

AMERICAN UNIVERSITY DESIGN STANDARDS





AMERICAN UNIVERSITY

W A S H I N G T O N, D C

MEMORANDUM

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PLANNING PROJECT MANAGEMENT

DATE: AUGUST 31, 2018

INTRODUCTION

The standards set forth in these documents are intended to serve as design and construction standard guidelines for American University. As such, they reflect the planning, design, construction, and maintenance expertise of University personnel. The standards have been compiled and edited by the Department of Planning and Project Management and Facilities Management within the Office of Finance and Treasurer.

As standards for the University, this information is to be applied to renovation and new construction from the very first planning and design stages through actual construction and facilities maintenance and management. The information included within each standard section contains procedures to be followed, materials to be used, or design guidelines that we at American University have found to be appropriate to assure the quality desired at the University now and through our future maintenance of these facilities. Personnel within the University, as well as outside architects, consultants, and contractors should become familiar with these standards.

American University uses its best efforts to promulgate standards for the benefit of those parties involved in providing services to American University in light of available information and accepted industry practices. American University does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with American University standards, or that any tests conducted under its standards will be non-hazardous or free from risk.

SCOPE OF THE STANDARDS

The standards included herein shall serve as a basis for a code of quality for all campus-wide design, construction, and maintenance procedures. The level of quality deemed by any one standard is determined on the basis of reliability, serviceability, safety, and cost (including design, construction,

inventory, operating, and maintenance costs). The information contained in these standards is not specific to any one project, but common to all projects. As the University constructs a wide range of facilities, these standards must be adjusted to meet specific project needs. These standards establish a baseline of quality and it is American University's expectation that deviations from these standards will be discussed with the University throughout the design process. If the designer does not bring forward suggested deviations from the Design and Construction Standards, drawings will be reviewed for conformance.

STANDARDS VERSUS SPECIFICATIONS

Standards shall form the basis from which to create specifications. All of the concepts and procedures included are for the use of designers and consultants. The use and inclusion of these standards in bid documents does not relieve the consultant or architect of the responsibility and legal liability for any bid documents created from these standards.

A DYNAMIC DOCUMENT

Standards from all areas of design and construction are continually being developed. As changes and new sections are ready for inclusion, changes shall be made. This document will never be published, but remains a "living" document keeping abreast of new and better procedures or materials as we become aware of them.

AVAILABILITY

These standards were developed and are maintained by the Department of Facilities Management, Osborn Building, American University, Washington, DC 20016. We appreciate any feedback you would like to give on the content of the standards or its format.



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Individual pdf versions of the contents are located in the tabbed sections at www.american.edu/standards.

Archived Documents (prior versions of the AU Design and Construction Standards) and the Standards Change Request form are available in the tabbed sections of the main web page www.american.edu/standards.



American University Design Standards Committee

The American University Design (AUDS) Committee is a multidisciplinary body of staff established to promulgate guidelines that communicate AU's requirements to persons who perform, manage, or coordinate work for the university. The Committee meets monthly to process recommendations for addition or deletion of acceptable products.

Access the latest approved version of the American University Design Standards at www.american.edu/standards.

Design Standards Committee Members - 2019

Name	Department Title
Juan Allen	Facilities Management Energy Conservation & Efficiency Manager
Denis Cofer	Technical Operations Communications Service Manager
Barrett Johnson	Facilities Management Electrical and Life Safety Manager/Master Electrician
Eddy Peng	Facilities Management Building Automation Supervisor
David Osborne	Facilities Management Director, Energy and Engineering
Paula McGee	Facilities Management Assistant Director, Facilities Maintenance Operations
Darlene Dunham	Facilities Management Material Supply Manager
Curtis Drew (Meeting Chair)	Facilities Management Commissioning & Acceptance Manager
William Flint	University Safety and Security Services Director, Emergency Preparation & Global Safety
Schyler Asman	Housing and Residence Life Associate Director, Residential Facilities
Brian Blair	Procurement and Contracts and Contracts Sr. Director Procurement
Vacant	Planning and Project Management Director, Planning & Project Development
Kristine Hesse	Planning and Project Management Facility & Campus Planner
Doug Pierce	University Safety and Security Services



Leanne Wright	University Safety and Security Services Assistant Director, Environmental Health & Safety
Doug Fairley	Facilities Management Capital Renewal & Deferred Maintenance Manager
Joseph van Story	Facilities Management Director, Facilities Management
Tony Cortes (Committee Chair)	Facilities Management Sr. Operations Manager
Michael Mastroda	Facilities Management Arboretum Manager/Landscape Architect
Stephen Kriesten	Facilities Management Planned Maintenance Manager
Megan Zanella-Litke	Office of Sustainability Director, Sustainability Programs

Administrative Oversight

Facilities Management	Planning and Project Management
AVP Vincent Harkins	AVP David Dower



PREFACE

The American University provides the Design Standards, a guide for Consultants, to assist in meeting the expectations of the University for professional design and construction services. It is our intention that this publication assists with your efforts and better enables you to be responsive to our needs and to fulfill our mission and achieve our goals.

The American University Design standards are for your benefit and ours, to clarify expectations for design and construction services. Although we believe it is comprehensive in scope, we do not claim that it covers every aspect of the professional services required or as elaborated in the engagement agreement.

These guidelines do not change your professional and legal responsibility to provide to American University with the highest quality design for the project. Please feel free at any time to contact us concerning this guideline as the University wants to ensure that communication is clear and that you are able to fulfill your duties.



FOREWARD

This publication was prepared for the guidance of Consultants providing architectural and engineering services under contract to the American University (AU). The American University Design Standards (AUCS) was developed with input from key stake holders including, Facilities Management (FM), Planning and Project Management (PPM), Office of Information Technology (OIT), Office of Sustainability (OS), Auxiliary Services (AS), University Safety and Security Services (USSS), Housing & Residence Life and Purchasing.

Consultants will use the AUDS for all new construction and renovation projects. The designated AU project manager may request, in writing, additions or exceptions to the technical standards for approval by AU's design standards committee. The committee will consider only fully developed technical submissions with performance and financial justifications.

A firm or individual providing consulting services to the American University will be the Designer of Record, and will incur the usual professional responsibilities and liabilities for the specific project. The Consultant should be familiar with the contract terms and content of this publication with respect to sustainable pre- construction, construction, and post-construction design responsibilities.

American University updates the document as necessary to reflect any required changes to the technical standards and specifications. It is the user's responsibility to ensure that he/she is working from the most current update. The most current version is available on the Facilities Management Website, which links to www.american.edu/standards. The University archives previous versions. Contractually, "the most current version" is the revision in effect on the Facilities Management Website when the design or consulting contract "Notice to Proceed" is given.



AMERICAN UNIVERSITY
DESIGN STANDARDS – GENERAL
REQUIREMENTS



CONSULTANT GUIDE

CONTRACT SERVICES

Contract services fall into two broad types:

1. Consultant services related to the planning, investigation, study, and project development for existing or proposed facilities. The deliverable of this type of service is typically a feasibility study or report.
2. Consultant services related to the design, construction, maintenance, alteration, or repair of facilities. This type of service produces a set of contract documents, consisting of, but not limited to drawings, specifications, cost estimates, and pre design and design support activities. (Soil borings, site topography, and construction monitoring).

MASTER PLANNING

American University undergoes a rigorous strategic planning process to match strategies, programs and facility improvements to the mission of the University. Consultants should avail themselves of information about current initiatives and campaigns during the design process. Campus information is available at the main university website www.american.edu.

A listing of departmental contacts to request information on current Master Plans pertinent to design and construction is available on the website at American University Design and construction website at www.american.edu/standards. Direct specific questions about university master plan requirements to Planning and Project Management or the assigned Project Manager.

UTILITIES AND SYSTEMS

Master planning is essential to the long-term reliability, operability, flexibility and efficiency of our systems. Facilities Management has developed utilities master plan committed to district heating and cooling whenever practical. Consultants shall work with Facilities Management to become familiar with these and other departmental campus plans.

Energy conservation and efficiency of mechanical and electrical systems is critically important to the university. A strategic objective for designs is supporting Energy Star ratings for our systems and facilities. The Consultant should not base design equipment/system selections solely on Energy Star or initial cost.



The Consultant will prepare a Life Cycle Cost Analysis (LCCA) in the early design stages and present the LCCA to the Project Manager and Director of Energy and Engineering for review and/ or approval. The university defines LCCA as the total cost to operate and maintain a piece of equipment, product or system over its useful life, including the cost of procurement. Additionally, high-energy system equipment such as HVAC chillers and pumping systems, require a Present Worth Analysis (PWA) over the projected life cycle. Both types of studies shall consider the time value of money and discount all future cash flows to present.

DESIGN QUALITY

At American University (AU), each project has its own unique, programmatic and contextual requirements. The Consultant shall take into consideration the location of the project and shall design with a full understanding of the unique surroundings. All design elements must be carefully explored with long-term goals in mind (projected life of facility, equipment, and systems).

New facilities will be designed with a minimum rating of LEED® Gold. Existing facilities will establish LEED® ratings targeting the same as practical, based on the current condition and the extent of renovation required. Energy Star rating will also be evaluated.

American University requires that the Consultant adhere to the latest edition of the AU Design and Construction Standards. The latest version of the AU Design and Construction Standards, which includes this Design Consultants Guide, is available at the website www.american.edu/standards.

Exceptions may be made on a case-by-case basis by requesting approval in writing from the Design Standards Committee (Chaired by Facilities Management's Director of Energy & Engineering). The University's Project Manager must maintain documentation for any exceptions.

The Consultant is expected to explore appropriate options toward making a recommendation for a design solution. There are no pre-established design styles or solutions for any project. Additional information applicable to design development of the project general requirements and construction documents is on the web site above under the CSI Divisions tab.

A detailed comparison and lifecycle economic analysis between various design options should be prepared where appropriate. Their use in determining the design solution shall be coordinated with AU's project manager and key stakeholders from the operations team. Design concepts shall incorporate the latest available technology wherever possible including the LEED® rating system.

Early in the design phase, the Consultant shall meet with the appropriate departments within the University Input and requirements. A typical project may include input from



Planning & Project Management (P&PM), the Office of Information Technology (OIT), University Safety and Security Services (USSS) which includes Public Safety, Access, and Risk Management and Facilities Management which includes Energy & Engineering (E&E), Grounds and Facilities Maintenance Operations (FMO).

DESIGN PROCESS

The design team shall establish and submit to the university's project manager a schedule identifying specific milestones, approval requirements, and the time necessary, after the project is approved, for design and/ or construction. The design team shall coordinate proposed projects with appropriate university reviewers, officers or departments to receive approval to continue. The Consultant shall prepare appropriate presentation materials to convey the design concepts at each phase.

AESTHETIC CONSIDERATIONS

The Consultant shall become knowledgeable with sustainable planning principles that have been established for the American University campus. This information is contained in the following documents (available as appropriate via AU's project manager):

- Campus Plan 2011
- Zoning Order approving the Campus Plan
- Related planning documents from the university where appropriate

The following general design principles have evolved over the years at the university:

- On or near the Freidheim Quadrangle, enhancement rather than dramatic departure from existing design is highly preferred.
- When selecting exterior building materials approvals from the University's Project Management and Facilities Maintenance representatives must be secured prior to proceeding with further design development.
- Provision for future expansion should be considered for any project. Future work may include flexibility for institutional programming changes and departmental master plan implementation.
- The American University campus is a certified arboretum. Each project shall be designed with limited tree removal and impact on traditionally forested areas.

UNIVERSITY RESPONSIBILITIES

American University's project manager may provide the following information or services:

1. Scope for design services
2. Project budget and schedule



3. Drawings of existing facilities and information pertinent to building services and utilities
4. American University Design and Construction Standards
5. Owners Project Requirements (OPR)
6. Hazardous materials testing and coordination for removal
7. Environmental monitoring
8. Coordination of drawings distributed for in-house reviews
9. Coordination of in-house reviews
10. Coordination of user/occupant reviews
11. Coordination of interior design-related needs
12. Coordination of user/occupant moves
13. Soils and material testing documentation
14. Coordination of university approval and/or committee reviews
15. Site survey and sub-surface investigating documentation
16. Building information access for all design phases
17. Access to existing building systems archive (blueprints, specifications, etc.)
18. Other responsibilities as defined in the current edition of AIA B151
19. Information on commissioning requirements and responsibilities

Document loaning terms: File searching and document retrieval shall be the responsibility of the Consultant. Under no circumstances shall documents be removed from the document archive. All documents loaned shall be accompanied with a transmittal from the Consultant to AU's Project Manager and/or the archives representative.

DESIGN SUBMITTALS

The Consultant shall develop for the university's project management and maintenance units' review and approval schematic design (30%), design development (65%) and construction documents (100%)

Documents shall establish the scope, relationship, forms, size and appearance of the project in accordance with the requirements of all Agreements.

Pre-design, programming and feasibility studies are not required, unless specifically requested by the university's project management.

The Consultant shall provide design calculations for review upon request. A tabulation of gross, net, and assignable square foot building areas shall be submitted with each design phase and shall follow FICM (Facilities Inventory and Classification Manual) methodology.



The latest edition of the American University Design and Construction Standards shall be used by the Consultant throughout the design process. Use of this document does not relieve the Designer of Record of the responsibility for the final design in accordance with the Project Agreement and with professional standards of practice.

Design submittals to the university's project and maintenance staff at each phase of design shall consist of multiple sets of drawings and specifications (including electronic copies). A detailed cost estimate, according to CSI format, is required with each phase of the project.

The Consultant shall submit design schedules to AU's project manager. When projects involve interruptions of existing building operations or major utility usage, the Consultant shall be responsible for discussing the required outages and service interruptions with Facilities Management during each phase of the design. The Consultant will establish schedule requirements for these interruptions that may adversely affect campus services or ongoing operations. A brief description of the restrictions and their basis is required.

SCHEMATIC DESIGN

Estimates of project costs are required for all project phases. Estimates shall include all expected project construction cost categories. A specifications outline shall point out the principle features of the project. A schematic outline specification shall be presented in CSI format.

Drawings shall include the following features:

Sustainable schematic site plan - Proposed location for the new building or alterations affecting the site of an existing building and its environmental impact on the site.

Architectural plans of each floor, including those below grade, all elevations, and typical building section and preliminary analysis and evaluation of LEED® criteria.

Utility and infrastructure plans –

- Campus utility connections and preliminary building utility load calculations including water, sewer, gas, electric, and chilled water
- Campus IT connections and bandwidth including phone, data, security, BAS, fire alarm, etc.
- Building mechanical, electrical and special systems – preliminary concept and equipment/system list and preliminary analysis and evaluation of LEED® criteria.



DESIGN DEVELOPMENT

GENERAL

- Written analysis of applicable codes
- LEED® analysis
- ADA requirements
- Updated building occupancy load and egress flow analysis
- Building envelope description and details
- Description of energy conservation renewable energy features which are incorporated into the project
- Energy modeling and life cycle cost analysis (LCCA) of all high energy use equipment
- Detailed estimate by major building component/system as required by the RFP or design contract
- Presentation of finish materials as required and/or appropriate

Participation in or development of and verification with project team of the Owner's Project Requirements and specifications outline as required by the RFP or design contract.

The specifications in this phase shall identify all significant architectural, mechanical and electrical materials and equipment in CSI format and how it conforms to the LEED criteria being sought for the project.

DRAWINGS

Drawings shall reflect an expansion of the schematic design phase and shall establish the final scope, form and size of the project. At the minimum, drawings shall present the following:

1. Site Plans
 - a. Site plan showing connections to all utilities with routing of new and existing services and connections
 - b. Site Improvements Plan to establish final scope and details of site improvement work and landscape concepts
2. Architecture
 - a. Floor plans, exterior elevations and sections including room numbers.
 - b. Fire life safety drawings showing means of egress, areas of refuge, rated partitions and doors, areas of high hazard
 - c. Exterior materials palette and samples that show any changes in materials, patterns, textures and color
 - d. Typical wall sections and major construction details



- e. Built-in equipment layouts to establish final project requirements
- f. Renderings or models as required
- g. Furniture and moveable equipment layouts as required
- 3. Structural
 - a. Plans of each building level to show basic structural systems
 - b. Drawings to show preliminary sizing of major structural components
 - c. Drawings to show critical clearances and height restrictions
- 4. Mechanical
 - a. Floor plans of each building level with single line layout
 - b. Riser diagrams of piping and ductwork, showing complete system as it applies to HVAC, plumbing and specialty systems
 - c. Drawings and specifications documenting fire protection and life safety systems including fire suppression systems and equipment, fire dampers, etc.
 - d. Preliminary equipment schedules with sizes and capacities of major system components. Equipment and asset identification consistent with university's existing nomenclature.
 - e. Equipment layouts for HVAC and plumbing to establish space requirements and clearance.
 - f. Acoustical and vibration control
 - g. Preliminary sequence of operations, set points and alarms, consistent with the University's' Division 25 Integrated Automation requirements in the technical sections of the current version of the AU Design and Construction Standards at www.american.edu/standards.
 - h. Preliminary BAS/EMS system architecture drawings and basis of design.
 - i. Energy conservation features/preliminary energy modeling
- 5. Electrical
 - a. Drawings to show plans for lighting, power, communication systems
 - b. Drawings and specifications documenting emergency and critical power systems
 - c. Drawings and specifications documenting fire protection and life safety systems including fire alarm systems and equipment.
 - d. Equipment schedules to show preliminary sizes and capacities of major equipment and electrical distribution system, equipment layout establishing space requirements and clearances. Equipment and asset identification consistent with the University's existing nomenclature.
 - e. Riser diagrams
 - f. Energy modeling
- 6. Landscape and site improvements



- a. Drawings that will establish final scope and details of landscape and site improvement work
7. Special Equipment
 - a. Drawings showing special equipment including general arrangement, elevations, schedules and details of conveying systems, kitchen equipment, materials handling systems, IT systems, A/V systems, etc.
 - b. Energy Star appliances and ratings
8. Design Calculations
 - a. Update of design calculations for the University's review and approval.

CONSTRUCTION DOCUMENTS

1. Energy conservation analysis prepared during the Design Development phase shall be updated and submitted for FM review and approval including updated energy modeling and LCCA.
2. The Consultant shall prepare a detailed code analysis which conforms to all applicable building codes, including ADA compliance requirements and cost of compliance.
3. Grounds conservation and recovery plan (for any disturbance to the grounds by project construction).
4. Project narrative including Basis of Design/Design Intent Document and OPR
5. Detailed estimate of construction costs by trade.
6. Presentation materials as required by the university's project management in the quantity and format as defined in the RFP or scope of design services. Examples include renderings, power point
7. Specifications in CSI format
8. The specifications shall allow contractors to prepare bids without the need to make assumptions or judgments.
 - a. For materials and equipment, the Consultant shall reference names of three manufacturers that are deemed to be suitable for meeting the desired product quality unless there are specific exceptions found within the Design and Construction Standards.
 - b. Drawings – The Contract Document drawings shall provide sufficient detail (including existing systems and sustainable design components) to allow for clear understanding of the scale and scope by the university and the Contractor as necessary to bid, permit and construct the project and to eliminate interference between new and existing systems. The drawings shall be an accurate and detailed set of documents suitable for construction.



EQUIPMENT PROCUREMENT

The university may elect to purchase equipment directly for some projects and will, in such cases, require the Consultant to assist in the preparation of equipment bid documents and bidding. The university's Project Manager will coordinate the equipment procurement and delivery schedule.

CONSTRUCTION AND CLOSE-OUT PHASES

The Consultant shall be responsible for, but not limited to, the following:

- Site visits to verify record drawings.
- Construction progress meetings, including representatives from all disciplines of the design, as needed.
- Review and respond to contractor RFIs, change order proposals, including representatives from all disciplines of the design, as needed.
- Updates to energy models (including LCCA) and record documents associated with design changes, pre-construction value engineering changes, submittal approvals, approved RFIs and change orders.
- Review of submittals, balancing reports and commissioning documentation.
- Punch list items shall be organized by CSI specification or division as applicable prior to submission to the Contractor and shall include comments and issues from all American University stakeholders, the commissioning agent and other project specific consultants.
- Verification and Submission of the project substantial completion certificate and project closeout form.

After completion of punch-list items by the Contractor, the Consultant shall submit a report of field verification and status of items. This status report will be updated at regular intervals until all punch-list items are resolved to the university's satisfaction.

Review operating and maintenance manuals submitted by the Contractor for completeness. These manuals shall include all pertinent information to successfully operate and maintain all equipment related to the project.

The Consultant shall provide consultation to the Contractor for the training of maintenance personnel. Consultant shall assist the university in defining correct operational parameters of new mechanical / electrical systems.



DIVISION 00 PROCUREMENT AND CONTRACTING REQUIREMENTS

The American University requirements for procurement and contracting are administered by the Finance Department Procurements and Contracting office located in the Spring Valley Building at 4801 Massachusetts Avenue NW.

Contact information can be obtained by emailing pcd@american.edu.



DIVISION 01 GENERAL REQUIREMENTS

The Planning and Project Management (PPM) department has developed American University specific General Requirements sections for capital construction and major renovations or upgrades. The designer is expected to be familiar with these AU requirements and use the body text “as is” in the project specifications. Any variance, other than adjustments in the header and/or footer, require discussion and concurrence by PPM and Procurement and Contracting.

General Requirements sections included in the Appendix include:

- 01 21 00 Allowances
- 01 25 00 Substitution Procedures
- 01 25 00a Substitution Attachment
- 01 31 00 Project Management and Coordination
- 01 32 00 Construction Progress Documentation
- 01 32 33 Photographic Documentation
- 01 33 00 Submittal Procedures
- 01 40 00 Quality Requirements
- 01 50 00 Temporary Facilities and Controls
- 01 60 00 Product Requirements
- 01 73 00 Execution
- 01 77 00 Closeout Procedures
- 01 78 23 Operation and Maintenance Data
- 01 78 39 Project Record Documents
- 01 91 13 General Commissioning Requirements



SECTION 01 21 00 ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump sum allowances.
 - 2. Unit cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
 - 5. Testing and inspecting allowances.
- C. Related Requirements:
 - 1. Section 01 22 00 "Unit Prices" for procedures for using unit prices.
 - 2. Section 01 40 00 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.3 DEFINITIONS

- A. Allowance is a quantity of work or dollar amount established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.



1.4 SELECTION AND PURCHASE

- A. At 10 business days after award of the Contract, advise Owner of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work. Each allowance shall be captured and tracked as an individual activity in CPM Schedule.
- B. At Owner's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Owner from the designated supplier.

1.5 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 COORDINATION

- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.8 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.



- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.9 UNIT-COST ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.10 QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.



1.11 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.12 TESTING AND INSPECTING ALLOWANCES

- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
- C. Costs of testing and inspection services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

1.13 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 - 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.



4. For unit-cost allowances, Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Quantity Allowance: Include 2000 cu. yd. (1529 cu. m) of unsatisfactory soil excavation and disposal off-site and replacement with satisfactory soil material from off-site, as specified in Section 31 2000 "Earth Moving."
 1. Coordinate quantity allowance adjustment with unit-price requirements in Section 01 2200 "Unit Prices."
- B. Allowance No. 2: Quantity Allowance: Include 1000 cu. yd. (765 cu. m) of rock removal and replacement with satisfactory soil material, as specified in Section 312000 "Earth Moving."
 1. Coordinate quantity allowance adjustment with unit-price requirements in Section 01 2200 "Unit Prices."
- C. Allowance No. 3: Lump-Sum Allowance: Include the sum of \$30,000 for three chandeliers for the main lobby as specified in Section 26 5100 "Interior Lighting."
 1. This allowance includes material cost, receiving, handling, and installation, and Contractor overhead and profit.



- D. Allowance No. 4: Unit-Cost Allowance: Include the sum of \$350.00 per thousand for buff-colored face brick as specified in Section 04 2000 "Unit Masonry" and as shown on Drawings.
- E. Allowance No. 5: Quantity Allowance: Include 5000 sq. yd. (4180 sq. m) of Carpet Type 1 installed, including urethane foam carpet cushion and related amount of tackless strip, as specified in Section 09 6816 "Sheet Carpeting."
- F. Allowance No. 6: Contingency Allowance: Include a contingency allowance of \$100,000.00 for use according to Owner's written instructions.
- G. Allowance No. 7: Testing and Inspection Allowance: Include the sum of \$1,000.00 for testing concrete to be provided by Owner as specified in Section 03 3000 "Cast-in-Place Concrete."
- H. Allowance No. <Insert number>: [Lump-Sum] [Unit-Cost] [Quantity] [Contingency] [Testing and Inspecting] Allowance: Include the sum of <Insert dollar or quantity amount of allowance>: Include <Insert allowance description> as specified in Section <Insert Section number> "<Insert Section title>" [and as shown on Drawings].
 - 1. This allowance includes [material cost] [receiving, handling, and installation] [and] [Contractor overhead and profit].
 - 2. Coordinate quantity allowance adjustment with corresponding unit-price requirements in Section 012200 "Unit Prices."

END OF SECTION



SECTION 01 25 00 SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 1. Section 01 21 00 "Allowances" for products selected under an allowance.
 2. Section 01 23 00 "Alternates" for products selected under an alternate.
 3. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit electronically each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number, title, and Drawing numbers and titles.
 1. Substitution Request Form: Use form attached at end of this Section.
 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication, or installation cannot be provided, if applicable.



- b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. 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 date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. 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.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. **Architect will notify Contractor** of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.



- b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Requested substitution provides sustainable design characteristics that specified product provided.
 - c. Substitution request is fully documented and properly submitted.
 - d. Requested substitution will not adversely affect Contractor's construction schedule.
 - e. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - f. Requested substitution is compatible with other portions of the Work.
 - g. Requested substitution has been coordinated with other portions of the Work.
 - h. Requested substitution provides specified warranty.
 - i. 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.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 30 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.



