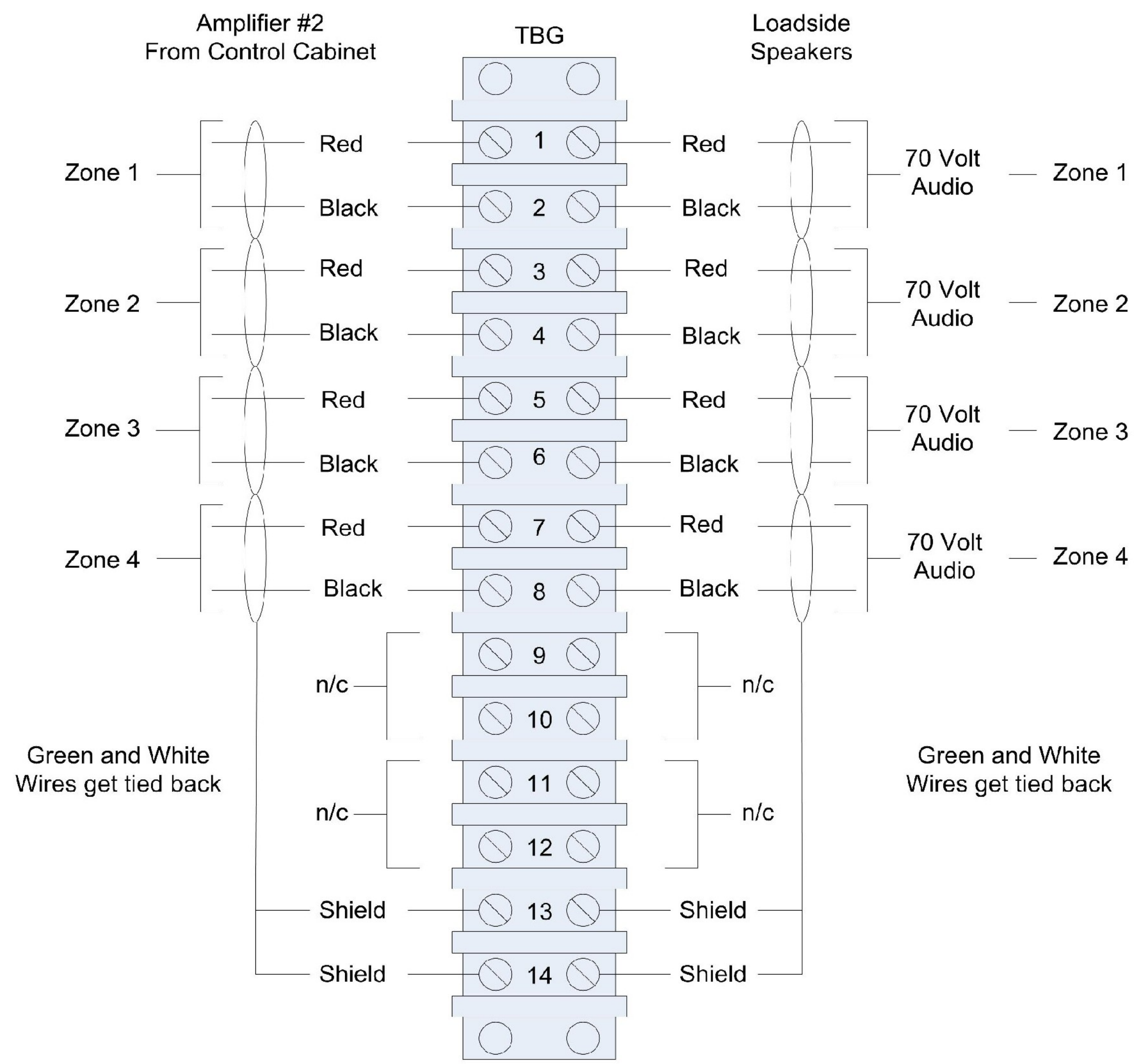


Montgomery County DTS

DESCRIPTION

MCFRS
DEMARC Terminal TBF
Watch Office Speaker Muting
Drawing 7

ENGINEER	DRAWN BY	REVISED	REV
B. SHERIFF	TED WEITZEL	08/18/06	1
FILENAME Montgomery County Drawing 7.vsd		SCALE NONE	SIZE A



TBG is for second speaker system
Scanner Speaker

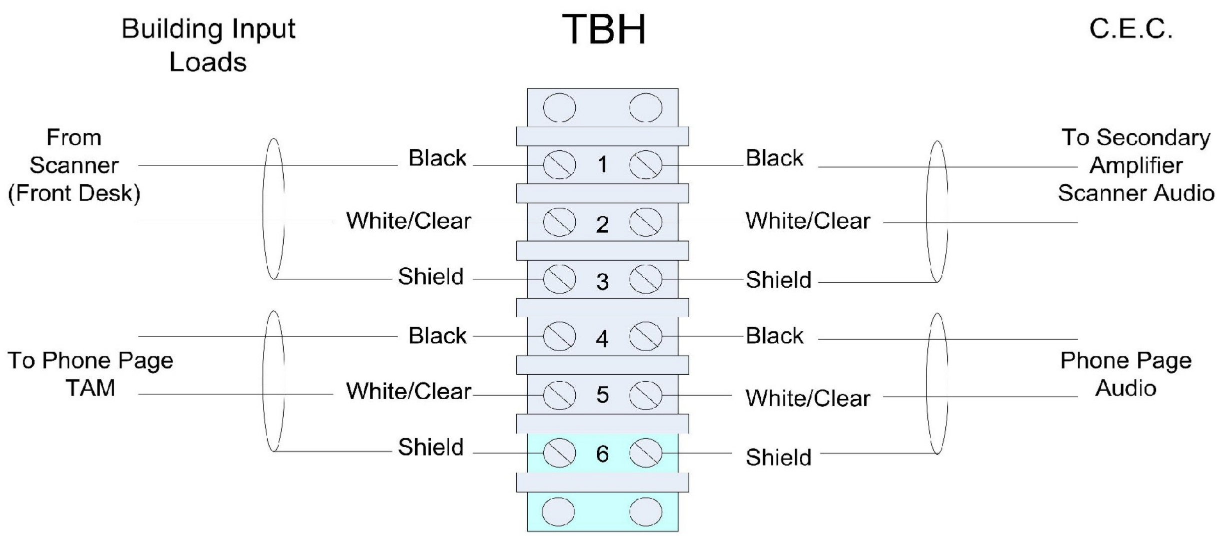
Zone 1 Engine room speaker

Zone 2 Inside speakers

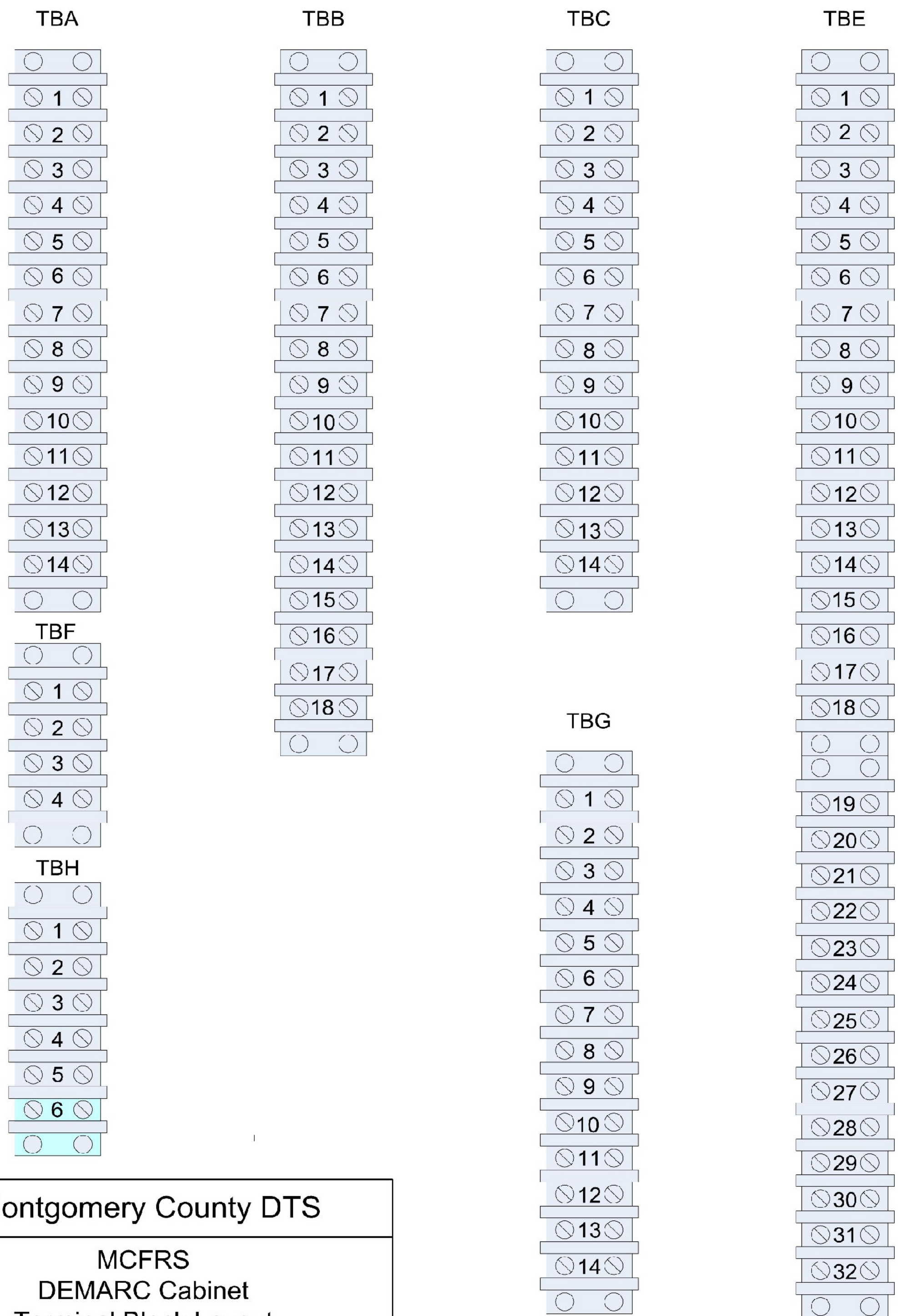
Zone 3 Inside speakers

Zone 4 Outside speakers only

Montgomery County DTS			
DESCRIPTION MCFRS DEMARC Terminal TBG Secondary Audio System Speaker Drawing 8			
ENGINEER B.SHERIFF	DRAWN BY TED WEITZEL	REVISED 08/21/06	REV 1
FILENAME Montgomery County Drawing 8.VSD		SCALE NONE	SIZE A