1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Requested substitution provides sustainable design characteristics that specified product provided.
 - e. Substitution request is fully documented and properly submitted.
 - f. Requested substitution will not adversely affect Contractor's construction schedule.
 - g. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - h. Requested substitution is compatible with other portions of the Work.
 - i. Requested substitution has been coordinated with other portions of the Work.
 - j. Requested substitution provides specified warranty.
 - k. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

- END OF SECTION -



REQUEST FOR SUBSTITUTION FORM

1. Date: _____ Request No: _____
2. Project Name: American University, Project Name.
3. Specification Reference: _____
4. Description of specified product or system: _____
5. Trade name, model number, and name of proposed substitution:
(List Original and Proposed information)

6. What effect does substitution have on applicable code requirements?

7. Differences between proposed substitution and specified item? *(Use attachment for additional space, if required.)*

8. Manufacturer's warranty on proposed and specified items are:
Same Different
(Explain on attachment.)
9. Reason for requesting substitution:
Cause Convenience

10. Monetary considerations:
Specified Product \$ _____
Proposed Substitution: \$ _____
11. Undersigned shall pay for changes to the building design, including engineering and detailing costs, caused by the requested substitution .



12. Enclosed data consists of:
Catalog Drawings Samples Tests Reports

13. List local vendors and supplier representatives:

14. List availability of maintenance service and replacement materials.

14. State effects of substitution on construction schedule and changes required in other work or product:

15. State effects of substitution on project sustainability goals:

16. Any license fees or royalties: Yes No

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 not affect or delay Progress Schedule.
- \$ Cost data as stated above is complete. Claims for additional costs related to accepted substitution that may subsequently become apparent are to be waived by the Contractor.
- \$ Proposed substitution does not affect dimensions or functional clearances.
- \$ Payment will be made for changes to building design, including architectural or engineering design, detailing, and construction costs caused by proposed substitution.
- \$ Coordination, installation, and changes to the Work as necessary for accepted substitution will be complete in all respects.

Submitted by:
Signature _____
Firm _____
Address _____
Date _____
Telephone _____

For use by Architect:
Accepted: Accepted As Noted:
Not Accepted: Received Too Late:
Date _____
Remarks: _____

Approved by (C.M.)
By: _____

LIST OF ATTACHMENTS:



SECTION 01 31 00 PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.9 RELATED DOCUMENTS

- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.10 SUMMARY

- B. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 1. General coordination procedures.
 2. Coordination drawings.
 3. Requests for Information (RFIs).
 4. Project Web site hosted by the contractor - Capital Projects
 5. Project meetings.
 6. Keying of miscellaneous locks.
- C. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- D. Related Requirements:
 1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 2. Section 01 77 00 "Closeout Procedures" for coordinating closeout of the Contract.
 3. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 4. Section 01 91 13 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

1.11 DEFINITIONS

- B. BIM: Building Information Modeling.
- C. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.



1.12 INFORMATIONAL SUBMITTALS

- B. Subcontract 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. 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.
- C. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
1. Post copies of list in temporary field office. Keep list current at all times.

1.13 GENERAL COORDINATION PROCEDURES

- B. Coordination: Coordinate construction operations included in different 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.
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 to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda 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 scheduled 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. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Commissioning meetings.
7. Preinstallation conferences.
8. Project closeout activities.
9. Startup and adjustment of systems.
10. Training and Demonstration

- E. Locks and cylinders not specified in Section 08 71 10 "Door Hardware" including locks at cabinets and equipment shall be coordinated to fit Owner's master key system. Provide full locksmith services to achieve fully coordinated keying. Turn over complete set of keys, in duplicate and labeled, to Owner at Substantial Completion.
- F. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1.14 COORDINATION DRAWINGS/MODEL

- B. Coordination Drawings/Model, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings/Model as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.



- d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on the Drawings or in the Model. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- C. Coordination Drawing/Model Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.



- c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor control center locations.
 - d. Location of pull boxes and junction boxes dimensioned from column centerlines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
 - D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
 1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using Portable Data File (PDF) format.
 3. Architect will furnish Contractor 1 set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Contractor shall execute a data licensing agreement in the form of AIA Document C106 or an Agreement form acceptable to Owner and Architect.
- 1.15 REQUESTS FOR INFORMATION (RFIs)
- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
 - B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation. RFIs shall include pertinent information listed below. RFI's that in the Architect's judgement contain insufficient information will be returned to Contractor for completion. Time for Architect's response will not begin until a complete RFI is received.
 1. Project name.
 2. Project number.



3. Date.
 4. Name of Contractor.
 5. Name of Architect.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution affects the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow 7 working days for Architect's response for each RFI. RFIs received by Architect after 1 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2600 "Contract Modification Procedures."



- a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. CSI Section
 6. RFI description.
 7. Date the RFI was submitted.
 8. Date Architect's response was received.
 9. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 10. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within 7 days if Contractor disagrees with response.

1.16 DIGITAL PROJECT MANAGEMENT PROCEDURES

- B. Use of Architect's Digital Data Files: Digital data files of Architect's drawings will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Models, Shop Drawings, and Project record Drawings.
 2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
 3. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement or an Agreement form acceptable to Owner and Architect.
 4. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106 or an Agreement form acceptable to Owner and Architect.
- C. **Web-Based Project Software**: Use Contractor's web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion at which time all digital data shall become property of the Owner.
1. Web-based Project software site includes, at a minimum, the following features:



- a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
2. Provide up to seven web-based Project software user licenses for use of Owner, Architect, and Architect's consultants. Provide 8 hours of software training at Owner's office for web-based Project software users.
 3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Owner. Provide data in locked format to prevent further changes.
- D. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 2. Name file with submittal number or other unique identifier, including revision identifier.
 3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.



1.17 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Contractor shall be responsible for conducting meeting and will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within 3 days of the meeting.
- B. Preconstruction Conference: **Architect/Owner** will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. 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. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. LEED requirements.
 - o. Preparation of Record Documents.
 - p. Use of the premises.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.



- w. Construction waste management and recycling.
 - x. Parking availability.
 - y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.
 - cc. Progress cleaning.
3. Minutes: Architect/Owner responsible will record and distribute meeting minutes.
- C. LEED Requirements Coordination Conference: Owner/LEED Consultant will schedule and conduct a sustainable design coordination conference before starting construction, at a time convenient to Owner Architect, and Contractor.
- 1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent and sustainable design coordinator; major subcontractors; suppliers; and other concerned parties shall attend the conference. 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 meeting sustainable design requirements, including the following:
 - a. Sustainable design Project checklist.
 - b. General requirements for sustainable design-related procurement and documentation.
 - c. Project closeout requirements and sustainable design certification procedures.
 - d. Role of sustainable design coordinator.
 - e. Construction waste management.
 - f. Construction operations and sustainable design requirements and restrictions.
 - 3. Minutes: LEED Consultant will record and distribute meeting minutes.
- D. Preinstallation Conferences: Contractor shall conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
- 1. Attendees: Authorized representatives of Owner, Contractor, Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect/Owner of scheduled meeting dates.
 - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.



- c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. LEED requirements.
 - i. Review of mockups.
 - j. Possible conflicts.
 - k. Compatibility requirements.
 - l. Time schedules.
 - m. Weather limitations.
 - n. Manufacturer's written instructions.
 - o. Warranty requirements.
 - p. Compatibility of materials.
 - q. Acceptability of substrates.
 - r. Temporary facilities and controls.
 - s. Space and access limitations.
 - t. Regulations of authorities having jurisdiction.
 - u. Testing and inspecting requirements.
 - v. Installation procedures.
 - w. Coordination with other work.
 - x. Required performance results.
 - y. Protection of adjacent work.
 - z. Protection of construction and personnel.
 - aa. Protection of completed work
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
 5. 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.

E. Commissioning Meeting:

- F. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than **90** days prior to the scheduled date of Substantial Completion.
 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting.



- Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Requirements for final written warranties and service response.
 - e. Requirements for completing LEED documentation.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Coordination of separate contracts.
 - m. Owner's partial occupancy requirements.
 - n. Installation of Owner's furniture, fixtures, and equipment.
 - o. Responsibility for removing temporary facilities and controls.
 4. Minutes: Contractor will record and distribute meeting minutes.
- G. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.



- 2) Provide 2 week look ahead schedule
- b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of LEED documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.
 - 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
4. Minutes: Contractor shall record and distribute the meeting minutes to each party present and to parties requiring information within 2 days following the meeting date.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- H. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.



- a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site utilization.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of RFIs.
 - 15) Proposal Requests.
 - 16) Change Orders.
 - 17) Pending changes.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 1. Startup construction schedule.
 2. Contractor's construction schedule.
 3. Construction schedule updating reports.
 4. Daily construction reports.
 5. Material location reports.
 6. Site condition reports.
 7. Unusual event reports.
- B. Related Requirements:
 1. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
 2. Section 01 40 00 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 2. Predecessor Activity: An activity that precedes another activity in the network.
 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.



- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of labor and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.
- B. **Startup construction** schedule.
 - 1. Submittal of startup construction schedule will not constitute approval of schedule of values.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
 - 3. Total Float Report: List of all activities sorted in ascending order of total float.



- E. Construction Schedule Updating Reports: Submit with Applications for Payment.
- F. Daily Construction Reports: Submit at weekly intervals.
- G. Material Location Reports: Submit at monthly intervals.
- H. Site Condition Reports: Submit at time of discovery of differing conditions.
- I. Unusual Event Reports: Submit at time of unusual event.
- J. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1. Review software limitations, content, and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including work stages, interim milestones, and existing conditions.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review delivery date of Contractor furnished equipment and long lead items (greater than 30 days).
 - 8. Review time required for review of submittals and resubmittals.
 - 9. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 10. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
 - 11. Review and finalize list of construction activities to be included in schedule.
 - 12. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.



1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of an Owner approved program that has been developed specifically to manage construction schedules.
- B. Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect/Owner.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 30 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 3300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
 4. Startup and Testing Time: Include no fewer than 15 days for startup and testing unless approved by Owner.
 5. Commissioning Time: Include no fewer than 15 days for commissioning unless approved by Owner. Include commissioning milestones as required.
 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. **Phasing:** Arrange list of activities on schedule by phase.
 2. **Work under More Than One Contract:** Include a separate activity for each contract.



3. **Work by Owner:** Include a separate activity for each portion of the Work performed by Owner.
 4. **Work Restrictions:** Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
 5. **Work Stages:** Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Mockups.
 - b. Fabrication.
 - c. Sample testing.
 - d. Installation.
 - e. Tests and inspections.
 - f. Adjusting.
 - g. **Building flush out. LEED**
 - h. Startup and placement into final use and operation.
 - i. Commissioning.
- E. **Milestones:** Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, Commissioning Completion, and Final Completion.
- F. **Upcoming Work Summary:** Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and Contract Time.
- G. **Contractor's Construction Schedule Updating:** At weekly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.



3. As the Work progresses, indicate final completion percentage for each activity.
- H. Recovery Schedule: When periodic update indicates the Work is seven or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- I. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, Commissioning Agent, and other parties identified by Contractor with a need-to-know schedule responsibility.
 1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 **STARTUP CONSTRUCTION SCHEDULE**

- A. **Gantt-Chart** Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within 7 days of Notice of Award.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 **GANTT-CHART** SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work.
 1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.



1.10 CPM SCHEDULE REQUIREMENTS

- A. CPM Schedule: Prepare Contractor's Construction Schedule using a fully developed time-scaled CPM network analysis diagram for the Work.
1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- B. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup schedule, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Start up and Training.
 - j. Testing and commissioning.
 - k. Punch list and final completion.
 - l. Activities occurring following final completion.
 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.



3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- C. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- D. Initial Issue of Schedule: Prepare initial schedule from a sorted activity list-indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
- E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.

1.11 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site per contractor and subcontractor.
 4. Equipment at Project site.
 5. Material deliveries.



6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Accidents.
 8. Meetings and significant decisions.
 9. Unusual events (see special reports).
 10. Stoppages, delays, shortages, and losses.
 11. Meter readings and similar recordings.
 12. Emergency procedures.
 13. Orders and requests of authorities having jurisdiction.
 14. Change Orders received and implemented.
 15. Construction Change Directives received and implemented.
 16. Services connected and disconnected.
 17. Equipment or system tests and startups.
 18. Partial completions and occupancies.
 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, 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. Indicate the following categories for stored materials:
1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



SECTION 01 32 33 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 1. Preconstruction photographs.
 2. Periodic construction photographs.
 3. Final completion construction photographs.
 4. Preconstruction video recordings.
 5. Periodic construction video recordings.
 6. Construction webcam.
- B. Related Requirements:
 1. Section 01 77 00 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
 2. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 3. Section 02 41 16 "Structure Demolition" for photographic documentation before building demolition operations commence.
 4. Section 02 41 19 "Selective Structure Demolition" for photographic documentation before selective demolition operations commence.
 5. Section 31 10 00 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL 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**] [**and**] [**video recording**]. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.



1. Submit photos on thumb-drive or by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
 2. Identification: Provide the following information with each image description **[in file metadata tag] [in web-based project software site]**:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.
- C. Video Recordings: Submit video recordings within 7 days of recording.
1. Submit video recordings on thumb drive or by uploading to web-based project software site. Include copy of key plan indicating each video's location and direction.
 2. Identification: With each submittal, provide the following information:
 - a. Name of Project.
 - b. Name and address of photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date video recording was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.
- D. Time-Lapse Video: Submit time-lapse sequence video recordings simultaneously with recording.
1. Submit time-lapse sequence video recordings monthly by uploading to web-based project software site.
 2. Identification: For each recording, provide the following information:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Date(s) and time(s) video recording was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.



1.4 QUALITY ASSURANCE

- A. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, approved web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project.

1.5 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in approved format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction technology. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. Metadata: Record accurate date and time from camera.
- E. File Names: Name media files with date and sequential numbering suffix.

1.6 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Preconstruction Photographs: Before **[commencement of excavation]** **[commencement of demolition]** **[starting construction]**, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take 20 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.



- C. Periodic Construction Photographs: Take 20 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.
- D. Time-Lapse Sequence Construction Photographs: Take 20 photographs as indicated, to show status of construction and progress since last photographs were taken.
 - 1. Frequency: Take photographs monthly, on the same date each month.
 - 2. Vantage Points: Following suggestions by Architect and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than 2 of the required shots from same vantage point each time to create a time-lapse sequence as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - d. Interior Work, through date of Substantial Completion.
- E. Final Completion Construction Photographs: Take 50 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.
- F. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergencies, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Substantial Completion of a major phase or component of the Work.
 - d. Extra record photographs at time of final acceptance.
 - e. Owner's request for special publicity photographs.

1.7 CONSTRUCTION VIDEO RECORDINGS

- A. Video Recording Photographer: Engage a qualified videographer to record construction video recordings.
- B. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each



change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.

C. Preconstruction Video Recording: Before starting [**excavation**] [**demolition**] [**construction**], record video recording of Project site and surrounding properties from different vantage points, as directed by Architect.

1. Flag [**excavation areas**] [**construction limits**] before recording construction video recordings.
2. Show existing conditions adjacent to Project site before starting the Work.
3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of [**excavation**] [**demolition**] [**construction**].
4. Show protection efforts by Contractor.

D. Periodic Construction Video Recordings: Record video recording monthly. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time shall be **30** minutes.

E. Time-Lapse Sequence Construction Video Recordings: Record video recording to show status of construction and progress.

1. Frequency: During each of the following construction phases, set up video recorder to automatically record one frame of video recording every 5 minutes, from same vantage point each time, to create a time-lapse sequence of **30 minutes** in length as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
2. Timer: Provide timer to automatically start and stop video recorder so recording occurs only during construction work hours.
3. Vantage Points: Following suggestions by Architect and Contractor, photographer shall select vantage points.

1.8 CONSTRUCTION WEBCAM

A. Webcam: Provide fixed-location camera with weatherproof housing, mounted to provide unobstructed view of construction site from location approved by Architect, with the following characteristics:

1. [**Static view**] [**Remotely controllable view with mouse-click user navigation for horizontal pan, vertical tilt, and optical zoom of 500 percent minimum**].



2. Capable of producing minimum 12 megapixel images.
 3. Provide power supply, active high-speed data connection to service provider's network, and static public IP address for each camera.
- B. Live Streaming Images: Provide web-accessible image of current site image, updated at 5-minute intervals when construction is underway.
- C. Web-Based Interface: Provide online interface to allow viewing of each high-definition digital still image captured and stored during construction, from the Internet.
1. Access Control: Provide password-protected access for Project team administered by Contractor, providing current image access and archival image access by date and time, with images downloadable to viewer's device.
 2. Storage: Maintain images on the website for reference during entire construction period, and for not less than 30 days after final completion. Provide sufficient memory on remote server to store all Project images.
 3. Online Interface: Provide website interface with Project and client information and logos; calendar-based navigation interface for selecting images; pan and zoom capability within high-definition images.
 4. Forward and Reverse: Provide capability to browse through images, moving forward and backward in time by individual image and by day.
 5. Slideshow: Provide capability to automatically display current images from sites when there are three or more cameras used.
 6. Time-Lapse: Provide capability for online display of project time-lapse.
 7. Dashboard: Provide capability to view thumbnails of all cameras on one screen.
 8. Weather: Provide corresponding weather data for each image captured.
- D. Maintain cameras and web-based access in good working order according to web-based construction photographic documentation service provider's written instructions until final completion. Provide for service of cameras and related networking devices and software.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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 Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.
- B. Related Requirements:
 - 1. Section 01 290 0 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 01 31 00 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
 - 3. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 01 32 33 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and completion construction photographs.
 - 5. Section 01 40 00 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 6. Section 01 77 00 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 7. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 9. Section 01 79 00 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 10. Section 01 81 13.13 "Sustainable Design Requirements - LEED 2009 for New Construction and Major Renovations" for sustainable design submittals.



11. Section 01 81 13.14 "Sustainable Design Requirements - LEED v4 BD+C" for sustainable design submittals.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 14 days of construction. List those submittals 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.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:



- a. Scheduled date for first submittal.
- b. Specification Section number and title.
- c. Submittal category: Action; informational.
- d. Name of subcontractor.
- e. Description of the Work covered.
- f. Scheduled date for Architect's final release or approval.
- g. Scheduled date of fabrication. **[These are for CPM scheduled jobs]**
- h. Scheduled dates for purchasing.
- i. Scheduled dates for installation.
- j. Activity or event number.

1.5 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Architect.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.
7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Architect.

C. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

D. **Paper Submittals:**



1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
 2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
 3. Action Submittals: Submit 3 paper copies of each submittal unless otherwise indicated. Architect will return 2 copies.
 4. Informational Submittals: Submit 2 paper copies of each submittal unless otherwise indicated. Architect will not return copies.
 5. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 6. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using AIA Document G810 or transmittal form acceptable to Architect.
- E. PDF Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number. **FOR E-MAILED SUBMITTALS**
- F. Submittals for **Web-Based Project Software**: Prepare submittals as PDF files, or other format indicated by Project software website.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. **Email**: Prepare submittals as PDF package, and transmit to Owner and Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.
 - a. Architect will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 2. **Web-Based Project Software**: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 3. **Paper**: Prepare submittals in paper form, and deliver to Owner and Architect.
- B. 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. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.



3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. 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.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 calendar days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 15 calendar days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is required, allow 15 calendar days for initial review of each submittal.
- D. 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 by highlighting revised information within the resubmittal package.
 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
 - 4.
- E. Distribution: 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.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.



1.7 SUBMITTAL REQUIREMENTS

- A. 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 published 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 catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: **FOR PAPER SUBMITTALS** Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-



1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).

- a. Three opaque copies of each submittal. Architect will retain 2 copies; remainder will be returned.
3. **BIM File Incorporation:** [Develop and incorporate] [Construction Manager will incorporate Contractor's] Shop Drawing files into Building Information Model established for Project.
 - a. Refer to Section 01 3100 "Project Management and Coordination" for requirements for coordination drawings.
- C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. **Email Transmittal:** Provide PDF transmittal. Include digital image file illustrating Sample characteristics, and identification information for record.
 4. **Web-Based Project Software:** Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 5. **Paper Transmittal:** Include paper transmittal including complete submittal information indicated.
 6. 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 that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 7. 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 1 full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
8. 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 3 sets of Samples. Architect will retain 2 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 3 sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
 5. Submit product schedule in the following format:
 - a. PDF electronic file.
- E. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."
- F. Contractor's Construction Schedule: Comply with requirements specified in Section 01 3200 "Construction Progress Documentation."
- G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 2900 "Payment Procedures."
- H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."



- I. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."
- J. Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."
- K. **LEED Submittals**: Comply with requirements specified in Section 018113.13 "Sustainable Design Requirements - LEED for New Construction and Major Renovations," Section 018113.16 "Sustainable Design Requirements - LEED for Commercial Interiors," Section 018113.19 "Sustainable Design Requirements - LEED for Core and Shell Development," and Section 018113.23 "Sustainable Design Requirements - LEED for Schools."
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- N. Certificates:
 - 1. Certificates and Certifications Submittals: Submit a 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. Provide a notarized signature where indicated.
 - 2. Installer Certificates: Submit 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.
 - 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 - 4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
 - 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 - 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents.



Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

O. Test and Research Reports:

1. Compatibility Test Reports: Submit 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.
2. Field Test Reports: Submit written reports 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.
3. Material Test Reports: Submit 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.
4. Preconstruction Test Reports: Submit 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.
5. Product Test Reports: Submit written reports indicating that 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.
6. Research Reports: Submit 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:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.8 DELEGATED-DESIGN SERVICES

- 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.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and 3 paper copies of certificate, signed and sealed by the responsible design professional, 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.
- C. **BIM File** Incorporation: **[Incorporate] [Construction Manager will incorporate]** delegated-design drawing and data files into Building Information Model established for Project.
 1. Prepare delegated-design drawings in the same digital data software program, version, and operating system as the original Drawings.

1.9 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: 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.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with **[a uniform approval stamp] [indication in web-based Project software]**. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Architect will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ARCHITECT'S REVIEW

- A. Action Submittals: Architect will review each submittal, indicate corrections or revisions required, and return it. Architect will physically or electronically stamp each submittal with an action stamp and will mark stamp appropriately to indicate action as follows:
 1. "FOR YOUR INFORMATION": Submittal is primarily for information purposes, record purposes, special processing, or other Contractor activity, the submittal will be returned. No further action required.
 2. "NO EXCEPTIONS TAKEN": The Work covered by the submittal may proceed provided it complies with the Contract Documents. Final acceptance will depend on that compliance.



3. "EXCEPTIONS AS NOTED": The Work covered by the submittal may proceed provided it complies both with Architect's notations and with corrections on the submittal and the Contract Documents. Final acceptance will depend on that compliance. Do not resubmit.
 4. "REVISE AND RESUBMIT": Do not proceed with the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity for the product submitted. Revise or prepare a new submittal according to Architect's notations and corrections.
 5. "NOT ACCEPTABLE": Do not proceed with the Work covered by the submittal. Prepare a new submittal for a product that complies with the Contract Documents.
 6. "FOR DESIGN USE ONLY": Submittal is not required by the Contract Documents. Submittal will be returned with no action taken.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.
- F. The Architect's approval of any submittal containing the phrase "By Others" or similar expression is not permission to delete any Work of the Contract. Work of the Contract referenced to be done by others shall be performed by the Contractor.
- G. Architect will return without review submittals received from sources other than Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



SECTION 01 40 00 QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, [**Commissioning Authority**,] [**Construction Manager**,] or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.
- C. Related Requirements:
 - 1. Section 01 21 00 "Allowances" for testing and inspecting allowances.
 - 2. Division 02 through 33 Sections for specific test and inspection requirements

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of



5 previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements or as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.
 - 2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.



- H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- J. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- K. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED-DESIGN SERVICES

- 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.

1.5 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.



1.6 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
 - 1. Indicate manufacturer and model number of individual components.
 - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.7 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality control activities and responsibilities.
- B. Qualification Data: Submit resume and experience for approval by owner of proposed QC/QA Manager. USACE CQM Certification preferred.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Entity responsible for performing tests and inspections.
 - 3. Description of test and inspection.
 - 4. Identification of applicable standards.
 - 5. Identification of test and inspection methods.



6. Number of tests and inspections required.
 7. Time schedule or time span for tests and inspections.
 8. Requirements for obtaining samples.
 9. Unique characteristics of each quality-control service.
- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan not less than 5 days prior to preconstruction conference. Submit in format acceptable to Owner. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 3. Owner-performed tests and inspections indicated in the Contract Documents[, **including tests and inspections indicated to be performed by the Commissioning Authority**].
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship



in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results grouped by the definable features of work. Include work Architect/Owner has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.9 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
 1. Date of issue.
 2. Project title and number.
 3. Name, address, and telephone number of testing agency.
 4. Dates and locations of samples and tests or inspections.
 5. Names of individuals making tests and inspections.
 6. Description of the Work and test and inspection method.
 7. Identification of product and Specification Section.
 8. Complete test or inspection data.
 9. Test and inspection results and an interpretation of test results.
 10. Record of temperature and weather conditions at time of sample taking, testing, and inspecting.
 11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
 12. Name and signature of laboratory inspector.
 13. Recommendations on retesting and reinspection.
 14. Provide documentation verifying deficiency has been corrected.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
 1. Name, address, and telephone number of technical 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.

- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
 2. Statement that equipment complies with requirements.
 3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
 4. Statement whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.

1.10 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.



- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
 - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. When testing is complete, remove test specimens, assemblies, and mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect[**and Commissioning Authority**], with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.



- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 2. Notify Architect 7 days in advance of dates and times when mockups will be constructed.
 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
 - a. Allow 7 days for initial review and each re-review of each mockup.
 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings and as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.
- M. **Room Mockups**: Construct room mockups incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work. Provide room mockups of the following rooms:
1. **<Insert room name or description>**.

1.11 QUALITY CONTROL

- A. **Owner Responsibilities**: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.



- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
 2. Engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect[, **Commissioning Authority**] and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect[, **Commissioning Authority**,] and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment



installation, including service connections. Report results in writing as specified in Section 01 3300 "Submittal Procedures."

- F. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. **Associated Contractor Services:** Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. **Schedule of Tests and Inspections:** Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
 - 1. **Distribution:** Distribute schedule to Owner, Architect, **[Commissioning Authority,]** testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.12 SPECIAL TESTS AND INSPECTIONS

- A. **Special Tests and Inspections:** **[Owner will engage] [Engage]** a qualified **[testing agency] [special inspector]** to conduct special tests and inspections



required by authorities having jurisdiction as the responsibility of Owner, **as indicated in Statement of Special Inspections attached to this Section**, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect [, **Commissioning Authority**,] [, **Construction Manager**,] and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect [**and Commissioning Authority** with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.
7. **<Insert requirements>**.

B. Special Tests and Inspections: Conducted by a qualified [**testing agency**] [**special inspector**] as required by authorities having jurisdiction, as indicated in individual Specification Sections **and in Statement of Special Inspections attached to this Section**, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect [, **Commissioning Authority**,] and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect [**and Commissioning Authority**] with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.



PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 ACCEPTABLE TESTING AGENCIES

- A. <Insert list of firms acceptable to perform designated tests and inspections>.

3.2 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's [, **Commissioning Authority's,**] **[and Construction Manager's]** reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.3 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 7300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

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 01 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," "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": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- 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.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

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 indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. 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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
 - 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.



10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
11. AF&PA - American Forest & Paper Association; www.afandpa.org.
12. AGA - American Gas Association; www.aga.org.
13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
15. AI - Asphalt Institute; www.asphaltinstitute.org.
16. AIA - American Institute of Architects (The); www.aia.org.
17. AISC - American Institute of Steel Construction; www.aisc.org.
18. AISI - American Iron and Steel Institute; www.steel.org.
19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
21. ANSI - American National Standards Institute; www.ansi.org.
22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
23. APA - APA - The Engineered Wood Association; www.apawood.org.
24. APA - Architectural Precast Association; www.archprecast.org.
25. API - American Petroleum Institute; www.api.org.
26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
27. ARI - American Refrigeration Institute; (See AHRI).
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASCE - American Society of Civil Engineers; www.asce.org.
30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWWA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.



45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - CSA Group; www.csa.ca.
65. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
79. ESTA - Entertainment Services and Technology Association; (See PLASA).



80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. **FM Global - FM Global**; (Formerly: FMG - FM Global); www.fmglobal.com.
87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.; www.floridarroof.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. IAS - International Approval Services; (See CSA).
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
113. ILI - Indiana Limestone Institute of America, Inc.; www.ili.ai.com.
114. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.



115. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
116. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
117. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
118. ISO - International Organization for Standardization; www.iso.org.
119. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
120. ITU - International Telecommunication Union; www.itu.int/home.
121. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
122. LMA - Laminating Materials Association; (See CPA).
123. LPI - Lightning Protection Institute; www.lightning.org.
124. MBMA - Metal Building Manufacturers Association; www.mbma.com.
125. MCA - Metal Construction Association; www.metalconstruction.org.
126. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
127. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
128. MHIA - Material Handling Industry of America; www.mhia.org.
129. MIA - Marble Institute of America; www.marble-institute.com.
130. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
131. MPI - Master Painters Institute; www.paintinfo.com.
132. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
133. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
134. NACE - NACE International; (National Association of Corrosion Engineers International); www.nace.org.
135. NADCA - National Air Duct Cleaners Association; www.nadca.com.
136. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
137. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
138. NBI - New Buildings Institute; www.newbuildings.org.
139. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
140. NCMA - National Concrete Masonry Association; www.ncma.org.
141. NEBB - National Environmental Balancing Bureau; www.nebb.org.
142. NECA - National Electrical Contractors Association; www.necanet.org.
143. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
144. NEMA - National Electrical Manufacturers Association; www.nema.org.
145. NETA - InterNational Electrical Testing Association; www.netaworld.org.
146. NFHS - National Federation of State High School Associations; www.nfhs.org.
147. NFPA - National Fire Protection Association; www.nfpa.org.
148. NFPA - NFPA International; (See NFPA).



149. NFRC - National Fenestration Rating Council; www.nfrc.org.
150. NHLA - National Hardwood Lumber Association; www.nhla.com.
151. NLGA - National Lumber Grades Authority; www.nlga.org.
152. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
153. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
154. NRCA - National Roofing Contractors Association; www.nrca.net.
155. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
156. NSF - NSF International; www.nsf.org.
157. NSPE - National Society of Professional Engineers; www.nspe.org.
158. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
159. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
160. NWFA - National Wood Flooring Association; www.nwfa.org.
161. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
162. PDI - Plumbing & Drainage Institute; www.pdionline.org.
163. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); <http://www.plasa.org>.
164. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
165. RFCI - Resilient Floor Covering Institute; www.rfci.com.
166. RIS - Redwood Inspection Service; www.redwoodinspection.com.
167. SAE - SAE International; www.sae.org.
168. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
169. SDI - Steel Deck Institute; www.sdi.org.
170. SDI - Steel Door Institute; www.steeldoor.org.
171. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
172. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
173. SIA - Security Industry Association; www.siaonline.org.
174. SJI - Steel Joist Institute; www.steeljoist.org.
175. SMA - Screen Manufacturers Association; www.smainfo.org.
176. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
177. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
178. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
179. SPIB - Southern Pine Inspection Bureau; www.spib.org.
180. SPRI - Single Ply Roofing Industry; www.spri.org.
181. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
182. SSINA - Specialty Steel Industry of North America; www.ssina.com.
183. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
184. STI - Steel Tank Institute; www.steel tank.com.
185. SWI - Steel Window Institute; www.steelwindows.com.
186. SWPA - Submersible Wastewater Pump Association; www.swpa.org.



187. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
188. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
189. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
190. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
191. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
192. TMS - The Masonry Society; www.masonrysociety.org.
193. TPI - Truss Plate Institute; www.tpinst.org.
194. TPI - Turfgrass Producers International; www.turfgrassod.org.
195. TRI - Tile Roofing Institute; www.tilerroofing.org.
196. UL - Underwriters Laboratories Inc.; <http://www.ul.com>.
197. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
198. USAV - USA Volleyball; www.usavolleyball.org.
199. USGBC - U.S. Green Building Council; www.usgbc.org.
200. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
201. WA - Wallcoverings Association; www.wallcoverings.org
202. WASTEC - Waste Equipment Technology Association; www.wastec.org.
203. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
204. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
205. WDMA - Window & Door Manufacturers Association; www.wdma.com.
206. WI - Woodwork Institute; www.wicnet.org.
207. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
208. WWPA - Western Wood Products Association; www.wwpa.org.

C. 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. This information is believed to be accurate as of the date of the Contract Documents.

1. DIN - Deutsches Institut für Normung e.V.; www.din.de.
2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
3. ICC - International Code Council; www.iccsafe.org.
4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. 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. Information is subject to change and is up to date as of the date of the Contract Documents.

1. COE - Army Corps of Engineers; www.usace.army.mil.
2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.



3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 4. DOD - Department of Defense; www.quicksearch.dla.mil.
 5. DOE - Department of Energy; www.energy.gov.
 6. EPA - Environmental Protection Agency; www.epa.gov.
 7. FAA - Federal Aviation Administration; www.faa.gov.
 8. FG - Federal Government Publications; www.gpo.gov/fdsys.
 9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- E. 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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 3. DSCC - Defense Supply Center Columbus; (See FS).
 4. FED-STD - Federal Standard; (See FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org/ccb.
 6. MILSPEC - Military Specification and Standards; (See DOD).
 7. USAB - United States Access Board; www.access-board.gov.
 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).



- F. State 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. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 3. CDHS; California Department of Health Services; (See CDPH).
 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
 7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservation.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



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 Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to Architect, testing agencies, and authorities having jurisdiction.
- B. Sewer Service: Owner will pay sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: Owner will pay water-service use charges for water used by all entities for construction operations. Contractor shall install approved DC Water meter.
- D. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.
- E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without payment of use charges. Provide connections and extensions of services as required for construction operations.



- F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Safety Plan: Show emergency contacts, rally points, evacuation routes, hot work program, lock out tag out requirements, pedestrian controls, delivery and project access routes, and identification of On Site Safety Supervisor. Plan must comply with OSHA or local jurisdiction requirements, whichever is more stringent
- C. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
- D. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, timesteps, graphic elements, and message content.
- E. LEED Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
 1. Locations of dust-control partitions at each phase of work.
 2. HVAC system isolation schematic drawing.
 3. Location of proposed air-filtration system discharge.
 4. Waste handling procedures.
 5. Other dust-control measures.

1.5 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. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top rails.
- B. **Portable** Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.
- C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.
- D. **Wood** Enclosure Fence: Plywood, **8 feet (2.4 m)** high, framed with four 2-by-4-inch (50-by-100-mm) rails, with preservative-treated wood posts spaced not more than 8 feet (2.4 m) apart.
- E. Dust-Control Adhesive-Surface Walk-off Mats: Provide mats minimum 36 by 60 inches (914 by 1624 mm).
- F. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.



2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or **mobile units** with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Field Offices, General: Owner will provide conditioned **interior space** for field offices for duration of Project.
- C. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no less than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- (1.2-m-) square tack and marker boards.
 - 3. Drinking water and private toilet.
 - 4. Coffee machine and supplies.
 - 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F (20 to 22 deg C).
 - 6. Lighting fixtures capable of maintaining average illumination of 20 fc (215 lx) at desk height.
 - 7. **Provide data/internet connectivity to support owner staff requirements**
- D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide 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 qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
 - 3. **LEED** Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with



MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 7700 "Closeout Procedures".

- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate 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.
 - 1. Locate facilities to limit site disturbance as specified in Section 01 1000 "Summary."
- 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.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
 - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- 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 water service**, meter, and distribution piping in sizes and pressures adequate for construction.



- D. Water Service: **Connect to Owner's existing** water service facilities and install an approved DC meter. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
 - 1. Toilets: Use of Owner's **existing toilet facilities if approved**, as long as facilities are cleaned and maintained daily by the contractor in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- F. Temporary Heating and Cooling: Unless Owner authorizes use of permanent HVAC system for temporary heating or 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. Methods of temporary heating shall be approved by governing agencies having legal jurisdiction. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary ventilation and dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- G. Isolation of Work Areas in **Occupied Facilities**: Prevent dust, fumes, noise, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- H. Electric Power Service: **Connect to Owner's** existing electric power service. Maintain equipment in a condition acceptable to Owner.



- I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 1. Install electric power service overhead unless otherwise indicated.
- J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
 2. Install lighting for Project identification sign.
- K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install Wi-Fi access equipment or land-based data line(s) for each field office.
 1. At each field office entry, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 2. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 3. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 1.0 Mbps upload and 15 Mbps download speeds at each computer.
 4. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
 5. Backup: External hard drive, minimum 2 terabyte, with automated backup software providing daily backups.

3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining



after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
 - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

- C. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to **Section 31 2000** "Earth Moving."
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proof rolling, compacting, and testing.
 - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to **Section 32 1216** "Asphalt Paving."

- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.

- E. Parking: **Use designated areas of Owner's existing** parking areas for construction personnel.

- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.

- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required informing public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.



3. Maintain and touchup signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in **Section 01 7419** "Construction Waste Management and Disposal."
- I. Waste Disposal Facilities: **Provide waste-collection containers** in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 7300 "Execution."
- J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- K. Temporary Elevator Use: [**See Section 142100 "Electric Traction Elevators," Section 142113 "Electric Traction Freight Elevators," Section 142400 "Hydraulic Elevators," Section 142413 "Hydraulic Freight Elevators," and Section 142600 "Limited-Use/Limited-Application Elevators" for temporary use of new elevators**].
- L. **Existing Elevator Use:** Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
 1. Do not load elevators beyond their rated weight capacity.
 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage Owner's elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- M. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- N. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- O. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.



3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 01 1000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with **LEED requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and** requirements specified in Section 311000 "Site Clearing."
- D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to **[erosion- and sedimentation-control Drawings] [LEED requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent]**.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- E. Storm water Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of storm water from heavy rains.
- F. Tree and Plant Protection: Comply with requirements specified in **Section 01 5639** "Temporary Tree and Plant Protection."
- G. Tree and Plant Protection: **Install temporary fencing** located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- H. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, 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 materials approved by authorities having jurisdiction.

- I. **Site Enclosure Fence:** [**Before construction operations begin**] [**Prior to commencing earthwork**], furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 1. **Extent of Fence:** As indicated on Drawings or if not indicated, 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.** Furnish one set of keys to Owner.
- J. **Security Enclosure and Lockup:** Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- K. **Barricades, Warning Signs, and Lights:** Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- L. **Temporary Egress:** Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- M. **Covered Walkway:** Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.
 1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 2. Paint and maintain appearance of walkway for duration of the Work.
- N. **Temporary Enclosures:** Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- O. **Temporary Partitions:** Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 1. Construct dustproof partitions with 20 gauge steel studs, gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.



- a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.
 2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
 3. Insulate partitions to control noise transmission to occupied areas.
 4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
 5. Protect air-handling equipment.
 6. Provide walk-off mats at each entrance through temporary partition.
- P. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses 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.

3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 3. Indicate methods to be used to avoid trapping water in finished work.



- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.

- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
 - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 - 2. Keep interior spaces reasonably clean and protected from water damage.
 - 3. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard, replace, or clean stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use permanent HVAC system to control humidity.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.



3.7 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 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.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 7700 "Closeout Procedures."

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 Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 01 21 00 "Allowances" for products selected under an allowance.
 - 2. Section 01 23 00 "Alternates" for products selected under an alternate.
 - 3. Section 01 2 500 "Substitution Procedures" for requests for substitutions.
 - 4. Section 01 42 00 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained 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. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Architect 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.



- B. **Basis-of-Design Product Specification:** A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. **Subject to Compliance with Requirements:** Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.

1.4 ACTION SUBMITTALS

- A. **Comparable Product Request Submittal:** Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number, title, and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. **Architect's Action:** If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
 - a. **Form of Approval:** As specified in Section 01 3300 "Submittal Procedures."
 - b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.
- B. **Basis-of-Design Product Specification Submittal:** Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.



1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 - 3. See individual identification sections in Divisions 21, 22, 23, 25, and 26 for additional identification requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- 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 on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.



- C. Storage:
 - 1. Store products to allow for inspection and measurement of quantity or counting of units.
 - 2. Store materials in a manner that will not endanger Project structure.
 - 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 - 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 6. Protect stored products from damage and liquids from freezing.
 - 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrently 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: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for 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 indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 01 7700 "Closeout Procedures."



PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, 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. 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.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.



- a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
 4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
 5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
 6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
 7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated 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 requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 01 2500 "Substitution Procedures" for substitutions for convenience.
- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.



1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 2500 "Substitution Procedures" for proposal of product.

- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated 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 architects and owners, if requested.
 5. Samples, if requested.
- B. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION



SECTION 01 73 00 EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 01 10 00 "Summary" for limits on use of Project site.
 - 2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
 - 3. Section 01 77 00 "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. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.
 - 5. Section 07 84 13 "Penetration Firestopping" for patching penetrations in fire-rated construction.

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 construction to original conditions after installation of other work.



1.4 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affecting by cutting and patching operations.
 - 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- B. Cutting and Patching Plan: Submit plan-describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities, Mechanical, and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
 - 6. For existing work which is cut and patched and is under warranty, submit documentation from warranting entity certifying existing work has been inspected and warranty remains in effect and unchanged.



- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Certified Surveys: Submit 2 copies signed by land surveyor.
- E. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - a. Before cutting concrete floors, search for concealed conduit, steel tendons, and other similar items by use of nondestructive testing.
 - 2. 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 that result in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Mechanical systems piping and ducts.
 - f. Control systems.
 - g. Communication systems.
 - h. Fire-detection and -alarm systems.
 - i. Conveying systems.
 - j. Electrical wiring systems.
 - k. Operating systems of special construction.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity that results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or



safety. Other construction elements include but are not limited to the following:

- a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements
- B. In-Place Materials: Use materials for patching 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 provide a match acceptable to Architect for the visual and functional performance of in-place materials.
- C. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.



PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: 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, mechanical and electrical systems, 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; underground electrical services, and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, 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. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to **[local utility]** **[Owner]** 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. **Review of Contract Documents and Field Conditions:** Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 3100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. **Verification:** Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. **General:** Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. **Site Improvements:** Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. **Building Lines and Levels:** Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.



- E. 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.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of 2 permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.



2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. 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 96 inches (2440 mm) in occupied spaces and 90 inches (2300 mm) in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. 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.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive 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 portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 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. Repair or remove and replace damaged, defective, or nonconforming Work.
 1. Comply with Section 01 7700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
 1. Notify warrantor before commencing with cutting and patching.
 2. Upon completion of patching, secure written certification from warrantor that warranty of cut and patched construction is unchanged and remains in effect. Submit certification at Project closeout.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. 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.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 1000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.



- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained 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 neatly to minimum 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.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. 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.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. 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 practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical 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 minimize 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: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. 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, prepare substrate and apply primer and intermediate paint coats appropriate for substrate 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 and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
1. 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.
 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. 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 waste materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
- 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: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in [**Section 01 5000 "Temporary Facilities and Controls."**] [**Section 01 7419 "Construction Waste Management and Disposal."**]
- 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.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in **Section 0 19113** "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.



- 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: Comply with qualification requirements in Section 01 4000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of **Existing Items**: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION



SECTION 01 77 00 CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Requirements:
 - 1. Section 01 32 33 "Photographic Documentation" for submitting final completion construction photographic documentation.
 - 2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 3. Section 01 78 39 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 4. Section 01 79 00 "Demonstration and Training" for requirements for instructing Owner's personnel.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.



- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, compliance documents, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by American University Material Supply Manager. Label with manufacturer's name, model number, and American University Asset Identification Number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain American University Project Manager's signature for receipt of submittals and contractor shall transmit items to American University Material Supply Manager for final signature of receipt.
 - 5. Submit test/adjust/balance records.
 - 6. Submit sustainable design submittals not previously submitted.
 - 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.



- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in heat and other utilities.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect and Commissioning Agent, that must be completed or corrected before certificate will be issued.
1. 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.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Section 01 2900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect and Commissioning Agent. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.



3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.
5. Submit final completion photographic documentation.

- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: 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.
1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems including commissioning items.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect.
 - d. Name of Contractor.
 - e. Page number.
 4. Submit list of incomplete items in MS Excel, PDF electronic file, or other format acceptable to Architect.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated 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 Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (215-by-280-mm) 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 executed warranty to include in operation and maintenance manuals.
- E. Warranty Electronic File: Provide executed warranties and bonds in PDF format. Assemble complete executed warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to the Owner, and/or by uploading to web-based project software site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. 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.
 - 1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels. (LEED)



PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. 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 designated portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, 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, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Sweep concrete floors broom clean in unoccupied spaces.
 - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - k. Remove labels that are not permanent.
 - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.



- m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - p. Clean, repair, or replace damaged or soiled ceilings, ceiling tiles, and fixtures. Painting of ceiling tiles and/or grid is not acceptable.
 - q. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
 - r. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 5000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 5000 "Temporary Facilities and Controls." and/or Section 01 7419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair, or remove and replace, defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
- 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
 - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - 3. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
 - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent to comply with requirements for new fixtures.



END OF SECTION



SECTION 01 78 23 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Section 01 91 13 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

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 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect, Owner, and Commissioning Authority will comment on whether content and organizational format of operation and maintenance submittals is acceptable.



2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 1. Submit on digital media acceptable to Owner or by uploading to web-based project software site to Architect.
 2. Submit electronic copy. Architect will return an approved copy.
 - C. Initial Manual Submittal: Submit draft electronic copy of each manual at least 30 days before commencing demonstration and training. Architect, Owner, and Commissioning Agent will comment on whether general scope and content of manual are acceptable.
 1. Correct or revise each manual to comply with Architect, Owner, and Commissioning Agent comments. Submit copies of each corrected manual within 5 days of receipt of Architect, Owner, and Commissioning Agent] comments and prior to commencing demonstration and training.
 - D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 14 days before commencing demonstration and training. Architect, Owner, and Commissioning Agent will return copy with comments.
 - E. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
 1. Binders: Heavy-duty, three-ring, vinyl-covered binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) 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 of the manual. 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 storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
 4. Supplementary Text: Prepared on 8-1/2-by-11-inch (215-by-280-mm) 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.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: 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: 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 and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 8. Name and contact information for Commissioning Authority.
 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 10. 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.
- 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."
- ## 1.7 EMERGENCY MANUALS
- A. 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.
- B. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
 2. Emergency instructions.
 3. Emergency procedures.
- C. 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. Flood.
 3. Gas leak.



4. Water leak.
 5. Power failure.
 6. Water outage.
 7. System, subsystem, or equipment failure.
 8. Chemical release or spill.
- D. 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.
- E. 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 including alarms.
 6. Restart and Release requirements.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
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.
- B. 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. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has 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.



- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 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.
- D. 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. Adjustment parameters.
 - 6. Instructions on stopping.
 - 7. Normal shutdown instructions.
 - 8. Seasonal and weekend operating instructions.
 - 9. Required sequences for electric or electronic systems including alarms.
 - 10. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
 - 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.
- B. 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 warranties and bonds as described below.

- C. 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 and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; 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.
 - a. 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.
 - 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.
- E. 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.
 - 6. Demonstration and training video recording, if available.
- F. 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.



- G. 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.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. 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.
- J. 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 maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. 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.
- C. 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 and drawing or schedule designation or identifier where applicable.
- D. 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.



- E. 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.

- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

- G. 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION



SECTION 01 78 39 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.
- B. Related Requirements:
 - 1. Section 0 173 00 "Execution" for final property survey.
 - 2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
 - 3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit copies of record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and 1 of file prints.
 - 2) Submit record digital data files including and 1 set of plots.
 - 3) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned record prints and 1 sets of prints.
 - 2) Submit record digital data including .dwg files and complete Revit file and 1 set(s) of record digital data file plots.



- 3) [Print] [Plot] each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
 - C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
 - D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 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 provide information for preparation of corresponding 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 acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 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 with damper locations.
 - i. Locations of concealed internal utilities.
 - j. Fire rated walls.
 - k. Changes made by Change Order or Construction Change Directive.
 - l. Changes made following Architect's written orders.
 - m. Details not on the original Contract Drawings.
 - n. Field records for variable and concealed conditions.
 - o. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 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. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. **Format:** Same digital data software program, version, and operating system as the original Contract Drawings.
 2. **Format:** Annotated PDF electronic file with comment function enabled.
 3. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 4. Refer instances of uncertainty to Architect for resolution.
 5. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 01 3100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. **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. **Format:** Annotated PDF electronic file with comment function enabled.



3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect.
 - e. Name of Contractor.

1.5 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. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 3. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. 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.
- C. Format: Submit record Product Data as annotated PDF electronic file.
 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.



1.7 MISCELLANEOUS RECORD SUBMITTALS

- A. 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.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
 - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents 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.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION



SECTION 01 79 00 DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 1. Demonstration of operation of systems, subsystems, and equipment by Contractor and/or Subcontractor responsible for installation. Training shall not be a part of start-up or commissioning processes.
 2. Training in operation and maintenance of systems, subsystems, and equipment.
 3. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and 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.
 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator, instructor, and videographer.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.



- a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Materials required for required scheduled maintenance
 - f. Project Record Documents.
 - g. Identification systems.
 - h. Warranties and bonds.
 - i. 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.

1.8 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 7823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner and Commissioning Agent with at least 14 days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in classroom setting and in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.



- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, a written, or a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in approved Owner format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.
 - 1. Submit video recordings on approved media.
 - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.



- c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded or by dubbing audio narration off-site afterwards. Include description of items being viewed.
- F. Transcript: Provide a transcript of the agenda and narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION



01 91 13 GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

Commissioning is defined as a systematic process of assuring by verification and documentation that all building facility systems perform interactively in accordance with the design documentation and intent, and in accordance with the owner's operational needs, including preparation of operations personnel.

This owner's commissioning specification is to be incorporated into design and construction specifications as part of the title section listed above, General Commissioning Requirements (01 9113). AU typically contracts directly with a third-party Commissioning Authority (CxA).

The Commissioning Authority must approve the incorporation of this specification into the design and construction specification no later than the fifty-percent (50%) submission (Design Phase). Items to be modified will be decided by consultation involving the AU Project Manager, the Commissioning Consultant, and Facilities Management (FM).

This Commissioning Specification is intended to cover the greatest extent of commissioning performed at American University (i.e. Capital Projects); thus, Facilities Management recognizes that the commissioning requirements of this specification will depend on the size and scope of the project.

The AU Facilities Management Commissioning (FM Cx) Team is to be included starting at the project initiation phase (Owners Program Requirement) through project closeout.

FM provides web based commissioning software that the project team is required to use. This software platform is not an intended as a substitute for other project planning, design, scheduling, or closeout tracking.

SUMMARY

A. This Section includes information on the following:

1. The commissioning plan
2. Commissioning coordination meetings and scheduling
3. Submittal reviews
4. Trend Logs
5. Test plans
6. Prefunctional checklists



7. Functional performance testing
8. Documentation of equipment and system deficiencies
9. Corrective actions and acceptance of corrected equipment systems
10. Operations and maintenance manuals review
11. Equipment and systems operations and maintenance training
12. Occupant training execution
13. Warranty information collection and hand-off
14. As-built documentation review
15. Systems manual and on-going commissioning plan
16. Warranty phase check-up and meeting

B. Scope of work

1. Commissioning requirements common to all sections
2. Systems and equipment start-up, pre-functional checks, and functional performance testing.
3. Validation of proper and thorough installation of systems and equipment
4. Documentation of procedures, tests, and installations
5. Coordination and requirements of training events
6. Preparation and logistics of Facility Manual content
7. Management of Record Construction Documentation
8. Sequencing

1.1 COMMISSIONING PLAN

- A. The American University Master Commissioning Plan, **Revision 1.1, dated March 05, 2012**—herein referred to as “MCP”—shall be incorporated into construction specifications explicitly and by reference.
- B. The MCP is intended to be a roadmap for the parties involved in the Commissioning process. It lists the systems to be commissioned, the Commissioning process activities, and the roles and responsibilities for each party involved.