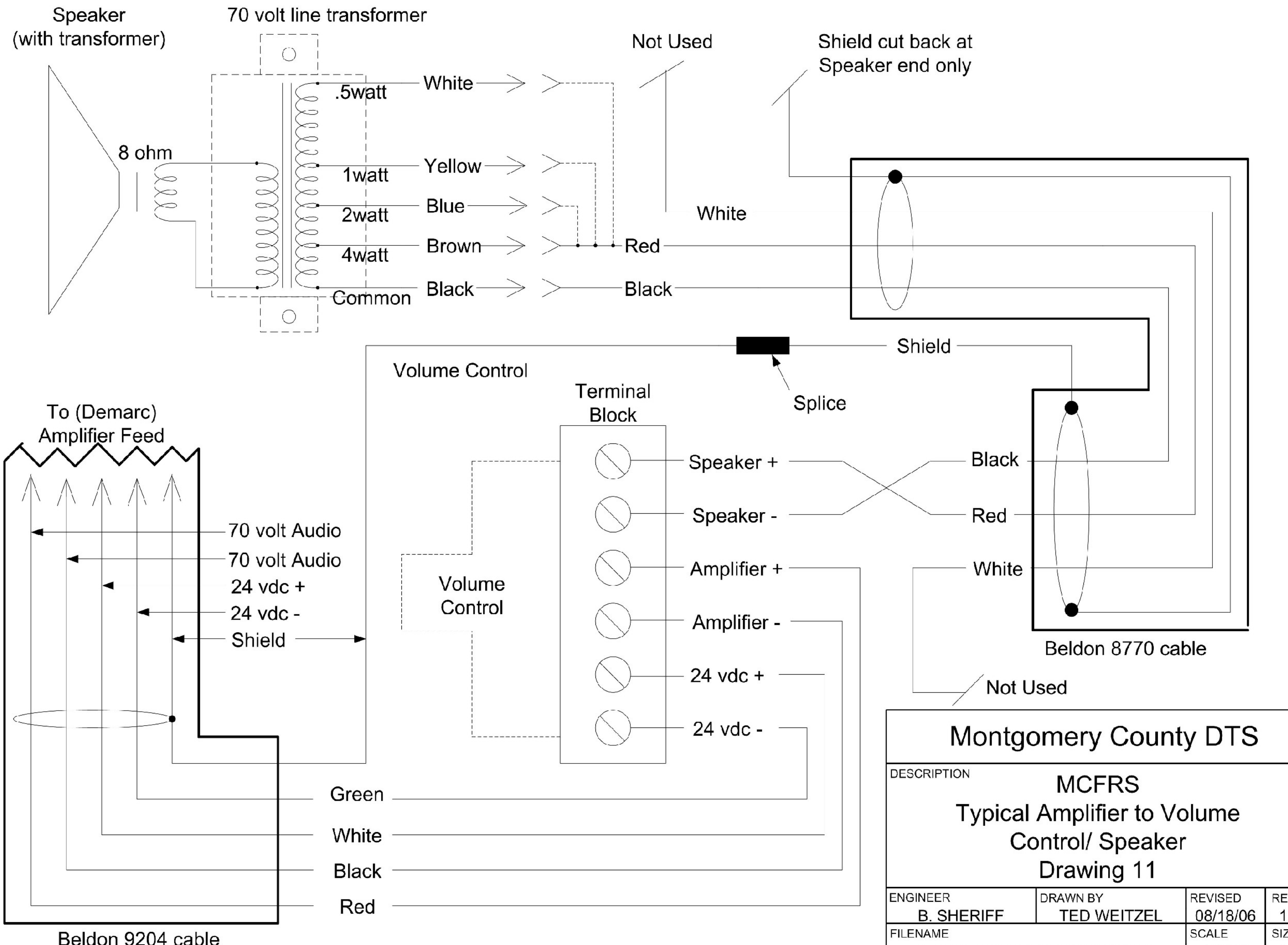


Montgomery County DTS			
DESCRIPTION: MCFRS DEMARC Terminal TBH Secondary Audio System Scanner/PhonePage Inputs Drawing 9			
ENGINEER B. SHERIFF	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 1
FILENAME Montgomery County Drawing 9.VSD		SCALE NONE	SIZE A