1.2 COMMISSIONING TEAM

For each member of the Commissioning Team include:

1. Name
2. Company name
3. Title
4. Years of experience
5. Office phone number
6. Cell phone number
7. Fax number
8. E-mail address



For each project, identify responsible individual for the following roles:

1. Owner: American University
2. AU Project Manager:
3. Commissioning Authority: Director of Energy and Engineering, F
4. AU Commissioning Coordinator:
5. Architect:
6. Design Engineer:
7. Build Contractor:
8. Mechanical Contractor:
9. Electrical Contractor:
10. LEED Facilitator:
11. Commissioning Professional:
12. Commissioning Coordination Supervisor:

The Contractor shall assign a person with five (5) years of experience with the coordination of disciplines of construction. The coordinator's responsibilities include:

1. Communication with Owner's Commissioning Professional
2. Commissioning coordination meeting attendance
3. Planning
4. Scheduling
5. Enforcement of subcontractors' specification requirements
6. Subcontractors' quality assurance
7. Documentation
8. Direction of subcontractors' corrective actions
9. Contractors' Representative:

Each of the subcontractors shall assign a person responsible for communications with the Contractor's Commissioning Coordination Supervisor. Responsibilities include:

1. Communication with Commissioning Coordinator Supervision
2. Commissioning coordination meeting attendance
3. Planning
4. Scheduling
5. Operations and Maintenance training manuals
6. Complete prefunctional checklists
7. Review of final functional performance test procedures
8. Functional performance test participation
9. Corrective actions



1.3 SYSTEMS TO BE COMMISSIONED

Systems to be commissioned shall be categorized and listed here as follows:

1. Mechanical systems
2. Life safety systems
3. Electrical systems
4. Security systems
5. Building envelope
6. Specialty systems

1.4 COMMISSIONING PROCESS MATRIX

The following matrix tabulates the major commissioning activities, when they occur during the project life cycle, and the commissioning team member roles and responsibilities for each activity. For additional detail, please refer to Section 1.6: Commissioning Activities Narratives.

In the Commissioning Team Member columns an “R” indicates the responsible team member for each activity, and a “√” indicates a team member who needs to participate in the activity.

	PROJECT PHASES					COMMISSIONING TEAM MEMBERS						
	Planning	Design	Construction	Acceptance	Warranty	AU Project Manager	AU Construction Mgr	AU Facilities Cx Authority	Other AU Departments	Design Team	Construction Team	Cx Manager
Preliminary Commissioning Plan	√							R				
Owner's Project Requirements (OPR) Document	√	√	√			√		R	√			√
Design Phase Commissioning Coordination Meetings		√				√	√	√		√		R
Basis of Design (BOD) Document		√				√		√	√	R		√
O&M Documentation Planning		√						R				√
O&M Training Planning		√						R				√



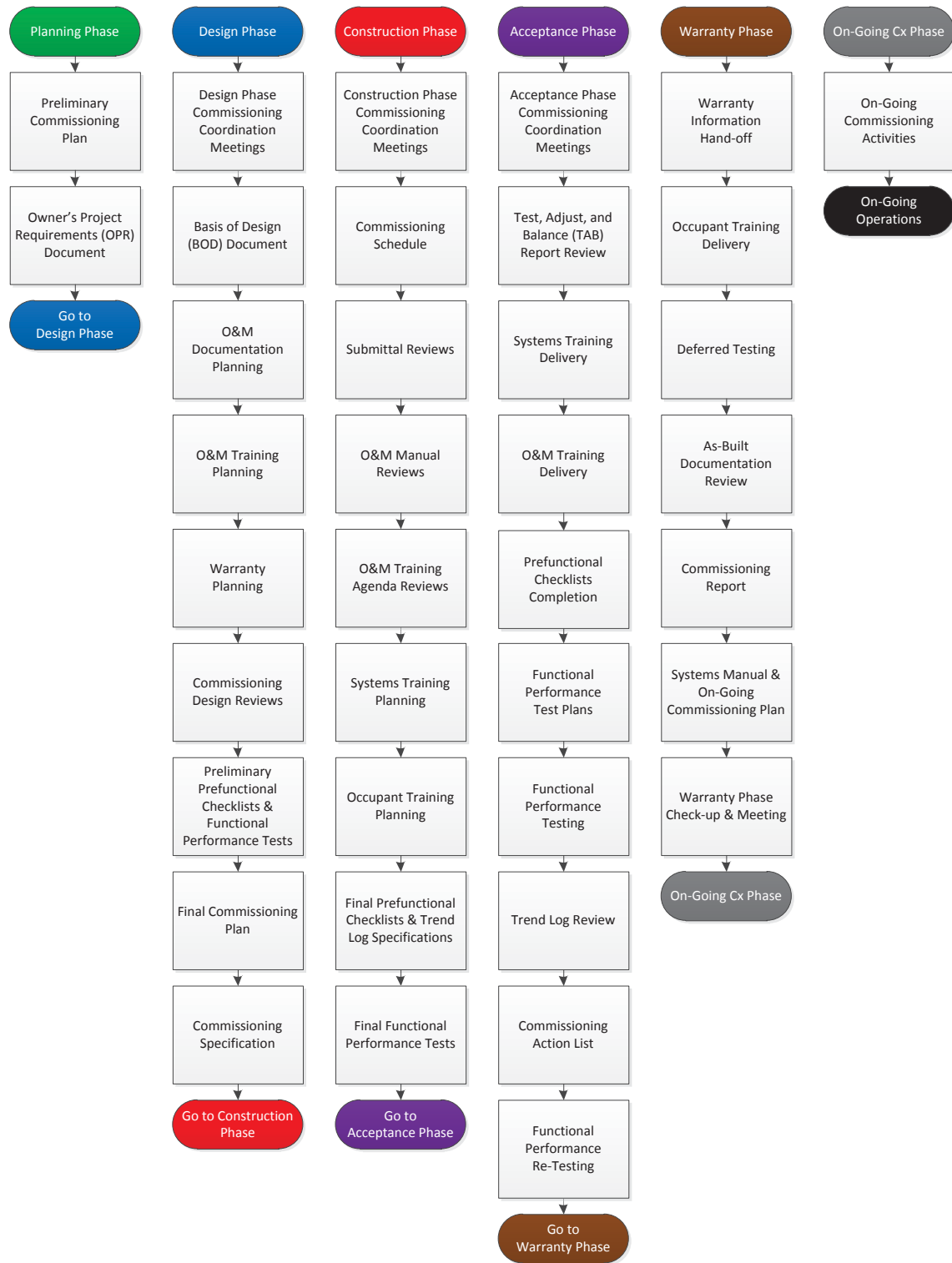
	PROJECT PHASES					COMMISSIONING TEAM MEMBERS						
	Planning	Design	Construction	Acceptance	Warranty	AU Project Manager	AU Construction Mgr	AU Facilities Cx Authority	Other AU Departments	Design Team	Construction Team	Cx Manager
Warranty Planning		✓				✓		R				✓
Commissioning Design Reviews		✓				✓	✓	✓	✓	✓		R
Preliminary Prefunctional Checklists & Functional Performance Tests		✓						✓				R
Final Commissioning Plan		✓				✓	✓	✓		✓		R
Commissioning Specification		✓						✓		✓		R
Construction Phase Commissioning Coordination Meetings			✓				✓	✓			✓	R
Commissioning Schedule			✓				✓	✓			R	✓
Submittal Reviews			✓					✓		✓	✓	R
O&M Manual Reviews			✓					✓			✓	R
O&M Training Agenda Reviews			✓					✓			✓	R
Systems Training Planning		✓						✓		✓	✓	R
Occupant Training Planning		✓						✓	✓			R
Final Prefunctional Checklists & Trend Log Specifications			✓					✓			✓	R
Final Functional Performance Tests			✓					✓			✓	R
Acceptance Phase Commissioning Coordination Meetings				✓			✓	✓			✓	R
Test, Adjust, and Balance (TAB) Report Review				✓				✓		✓	✓	R



	PROJECT PHASES					COMMISSIONING TEAM MEMBERS						
	Planning	Design	Construction	Acceptance	Warranty	AU Project Manager	AU Construction Mgr	AU Facilities Cx Authority	Other AU Departments	Design Team	Construction Team	Cx Manager
Systems Training Delivery		✓						✓		✓	✓	R
O&M Training Delivery				✓				✓			R	✓
Prefunctional Checklist Completion				✓							R	✓
Functional Performance Test Plans				✓				✓			✓	R
Functional Performance Testing				✓				✓			✓	R
Trend Log Review				✓				✓			✓	R
Commissioning Action List		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	R
Functional Performance Re-Testing				✓				✓			✓	R
Warranty Hand-off Information					✓		R	✓			✓	✓
Occupant Training Delivery				✓			✓	✓	✓			R
Deferred Testing					✓			✓			✓	R
As Built Documentation Review					✓		✓	✓		✓	✓	R
Commissioning Report					✓			✓				R
Systems Manual & On-Going Cx Plan					✓			✓		✓	✓	R
Warranty Phase Check-up & Meeting					✓	✓	✓	✓	✓	✓	✓	R
On-Going Commissioning Activities								R				



1.5 COMMISSIONING PROCESS FLOWCHART





1.6 COMMISSIONING ACTIVITIES NARRATIVES

1.6.1 PLANNING PHASE ACTIVITIES

Preliminary Commissioning Plan

The Preliminary Commissioning Plan will focus on identifying project-specific commissioning activities, commissioning team members, and roles and responsibilities for all team members as part of the commissioning process. The Preliminary Commissioning Plan will be prepared by the Facilities Management Commissioning Authority and will be incorporated into requests for proposal for Design Team and Commissioning Manager services.

Example prefunctional checklists (PFCs) and functional performance test procedures (FPTs) will be included in the Preliminary Commissioning Plan as appendices to demonstrate level of rigor required of future commissioning team members.

Owner's Project Requirements (OPR) Document

The Owner's Project Requirements (OPR) will quantitatively define the performance and operational requirements for the commissioned systems. These performance requirements will be the acceptance criteria against which the systems will be judged. They will include parameters such as temperatures, flows, pressures, moisture content, light fixture types, light levels, warranty information requirements, central system availability/tie-in capability, electrical spare capacity requirements, building automation system requirements, etc.

For LEED certification purposes, the OPR must include the following sections:

- Owner and User Requirements
- Environmental and Sustainability Goals
- Energy Efficiency Goals
- Indoor Environmental Quality Requirements
- Equipment and System Expectations
- Building Occupant and Operations and Maintenance Requirements

The Facilities Management Commissioning Authority will oversee the development of the OPR, but critical input will be needed from the Project Manager, Occupant/User Groups, and the Designers.



The Commissioning Manager will maintain the OPR throughout the duration of the project, editing as necessary to reflect American University performance expectation changes.



1.6.2 DESIGN PHASE ACTIVITIES

Design Phase Commissioning Coordination Meetings

The Commissioning Manager in conjunction with the AU Project Manager will plan, facilitate and document Design Phase Commissioning Coordination Meetings. The coordination meetings are intended to help every team member understand and execute their roles and responsibilities within the commissioning process, to coordinate the details of current and upcoming commissioning activities, and to review outstanding action items.

The first meeting will be a Design Phase Commissioning Kickoff Meeting to review the specifics of the Commissioning process, identify representatives to the Commissioning Team, and establish communication and documentation protocols for implementing the Commissioning process as effectively and efficiently as possible. This meeting provides an overview so that the team understands the big picture and the benefits they will accrue by participating in the process.

Subsequent Commissioning Coordination Meetings will be held as frequently as deemed necessary by the Commissioning Manager to remain integrated into the Design Phase process and to coordinate Commissioning deliverables into the bid documents.

The Commissioning Manager will assist with the development of the project specific Owner Program Requirements (OPR) by engaging with the Design Team and AU. The Commissioning Manager will identify for owner pre-review any variances with the existing AU Temperature Control Policy and accepted Building Master Plan sequences and strategies for exception approval by the Design Team and Facilities Management prior to developing the Basis of Design document.

Basis of Design (BOD) Document

The Basis of Design (BOD) documents the Design Team's approach to achieving the requirements of the OPR. It describes the types of equipment to be used, system configurations, systems interactions, and general operating strategies. It also documents any general rules, philosophies, and assumptions made by the Design Team. This document will be created and managed by the Design Team and reviewed by the Facilities Management Commissioning Authority and the Commissioning Manager.

Throughout the life of the project, the Commissioning Manager will monitor the design Evolution and bring any deviations from the BOD to the attention to the Design Team. If changes to the system design and operational strategies are made during the project, a final BOD will be prepared by the Design Team at the end of construction.



Operations & Maintenance (O&M) Documentation Planning

In the Construction Phase, the Contractor will facilitate and manage the delivery of accurate, meaningful, and timely operation and maintenance (O&M) documentation to the Facilities Management Commissioning Authority. Planning for this will take place in the Design Phase in order to incorporate project-customized requirements into the contract documents.

The Commissioning Manager will participate in the discussion and definition of requirements for O&M documentation (e.g., hardcopy & electronic copy requirements, equipment O&M criteria, planned maintenance schedules, systems manual and on-going commissioning criteria, etc.) with the Facilities Management Commissioning Authority. The Commissioning Manager will coordinate with the Design Team to confirm that project specifications reflect American University's O&M documentation requirements.

System Training Planning

Whereas the O&M Training sessions will pertain to individual pieces of equipment, the Systems Training sessions will focus on how those components are uniquely put together as systems for the project. The Commissioning Manager will facilitate the development of a Systems Training program. The purpose of this training will be to present all of the commissioned systems; their design intent; schematic diagrams; sequences of operation; integration with other systems; and areas of the building served by the systems.

Although facilitated by the Commissioning Manager, Systems Training will be a collaborative effort between the Design Team, the Contractors, and the Commissioning Manager; each delivering their area of expertise for each system.

Systems training planning will require defining the type and level of training required for the systems; number of sessions; video recording expectations; training agenda; and presentation/documentation materials. The Commissioning Manager will compile Systems Training presentation materials from documents submitted by the Design Team and the Construction Team.

Operations & Maintenance (O&M) Training Planning

To achieve successful operations & Maintenance (O&M) training delivery, the FM Commissioning Authority needs to start with a well-thought-out, un-hurried process for planning the training process. The Commissioning Manager will involve the Facilities Management Commissioning Authority as much as possible to define what training the Facilities Management staff needs and wants in order to understand the systems and equipment that they will have to operate. This will involve customizing training to



match the level of experience and detail that AU Facilities Management will require for each system.

The Commissioning Manager will participate in the discussion and definition of requirements for O&M training (e.g., differentiating between systems and equipment training; addressing levels of training; O&M shift coordination; video recording expectations; training agenda and documentation requirements, etc.) with the Facilities Management Commissioning Authority.

Occupant Training Planning

With an understanding that some building systems require certain behaviors from building occupants and system users in order to perform as intended, the Commissioning Manager will facilitate the development of an Occupant Training program. The Occupant Training program will introduce, in appropriately technical terms for the occupants, the systems affecting the occupied spaces. The training will also present the various ways in which the occupants may be able to influence system performance (i.e., opening doors and windows, adjusting thermostats, introducing space heaters, moving furniture, overriding occupancy sensors, etc.) and establish ground rules for building occupant behavior.

Warranty Planning

The warranty information requirements will be defined in the contract documents and will define how the warranty information is transitioned from the Contractor to the Facilities Management Commissioning Authority at the end of construction. The Facilities Management Commissioning Authority and the Commissioning Manager will work with the Project Manager to define the warranty information format which will include, at a minimum, master equipment lists; warranty start and end dates; manufacturer contact information; extended warranty (if any) details; planned maintenance activities required to keep equipment under warranty; etc.

The Commissioning Manager will coordinate with the Design Team to confirm that project specifications reflect American University's warranty requirements.

Commissioning Design Reviews

The Facilities Management Commissioning Authority, the AU Construction Manager, AU Other Departments, and the Commissioning Manager will review the design documents at predetermined design phase milestones (e.g., DD, 50% CD, 100% CD/Permit documents). For LEED certification purposes, at least one commissioning design review at the 50% CD phase is required, along with a back check to confirm incorporation of commissioning review comments into the final construction documents.



The Commissioning Manager will review the design drawings and specifications for the following commissioning-related items:

- Compliance with the Owner's Project Requirements.
- Clarity of the design.
- Clear integration requirements between equipment and systems
- Equipment accessibility and maintainability.
- Ability to test and validate system operation.
- O&M Documentation, Training, and Warranty details

Comments will be categorized as follows:

Critical: Issues that in the Commissioning Manager's professional opinion are related to a system's ability to achieve the Owner's Project Requirements performance criteria.

Question: Requests for clarification of intent.

Suggestion: Design features which can meet the Owner's Project Requirements but for which the Commissioning Manager has a recommendation for improved efficiency, increased reliability, and/or lower life cycle cost.

Coordination: Although a commissioning review is not a coordination review, the Commissioning Manager will note coordination items noticed during the course of the commissioning review.

Along with the Commissioning Manager's comments, the Commissioning Manager will collect and consolidate comments from the FM Commissioning Authority and AU Other Departments.

The Design Team will respond in writing to each of the comments provided. Refer to Section 7 of the MCP for the Document Review Template.

Preliminary Prefunctional Checklists & Functional Performance Tests

The Commissioning Manager will prepare preliminary prefunctional checklists and functional performance test procedures for the systems to be commissioned based on the design documents. There shall be one prefunctional checklist and one functional performance test procedure for each commissioned system.

These preliminary documents should be included in the Final Commissioning Plan and incorporated into the bid documents to demonstrate anticipated level of rigor to the Contractor. If project-specific prefunctional checklists and functional performance test procedures cannot be developed, sample documents for similar system types will suffice.



Refer to Section 7 of the MCP for examples of both Prefunctional Checklists and Functional Performance Test Procedures. These examples are intended to communicate format and level of rigor. The actual project checklists and test procedures will be customized to match the final design requirements for each system.

Final Commissioning Plan

The Commissioning Manager will prepare the Final Commissioning Plan, building on and editing the Preliminary Commissioning Plan to reflect the project at the end of the Design Phase. The systems to be commissioned section will be refined to represent the quantity and types of systems in the final construction documents. Sampling strategies pertaining to the functional performance testing will be detailed in the Final Commissioning Plan. The Final Commissioning Plan will be incorporated into the bid documents by reference.

Commissioning Specification

The Commissioning Manager will prepare a Commissioning Specification to be included in the construction documents. The Commissioning Specification will detail the Contractor's responsibilities (as outlined in the Final Commissioning Plan) during the Construction, Acceptance, and Warranty Phases of the project. The Design Team will incorporate the Commissioning Specification into the Division 1 specification section.

The Commissioning Specification will include, but not be limited to commissioning-related scheduling; submittal management; prefunctional checklists; functional performance testing; O&M and systems manuals; O&M and systems training; as-built drawings; and warranty management. Furthermore, the Commissioning Specification will include language defining incentive program(s), if applicable, established to encourage Contractor readiness for functional performance testing.

The Commissioning Manager will recommend coordination language to be included in other Design Team specification sections that will direct the Contractors' attention to the Division 1 Commissioning Specification for required commissioning activities. The Design Team will incorporate, as they deem appropriate, the coordination language into their respective specification sections.

Systems Training Delivery

The Commissioning Manager will facilitate the scheduling of Systems Training with the AU Commissioning Coordinator, the Design Team, and the Construction Team. Systems Training will be executed in two (2) training events: There will be a Mechanical Systems Overview, and an Electrical & Life Safety Systems Overview.



At a minimum, the Mechanical Systems Overview must educate the Facilities Staff on the design intent of the mechanical systems, including the way(s) the building heats, cools, is fed utilities (to include plumbing systems), and connects / interacts with other equipment. The primary audience for this training is AU's Facilities Operations Staff, the Central Plant Staff, and the Energy Management Staff.

The Electrical & Life Safety Systems Overview will, at a minimum, educate the Facilities Staff on the electrical distribution systems, including the normal power, emergency power, and any dedicated uninterruptable power, and the fire suppression system. The primary audience for this training is AU's Facilities Operations Staff, the Electrical & Life Safety Staff. The secondary target audience is the Central Plant Staff and the Public Safety Staff who will respond to University matters after non-normal business hours.

The Mechanical Engineer and the Electrical Engineer will deliver the systems training. Each training session will be scheduled for ninety (90) minutes, allowing an hour for the overview and thirty (30) minutes for a question-and-answer period. The training events will be coordinated for the convenience of the trainees, i.e., between shifts, manageable amounts of training at a time to accommodate trainees' other responsibilities, etc. As a minimum, no training event will be offered less than two (2) times, and will be scheduled on separate days. Training sessions may be offered on the same day if at least one session is video recorded and with the approval of AU Commissioning Authority.

The Commissioning Professional will schedule and coordinate the video recording of the Systems Training sessions with assistance from the American University Commissioning Coordinator.

1.6.3 CONSTRUCTION PHASE ACTIVITIES

Construction Phase Commissioning Coordination Meetings

The Commissioning Manager will plan, facilitate and document Construction Phase Commissioning Coordination Meetings. The coordination meetings are intended to help every team member understand and execute their roles and responsibilities within the commissioning process, to coordinate the details of current and upcoming commissioning activities, and to review outstanding action items.

The first meeting will be a Construction Phase Commissioning Kickoff Meeting to review the specifics of the Commissioning process, identify new representatives to the Commissioning Team, and establish communication and documentation protocols for implementing the Commissioning process as efficiently and effectively as possible. This meeting provides an overview so that the team understands the big picture and the benefits they will accrue by participating in the process.



Subsequent Commissioning Coordination Meetings will be held as frequently as deemed necessary by the Commissioning Manager to remain integrated into the Construction Phase process. Frequency will vary throughout the construction as the Commissioning process requirements vary depending on what is happening on the construction site.

Commissioning Scheduling

There will not be a separate commissioning schedule. The Contractor will be required to incorporate commissioning activities into the master construction schedule. The Commissioning Manager will assist the Contractor, as needed, to understand the relationship between construction and commissioning activities. The Facilities Management Commissioning Authority will regularly review the master construction schedule in order to coordinate the availability of Facilities Management staff for critical commissioning activities.

Master construction schedule commissioning milestones will include, but not be limited to, O&M manual submissions; training agenda submissions; training delivery; prefunctional checklist completion; functional performance testing; system manual and on-going commissioning plan submissions; as-built drawing submissions; and the warranty information hand-off. Some of the activities may require multiple milestones due to some systems following a different construction schedule than others.

Submittal Reviews

The Commissioning Manager will identify submittals associated with systems to be commissioned that need to be reviewed by the Commissioning Manager and Facilities Management staff. The Facilities Management Commissioning Authority, AU Other Departments, and the Commissioning Manager will review the submittals concurrent with the Design Team.

The Contractor will send copies of the selected submittals to the Facilities Management Commissioning Authority and to the Commissioning Manager simultaneous with issuing them to the Design Team for review. The Facilities Management and AU Other Departments reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the Design Team. The Design team will incorporate the commissioning comments, at their discretion, into their formal submittal review responses to the Contractor. The Design Team will provide written responses to each submittal review comment to the Commissioning Manager.

Commissioning submittal review comments will focus on the same areas as the commissioning design reviews (e.g. compliance with the OPR, clarity of the design, integration coordination, accessibility and maintainability, O&M training and



documentation requirements, and the ability to test and validate system operation). Refer to Section 7 of the MCP for the Document Review Template.

The Commissioning Manager and Facilities Management Commissioning Authority will be given access to all approved submittals after processing by the Design Team.

Operations & Maintenance (O&M) Manual Reviews

Early submission of the O&M manuals will help ensure they are complete and approved prior to the start of the AU Facilities Management staff training. The manuals will serve a critical part of the training program.

The Commissioning Manager will identify O&M manuals associated with systems to be commissioned that need to be reviewed by the Commissioning Manager and Facilities Management staff. The Facilities Management reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the Contractors.

O&M Training Agenda Reviews

Each training session - represented by a row in the Training Plan (refer to Section of the MCP 7 for a Training Plan example) - will have a Training Agenda. The Training Agenda requires specific detailed information about the content of its respective session. The agenda will be completed by the Contractor responsible for the training session and will be reviewed by the Facilities Management Commissioning Authority and the Commissioning Manager. The Facilities Management reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the Contractors.

During delivery of the O&M training sessions, each approved Training Agenda form will be used to document attendees of the training session and to formalize American University's acceptance of the training.

Final Prefunctional Checklists & Trend Log Specifications

The Commissioning Manager will finalize Prefunctional Checklists (PFCs) customized for each system to be commissioned after reviewing approved submittals, requests for information, change orders, supplemental instructions, and other construction phase modifications and/or additions. The Commissioning Manager will issue final PFCs to the Facilities Management Commissioning Authority for review and comment. Upon incorporation of accepted Facilities Management Commissioning Authority comments,



the Commissioning Manager will issue final PFCs for completion and sign-off by the Contractor during final system checkout.

The PFCs shall be used to document that key system-level installation, startup, programming, coordination, integration, and testing activities have been completed. These are not contractor quality control checklists for each piece of equipment but system-level confirmation of readiness for the system's Functional Performance Test. The General Contractor will be responsible for overseeing the completion of the checklists by the Subcontractors, because each system typically requires the participation of multiple Subcontractors to be complete and ready for testing.

Examples of Prefunctional Checklist items include, but are not limited to, pipe pressure testing; duct air leakage testing; electrical wiring; major equipment startup; variable frequency drive setup; controls point-to-point checkout; controls programming; test, adjust, and balance completion and issues resolution; successful completion of the contractor-only dry run of the Functional Performance Test, etc.

PFCs for systems controlled and /or monitored by central campus energy management system (EMS) include a requirement that building automation system graphics screen is complete, points have been properly mapped to the central EMS, and AU Facilities Management personnel have access to view system status and operation.

PFCs for systems controlled and/or monitored by the building automation system also include requirements for building automation system trend logs to be programmed prior to the start of Functional Performance Testing. These requirements will include the points to be trended, the frequency of the trends, and the points to be included together on color graphic trend logs when submitted for review.

Final Functional Performance Tests

The Commissioning Manager will finalize Functional Performance Test Procedures (FPTs) for each system to be commissioned after reviewing approved submittals, requests for information, change orders, supplemental instructions, and other construction phase modifications and/or additions. The following are the minimum requirements for American University FPTs:

Step-by-Step Script

FPTs should dictate a chronological list of steps to be followed. The steps should be scripted in an efficient manner, minimizing the level of redundancy between steps as much as practical. The intent of testing is to demonstrate performance of each mode of system operation as effectively and efficiently as possible.

Repeatable



Although the Commissioning Manager will develop and oversee the execution of FPTs when they are implemented at the end of construction, the test procedures are required to be designed to be referenced by future Facilities Management staff for recommissioning purposes. As such, the test procedures should be designed to stand alone and be understood by reasonably knowledgeable building operations personnel without the Commissioning Manager's involvement.

The action required for each step should not be open to interpretation in the field. For example, a step that reads, "Put the system into economizer mode," does not explain how that should be done. The Commissioning Manager should define whether that should be accomplished by overriding outdoor air inputs, overriding return air inputs, changing set points, overriding the economizer mode software point, or some other method appropriate for the system and sequence being tested. Given the differences between building automation systems and their programming, a systems' reaction is likely to vary depending on how the action is performed. To the greatest extent practical, this needs to be understood by the Commissioning Manager prior to the start of field testing.

Unambiguous Pass/Fail Acceptance Criteria

For each step of the test procedure, there should be a pass/fail definition of acceptable response. This typically is a description of how each device in a system is designed to react to the scripted action imposed on the system.

In the interest of field testing efficiency, the acceptance criteria should be clearly defined in terms that everyone in the field can understand and agree on. Valves and dampers should "open" or "close;" fans and pumps shall "start" or "stop;" modulating devices shall "modulate higher" or "modulate lower." Simply stating that the system should respond "as specified," is not acceptable in an FPT procedure.

Customized

Each test procedure must reflect the final design and approved shop drawings for the unique systems in each project. There should be nothing "not applicable" in a project's FPT, i.e., if a step or reaction is not applicable, it should be removed from the procedure.

Sampling Strategies

The Contractor can employ a sampling strategy to functionally test a fraction of the total number of non-life safety or non-critical equipment that are identical or near identical pieces of equipment (e.g., terminal units, occupancy sensors, exhaust fans, etc.). The sampling strategy must be well-defined and approved by AU Facilities during the Design Phase and documented in the Final



Commissioning Plan and the Commissioning Specification. The sampling strategy must define the applicable project-specific equipment, the percent of randomly selected equipment to be tested, the failure rate threshold, and recourse plan if excessive failures are discovered.

The Mechanical, Electrical, TAB, and Controls Contractors will review and comment on the efficiency and safety of the proposed test steps, and the Facilities Management Commissioning Authority will review for completeness and rigor. The Commissioning Manager will incorporate Facilities Management Commissioning Authority's and the Contractors' recommendations as appropriate. It is the review activity that helps prevent surprises in the field on test day. Upon incorporation of the accepted Facilities Management Commissioning Authority and Contractor comments, the Commissioning Manager will issue final FPTs for use in the system functional performance testing process.

Refer to Section 7 of the MCP for examples of both Prefunctional Checklists and Functional Performance Test Procedures. These examples are intended to communicate format and level of rigor. The actual project checklists and test procedures will be customized to match the final design requirements for each system.

1.6.4 ACCEPTANCE PHASE ACTIVITIES

Acceptance Phase Commissioning Coordination Meetings

The Commissioning Manager will plan, facilitate and document Acceptance Phase Commissioning Coordination Meetings. These meetings will be heavily focused on system readiness for Functional Performance Testing and scheduling of that testing. Acceptance Phase Commissioning Coordination Meetings will be held as frequently as deemed necessary by the Commissioning Manager to keep the Commissioning process on track for completion prior to Substantial Completion.

Test, Adjust, and Balance (TAB) Report Review

The TAB Contractor will prepare a balancing report documenting that all air and hydronic systems have been adjusted and are within acceptable design values. The Facilities Management Commissioning Authority and the Commissioning Manager will review the report submitted by the TAB Contractor, concurrent with the Design Team as the TAB Contractor completes work on individual systems (i.e., not all systems need to be balanced before the reporting process begins). The Commissioning Manager will verify that all required data has been collected, that the measured results are in compliance with the design documents, and that any non-compliance items have been resolved and rebalanced prior to the start of Functional Performance Testing.



The Facilities Management reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the Design Team. The Design team will address these comments, incorporating them as appropriate into their formal TAB report review response to the Contractor. The Design Team will provide written responses to each TAB report review comment to the Commissioning Manager.

Refer to Section 7 of the MCP for an example of the Document Review Template.

O&M Training Delivery

Operation and Maintenance (O&M) Training delivery will include equipment specific training and training on the Building Automation System (BAS).

After the Training Agendas have been reviewed and accepted by the Facilities Management Commissioning Authority, the Commissioning Manager will convene a meeting with the Contractors and the AU Commissioning Coordinator to schedule the individual O&M Training sessions. The training events will be coordinated for the convenience of the trainees, i.e., between shifts, small amounts of training at a time to accommodate trainees' other responsibilities, etc. Training will be concurrent with equipment start-up by the Contractor.

As a minimum, no training event will be offered less than two (2) times, and will be scheduled on separate days. Training sessions may be offered on the same day if at least one session is video recorded and with the approval of AU Commissioning Authority.

The Contractor will formally document each training session and the acceptance of the training. Documentation of Facilities Management acceptance will require that someone representing the trainees formally and in writing accept each training session as complying with that session's Training Agenda. The Commissioning Manager will collect this documentation in the form of fully executed Training Agendas and include them as part of the Final Commissioning Report.

The Commissioning Professional will schedule and coordinate the video recording of the O&M Training sessions with assistance from the American University Commissioning Coordinator.

Prefunctional Checklists Completion

The prefunctional checklists are used to document that the systems are fully installed, connected, started-up, programmed, integrated and have successfully passed their respective Functional Performance Tests in a contractor-only dry run. Fully executed



Prefunctional Checklists are the Contractor's validation that the systems are ready for successful Functional Performance Testing witnessed by Facilities Management and the Commissioning Manager. The Prefunctional Checklists will be documented in writing by personnel representing the responsible Contractors; multiple Subcontractors will need to sign-off on each system's checklist.

These checklists are primarily inspections and procedures to prepare the equipment or system for initial operation (e.g., oil levels, fan belt tension, labels affixed, gauges in place, sensor calibration, etc.). However, some checklist items entail simple testing of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three phase pump motor of a chiller system). Each piece of equipment is to receive full checkout by the Contractors. No sampling strategies will be permitted.

All building automation system trend logs required for a system must be programmed and collecting data before the PFCs are completed and submitted by the Contractors.

Functional Performance Test Plans

The Commissioning Manager will prepare and distribute Functional Performance Test Plans prior to the start of Functional Performance Testing. This will allow the Construction Team to review the proposed testing schedule; to understand which test procedures will be conducted during a specific testing period; to schedule the appropriate people to be in attendance for each test; and to verify that the necessary equipment is available when testing begins.

The Facilities Management Commissioning Authority will schedule Facilities Management staff to participate in and witness Functional Performance Testing based on the schedule outlined in each Test Plan.

Functional Performance Testing

Functional Performance Testing is the technical culmination of the Commissioning process for systems acceptance by the Facilities Management Commissioning Authority and should be performed prior to Substantial Completion.

The Commissioning Manager will field-direct, witness, and document the Functional Performance Test Procedure (FPT) for each system to be commissioned. Although the Commissioning Manager directs the tests, the Contractors will manipulate the systems and controls in accordance with the FPTs reviewed and accepted by all team members before the start of testing. The Facilities Management representatives will witness and participate in the Functional Performance Testing, as determined by Facilities Management, to understand how the systems operate and how optimal performance can be maintained.



Trend Log Review

The Contractor will download and submit electronic trend data to the Commissioning Manager for review at a time scheduled by the Facilities Management Commissioning Authority and the Commissioning Manager. This may be prior to the start of Functional Performance Testing, immediately following Functional Performance Testing, or after occupancy.

The trend data will be submitted in editable spreadsheet format and in color graphs designed as specified in the Prefunctional Checklist for each affected system.

Any trend logs demonstrating performance not meeting the construction document requirements will be re-run, following remediation of the problems, and re-submitted to the Commissioning Manager for review.

Commissioning Action List

The Commissioning Manager will maintain a Commissioning Action List - starting in the Design Phase and continuing through the Warranty Phase - to track the status of all Commissioning-related items. The Commissioning Action List includes process-related and technical-related issues associated with successful completion of the Commissioning process.

For each deficiency found during Functional Performance Testing, the Commissioning Manager will add the item to the Commissioning Action List. The Commissioning Action List is the vehicle for communicating, tracking, and documenting the status and correction of each deficiency.

The Commissioning Manager shares the Commissioning Action List with the Contractors who inform the Commissioning Manager in writing upon correction of each problem with an explanation of what was done to resolve the issue. If the Functional Performance Test demonstrates a system performs as designed but does not meet the OPR criteria for that system, the associated Commissioning Action List item will be assigned to the Design Team to engage them in the issue resolution process.

Upon notification of the completion of a Commissioning Action Item, the Commissioning Manager will schedule re-testing for the affected system to verify satisfactory resolution of the deficiency.

Refer to Section 7 of the MCP for the Commissioning Action List template.

Functional Performance Re-Testing



The Commissioning Manager will field-direct, witness, and document Functional Performance Re-Testing for each system that failed to pass its initial FPT. For systems tested with a sampling strategy, as defined in the Final Functional Performance Test Procedures, additional samples will need to be tested during re-testing if the failures of the initial sample exceed the failure rate threshold.

The extent and level of rigor of retesting will be as the Commissioning Manager deems necessary to confirm successful resolution of the initial deficiencies without sacrificing performance elements which had originally passed the system FPT.

Although the Commissioning Manager directs the re-tests, the Contractors will manipulate the systems and controls. Facilities Management representatives will witness and participate in the Functional Performance Re-Testing as determined by Facilities Management.



1.6.5 WARRANTY PHASE ACTIVITIES

Warranty Information Hand-off

The Contractor and the AU Construction Manager will provide warranty information to the Facilities Management Commissioning Authority for the commissioned systems. The warranty information will be transferred prior to Substantial Completion and will include, but not be limited to, master equipment list; warranty start and end dates; manufacturer contact information; extended warranty (if any) details; planned maintenance activities required to keep equipment under warranty; etc. The Facilities Management Commissioning Authority will review and approve the warranty information submitted at the end of construction for compliance with the specifications.

Occupant Training Delivery

The Commissioning Manager will facilitate the scheduling and delivery of Occupant Training with the Facilities Management Commissioning Coordinator and representatives of the building occupants. The training events will be coordinated for the convenience of the trainees, i.e., between shifts, manageable amounts of training at a time to accommodate trainees' other responsibilities, etc.

The Commissioning Manager will lead the Occupant Training sessions with participation by the Facilities Management Commissioning Authority.

The Facilities Management Commissioning Coordinator will schedule and coordinate the video recording of the Occupant Training sessions.

Deferred Testing

Functional Performance Tests (FPTs) may need to be deferred until after Substantial Completion for a variety of reasons. The most common reasons include (1) HVAC systems may need to have different weather conditions than those at the end of construction and (2) commissioned systems may need to have a load put on them before testing can be considered meaningful. FPTs that occur after Substantial Completion will be conducted, documented, and tracked in a manner identical to the Acceptance Phase process.

As-Built Documentation Review

The AU Construction Manager will provide the Facilities Management Commissioning Authority with as-built documentation including, but not limited to, (1) record installation drawings and (2) the final building automation system controls manual. The as-built building automation system controls manual will include the final "as commissioned" system schematics, sequences of operations, set points, and alarm limits.



These documents will be reviewed by the Commissioning Manager and Facilities Management staff. The Facilities Management reviewers will submit their comments to the Commissioning Manager who will consolidate all comments and forward them to the AU Construction Manager for resolution by the Design and Construction Teams.

Commissioning Report

Following resolution and/or acceptance of all Commissioning Action Items, the Commissioning Manager will prepare the Commissioning Report. The report will be a compilation of documentation (both technical and process-related) associated with the Commissioning process. It will be prefaced with an Executive Summary documenting the final system status compared to the Owner's Project Requirements document.

The Commissioning Report will include at least the following sections:

1. Introduction
2. Executive Summary
3. Owner's Project Requirements
4. Basis of Design
5. Commissioning Plan
6. Commissioning Specification Section
7. Commissioning Action List
8. Commissioning Coordination Meeting Minutes
9. Warranty Phase Check-up Meeting Minutes
10. Design Review Comments
11. Submittal Review Comments
12. TAB Report Review Comments
13. As-Built Documentation Review Comments
14. O&M Manual Review Comments
15. O&M Training Plan
16. O&M Training Agendas (fully executed)
17. Systems Training Agendas
18. Occupant Training Agendas
19. Prefunctional Checklists (fully executed)
20. Functional Performance Test Plans
21. Blank Functional Performance Test Procedures

The Commissioning Manager will submit the Commissioning Report to the Facilities Management Commissioning Authority for review.

The Commissioning Manager will amend the Commissioning Report at the end of the Warranty Phase to document pertinent Warranty Phase activities, findings, decisions, etc.



Systems Manual & On-Going Commissioning Plan

The Commissioning Manager will collect and compile the Systems Manual & On-Going Commissioning Plan, based on American University standards for this document. At a minimum, these document shall include the following for the commissioned systems:

1. Owner's Project Requirements
2. Basis of Design
3. Integrated Building Systems Operating Instructions
4. System Schematic Diagrams
5. As-Built Control Sequences of Operation and Initial Setpoints
6. Planned Maintenance Activities and Recommended Frequencies
7. Recommended Control System Sensor & Actuator Calibration Frequencies
8. Recommended Building Automation System Trend Logs for On-Going Commissioning Monitoring and Evaluation
9. Recommended System Re-Testing Frequencies
10. Blank Functional Performance Test Procedures for Re-Testing

In the Design Phase the Commissioning Manager will prepare an outline of the Systems Manual & On-Going Commissioning Plan along with assigned roles and responsibilities for project team members to produce the various elements of the document. These requirements will be incorporated into the Commissioning Specification and included in the bid documents.

During the Construction Phase, the Commissioning Manager, Design Team, and Construction Team will prepare a preliminary schedule of when each element will be submitted to the Commissioning Manager over the course of the project.

The Commissioning Manager will submit the Systems Manual & On-Going Commissioning Plan to the Facilities Management Commissioning Authority for review.

The submissions shall be in an electronic format compatible with the rest of the Systems Manual and On-Going Commissioning Plan sections (Adobe PDF and/or Microsoft Excel). It shall be formatted for printing no larger than 11 inches by 17 inches and preferably 8.5 inches by 11 inches.

Warranty Phase Check-up & Meeting

No later than 2 month before the end of the Warranty Phase, a warranty meeting will be planned, facilitated, and documented by the Commissioning Manager. This meeting is an opportunity for Facilities Management and other AU Department representatives to provide feedback on the effectiveness and efficiency of the new equipment and systems. The Design Team and Construction Team are required to participate in the warranty meeting.



The Facilities Management Commissioning Authority will oversee the collection of operations issues, concerns, challenges, etc., throughout the Warranty Phase in order for the warranty meeting to be as comprehensive and meaningful as practical.

Information received by the Design Team and Construction Team will be used to track and correct warranty-related issues; to contribute to future Owner's Project Requirements documents; and to refine American University's project delivery process.

1.6.6 ON-GOING COMMISSIONING ACTIVITIES

On-Going Commissioning Activities

AU Facilities addresses changes in occupancy, use, maintenance and repair and makes periodic adjustments and reviews of building operating systems and procedures essential for optimal energy efficiency and service provision.

PART II — OTHER COMMISSIONING REQUIREMENTS

1.5 SUBMITTALS

A. Contractor shall submit the name of person(s) assigned as Commissioning Coordination Supervisor within two (2) weeks of construction notice to proceed. Contractor shall submit the following information for each assigned Commissioning Representative:

1. Company Name
2. Name
3. Title
4. Years of Experience
5. Office Phone Number
6. Cell Phone Number
7. Fax Number
8. E-Mail Address

B. Each Contractor shall submit the name of person(s) assigned as representatives to Commissioning Team within two (2) weeks of construction notice to proceed. Each Contractor shall submit the following information for each assigned Commissioning Representative:

1. Company Name
2. Name
3. Title



4. Years of Experience
5. Office Phone Number
6. Cell Phone Number
7. Fax Number
8. Email Address

C. Equipment submittals and shop drawings

1. Submit a list of all required submittals to the Commissioning Professional prior to submitting any equipment submittals for review.
2. Commissioning Professional will identify submittals for which copies shall be submitted to the Commissioning Professional.
3. Submit copies of selected submittals to Commissioning Professional, Owner, and Owner's Facilities Management for review.
4. Submit copies of selected submittals to Commissioning Professional, Owner, and Owner's Facilities Management for review.

D. Master Construction Schedule: Incorporate all commissioning milestones into the Master Construction Schedule. See "Q" below for a listing of minimum milestones for inclusion in the Master Construction Schedule.

1. Submit Master Construction Schedule with the inclusion of the commissioning milestones no later than eight (8) weeks after Construction Notice-to-Proceed.
2. Submit updated Master Construction Schedule to the Commissioning Professional at a minimum once per month.

E. Submit copies of Construction Meeting Minutes, Requests for Proposals (RFP), Requests for Information (RFI), Addenda, Proposal Requests (PR), etc., to the Commissioning Professional.

F. Submit a single set of preliminary operation and maintenance manuals for systems being commissioned to the Commissioning Professional for review. Submit within eight (8) weeks after all submittals for systems to be commissioned have been accepted.

G. Submit a single set of revised operation and maintenance manuals four (4) weeks after receiving comments from the Commissioning Professional.

H. Submit the full quantity of final operations and maintenance manuals to the Commissioning Professional a minimum of four (4) weeks prior to start of owner training. The full quantity of manuals to be submitted to the Owner, as defined in the general specifications execution requirements and shall be required only after review and approval of a single set.



- I. Submit equipment training session agendas to the Commissioning Professional for approval no later than eight (8) weeks after acceptance of associated equipment submittals. Refer to the Training Plan Example and the Training Agenda Example in the Commissioning Plan.
- J. Submit the specific date, time and place for individual training sessions no later than four (4) weeks prior to the scheduled training sessions.
- K. Submit detailed functional performance testing schedule to the Commissioning Professional at least four (4) weeks prior to the start of testing.
- L. Submit fully executed Prefunctional Checklists to the Commissioning Professional upon completion and at least two (2) working days before the scheduled start of functional performance testing for the respective system. System functional performance testing shall not commence until its system is documented to be ready for testing.
- M. Submit estimated completion dates and status updates to outstanding items on the Commissioning Action List to the Commissioning Professional weekly.
- N. Submit warranty details for commissioned systems at least four (4) weeks prior to substantial completion.
- O. Submit as-built documentation no later than two (2) weeks following substantial completion.
- P. Materials — Provide tools, services and instruments required to test and adjust equipment and to verify compliance with design documents. Refer to individual Functional Performance Test Procedures for the requirements of each procedure.
- Q. Commissioning scheduling — Include the following commissioning milestone activities in the master schedule (not a separate commissioning schedule):
 - 1. Operations and maintenance manual submissions
 - 2. Equipment training agenda submission
 - 3. Training delivery
 - 4. Testing and balancing
 - 5. Equipment training sessions
 - 6. Prefunctional checklist completion
 - 7. Functional performance testing
 - 8. Deficiency correction
 - 9. Functional performance retesting (as necessary)
 - 10. System manual and on-going commissioning plan submissions
 - 11. Warranty information submission
 - 12. As-built documentation submissions



R. Re-testing — The contractor is responsible for the owner's additional costs associated re-testing activities requiring an additional trip to the project site, unless the deficiency discovered during the initial functional performance testing could not have been identified as part of the dry-run testing by the contractors. The owner's additional costs include, but are not limited to, the commissioning professional's time and expenses (at cost) to direct, witness, and document the re-testing activities.

S. Deficiency tracking/corrective actions

1. Perform corrective actions for resolution of deficiencies found during, but not limited to, the following activities:

- a. Site observations
- b. Test and balance
- c. Prefunctional checkout
- d. Functional performance testing

2. During Functional Performance Testing, a deficiency is defined as equipment that does not function as expected and more than five (5) minutes is required to correct the problem.

- a. During construction or testing anyone finding deficiencies may document the deficiencies on a Commissioning Action List (CAL) (refer to Commissioning Plan) within one working day of discovery. The deficiency shall then be forwarded to the Commissioning Professional.
- b. Deficiency Identification Process (by Commissioning Professional)
- c. Date
- d. Comment Generator
- e. Responsible Party
- f. Description of deficiency
- g. Estimated Completion Date
- h. Distribute copies to:
 - i. Contractor
 - j. Owner's Facilities Management Staff

3. Corrective Action Completed (by Contractor)

- a. Date of correction
- b. Description of final equipment status or corrective action performed
- c. Name of person(s) performing the work
- d. Contractor to inform the Commissioning Professional who will update the Commissioning Action List
- e. Commissioning Professional distributes updated copies to:
 - i. Contractor



ii. Owner's Facilities Management Staff

4. Verification of Corrective Action Completion (by Commissioning Professional)

- a. Date of correction
- b. Description of final equipment status or corrective action performed
- c. Name of person(s) performing the work
- d. Contractor to inform the Commissioning Professional who will update the Commissioning Action List
- e. Commissioning Professional distributes updated copies to:
 - i. Contractor
 - ii. Owner's Facilities Management Staff

U. Commissioning documentation

1. Commissioning Action List Template (Reference Commissioning Plan)
2. Document Review Template (Reference Commissioning Plan)
3. Training Plan Example (Reference Commissioning Plan)
4. Training Agenda Example (Reference Commissioning Plan)
5. Example Prefunctional Checklists (Reference Commissioning Plan)
6. Example Functional Performance Test Procedures (Reference Commissioning Plan)

- END OF SECTION 01 91 13 -



AMERICAN UNIVERSITY
DESIGN STANDARDS – TECHNICAL
REQUIREMENTS



DIVISION 2 EXISTING CONDITIONS

The American University Campus has unique architectural and exterior spatial design qualities, especially around the Freidheim Quadrangle. All Site work shall follow current LEED guidelines for Site Selection as applicable to the particular project requirements at the University.

SPECIFIC DESIGN PARAMETERS

The design of new buildings, renovation of existing facilities and site improvement projects shall accomplish the following:

1. Adhere to the AU Campus Plan which can be accessed online via <http://www.american.edu/finance/PPM/2011-Campus-Plan.cfm>
2. Respect the historic fabric and detail of the Campus and integrate each built project into the surrounding Campus context.
3. Emphasize safe and attractive pedestrian circulation within the Campus and arrival into the Campus to provide:
 - a. clear arrival sequence
 - b. accessibility as required by Americans with Disabilities Act (ADA): durable slip-resistant materials, site lighting and emergency telephones, screening of service functions, orientation to and framing of special views
 - c. Accommodate safe and convenient vehicular circulation, arrival, drop-off and parking.
4. Provide safe, attractive and functional outdoor spaces.
5. Provide suitable horticultural soils, drainage and irrigation to support successful horticultural development and sustainability.
6. Emphasize the use of plants for energy conservation and ecological appropriateness.
7. Retain mature trees wherever possible, particularly where they occur in groups, through creative use of retaining walls, bio-retention, grading and other site design techniques.
8. Maintain aesthetic consistency.

SITE DESIGN STANDARDS

All campus site designs shall meet the campus wide standards established by the University for landscaping, irrigation, parking, drainage and utilities.

All site design shall comply with all applicable DC codes and applicable sections of current LEED guidelines. Requirements in Division 32 Exterior Improvements and Division 33 Utilities are applicable.



STRUCTURE DEMOLITION 02 41 16

Provide Facility Management Energy and Engineering with footprint (area in square feet) of buildings, structures, and associated site improvements removed during construction for impervious service credit with DC Water. Demolition date required.

—END OF DIVISION 2—



DIVISION 3 CONCRETE

GENERAL

Concrete design shall be in accordance with the latest edition of the DC Building Code and comply with requirements of the American Concrete Institute (ACI); specifically, the requirements of ACI-301, ACI-318 for reinforced concrete structures, ACI 3xx for hot weather construction and ACI-306 for cold-weather construction. Design strength shall be appropriate to the use intended, but shall be a minimum 3000 psi (at 28 days).

The Contractor shall provide a design mix from a commercial testing laboratory approved by the Consultant, using samples of aggregates and cement approved for use. Cost of the design mix preparation shall be borne by the Contractor.

Admixtures in concrete used for building design shall be approved by the Owner and shall be in accordance with requirements of the project, relative to hot weather, cold weather, pour schedules, sustainability and other special project requirements.

In support of project LEED requirements and AU sustainability goals, consider the following:

1. Require fly ash, slag cement, silica fume and/or another pre-consumer recycled material for concrete. Require post-consumer recycled material in the aggregate. <http://greenlivingideas.com/2008/12/21/can-concrete-be-eco-friendly/>
2. Set an overall target as per the LEED formula so: $(\text{Product Cost} * \text{Preconsumer \%} * 0.5) + (\text{Product Cost} * \text{Post-Consumer \%}) \geq$ to 20% of total concrete spend
3. Slag cement dramatically reduces embodied energy and greenhouse gas emissions in concrete. Most slag cement in the U.S. is recovered at iron blast furnaces located within the U.S. or Canada.
4. Silica fume is a byproduct of producing silicon metal or ferrosilicon alloys. One of the most beneficial uses for silica fume is in concrete. Concrete containing silica fume can have very high strength and can be very durable.
5. For all materials included in CSI specification sections 2–10, provide the total hard cost of each material (excluding labor and equipment). Be sure to include manufacturing and extraction locations and manufacturer's data, and/or product information confirming the product's sustainable attributes (such as percentage of recycled content, certifications).

Curing components used in slabs shall be compatible with applied finishes, including vinyl flooring and carpeting. The Contractor shall measure moisture content in slab construction prior to installation of these finishes; all installation will be performed in accordance with manufacturer's requirements.



Testing services for concrete are to be paid for by the Owner and conducted by an independent testing laboratory selected by the Owner. Laboratory-cured test specimens and field-cured specimens shall be used to confirm the quality and strength of the concrete material. A list that includes the type, quantity and frequency of tests shall be kept for all tests.

All sealants must be low-VOC in accordance with LEED requirements per Division 7.