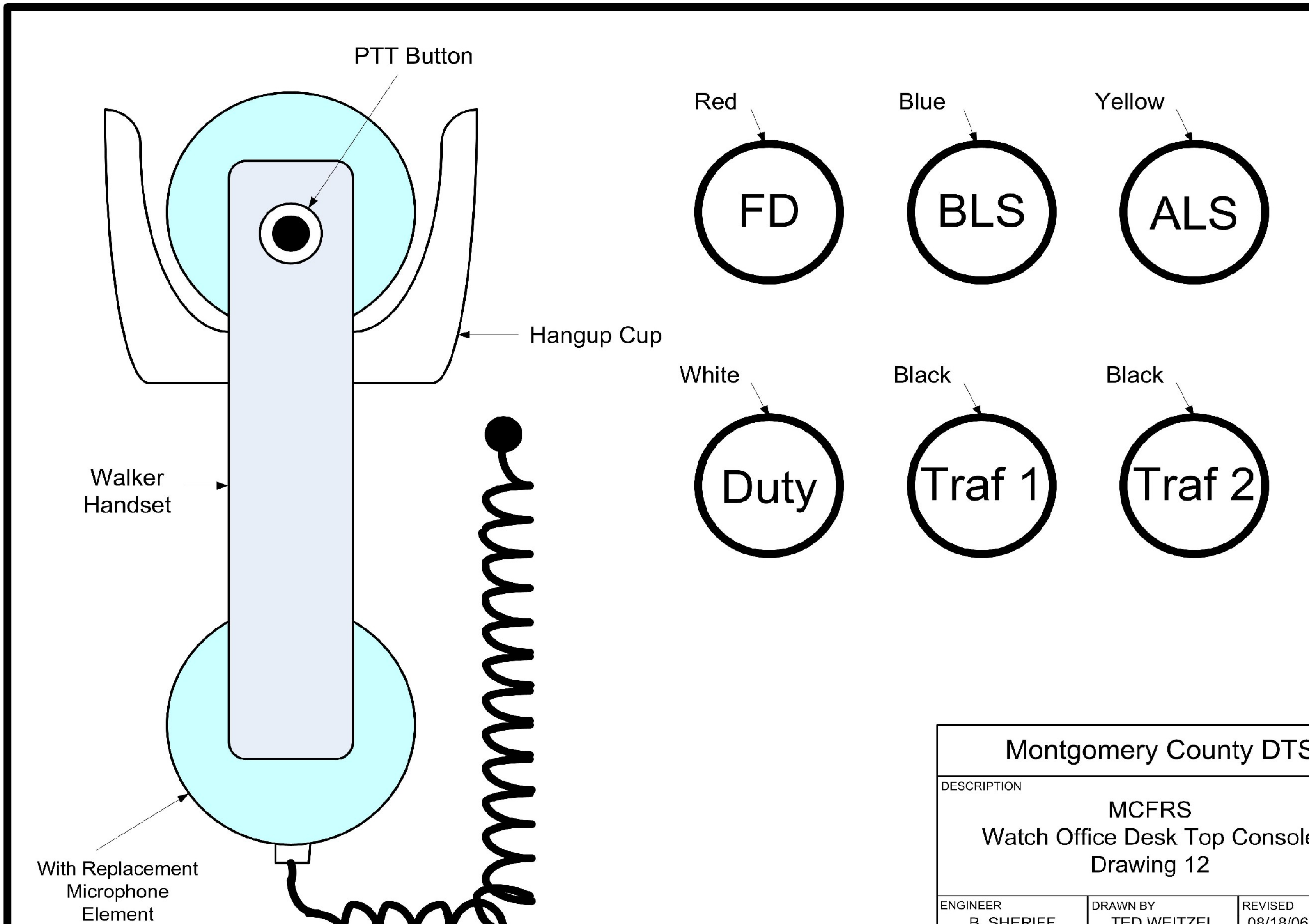


Montgomery County DTS

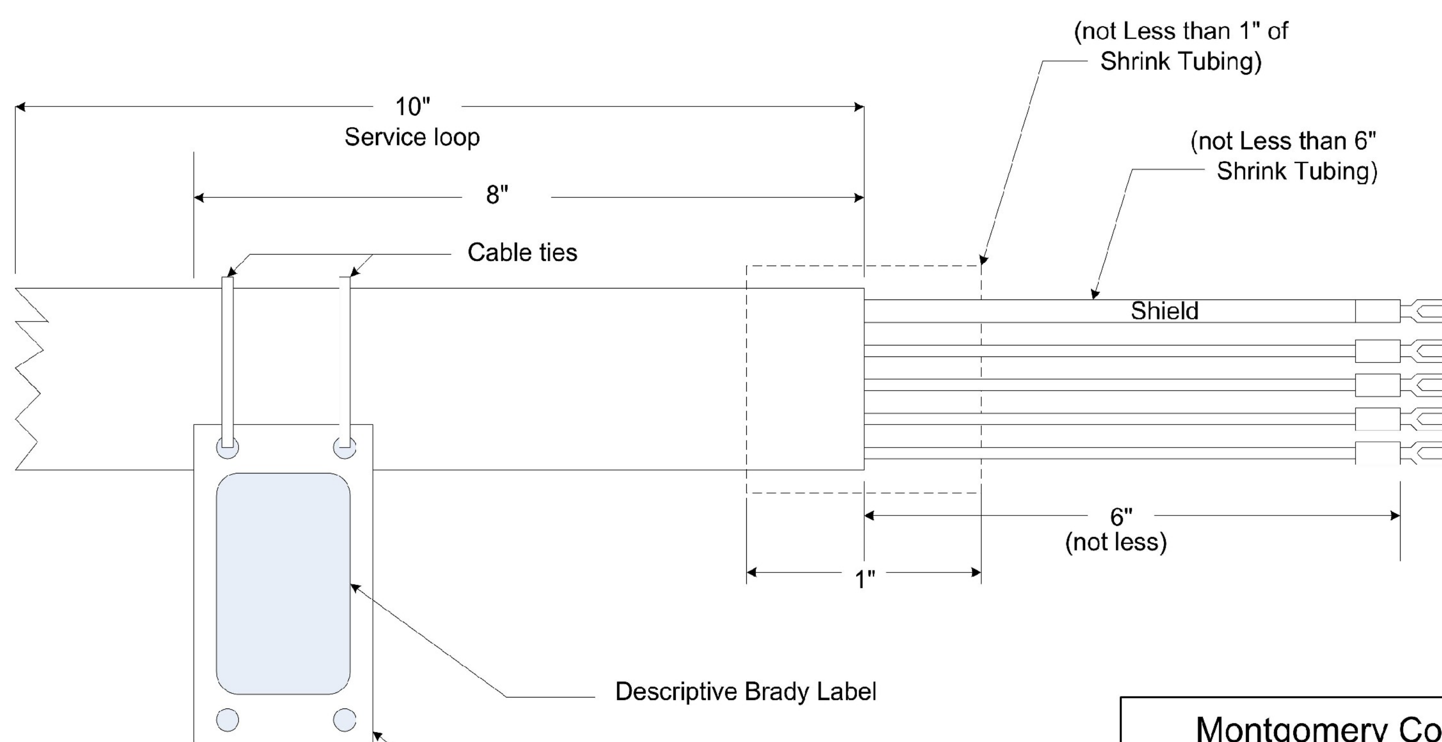
DESCRIPTION MCFRS DEMARC Cabinet Terminal Block Layout Drawing 10			
ENGINEER B. SHERIFF	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 1
FILENAME MONTGOMERY COUNTY DRAWING 10.VSD		SCALE NONE	SIZE A