PRE-CAST CONCRETE – 03 41 00, 03 45 00

Design of pre-cast concrete panels shall be approved by the Owner using finish samples or mock-ups. Colors and texture shall be in context with existing architectural elements on Campus. Sealing compounds, matrix design, finish and joint sealers shall be a consideration in the long-term maintenance of pre-cast concrete systems.

STRUCTURAL CONCRETE – 03 41 00

Perlite and vermiculite are not permitted for use in structural concrete; fly ash is preferred.

— END OF DIVISION 3 —



DIVISION 4 MASONRY

GENERAL

Concrete Masonry Units, brick and other masonry units exposed to view shall be approved by the Owner based on compatibility in color and texture with existing exterior building materials on Campus. Sample panels shall be constructed in order to obtain approval by the Consultant and the Owner.

Design of masonry walls shall be in accordance with current building code and applicable American Society for Testing and Materials standards.

Masonry units shall match or compliment adjacent buildings as closely as possible.

Careful consideration will be given by the Consultant to design of the wall with regard to cavity wall construction, flashing details, control joints, mortar joint details and wall materials.

Masonry shall be measured for moisture presence prior to installation of final paint coatings.

Prevention of efflorescence is of critical importance in the mortar mix design and installation.

STONE

Bluestone used in Campus walks shall match the texture, color and size of existing units.

RENOVATION PROJECTS

In renovation projects involving exterior stone, brick, or other masonry: existing units shall be carefully removed and reused if possible. If new material is needed, it shall closely match the existing wall.

Masonry joint repairs for older structures shall be made in accordance with requirements of historic structures, with regard to proper mortar mix, color range and proper pointing procedure.

CLEANING OF MASONRY – 04 01 10

Cleaning agents shall include diluted detergents, nonmetal bristle brushes, potable water and non-acid washing solutions. The use of abrasive brushes or cleaning agents is not permitted. Sandblasting of masonry is not permitted.

— END OF DIVISION 4 —



DIVISION 5 METALS

GENERAL

Steel-framed structures shall be designed in accordance with the D.C. Building Code and in accordance with American Institute of Steel Construction specifications. Steel joists shall be designed in accordance with the Steel Joist Institute standards. Welding requirements shall be in accordance with the American Welding Society standards for certified welders. To the extent possible, steel products should be made with recycled material.

All exterior exposed ferrous material, including ornamental frames, steel gratings, stairs, handrails, plaques and structural elements shall be hot-dipped galvanized after fabrication and protected from corrosion by a method acceptable to the Owner. Preference should be given to final finishes that are maintenance free (no cyclic painting).

Using screws to attach metal roof decks to structures is recommended, but attachment of metal decks by welding is allowed, with the condition that the welding be inspected and approved by the Consultant prior to installation of the final roof covering. The Consultant shall inspect composite deck assemblies.

Anchorage of structural elements or ornamental assemblies shall be clearly detailed. Bolt sizes shall be indicated.

Where downspouts are utilized in the building design, cast iron boots shall be provided to connect downspouts to underground drainage lines.

Tolerances, connections, attachment to metals, coping and clearances shall be detailed on the construction documents.

Metal materials/ products shall contain the maximum amount of recycled content allowed that retains material integrity and contain as much locally harvested and processed or extracted and processed material (within 500 miles) as feasible. Any adhesives or sealants used must comply with maximum allowable VOC requirements as defined by the applicable reference standard (e.g. SCAQMD). Submit product cut sheets indicating recycled content, place of origin, and VOC levels. Track all purchases as a percentage of total spend complying with each sustainability criterion.

— END OF DIVISION 5 —



DIVISION 6 COMPOSITES, PLASTICS, AND WOOD

GENERAL

Wood structural design and finish materials shall be in accordance with the D.C. Building Code, applicable National Fire Protection Association requirements and FSC (Forest Stewardship Council) requirements for wood products from managed forests. Wood trim materials shall be the type and grade of wood suitable to the intended purpose and design, with consideration given to long-term maintenance and intended final finishes.

Wood, composite, and plastic materials/ products shall contain the maximum amount of recycled content allowed that retains material integrity, contain as much locally harvested and processed or extracted and processed (within 500 miles) material, rapidly renewable material, and FSC-certified content as feasible. Any adhesives or sealants, paints or coatings must comply with the maximum allowable VOC requirements as defined by the applicable reference standard (e.g. SCAQMD). Composite and agrifiber products must contain no added urea formaldehyde resins. Contractor shall submit product cut sheets indicating recycled content, place of origin, rapidly renewable material, FSC-certified wood content, VOC levels, and urea formaldehyde resin limits, as applicable. Track all purchases as a percentage of total spend complying with each sustainability criterion.

ROUGH CARPENTRY – 06 10 00, 06 10 53, 06 1 063

Preservative-treated lumber shall be used in damp areas and shall be used when in contact with concrete, masonry, plaster and roof blocking. Material shall be kiln-dried to a maximum 15% for plywood and 19% for lumber moisture content after treatment.

Truss systems shall be designed in accordance with the building code. The Consultant shall carefully consider anchorage, joint connections and bracing in the design of the truss system. Heavy timber or laminated timber shall not be exposed to weather. Design load data for truss design shall be shown on the project drawings.

Blocking and grounds shall be installed plumb and in alignment, in order to ensure proper fit of subsequent finish material (such as wood trim, gypsum board or plaster), treated with fire retardant chemicals to provide a flame spread classification of 25 or less.

Countertops with sinks shall be solid surfacing material or quartz composite. Countertops in dry areas can be laminate. Coordinate with the Project Manager on selection of materials required for specialty areas such as laboratories, animal facilities, and wash down areas.



FINISH CARPENTRY – 06 20 13, 06 20 23

Finish wood material shall conform to requirements of the Architectural Woodwork Institute (AWI) quality standards, premium grade unless approved otherwise. Forest Stewardship Council (FSC) wood products shall be used. Endangered tree and plant species, including redwood shall not be permitted.

Wood trim with transparent finish shall be appropriate to the design of the building or project. Painted or concealed wood trim shall be fir, birch or poplar.

Particleboard is not permitted for use in any application including cabinets, carpentry, countertops and sheathing.

Blocking and finish material shall be installed to allow for natural wood movement and building movement.

- END OF DIVISION 6 -



DIVISION 7 THERMAL AND MOISTURE PROTECTION

GENERAL

The Consultant must consider the effects of environmental design factors; that is, the degenerative forces exerted on roofing systems and wall systems by exterior and interior conditions. These forces include sunlight exposure, rainfall, ice, snow, wind, the chemical environment and the installation environment. The task is to select components that will withstand such environmental factors, integrate these components into a complete system, and integrate Indoor Environmental Quality, Environment and Atmosphere requirements from the current LEED rating system in use.

Building occupancy factors should be considered in the design of roofing systems and wall systems. Humidity and occupancy help determine the necessity for vapor retarders and venting. Any occupancy with a chemical function, such as laboratories, will require special consideration. The system should be designed so that temperature and relative humidity can be controlled. Particular attention must be paid to operating costs.

Thermal and moisture protection materials/ products shall contain the maximum amount of recycled content allowed that retains material integrity, contain as much locally harvested and processed or extracted and processed (within 500 miles) material, and FSC-certified content as feasible. Any adhesives or sealants must comply with the maximum allowable VOC requirements as defined by the applicable reference standard (e.g. SCAQMD). Submit product cut sheets indicating recycled content, place of origin, FSC-certified wood content, and VOC levels, as applicable. Track all purchases as a percentage

Density of insulation must be sufficient to allow foot traffic or other traffic on the roof. Resistance to water, liquid and vapor shall be specified. Select and install insulation for reuse in re-roofing.

Specify roof insulation by type and manufacturer. Specify minimum density or compressive strength. Specify roof insulation in order to obtain a "total system" warranty from the roofing manufacturer.

Specify application criteria. Insulation shall be two or more layers, with joints staggered.

Mechanical attachment is prohibited except on a steel metal deck; in this case, mechanically attach the first layer and fully adhere the next.

The Consultant must specify a "Class A" fire rated roof assembly on all University buildings. The assembly shall include both the deck and the insulation systems. Material used shall not contain asbestos.



Architectural metal and structural standing-seam roofing shall have a minimum slope of 4 inches per foot. Copper, lead-coated copper and terne-coated stainless steel are preferred.

Limit the use of exposed fasteners through the panels to end and side panels. Specify systems that do not penetrate the panels. Use continuous no-seam panels. Avoid skylight panels due to problems with leaks, condensation and safety concerns.

EXTERIOR WALL ASSEMBLIES

There are two important factors in designing exterior walls that should be incorporated into the roofing system:

1. Ensure that with the addition of the specified thickness of insulation, tapered insulation and associated crickets and saddles, there is a minimum 8" clear flashing height
2. Precautions should be taken to ensure that water cannot migrate from the exterior walls or curbs into the roofing system

Parapet walls and interior roof curbs should be part of the roof deck, not independent of the roof deck.

Incorporate parapet walls in the building design if possible. This will provide greater resistance to wind up-lift and provide a safer place for maintenance personnel to work. Keep the roof shape as simple as possible.

Two-piece, through-wall flashings should be installed at all masonry walls. Through-wall metal reduces the possibility of water entering the roofing system or building interior through vertical wall cavities. Weep-holes should be provided on top of the through-wall metal to allow escape of any water entering the wall above the metal.

The exterior wall assembly or interior curbs shall be independent of the roofing system. Design the assembly so it will not interfere with future re-roofing of the building.

ROOFING

Several factors repeatedly show up during the inspection of roofs that have failed prematurely. They include inappropriate use of materials, poor drainage systems, poor details for installation of roof accessories, damage by construction traffic and poor access to all parts of the roof area. The design of a roof should incorporate these fundamental features: appropriate and proven materials, good drainage and drains, good accessory details, proper protection and good access to the roof and areas around roof-mounted equipment.

The cardinal rule of roof design is to provide slope for rapid and dependable drainage. The second-highest priority for a roofing system is puncture resistance. Design the roofing system and all other components (i.e., mechanical equipment and wall assemblies) to allow for re-roofing in the future.



Ease of maintenance should be an important part of the roofing design. Design the roofing system to comply with Factory Mutual (FM) or Underwriters Laboratories (UL) standards. Criteria must be considered as they affect insurance requirements for American University.

RE-ROOFING

Re-roofing projects are basically the same as new construction, except that thorough investigation is needed to determine conditions of the existing building, and projects must consider the condition and usability of existing flashings.

The top priority during re-roofing is to determine the weaknesses of the existing system and design them out of the new roof. Re-roofing over an existing roof is prohibited, except in special situations.

Protect building components from damage during the re-roofing process.

Water shedding roofs with a slope greater than four (4) inches per foot shall be specified whenever practical. Low slope roofs shall be sloped a minimum of $\frac{1}{4}$ " / ft.

Avoid locating long skylights, HVAC units and other obstructions perpendicular to the slope. Furnish crickets where necessary to provide drainage around obstructions. Valleys should not be located over a beam-column line.

DRAINAGE

Comply with current building codes for primary and secondary drainage. Do not locate drains adjacent to roof columns, adjacent to walls that support decks or adjacent to walls that are extended to the roof deck. Locate drains symmetrically in order to simplify the tapered insulation design.

OVERFLOWS

Conductor heads should have an overflow port, permitting water to escape if the downspout becomes obstructed.

Scuppers should be sloped outward and downward. An overflow scupper should be designed so that no more than 6 inches of water will accumulate at the inlet if the drain fails to work.

EXTERNAL DRAINAGE SYSTEMS

Materials, gauges, shapes and details shall follow the recommendations in the SMACNA Architectural Sheet Metal Manual. The Consultant may reference this manual in the Contract Documents but shall not substitute that reference for appropriate specifications and



details. External drainage systems shall not incorporate pop rivets and caulking in their design.

INTERNAL DRAINAGE SYSTEMS

A sump created by tapered insulation should be provided at the drain to lower it below the level of the roof.

Vertical leaders must have expansion joints at the drains if there is any possibility of deck movement. Horizontal leaders must be insulated to prevent condensation from forming and dripping to the ceiling.

Drains and slopes should be shown on a separate architectural roof plan. Key elevations and slope arrows should be given to the roofing contractor.

DRAIN TYPE

Drain receivers should be used on metal decks and other types of decks that may need the distributed loading for a secure connection to the deck. Threaded drains do not leak as often as hot-poured or caulked drains.

PENETRATIONS

Minimize penetrations through the roof membrane. Route the penetrations through side walls when possible. Use curbs; do not use pitch pockets. Reference the NRCA manuals for approved details.

ACCESSIBILITY TO ROOF

Walkout access from a stairwell extension is preferred. Access from a penthouse is also acceptable. Doors and hatches providing roof access shall have locks.

Provide hose bibs and electrical outlets on the roof for maintenance purposes. On a large roof, multiple access points at opposite ends will prevent unnecessary backtracking.

When stairways are not required, a roof scuttle shall be provided. It shall be a minimum 2'x 4' in size and have a fixed ladder. Where roof access is frequent and involves moving machinery and equipment, increase the size of the roof hatch to 3" x 5". Include handrails and hatch restraints. Confirm with American University Risk Management the final layout of ladders, supports, and ease of equipment lifting to minimize employee injury.



FASTENERS

Fasteners must meet UL/FM standards and be approved by the roofing manufacturer for the application and system rating. Fasteners must meet FM 4470 standard for corrosion resistance, and must have a mechanism to prevent back out of the fastener.

DECKING

Deck selection should be made in close regard to the assembly category selected and may often dictate system component type. Because the deck is the foundation of the roof system, consideration for design should be based on stability.

INSULATION – 07 21 00

No other component of a building has a greater influence on the life-cycle costs or greater effect on other building components. Thus, careful thought must be given to thermal insulation, insulation type, location its durability, flammability and formaldehyde content. When renovating or fitting out an existing space, a thorough inspection and careful consideration must be given to the presence or condition of existing insulation to determine what repairs, replacement or new installations are necessary. It is important to ensure damaged insulation is removed and new insulation is properly installed, secured and sealed in accordance with industry standards and manufacturer's requirements.

The Consultant in accordance with Energy and Building codes shall determine "R" factors and "U" factors. Do not simply specify that roof insulation must meet a certain "R" or "U" factor for the roof structure; the Consultant should decide on the insulation best suited to the project, make the calculation and specify a thickness that enables the project to meet ASHRAE 90.1 requirements per LEED guidelines of minimum energy performance prerequisite (EA_p2) and project building target for optimized energy performance (EA_c1).

VAPOR RETARDERS – 07 26 00

Vapor retarders should be used only when necessary, as they tend to hide leaks in a roof system until large areas of insulation become wet. This results in an increase in the size of the damaged roof area, which translates into an increased cost for repairs.

SHINGLES AND ROOFING TILES – 07 31 xx

The NRCA Roofing Manual and standards set by the Sheet Metal and Air Conditioning Contractors National Association (SMACNA), the National Slate Association, and the American Society for Testing and Materials (ASTM) shall constitute the minimum basic roofing criteria for the following roofing systems and materials:

- A. asphalt shingles
- B. slate
- C. tile
- D. metal



- E. architectural metal roofing
- F. asphalt built-up roofing
- G. fiberglass shingles

FLASHING AND SHEET METAL – 07 62 00

All flashing should be detailed to permit thermal movement and to shed water "mechanically" by lapping. The detail shall be designed without the use of sealants. Thermal expansion will generally, over time, exceed the performance capacity of most sealants.

Keep the roof "clean" of penetrations and equipment. Do not install a metal roof if there is equipment that needs to be maintained or if there is an excessive number of penetrations planned.

Keep the roof design simple and sustainable. Use continuous panels if possible, rather than joining smaller panels using exposed fasteners.

All sheet metal materials should be designed for easy removal without interfering with building operations. No conduit or piping should be attached to coping covers. Where pipes cross over flashings or wall tops, there should be sufficient clearance to permit removal of metal without disturbing the pipes.

All metals used in the roofing assembly shall be of the same type and material. Preferred materials: copper, stainless steel, terne-coated stainless steel and aluminum

Mechanical or interlocking joints are preferred to ensure that wide metal sections stay in contact and do not admit water through open laps at metal joints.

Wood blocking attached on the perimeter of the roof must be pressure treated and provided in strict accordance with FM requirements for an I-90 rating.

With the use of metal gravel guards and fascia, temperature movements in heavy gauge metal must be considered. If heavy gauge metal is used, gravel guards should not be heavier than 24 to 26--gauge stainless steel, 16-ounce copper or 30-to 40 mil aluminum in maximum 10' lengths. Hook strips should be one gauge heavier than the fascia.

Gutters should be designed so they can be replaced without damaging the roof edges.

SMACNA and NRCA Manuals for sustainable treatments shall be used as a reference for details. Details and dimensions shall be shown, not simply referenced from the manuals. Do not call for "...design and installation in accordance with SMACNA Manual."

ROOF SPECIALTIES AND ACCESSORIES – 07 7100, 07 7720

If approved by the Owner, roof-mounted equipment must be supported on a properly constructed curb or an elevated metal frame.



Curbs must extend either a minimum of 8 inches above the finished roof surface or above the height of any emergency overflow pipe or scupper. See NRCA Details "IL-2" and "N" for fan curbs and equipment requiring a continuous edge curb.

Metal frames should be used to support heavy equipment or structures above the roof surface. Clearance below equipment shall be as suggested by NRCA Detail "M-1." Provide approved walkway pads up to and around equipment requiring frequent service or inspection. Location of pads to be confirmed by the Owner.

JOINT SEALERS – 07 92 00

Caulking should be reserved for sealing joints in vertical surfaces between relatively stable components of the building. It should not be used where significant water will stand or regularly run across the joint.

— END OF DIVISION 7 —



DIVISION 8 OPENINGS

GENERAL

Doors, Windows and other openings are critical to efficient building envelopes and effective building security. Ensure that security features are coordinated with Division 28 requirements located within this document.

Ensuring tight seals around openings and their frames is essential to their performance and the building envelopes integrity. Insulation, flashing, gaskets and other water/vapor seals must be of high quality, highly durable, appropriate for the application and installed in accordance with industry standards and manufacturer's recommendations. In renovation and fit out projects such components no longer in serviceable condition shall be repaired or replaced.

Windows, Doors or Openings no longer able to maintain envelope integrity shall also be identified, costed and considered for replacement as part of design efforts.

All doors shall have a minimum 3'-0" width and 7'-0" height. Heavy duty hinges or continuous hinges are required. Knock down frames are to be avoided.

Knock down door frames shall be avoided.

All doors shall have locking hardware approved by the security representative of American University.

Openings materials/ products shall be built with FSC Certified wood cores and veneers and/or contain the maximum amount of recycled content allowed that retains material integrity, contain as much locally harvested and processed or extracted and processed (within 500 miles) material, and rapidly renewable content as feasible.

Any adhesives/sealants, paints/coatings, and/or composite wood must comply with the maximum allowable VOC requirements as defined by the applicable reference standard (e.g. SCAQMD).

Any composite and agrifiber products must contain no added urea formaldehyde resins. Submit product cut sheets indicating recycled content, place of origin, rapidly renewable material content, FSC-certified wood content, VOC levels, and urea formaldehyde resin limits, as applicable. Track all purchases as a percentage (%) of total spend complying with each sustainability criterion.



All exterior doors and jambs should be hollow metal (steel) or aluminum and glass (storefront systems) made from recyclable material. Steel doors shall be a minimum of 16 gauge; jambs shall be a minimum of 14 gauge.

All exterior handicap door access operator switches must be completely protected from the weather. Door controls and push plates must be hard wired. Door operators must work with card readers where applicable.

Doors in high-traffic areas, loading docks, mechanical rooms, and corridors must be designed to include metal door edge guards and protection plates on both sides. The frame and door hardware shall be designed to accept this additional weight.

See entryway walk off mat requirements in Division 12 Furnishings.

EXTERIOR ENTRANCE DOORS

Preferred entrance doors are Fiberglass Reinforced Polyester (FRP) Exit Door Systems by Special-Lite or approved equal.

Provide extra space for and factory installed bracing for door hardware, automatic openers, and access control and/or security wiring.

Entrance doors shall have door sweeps and/or manufacturers gasket assemblies suitable for pest exclusion.

Continuous hinges are preferred.

FLOOR AND JAMB ANCHORS

The number of anchors provided on each jamb shall follow manufacturer's recommendation for commercial applications.

Floor anchors shall be securely welded or screwed inside each jamb, with two holes provided at each jamb for anchorage.

Frames for installation in masonry walls shall be provided with adjustable wire type jamb anchors. Anchors shall be not less than 0.156" diameter steel wire.

Frames for installation in stud partitions shall be provided either with steel anchors of not less than 18 gauge thickness, securely welded inside each jamb, or insert type with notched clip to engage stud inserted to back of the frame as identified above.



FABRICATION AND STORAGE

Stave lumber doors shall be AWI specification symbol SLC-5. Wood used in construction of the doors shall be thoroughly seasoned, low-density, non-resinous, kiln-dried hardwood with moisture content between 5% and 8%.

Contractors shall store and transport doors as per the manufacturers requirements. The Contractor shall replace doors and frames damaged by improper storage and moving upon request.

All doors trimmed on site shall be resealed or primed and painted at the trim area. This includes edges and installed in place openings or glass kits.

Doors with missing, altered or unreadable ratings will be rejected and replaced at no cost to the University.

METAL DOORS AND FRAMES

Fire-rated doors required to be B-Label classification shall be made of recycled metal. On labeled fire doors, all closers shall be of a "non-hold-open" type approved by Underwriters Laboratories (UL).

Fire rated doors that open to corridors and contain glass shall use 1/4" UL fire-rated tempered glass.

Where specified or scheduled, doors shall be provided with either aluminum or steel moldings to secure glass in accordance with glass opening sizes as shown on approved shop drawings.

WINDOW ASSEMBLIES

In large window assemblies, install a double balance in order to provide a window that is easier to open and to decrease the frequency of repairs.

Operable windows above ground level may require the addition of safety hardware to limit opening. Confirm feasibility of operable windows readily accessible from the ground with Risk Management.

All screws and other miscellaneous fastening devices incorporated in the product shall be concealed within the window assembly.



Plastic materials are not acceptable.

Minimum warranties:

- A. Windows shall be warranted against defects in material and workmanship for a period of one (1) year from date of installation
- B. Insulating glass shall be warranted to be free from obstruction of vision by film formation or dust collection between the interior surfaces of the glass panes for a period of ten (10) years from date of installation pigmented organic finishes of the window and related component parts shall be warranted against blistering, cracking, peeling or chipping for a period of fifteen (15) years from the date of installation
- C. Where natural ventilation strategies are used, LEED and ASHRAE standards must be met to comply with applicable code and regulatory requirements, and shall support AU's continuous commissioning LEED prototype for Indoor Air Quality (IAQ).

WOOD AND LAMINATE DOORS – 08 1416

Provide doors that meet or exceed the minimum standards of the Architectural Woodwork Institute (AWI) Quality Standards, Section 1300 (latest edition) and FSC Certified Wood Standards for Veneer Doors.

FIRE-RATED FLUSH WOOD DOORS – 08 14 16

Type and construction shall be the standard of the manufacturer, with the following exceptions:

1. Provide balanced construction by furnishing manufacturer's laminated stile edge for improved screw holding to both stiles of all C-Label and B-Label doors
2. Stile edge split resistance shall exceed 751 pounds, in accordance with ASTM D143-52

SOUND-RETARDANT DOORS – 08 34 73

Doors shall have the AWI specification symbol SR.Sound Transmission Class (STC) shall be not less than 32 as tested by Riverbank Acoustical Laboratories in accordance with requirements of ASTM E90 and E413. Doors shall be five- ply and shall be the



standard of the manufacturer, with matching edge strips bonded to particleboard or stave lumber core with resin glue.

Doors shall be furnished complete with automatic threshold-sealing-device gaskets. Doors shall be not less than 1 3/4" (unless otherwise stated), according to the manufacturer's standard, in order to provide the sound transmission class specified.

OVERHEAD COILING DOORS – 08 33 23

All overhead doors shall be serviceable. Overhead Door Company due to existing in-place service contract.

HARDWARE – 08 71 00, 08 71 11

Prepare steel frame units to receive mortised and concealed hardware (including cut-outs, reinforcing, drilling and tapping) in accordance with the final finish Hardware Schedule and templates provided by the hardware supplier. Comply with requirements of ANSI A115.1.

Coordinate all door hardware selections for access and security with requirements with University Safety and Security Services. Door assemblies may require additional width or bracing to accommodate required security hardware.

AUTOMATIC DOOR OPERATORS – 08 71 13

Automatic door operators for doors 350 pounds or less shall be Stanley Magic-Force or LCN. For doors heavier than 350 pounds, the Consultant will request product and/or performance information for review by Facilities Management.

Provide additional backing to accommodate the door operator.

Include one-year emergency service, required maintenance with end of warranty adjustment during the first year after Substantial Completion.



DIVISION 8 – PRODUCTS AND MATERIALS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Automatic Door Openers

1. LCN
2. Stanley Magic Force

Door Closers

1. LCN

Finish Hardware

1. USD26D

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to, the following:

Aluminum Entrances and Windows

1. Kawneer Entra 1600 Wall System

Aluminum Entrance Doors

1. Specialite

Glass and Glazing

1. Nippon Firelight Plus
2. Pilkington Pyrostop 90
3. Solutia Sarlex Interlayer Clear
4. Viracon Screen 5023

— END OF DIVISION 8 —



DIVISION 9 FINISHES

GENERAL

The Consultant shall consider the use of the space and long-term maintenance requirements in the selection of finishes

D.C. Building Code and National Fire Protection Association (NFPA) requirements shall be adhered to for materials and installation

.

All finishes should follow LEED and ASTM guidelines for VOC content, off-gassing, adhesive content, caulking compounds, asbestos and lead content, recyclability, face fiber and backing content (carpets), biodegradability and green cleaning. MSDS sheets must be available for all finish products.

Finishes shall contain the maximum amount of recycled content allowed that retains material integrity, contain as much locally harvested and processed or extracted and processed (within 500 miles) material, rapidly renewable material, and FSC-certified content as feasible.

Any finishes (such as adhesives/sealants, paints/coatings, and/or composite wood) must comply with the maximum allowable VOC requirements as defined by SCAQMD.