Montgomery County DTS			
DESCRIPTION MCFRS Typical Amplifier to Volume Control/ Speaker Drawing 11			
ENGINEER B. SHERIFF	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 1
FILENAME MONTGOMERY COUNTY DRAWING 11.VSD		SCALE NONE	SIZE A



Montgomery County DTS			
DESCRIPTION MCFRS Watch Office Desk Top Console Drawing 12			
ENGINEER B. SHERIFF	DRAWN BY TED WEITZEL	REVISED 08/18/06	REV 5
FILENAME MONTGOMERY COUNTY DRAWING 12.VSD		SCALE NONE	SIZE A

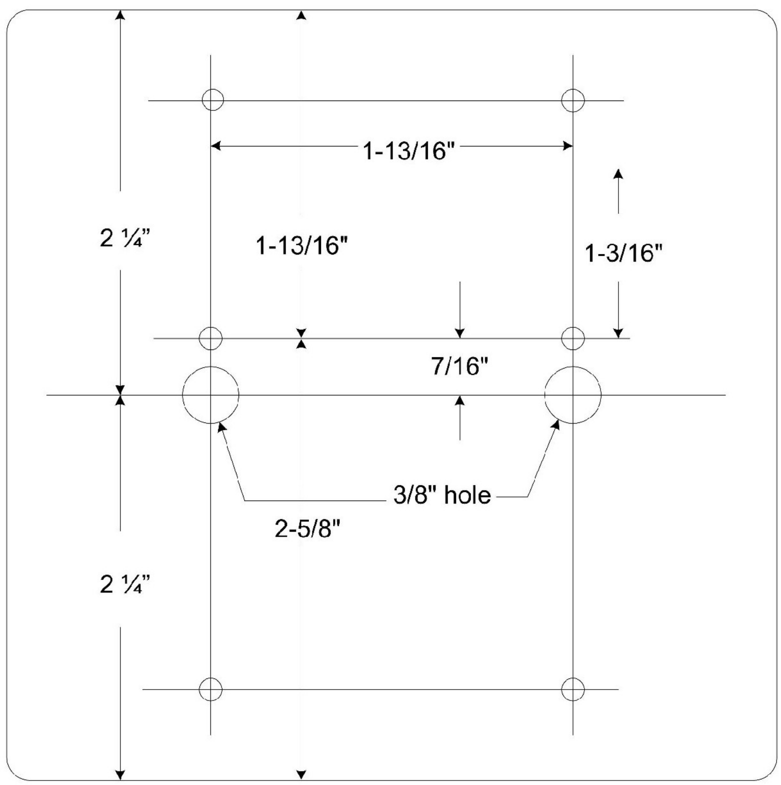


Montgomery County DTS

DESCRIPTION

MCFRS
DEMARC Cabinet
Cable End Detail
Drawing 13

ENGINEER	DRAWN BY	REVISED	REV
B. SHERIFF	TED WEITZEL	08/16/06	1
FILENAME		SCALE	SIZE
MONTGOMERY COUNTY DRAWING 13.VSD		NONE	A