Submit product cut sheets indicating recycled content, place of origin, rapidly renewable material content, FSC-certified wood content, and VOC levels, as applicable. Track all purchases as a percentage of total spend complying with each sustainability criterion.



Some existing walls, ceiling tile, insulation, floor tile and acoustical plaster contain asbestos or are finished with lead-based paint. The Owner surveys the project during the planning process to determine which areas need to be abated prior to the beginning of construction.

Existing to remain finishes, equipment and surfaces within renovations will be reviewed for cleaning or restoration during the project. Examples include handrails, light fixtures, and ceiling grid.

University Housekeeping will participate in the final site punch list inspection to confirm that final finish conditions at an acceptable turn over level and are maintainable per the University housekeeping standards.

CEILING PANELS

Panels shall generally be a directional-fissured design, unless a special design is necessary to a "feature" area. Panels shall be smooth vinyl when used in high-moisture locations such as food-preparation and toilet areas.

Concealed spline ceilings are not recommended. Return air plenums are not desirable, but where they occur, hold-down clips shall be provided at ceiling panels.

Corner trim shall be provided where grid changes direction at wall. Light fixtures, smoke detectors, sprinkler heads, speakers and fire horns shall be centered within tiles. Check with Facilities Management for individual building standards.

Selecting acoustical tile products already in-use and stocked on campus is encouraged.



CONCRETE FLOORS

Concrete floors shall be examined, and tested if required, for the presence of moisture or foreign materials prior to application of new finishes.

New concrete slab areas shall be designed with curing compounds or other admixtures to be compatible with final floor finishes.

FLOOR COVERINGS:

All floor coverings will meet the Federal Flammability Standard, ASTM D-2859, and Standard Test for Flammability of finished textile floor covering materials, commonly referred to as the "Pill Test". Floor coverings utilized may be Class I (minimal radiant flux of 0.22 w/sq. cm) according to NFPA 253, standard method of test for critical radiant flux of floor covering systems using a radiant heat energy source.

LEED and Green Source guidelines shall be followed for floor coverings.

LATH AND PLASTER

Many of the walls on Campus are plaster. In renovation projects, it is preferred to patch plaster with a plaster material compatible with the existing material. When existing plaster ceilings are penetrated directly for mechanical or electrical work, the plaster shall be patched tightly in order to maintain the existing fire and acoustical protection.

Exterior plaster shall be reinforced with galvanized metal lath and the tie wires shall be stainless steel. Exterior plaster shall be designed as cement plaster or stucco, according to the use of the space.



WALL COVERINGS

Wall coverings are generally not recommended, unless as designed in feature areas and approved by the Owner. An exception is frequently made for custom accent graphics.

The Consultant shall consider the following in selecting wall coverings:

- A. Type 1 commercial vinyl or reinforced fabric required
- B. flame spread must be 25 or less
- C. good cleanability
- D. low maintenance

GYPSUM WALLBOARD – 09 29 00

Drywall construction generally shall be designed to be consistent with the institutional nature of the Campus, with regard to use and abuse by the occupants and the function of the space.

CERAMIC TILE – 09 301 3

Ceramic tile floors and walls shall be designed to conform to the requirements of the Tile Council of America and the American National Standards Institute for wear, installation and sustainability. Ceramic tile with a "non-slip" finish shall be recommended for toilet areas, and ceramic wall tile shall be employed around floor-mop receptors.

Grouts shall be selected for long-term service and cleanability, as well as for flexural and tensile strength and sustainability. Generally, acrylic latex emulsions shall be used in general-use areas, and epoxy additives used for chemical-resistant or food-preparation areas.



Floor drain design shall be coordinated with tile installation, and the tile shall be cut neatly around the floor drain.

WOOD FLOORING – 09 64 00

Wood flooring is not recommended for use in facilities except for gymnasiums, special performing-arts areas or areas where wood floors already exist because of inherently high maintenance needs.

RESILIENT FLOORING – 09 96 16

Existing vinyl asbestos tile to remain in place shall not be penetrated by core drilling, attachment of equipment or by any other manner.

Solid (un-patterned) colors are not recommended due to scratching and maintenance considerations except possibly for use in border designs or accent strips. Vinyl tile shall not be used in high-moisture areas. Seamless flooring, with a minimal number of joints, is recommended for laboratory areas and to meet LEED requirements.

The Consultant, in conjunction with AU's Project Manager, shall research the type of chemicals used in laboratory areas to determine the appropriate type of flooring and joint design.

Rubber base is recommended, and shall be a minimum .080 gauge cove type for use with direct-glue-down carpet or vinyl flooring. In laboratory areas, use an "integral" base with flooring if seamless flooring is chosen.



TERRAZZO- 09 66 13, 09 66 23

Terrazzo used in public areas shall employ non-slip aggregate or finish. The Consultant shall consider expansion joint design and placement in coordination with structural movement of the building. Exterior terrazzo is generally not recommended. Terrazzo is not recommended for toilet areas. Integral terrazzo cove-type base is recommended.

CARPET – 09 68 13, 09 68 16

The Owner may elect to purchase carpet directly from the mill and have the Contractor install it, or the Owner may require the Contractor to supply and install the carpet. Traffic patterns, use of the space and maintenance requirements must be considered in the selection of carpet. The use of carpet tile, modular tile or border accent tile are preferred, when appropriate.

Carpets must meet requirements of the Carpet and Rug Institute's Green Label Plus program and carpet cushions must meet requirements of the Carpet and Rug Institute's Green Label program, or other comparable LEED-compliant standards.

PAINTING – 09 91 13, 09 91 23

Substrate preparation is of utmost importance. Surfaces shall be adequately prepared for painting by filling, scraping, sanding, caulking, priming, cleaning or brushing; the presence of any moisture in areas to be painted is unacceptable.

Although epoxy paint is desirable in high-moisture or abuse areas, its curing time and odor must be accounted for in potentially sensitive areas. Pre-finished (factory finished) items shall not be painted.



Fire protection and other life safety devices shall not be painted.

Receptacle, switches or similar cover plates shall be removed for painting and replaced.

Sherwin Williams zero VOC paint shall be specified for all projects. Performance based substitutions will be considered on a case-by-case basis.

Paints, stains, and finishes certified to Green Seal GS-11, GS-43, GS-47 and EcoLogo 047 are required when available.

On previously painted surfaces, a minimum of one coat of finish paint shall be provided. If patching is required, a primer and at least two finish coats shall be used. Paints are to be applied by brush or roller; spray painting is not permitted.

Touch up of holidays shall be corner to corner to minimize observable variance in paint application.

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DIVISION 9 – FINISHES PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Restroom Accessories (tissue holders, soap dispensers, paper towel holders)

1. Owner provided (Housekeeping), Contractor install

Paint, preferred (FM has purchase discount in place)

1. Sherwin Williams Zero VOC ProMar

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to, the following:

Carpet

1. Interface
2. Milligan
3. Shaw

Restroom Accessories (mirrors, hooks, shelves, etc.)

1. Bobrick

— END OF DIVISION 9 —



DIVISION 10 SPECIALTIES

GENERAL

Specialty items typically receive frequent use and shall be designed with this factor in mind. The Consultant also shall consider mounting these items to walls and floors in order to achieve low maintenance.

All items shall have a factory finish, with no field painting required. Stainless steel items shall conform to standards of the American Society for Testing and Materials (ASTM) and the American National Standards Institute for Type 304 stainless steel. Chrome-plated items shall conform to ASTM B456 standards for nickel and chromium electro-deposited on base metal. Cold rolled steel sheet material shall conform to the requirements of ASTM A366.

Specialty items shall contain the maximum amount of recycled content allowed that retains material integrity and contain as much locally harvested and processed or extracted and processed (within 500 miles) material as feasible. Any adhesives/sealants, paints/coatings, and/or composite wood must comply with the maximum allowable VOC requirements as defined by SCAQMD.

Carpets must meet requirements of the Carpet and Rug Institute's Green Label Plus program and carpet cushions must meet requirements of the Carpet and Rug Institute's Green Label program. Submit product cut sheets indicating recycled content, place of origin, rapidly renewable material content, FSC-certified wood content, and VOC levels, as applicable. Track all purchases as a percentage of total spend complying with each sustainability criterion

Fasteners shall be concealed. Fasteners located against or inserted into walls should be galvanized; exposed fasteners should be stainless steel.

The Designer shall provide, in the design of every new building, the following provisions and spaces, with net areas as indicated in the Service Space Allocation Division. Refer to departmental requirements such as the FM Space Needs document in the references section at www.american.edu/standards.

SERVICE CLOSETS

Service closets (typically described in 01 57 00) containing floor-mop receptors shall incorporate the following:



- mop receptors shall contain a waterproofing membrane on the floor, installed prior to placement of the basin
- built-in mop receptors shall be lined in ceramic tile and/or ceramic tile wainscot shall be provided on the walls of the service closet to a height of 6 feet above the floor
- shelving shall be provided for storage of housekeeping supplies
- power as needed for equipment
- keying and use separate from other operational units

CUSTODIAL EQUIPMENT ROOMS

Minimum Size: 60 square feet per 22,000 sq. ft. of gross area.

Location: Room should be strategically located on all floors

Shape: Room shall be rectangular.

Designer to confirm room size is sufficient for maintenance equipment storage and use. Some equipment requires electrical or water connections.

DRY TRASH ROOMS

Shall be located directly off the loading dock and from a corridor. They shall be of fire-proof construction and shall be protected with sprinklers.

FACILITIES MAINTENANCE CONTROL ROOM

Minimum size 80 square feet can serve a building size up to 80,000 gross square feet. 100 square feet size room will serve a building over 80,000 square feet up to 175,000 gross square feet. 160 square feet size room will serve a building having over 175,000 gross square feet. Refer to FM Space Needs for additional requirements.

FACILITIES MAINTENANCE REQUIREMENTS

Refer to the FM Space Needs document in references on the www.american.edu/standards website for room size requirements, specialties, furnishings and accessories.

The Designer will need to accommodate restrictions on shared space and access to address departmental contractual, safety and service requirements. Generally, FM does not share service space with other departments. For example, do not co-locate OIT and FM equipment. Similarly, University Housekeeping and FM do not share space.



VENDING AREAS

The Consultant shall consider the long-term maintenance of the walls and floors in designated vending areas. Slip-resistant tile or commercial-grade sheet vinyl flooring shall be employed in these areas. Auxiliary Services (AS) coordinates the placement of vending machines and the Consultant shall coordinate electrical, plumbing and the placement of card reader wiring items with this office.

Project vending area shall consider placement of outlets, drainage, visual placement of the units, accessibility to the units, floor texture at area of machines (vinyl flooring or nonskid hard surfacing is recommended), adequate lighting and adequate ventilation.

WET WASTE OR HAZARDOUS WASTE ROOMS

If required by the building usage, shall be located directly off the loading dock and from a corridor. Room shall be fireproof and shall provide other protection as determined by the nature of the waste material. Designer should consult with the American University Environmental Health and Safety Office before the design process begins. Provide 60 sq. ft. minimum for chemistry or similar laboratory facilities.

VISUAL DISPLAY BOARDS – 10 11 00

Marker boards shall be white porcelain-type boards, for use with felt-tipped markers made from sustainable material.

Chalkboards shall be porcelain enamel steel with matte writing surface and minimum 1/4" thick hardboard backing.

Tack boards shall be cork surfacing on minimum 1/4" thick hardboard backing.

Marker boards and chalkboards generally shall have aluminum trim and continuous chalk troughs.

TOILET COMPARTMENTS – 10 21 13

Partitions and doors shall be made of recycled phenolic material, and shall be anchored to the floor or ceiling mounted and provided with overhead bracing and an approved handrail. (Side panels and door panels shall be a minimum 1" thick. Stainless steel plinths (movable for cleaning) on pilasters shall be provided.)



TOILET AND BATH ACCESSORIES – 10 28 00

Toilet Accessories (tissue dispensers, towel dispensers and soap dispensers and sanitary napkin disposals) will be provided by the Owner and installed by the General Contractor.

Other toilet or bath accessories provided and installed by the General Contractor shall be made of stainless steel, with provision for concealed mounting.

Units shall be mounted in accordance with the D.C. Building Code and the requirements of the Americans with Disabilities Act (ADA). Tissue dispensers must be mounted so they are clear of the compartment's grab bars and "door swing," and should not be mounted with screw heads visible on the wall of adjacent compartments.

Bath accessories in residence halls may be Contractor supplied and installed. Consult with University Housekeeping on length of stocked shower curtains and confirm required overlap prior to mounting rod.

Provide blocking in walls as necessary for mounting of equipment.

Handicap showers shall be fully accessible and designed in accordance with the D.C. Building Code and ADA requirements, and shall have a hinged seat, flexible shower spray and soap dispenser.

LOCKERS – 10 51 13

Metal lockers shall consist of minimum 16 gauge bodies and doorframes of cold rolled, recycled steel with baked enamel finish. Lockers shall be placed on a concrete base, or approved alternative and shall have sloped tops or built into the wall and provision for padlocks. Number plates and interior coat hooks shall be furnished.

In some instances, wood lockers with melamine interior and laminated plastic exterior finish shall be considered.

Coordinate keying scheme and labeling of lockers jointly with department and University Lock Shop. Transmittal of keys to follow procedure described in Division 1.

SIGNAGE – 10 14 23

Current signage shall be replaced with signage conforming to ADA requirements as part of the Owner's phased program of accessibility upgrades or during renovation projects, whichever occurs first.



Larger projects may require the use of a building directory, which shall be a type in which information can be changed without special tools. Directional signage shall be considered part of the signage system for each project. In some instances, the use of cast bronze plaques with raised letters is required for a dedicatory function. The Owner shall furnish text for the plaque.

A uniform system of signs for the Campus is necessary for ease of maintenance and replacement. American University has adopted exterior and interior sign standards. All campus signage projects must follow the current sign standards. The designer should consult with Planning and Project Management.

Emergency evacuation diagrams shall be provided for all buildings per IFC 404.3.2. Room identification and code required notices shall be provided as required by NEC, NFPA, or other applicable DCRA codes. Signage required by Risk Management or the University insurance carrier shall also be provided.

FIRE EXTINGUISHERS/CABINETS – 10 44 13, 10 44 16

Fire extinguishers and cabinets must meet the D.C. Building Code and be approved by American University's Facilities Management (FM), and must meet the FM's Guidelines for Fire Alarm and Fire Suppression Systems Standards and Specifications, including recyclable material usage.

The Owner will provide standard ABC fire extinguishers, to be installed by the General Contractor. The General Contractor will supply and install specialty suppression equipment, canisters or extinguishers. Cabinets will be provided and installed by the GC.

Although not required by code, pantries and kitchen areas should have small extinguishers. A fire extinguisher shall be provided in each pantry or common kitchen area where a microwave or other heating appliance is installed.

Fire extinguishers are required in mechanical rooms and elevator rooms.

All contractor supplied fire extinguishers and suppression equipment will be certified prior to Occupancy. Testing of equipment and associated alarms, especially those integrated with the fire alarm system or the HVAC system is required.



DIVISION 10 – SPECIALTIES PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Fire Extinguishers

1. Owner Provided, Contractor Installed unless indicated

Toilet Accessories – Paper Towel, Tissue Holders, Soap Dispensers, Sanitary Holders

1. Owner Provided, Contractor Installed

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to, the following:

Fire Extinguisher Cabinets

1. Larsen's

Moveable Partitions and Walls

1. Hufcor
2. NanaWall

Toilet Accessories – ADA Guards

1. TCI Products Skal+Gard
2. Trubro Lav-Guard

Toilet Accessories – Other

1. Bobrick
2. Scott

Toilet Compartments

1. Santana Envirosafer
2. Yemm & Hart Solid Colors

— END OF DIVISION 10 —



SECTION 10 14 10 MECHANICAL ROOM SAFETY ALERT DRAWINGS

PART 1 - GENERAL

1. SUMMARY

- a. Description: contractors or engineers performing new and/or renovation work that will, upon completion of construction, render the current Safety Alert Drawings obsolete shall update Safety Alert Drawings.
- b. Purpose: To accurately locate, identify, update and catalogue electrical, mechanical, and plumbing equipment that are vital to proper building operations and to provide equipment operators and service/repair persons with a list of safety precautions that are applicable for that particular electrical and/or mechanical room.
- c. Quality Assurance: Safety Alert Drawings shall be original or updated, produced, and provided in accordance with this specification by the responsible party as indicated by the contract documents.

2. SECTION REQUIREMENTS

- a. Provide as a submittal:
 - i. One hard copy of each newly updated or original Safety Alert Drawing for approval by American University before mounting and final installation.

PART 2 – PRODUCTS

1. MATERIALS

- a. Mounting Boards: Approved drawings shall be mounted on “gator” board and laminated.
- b. Drawings shall be clean and free of debris.
- c. Lamina shall cover the front, edges, and 1 ½ -inches of the backside of the drawings.
- d. Drawings with wrinkled lamina or entrapped debris are not acceptable.

2. SIGNS

- a. Format: Drawings shall be large enough to clearly display all text and equipment symbols; and sizes are determined by the location of the drawing in the room. Drawings shall be sized to permit unobstructed installation in mechanical/electrical rooms.
- b. Drawings shall be one of the following drawing sizes, decided by the University Project Manager and based on the site:
 - i. 24”x 36”



- ii. 18"x 24"
 - iii. 11"x 17"
 - c. File names shall contain the building name, room type, and room number. For example, a drawing file created for Anderson Hall mechanical room T126A would be "anderson_mech_t126a.dwg".
 - d. American University shall provide an example drawing in electronic format that will contain the standard border, layers, fonts, pen tables, equipment symbols, equipment names, and general layout of a standard safety alert drawing.
3. DRAWING REQUIREMENTS:
- a. The architectural layout of all drawings shall be orientated to coincide with the drawing location within room.
 - b. The drawing location shall be clearly shown on the drawings and selected so that it is visible as the room is entered or shortly thereafter.
 - c. The section of the drawing labeled "ALERT PRECAUTIONS THIS ROOM" shall contain all alert precautions present in that mechanical and/or electrical room.
 - d. Equipment names conform to the American University standard: building abbreviation-floor abbreviation-equipment abbreviation and equipment number. For example, air handler 001 located on the terrace level of Anderson Hall would be labeled: AH-TL-AHU001. Facilities Management assigns new equipment names and numbers.
 - e. All equipment shall be shown using the correct standard mechanical symbol. A brief description of each equipment item shall be listed below the equipment name. Important information to include in the description shall include, but are not limited to: equipment function, motor hp, voltage/phase, areas served by air handlers, fluid type of service for pumps (chilled water, etc...), location of nearest disconnect, and equipment served by electrical panels.
 - f. A leader line shall be shown from the equipment name to the location of the equipment symbol. Larger equipment items such as chillers, cooling towers, and boilers may have the equipment name placed inside the equipment symbol.
 - g. As required to save space on drawings, equipment schedules may be used to convey pertinent equipment information.
 - h. All motor control centers (MCC) shall be located on the drawings. In addition to this an elevation detail drawing accurately portraying the location and name of each motor controller shall be shown on the drawing.



4. EXISTING DRAWING FILES:

- a. Existing drawing files, provided by American University, shall retain the same cad file name, drawing name, drawing size and general format unless a change is requested by the American University project manager.
- b. Existing drawing files shall be edited to show changes as a result of construction. Items of importance include, but are not limited to architectural layout; deletion of electrical, mechanical, or plumbing equipment; and the addition of electrical, mechanical or plumbing equipment. Date of revision must be shown on revised drawings.

PART 3 - EXECUTION

1. INSTALLATION:

- a. The Contractor shall update all equipment tags as required. The contractor/engineer shall perform a field visit to verify the locations and equipment tags of all equipment.
- b. Create or edit Safety Alert Drawings in accordance with the drawing requirements of this specification.
- c. Submit updated/new Safety Alert Drawings to the American University for approval.
- d. Upon approval, mount drawings in accordance with this specification and install at location designated by American University. Install flat, to the subsurface, with one (1) pan head stainless steel screw in each corner of drawing.
- e. Submit an electronic copy of all Safety Alert Drawings on a compact disk in AUTOCAD format and as a pdf.
- f. Include copy of ALERT drawing (8-1/2x 11) in O&M manual and describe thoroughly during system and equipment training.

- END OF SECTION 10 14 10 -



DIVISION 11 EQUIPMENT

GENERAL

Special equipment shall be designed with the following considerations:

1. Integration with existing systems, equipment or programs
2. Service and maintenance access
3. Maintenance and service life
4. Education of users regarding proper operation of equipment
5. Warranty provisions
6. Replacement parts
7. Recycled content

The Designer should consult with the Office of Information Technology and Audio Visual Services for audiovisual equipment and projection equipment selection criteria and hookup requirements.

ENERGY STAR DESIGN PARAMETERS

Energy Star rated equipment is required for commercial dishwashers, fryers, griddles, hot food holding cabinets, ice machines, ovens, refrigerators and freezers, and steam cookers as well as any other product category as ratings become available.

The Designer shall review equipment, including residential appliances, computers, imaging, and audio visual for EPEAT and ENERGY STAR compliance. See http://www.energystar.gov/index.cfm?c=products.pr_find_es_products.

LABORATORY EQUIPMENT

The Owner may purchase movable equipment, such as balances, refrigeration equipment, centrifuges and other portable laboratory equipment. The Consultant shall closely coordinate the electrical and plumbing tie-ins for this equipment.

Casework generally shall comply with requirements of Division 6 with regard to wood construction and as a basis for manufactured casework. Casework designed for storage of sensitive equipment or for chemical storage shall have locks.

Eyewashes, shower washes and fire extinguishers shall be supplied in laboratory areas. In some cases, wall-mounted fire blankets shall be required. Eye washes and emergency showers must meet the requirements of the American National Standards Institute (ANSI), as specified in the latest edition of ANSI Z358.1.



Vacuum and air connections shall be employed in laboratory areas, and gas connections shall be employed where required. Vacuum breakers shall be provided on faucets.

Laboratory casework shall be placed with at least 5 feet between benches to allow for handicap accessibility.

Refrigeration equipment used in laboratory areas may be purchased by the Owner and installed by the Contractor. Refrigeration equipment used for critical experimentation must be placed on emergency electrical back-up service. Consult with the American University Master Electrician to confirm generator load capacity.

COMMON EQUIPMENT MOTOR REQUIREMENTS – 11 05 13

Designers shall confirm that the specialty equipment motors and connections meet the motor requirements of the equipment manufacturer and are consistent with Division 26 Electrical. Confirm unique needs with the University Master Electrician.

PARKING CONTROL EQUIPMENT – 11 12 00

The Owner currently contracts with parking control vendors to supply this equipment. The Contractor shall supply conduit and wiring to the site of the equipment, and the Owner is responsible for the installation and final connection. The Owner shall supply equipment drawings and electrical requirements to the Consultant for reference.

Provision should be made for Card Reader equipment to be set in a 3/4" conduit to run from the stand to the gate box. Confirm Pay Box requirements with Transportation and Park Services.

LOADING DOCK BUMPERS – 11 13 13

Dock bumpers shall be provided at loading areas. Coordinate with Facilities Management, Auxiliary Services and department to confirm delivery vehicle types for placement and size of bumpers.

LOADING DOCK EQUIPMENT – 11 13 19

Loading dock edges shall be provided with steel angle edging with steel anchors concealed in concrete. The use of motorized dock levelers is not recommended; the Consultant shall accomplish proper driveway back-up clearance for vehicles on "flat grade" to the dock area, at the height of the vehicles most commonly serving the building.



RESIDENTIAL APPLIANCES – 11 30 13

Equipment selection criteria shall include operating energy rating and usage along with performance. Consult with Housing and Residence Life for the most recent approved list of appliances and requirements.

FOOD SERVICES EQUIPMENT- 11 40 00

Where food service areas are part of the project, the designer shall consult with Planning and Project Management and Office of Campus life (OCL) for design and layout of the space. Food service equipment may be purchased by American University and provided to the Contractor for connection. Refer to the products sections for equipment currently used in food service locations.

Refrigerators, microwave ovens and coffee makers used in lounges or break rooms may be purchased by the Owner. The designer shall provide dedicated electrical circuitry for these items.

LABORATORY FUME HOODS – 11 52 13

Fume hoods and bio-safety hoods may be purchased by the Owner and installed by the Contractor. The Consultant shall give special attention to ventilation requirements, particularly taking into consideration the types of chemicals used in the laboratories, air-velocity sensing devices and the need for emergency back-up power.

Motorized elements such as fans shall be designed to provide protection suited to the type of chemicals used. Safety of the user is of highest priority in hood sash (and opening) design and in the design of ventilating storage cabinets. New fume hood design strategies have been demonstrated to reduce energy use by 75%, while maintaining or enhancing safety. Therefore, High Performance, energy efficient fume hoods (e.g. VAV system equipped with a sensor-based auto sash closure) are required.

FACILITY WASTE BALERS – 11 82 36

Designers should consult with Facilities Management prior to including balers, toters, and dumpsters or compactors in their design. All waste is collected in AU's standard Zero Waste Interior Containers. These materials either are then transported to toters or designated compactors outside. All materials hauled off campus by a contractor is only large open tops or 34 yd. compactors. This type of equipment shall be furnished by the Owner, Contractor Installed.

Waste compactors when included shall have push button controls totally enclosed with dock-fed hopper, guide rolls/stop and hinged breaker bar teeth



Cardboard bales are picked up by internal AU recycling staff and transported to the 15 yd. open top(s) designated for cardboard recycling. Loose and baled cardboard are collected in this open top that has a covered lid to protect from weather elements. Cardboard is sent to an off-campus recycling facility.