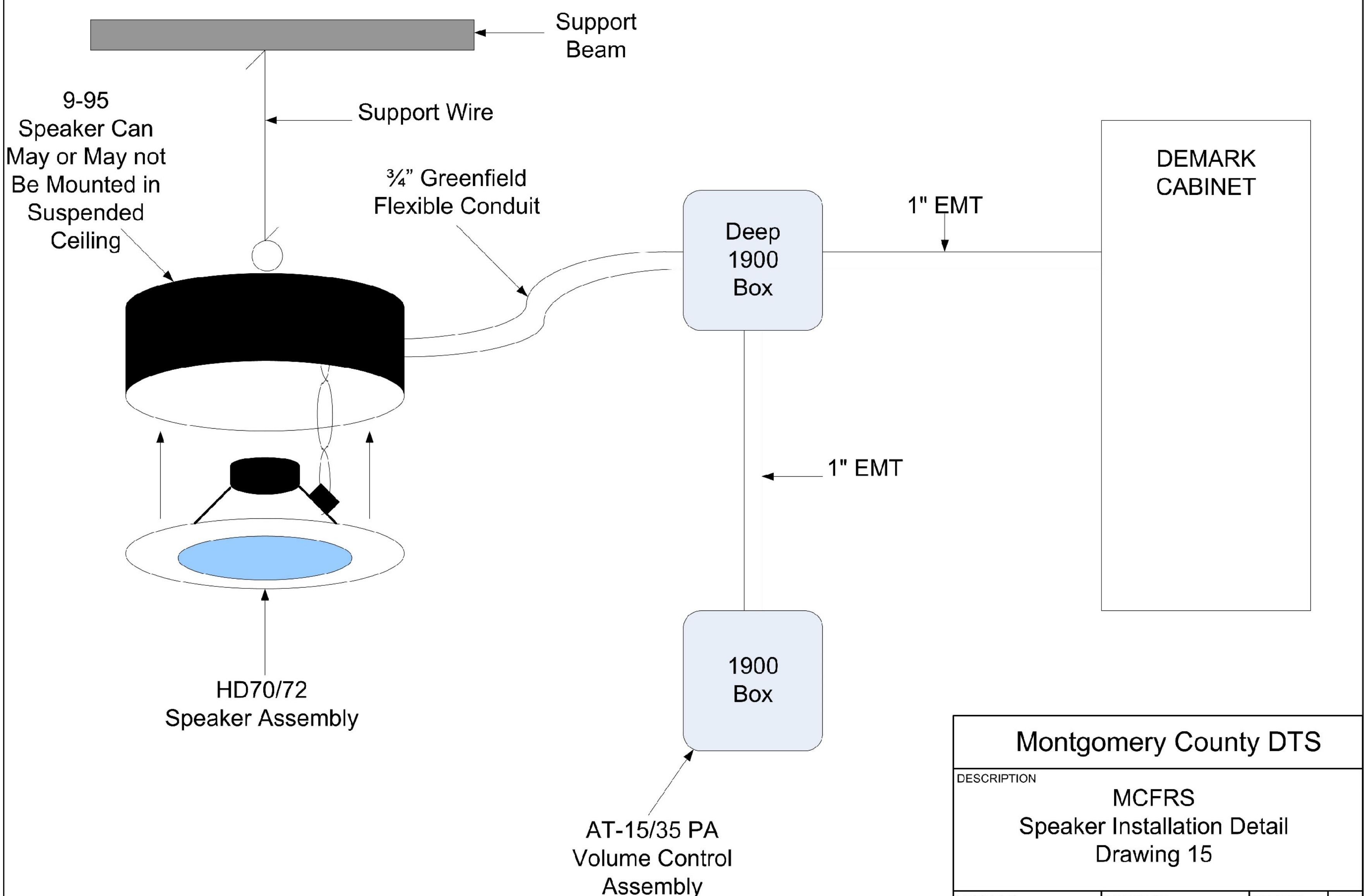


Blank Two Gang Stainless
Marbury# 97152

0 MAIN 10   0 SCAN 10

Label 3" x 3/8"
Not less than ¼” type

Montgomery County DTS			
DESCRIPTION MCFRS Dual Volume Control Plate Drawing 14			
ENGINEER B. SHERIFF	DRAWN BY TED WEITZEL	REVISED 08/21/06	REV 1
FILENAME Montgomery County Drawing 14		SCALE NONE	SIZE A



Montgomery County DTS			
DESCRIPTION MCFRS Speaker Installation Detail Drawing 15			
ENGINEER	DRAWN BY TED WEITZEL	REVISED 08/17/06	REV 1
FILENAME MONTGOMERY COUNTY DRAWING 15.VSD		SCALE NONE	SIZE A

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