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DIVISION 11 – EQUIPMENT PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Commercial Bane Marie

1. Hatco

Commercial Chopper

1. Hobart

Commercial Dish Machine

1. Hobart
2. Jackson

Commercial Disposal

1. Red Goat (preferred)
2. Salvajor

Commercial Garbage Disposal

1. Insinkerator Badger

Commercial Grill

1. Garland
2. Vulcan

Commercial Grinder

1. Hollymatic

Commercial Hot Well

1. APW Wyott
2. Delfield
3. Duke

Residential Appliances

1. Current approved list by Housing

Solid Waste Bins

1. ErgoCan EC1119
2. ErgoCan EC
3. ErgoCan 2626

Solid Waste Funnel

1. ErgoLid EC1119F
2. ErgoLid EC1818F

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to, the following:

Commercial Beverage Dispense

1. Bunn
2. FETCO

Commercial Coffee Urn

1. Bunn



2. FETCO

Commercial Cold Line

1. Atlas
2. Delfield
3. True

Commercial Conveyor

1. Aeroworks
2. Caddy
3. Trayco

Commercial Freezer

1. Beverage Air
2. Delfield
3. Master Bilt
4. Nor-lake
5. True

Commercial Fryer

1. Dean
2. Frymaster
3. Hart
4. Vulcan

Commercial Hotline

1. American Metal Fab
2. APW Wyott
3. Atlas Metal

Commercial Ice Cream Dispenser

1. Sani Serv
2. Taylor

Commercial Ice Machine

1. Manitowoc (basis of design)
2. Follett
3. Hoshizaki
4. Kitchenaid
5. Scotsman

Commercial Juice Dispenser

1. Dove

Commercial Kettle

1. Cleveland
2. Groen
3. Hart
4. Vulcan

Commercial Microwave

1. Amana
2. MenuMaster
3. Merrychef



4. Panasonic
5. Sharp
6. Turbochef

Commercial Mixer

1. Hobart
2. Robot Coupe

Commercial Oven

1. American Range
2. Baxter
3. Blodgett
4. Doyon
5. Garland
6. Lincoln
7. Turbochef

Commercial Potwasher

1. Hobart

Commercial Presser

1. Doughpro

Commercial Proofer

1. Gemini
2. Nu-Vu

Commercial Range

1. Garland
2. Hart
3. US Range
4. Vulcan

Commercial Refrigerator Prep Station

1. Delfield

Commercial Refrigerator

1. True (preferred)
2. Beverage Air
3. Brown
4. Delfield
5. Duke
6. Federal Industries
7. Hercules
8. Nor-Lake
9. RPI
10. Structural Concepts

Commercial Skillet

1. Cleveland
2. Hart
3. Vulcan

Commercial Slicer



1. Hobart
2. NEMCO

Commercial Soup Well

1. Wells

Commercial Steam Well

1. APW Wyott
2. Delfield

Commercial Steamer

1. Accutemp
2. Cleveland
3. Nemco
4. Wells

Commercial Toaster

1. APW Wyott
2. Hatco
3. Holmon
4. Savory

Commercial Walk-in Freezer

1. Bally
2. Brown
3. Hercules
4. Master Bilt
5. Tafco

Commercial Walk-in Refrigerator

1. Bally
2. Brown
3. Master Bilt
4. TafcoCommercial Warmer

1. Crescor
2. Hatco
3. Metro

— END OF DIVISION 11 —

DIVISION 12 FURNISHINGS

GENERAL

The Owner usually supplies furnishings. The Owner typically contracts with private vendors who make field measurements, manufacture and install the items. These items include:

- window blinds
- draperies, selected by the Owner and used in certain areas; the Consultant shall coordinate the design of support alcoves and proper substrates to provide for the mounting hardware and rods
- movable rugs
- interior plants
- artwork
- movable furniture and accessories; in larger projects, the Owner may employ the Consultant to assist in the selection of these items through an interior design contract
- upholstered furniture and components utilized may be Class I or Class II according to NFPA 260, standard method of tests and classification system for cigarette ignition resistance of upholstered furniture and will have a peak rate of release limit of 500 kw in accordance with NFPA 261, standard method of test for determining resistance of mock-up upholstered furniture material assemblies to ignition by smoldering cigarettes.

The furnishings listed above shall be included as part of the overall interior design considerations for the project, and shall be included on color presentation boards as required.

Furnishings shall contain the maximum amount of recycled content allowed that retains material integrity, contain as much locally harvested and processed or extracted and processed (within 500 miles) material, rapidly renewable material, and FSC-certified content as feasible. Any adhesives/sealants must comply with the maximum allowable VOC requirements as defined by SCAQMD.

Composite and agrifiber products must contain no added urea formaldehyde resins. Submit product cut sheets indicating recycled content, place of origin, rapidly renewable material content, FSC-certified wood content, VOC levels, and urea formaldehyde resin limits, as applicable. Track all purchases as a percentage of total spend complying with each sustainability criterion.

All furnishings shall be totally chlorine free, processed chlorine free, and low to non-toxic.

Furnishings that are Owner Supplied, Contractor Installed are identified as such in the project scope of work or specifications.

CUTRAINS AND DRAPES – 12 22 00

All fabrics shall be flame resistant. Flame resistant fabrics must pass both the large and small-scale tests in accordance with NFPA 701, standard methods of fire tests for flame resistant textiles and films.

MANUFACTURED EQUIPMENT – 12 63 13, 12 32 13, 12 32 16

Built-in theater, auditorium and classroom seating shall conform to requirements of the D.C. Building Code, with respect to spacing, egress and fire-resistant classifications. The decision to purchase the seating outside the construction contract shall be made by the Owner.

The requirements of manufactured casework are similar to casework requirements described in Division 6. On larger projects, the Owner may require mock-up assemblies for review by the user, prior to manufacture. Mock-ups shall include all represented items associated with the assembly, including sinks, backsplashes, finish and hardware.

ENTRANCE MATS – 12 4813, 12 4816

Entrance mats shall be designed according to the following criteria:

- non-slip surface
- wearability and service life (no rotting or mildew)
- ability to clean foot traffic on textured nylon or polypropylene surfaces without "tracking"
- drainage of recessed area
- maintenance and cleaning of recessed areas and mat
- replacement of parts
- color fastness of "colored" mats; drying capability of mats
- stability of the mat system (no "rattling" of slats when walked upon)
- fire resistance

The design of recessed mat systems employing aluminum-edge "slat" type grating or full-perforated rubber or vinyl is not recommended. Entryway systems (grilles, grates, mats) must be at least 10' long in the primary direction of travel to capture dirt and particulates entering the building at all public entry points.

Mat systems should be appropriate for the climate, should have high void volume within fibers, solid backings, fire-retardant ratings that exceed DOC-FF-1-70, and electrostatic propensity levels of less than 2.5 KV. Systems with recycled-content and rubber backings are preferable.

SOLID WASTE BINS

Each waste location will include 3 bins. One for recycling, one for compost/organics and one for landfill trash. The models and manufacturer outlined below are the only acceptable manufacturer and model to match the campus standards. The 30 gallon bins (EC 1119) should be used in lower traffic areas and office suites. The larger 40 gallon bins (EC 1818) should only be used in very high traffic areas. Panel design artwork should be requested from the Zero Waste Manager or ErgoCan.



DIVISION 12 – FURNISHINGS PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Bike Racks

1. Victor Stanley BRHSA – 101 Century Collection in Tavern Square Green

Solid Waste Bins

1. 30 Gallon - ErgoCan EC1119
2. 45 Gallon - ErgoCan EC1818

Solid Waste Lids

1. Mixed Recycling 45 Gallon - ErgoCan EC 1818 Hole-Slot Lid
2. Compost/Organics 45 Gallon - ErgoCan EC 1818 Diamond Lid
3. Landfill/Trash 45 Gallon - ErgoCan EC 1818 Funnel Lid
4. Mixed Recycling 30 Gallon - ErgoCan EC 1119 Hole-Slot Lid
5. Compost/Organics 30 Gallon - ErgoCan EC 1119 Diamond Lid
6. Landfill/Trash 30 Gallon - ErgoCan EC 1119 Funnel Lid

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to, the following:

Entrance Mats

1. Waterhog

— END OF DIVISION 12 —



DIVISION 14 CONVEYING SYSTEMS

GENERAL

Elevators shall be easy to maintain and service. Maintenance of finish materials is of particular concern, given the frequent use of most elevators. Installation shall take place based upon the latest applicable code governing conveyance systems.

The Contractor shall provide the University with the final inspection report indicating that the elevator installed complies with all appropriate state and federal codes and regulations. This includes all associated items provided by the manufacturer.

CAR ENCLOSURES

Emergency telephones shall dial into the University Safety and Security Service. Telephone number 202-885-2527.

For elevators that will have utility use, cars may be furnished with removable wall pads and hooks, as well as with handrails. The Designer is to clarify with the Owner.

Cars shall contain a lighted floor indicator above the door or in the return column; soffit mounting is not acceptable. Color shall be blue. Exception Mary Graydon Center passenger elevators indicators are currently red. Consult with Owner to confirm blue or red indicator.

An electrical receptacle for housekeeping purposes shall be provided in the corridor adjacent to the elevator landing on each floor.

Interior cab finish companies shall fall under the control of the elevator installation contractor. Cab finishes shall be determined and approved by the University approved architect.

Elevators must comply with the requirements of the Americans with Disabilities Act (ADA).

Floor covering, underlayment, and its adhesive shall have a critical radiant flux of not less than 0.45 W/cm^2 , as measured by ASTM #648.

MACHINE ROOMS, PIT AREAS AND PENTHOUSES

Where equipment is subject to severe or sudden vibrations, sound-deadening material shall be used to isolate any sounds or vibrations from the supporting floor or wall.



Machine rooms shall comply with the latest applicable code with regards to its dimensions, fire protection and atmospheric control.

Access to pits and machine rooms shall be built in accordance with the latest applicable D.C. Code for Elevators.

ELEVATOR CONTROLLERS

Elevator controllers shall be non-proprietary in their design. This is defined as having equipment that in which at least three elevator companies can work on without the use of special tools, passwords and any more technical expertise than is already possessed. Typical non-proprietary manufacturers are ones such as Motion Control or GAL. Proprietary manufacturers are ones such as OTIS, Thyssen-Krupp, and Kone. Although the aforementioned companies tend to offer their own manufactured systems which are proprietary, if specified, these can install non-proprietary systems.

The installation company shall provide all necessary tools for the purpose of monitoring and or adjusting elevator controllers. This includes any special software or handheld devices normally used.

ELEVATOR DOOR EQUIPMENT

Elevator door equipment shall be from GAL using the closed loop door operator MOVFR system

TRACTION ELEVATORS

When the building design prevents the use of a penthouse machine room or the decision is to not install hydraulic elevators, the installation of Machine Room Less (MRL) traction type elevators can be installed. MRL elevators shall be such that it will not require proprietary tools or equipment to be serviced.

All traction machines shall be in compliance with the Office of Sustainability and be equipped with regenerative drives.

HYDRAULIC ELEVATORS

Hydraulic elevators can be of either a single jack system or a dual post jack system. Choice of which jack to install is dependent on ground conditions.

To protect elevator single jack units, the casing and any underground piping shall have an approved coating designed to resist electrolytic and chemical corrosion. The jack shall be installed in a double bottom cylinder. Where drilling for full travel is unavailable,



consider using an inverted telescopic jack. The Consultant shall inspect the casing prior to back filling.

VERTICAL WHEELCHAIR LIFTS

The Consultant should submit complete product information to the Project Manager for approval prior to ordering the lift and constructing the surrounding areas. The information should cover major components; lift dimensions, control diagrams, surrounding construction configurations and electrical connections.

The Consultant shall submit to the Owner a certificate indicating that the lift complies with the applicable D.C. Code. This includes all associated items provided by the manufacturer.

Self-closing gates and associated items at top and bottom levels, along with all "electromagnetic" and mechanical hardware, shall comply with the D.C. Vertical Wheelchair Lift Code.

The lift's rated speed shall not exceed 40 feet per minute.

The following guidelines for platforms and ramps shall be observed:

- platforms shall be at least 36" wide and have an inside area of not more than 12 square feet
- platform surfaces shall be constructed of material that is relatively smooth and skid-proof
- ramps shall be provided as required for access to platforms
- ramps shall be designed and constructed as required by the D.C. Vertical Wheelchair Lift Code
- platforms shall be designed and constructed to prevent wheelchairs from leaving the platforms prematurely

STAIR LIFTS

Stair lifts shall comply with all applicable elevator and ADA codes. Design shall be in accordance with the conditions in which it is installed. If a stair lift is intended to be exposed to the outside elements, then the design and or equipment shall be such that all operating components will resist corrosion or complication due to the elements.



DIVISION 14 – CONVEYING SYSTEMS PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Elevators

1. Non-proprietary (preferred, basis-of-design)
2. Kone
3. Schindler

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to, the following:

Interior Lifts

1. Wheel-O-Vator

Exterior Lifts

1. Graventa

— END OF DIVISION 14 —



DIVISION 15 MECHANICAL

The American University Design Standards follow the expanded CSI format using the Facilities Services Subgroup format. Refer to:

- Division 21 Fire Suppression
- Division 22 Plumbing
- Division 23 Heating Ventilating and Air Conditioning
- Division 25 Integrated Automation
- Division 26 Electrical
- Division 27 Communications
- Division 28 Electronic Safety and Security

Information is organized based upon MasterSpec December 2017.



DIVISION 16 ELECTRICAL

The American University Design Standards follow the expanded CSI format using the Facilities Services Subgroup format. Refer to:

- Division 21 Fire Suppression
- Division 22 Plumbing
- Division 23 Heating Ventilating and Air Conditioning
- Division 25 Integrated Automation
- Division 26 Electrical
- Division 27 Communications
- Division 28 Electronic Safety and Security

Information is organized based upon MasterSpec December 2017.



DIVISION 21 FIRE SUPPRESSION

GENERAL

FIRE DETECTION & ALARM

Fire detection and alarm systems are critical in assuring life safety and to protect University owned property. It is imperative that they perform their vital function properly and reliably.

These standards are applicable to new installations of fire and smoke detection and alarm systems in all Campus facilities, as well as all modifications, upgrades and renovations to existing systems.

Contractor shall perform maintenance and adjustments for the duration of the substantial completion warranty period. A full annual inspection shall be conducted prior to turning over the system fully to the University, inclusive of all testing, records, and certificates.

Designer shall review and comply with the provisions within the current version of the Facilities Management (FM) Fire Suppression Master Plan and Fire Alarm Master Plan. All projects or renovations will include monitoring and reporting to the university head end at University Safety and Security Services (located at East Campus) and the Manager of Life Safety Systems (located in Osborne) and include graphics updates.

Equipment identification shall follow the existing Facilities Management asset tag scheme. Submit list of new or replacement equipment to FM Planned Maintenance Manager for confirmation.

Equipment labeling shall follow the AU electrical labeling identifying power source.

All new work or changes require updating of the fire alarms graphics and alarms, which shall be the responsibility of the Contractor.

Designer should review the Generator division specification for integration capabilities with fire alarm system monitoring.

SPRINKLER AND STANDPIPE SYSTEM MONITORING

Standpipe installation shall comply with the latest version of NFPA 14. Sprinkler installation shall comply with NFPA 13 or 13R (latest versions) and Appendix D: Standards for Automatic Sprinkler Systems.



Each water-flow switch will be provided with an integral 20 to 40 second time delay device to prevent nuisance alarms from surges in water pressure. Permanent provision shall be made for testing each switch by water flow equivalent to that from a standard 1/2 inch sprinkler head.

Separate water-flow switch(es) shall be provided for each floor, just downstream of every zone valve, on each branch from the riser.

Sprinkler supervisory circuits for monitoring valve tamper are limited to no more than three valves each, on either one floor or one riser. Other sprinkler system supervisory functions, such as dry pipe/pre-action system hi-low air pressure monitoring, must be on individual circuits.

Rooms housing sprinkler control valves will be marked with a white sign with red letters stating "Sprinkler Controls Inside". All sprinkler control valves shall be numbered and identify what section of the sprinkler it controls.

Inspector's test valves will be located at the highest point and whenever possible, piped to ground level and outside of the building with the appropriate 1/2" test fitting installed on the end of the pipe. Test valve discharge will not flow onto or across any sidewalk, stairs or public walkways.

Post indicator valves will be provided for each sprinkler system. Post indicator valve control shall be tied into the Fire Alarm Control Panel (FACP) on a separate module and wired in such a manner as to activate the "Trouble Alarm".

Standpipe flow switches shall be tied into the FACP on a separate module and wired in such a manner as to activate the "General Fire Alarm". Each standpipe flow switch will be provided with a spring loaded ball type check valve or an integral 15 to 20 second time delay device to prevent nuisance alarms from surges in water pressure.

Standpipe tamper switches shall be tied into the Fire Alarm Control Panel on a separate module and wired as to activate the "Trouble Alarm". Operation of the tamper switch shall not affect the operation of the flow switch and shall not activate the General Fire Alarm.

Standpipe control valves shall be enclosed in a cabinet or room and clearly marked by a white sign with red letters stating, "Fire Department Use Only". Standpipe fire hoses will not be installed in the hose cabinets; however, each standpipe connection must match District of Columbia Fire Department threads and diameter.

Systems with associated backflow preventers shall be tested as described in Division 22.



The use of dissimilar metals within piping systems is prohibited. Exceptions require Facilities Management approval and are limited to die-electric fittings only such as when existing material incompatibilities are discovered during renovations.

KITCHEN EXHAUST HOOD EXTINGUISHING SYSTEMS

All kitchen exhaust hood-extinguishing systems shall be Ansul R-102 Wet Suppression System - no other suppression system will be specified or installed without the approval of the Risk Management and Facilities Management. Each system shall comply with NFPA 17A and NFPA 96, latest versions.

Systems shall be interconnected with the fire alarm, on a dedicated zone. The exhaust fan must continue running after the system has been discharged to remove smoke, but the supply fan serving the space with the hood shall stop.

Appliances under the kitchen hood must have their gas or electric fuel automatically shut off upon agent release. Both of these functions are normally performed directly by the extinguishing system, through mechanical linkage to the gas valve or via internal micro-switches controlling shunt trip breakers. All shut down devices shall require manual reset prior to fuel or power restoration.

Initiation devices shall be fusible link rather than electrical devices for standardization of hood suppression systems, reduction of maintenance costs and to simplify training for emergency response personnel. University Safety and Security Services has approved the following suppression system for installation in Campus facilities:

A "Puff Test" shall be performed and witnessed by AU Fire Safety personnel and District of Columbia Fire Marshall.

Contractor shall perform maintenance and adjustments for the duration of the substantial completion warranty. Coordinate with Facilities Management Life Safety Manager prior to performing any work. All routine maintenance and service must be scheduled two-weeks in advance and will be supervised by University personnel.

Integration with the Building Automation System and commissioning testing is required for all kitchen exhaust hood systems. Refer to additional alarm and connection requirements in Division 25.



DIVISION 21 – FIRE PROTECTION PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Fire Alarm System

1. Siemens XLS

Smoke Detectors - Standalone

1. Kiddie – 10 year battery

Exit Signs

1. Lithonia Emergency LED

Generators (Diesel) – see 26 32 13 Engine Generators (for integration requirements)

1. Cummins, with matching ATS

Kitchen Exhaust Hood Extinguishing Systems

1. Ansul R-102 Wet Suppression System

Subject to compliance with project requirements, acceptable manufacturer(s) include, but are not limited to, the following:

Fire Alarm Panel

1. Siemens

Fire Hydrant

1. AP Smith
2. Kennedy
3. Mueller

Fire Pump

1. Aurora
2. Emerson

Fire Notifications Device

1. Siemens

— END OF DIVISION 21 —



DIVISION 22 PLUMBING

GENERAL

The Consultant shall provide a written description of how the entire system is designed to operate. This Basis of Design (BOD) narrative also shall describe how project objectives are being met. It shall be provided in a format that can be easily understood by a lay person, the end user. The narrative shall identify items that specifically meet the University's Project Requirements (OPR) and the most recent Facilities Management (FM) or department System Master Plan(s) and articulate a rationale for any variance.

For renovations, the systems selected shall be compatible with the existing building's mechanical and plumbing systems. The integrity of the basic existing building system shall not be compromised, except where agreed to by the University. Work shall be designed and sequenced to minimize impact and interruptions in occupied buildings. Consult with FM to identify timing necessary for notifications and operational requirements (e.g. after hours work, backup systems, or field support).

For site work, the Consultant shall indicate all existing such as piping, valves, manholes, electric wiring and telephone underground work using the latest American University (AU) utility plan, whether new connections are being made or not. Profiles of all new storm and sanitary sewers need to be shown to facilitate coordination with the crossing of other utilities.

The Consultant shall incorporate any requirements from the University insurance carrier or Risk Management into the design and specifications.

PLUMBING, DOMESTIC AND SANITARY SYSTEMS DESIGN CRITERIA

The Consultant shall allow for normal expansion and contraction of the piping system. In addition to construction drawings, the project as-built drawings shall indicate expansion joints or pipe swings where designed or added.

All fluid systems shall be designed to be fully drainable.

American University is committed to energy efficiency and water use reduction. Designers should consider water reduction methodologies if applicable for incorporation into the project. Do not discharge water-cooled equipment to drains.

Metering at the campus level and/or sub-metering at the building level is required. Meter records (size, purpose) along with a photograph of the installation with the meter number clearly shown shall be submitted to FM Energy and Engineering (E&E) when placed in service.



Meters associated with billing are required to be supplied by DC Water. This applies to domestic, irrigation, cooling tower makeup or similar applications. Sub-meters for irrigation and cooling towers should be programmed by DC Water to receive sewer credit on the utility bill.

Plumbing design shall be compatible with the latest version of the local energy code(s) as amended to include water conservation requirements. Energy conservation measures shall be incorporated into all projects.

Piping and plumbing equipment design and selection shall allow for anticipated future building expansion. The need for expansion should be discussed during the project design phase. The Consultant shall evaluate piping that might be subject to freezing and provide proper freeze protection as necessary.

Water or sanitary piping will not be allowed in telephone rooms, electric equipment rooms and closets, elevator machine rooms, emergency generator rooms or over motor control centers. In addition, sanitary drainage piping shall not be run at the ceiling of any food- preparation or serving area.

Water (and gas piping) shall not be run under buildings where access is not readily available except where necessary to pass through the exterior wall of a building and then immediately turn up into the building.

The following flow and flush rates are required minimums for all new and replacement plumbing fixtures. Indoor plumbing renovations must include plumbing fixture replacements compliant with the flush and flow rates below as a minimum or as required by local code, whichever is more stringent.

AU Plumbing Fixture Flow Rate Chart

Fixture	Flow / Flush Rate
Water closet	1.28 / .08 GPF dual flush
Urinal	0.125 GPF (pint flush) urinal
Lavatory faucet	0.5 GPM
Kitchen / janitorial sink	2.2 GPM
Shower	1.5 GPM

Where options exist for low flow rates for other fixtures, the lowest flow rate should be selected. Fixtures that exceed the flow rates above should be submitted for approval as an exception and will be considered only on a case-by-case basis.

The design of plumbing systems should take into account serviceability of equipment, valves and accessories and isolation for repairs. Vents and drains shall be identified on the drawing. Design drawings should include a detail showing piping size, valve and hose connection. For large projects, isometric piping diagrams shall be included in the drawings. Drains shall route to the closest or readily accessible drain in a manner to



prevent a tripping hazard. System and branch drains located within areas occupied by non-FM departments should be avoided.

The height preference for valve handle access is less than five (5) feet or as required by code. Valve handles over eight (8) feet shall have a chain operator or similar device. The same applies to installed access panels. Refer to Division 23 for size requirements.

Isolation valves to be high performance bubble free, and required for all ball valves and butterfly valves 2 inches and larger.

Orient valves, gages and indicators so that position is visible from the floor level without ladder use.

Backflow preventers shall be certified within one (1) week of occupancy with a copy of the required forms and printout formally transmitted to Facilities Management.

Include trap primers for drains in interior locations including under equipment, within restrooms and wash down areas. Mechanical rooms and locations with infrequent use shall have drain trap primers. Trap guards are acceptable on renovations to existing buildings not new construction.

The placement of cleanouts shall consider maintenance equipment requirements such as drain snakes or inspection cameras. Identify on drawing distance requirements and confirm access to a water source with hose bibb and a dedicated electric receptacle. Fixture removal as a cleanout should be the last resort and avoided if possible. All sanitary piping cleanouts shall be installed facing non-occupied spaces (i.e. hallways, corridors, etc.).

Equipment naming and labeling shall be consistent with other University systems and used consistently throughout the project., refer to the Equipment Naming Scheme document in the references section at www.american.edu/standards and related control naming document in Section 25 55 00.13 Control of HVAC_Object Naming Convention. Submit equipment schedule during design phase for confirmation of the FM AiM asset identification. Include on drawings across all disciplines. See Division 26 for required color-coding of labels for equipment and components based upon energy source.

Do not design a system that uses Victaulic or similar gasketed pipe for primary or secondary domestic water distribution within the building. The exceptions are readily accessible mechanical areas and fire suppression.

All flexible connections shall comply with any requirements by the University insurance provider.



PVC piping is acceptable only for non-potable water applications such as condensate or similar applications. PVC pipe jacketing is not to be installed on the roof; only aluminum pipe jacketing is acceptable for exterior process piping.

On each floor, cold-water hose bibb connections are to be provided in a janitor's closet or if not feasible in discrete locations behind access doors.

Roof mounted equipment condensate and/or service drains will not be permitted over sensitive spaces. If not possible, oversize drain size to prevent flooding.

Install one (1) hose bibb on each side of a building, as well as one (1) on the roof for equipment requiring cleaning or vegetative roofing.

Projects using BIM modeling shall detail all manufacturer's requirements for equipment service clearances.

Specialty plumbing equipment are to be purchased with an associated minimum two-year service contract. Examples include acid neutralization, vacuum pumps, air compressors, etc.

Type L copper piping is required for domestic water piping distribution. Type M copper is not acceptable.

The use of t-drill as an installation method on 2 inch and larger piping is acceptable.

Pro-press as a connection is allowed in accessible areas only and shall be so noted on the as-built drawings. FM possesses a complete Pro-press kit for maintenance purposes for sizes up to 4 inch; other manufacturers will not be considered.

Mechanical equipment rooms above the lowest floor shall be curbed to prevent flooding. Incorporate ceiling mounted lifting eyes for ease of removal on equipment exceeding sixty (60) pounds installed five (5) feet or more above finished floor. Should ceiling restrictions exist, design should include sufficient space for using a portable lifting device.

All wastewater, injectors and sump pump pits and assemblies to have odor free lids and gasketing to manage odor. Include pump lift mechanism on pits exceeding three (3) feet. Sump pump must report and alarm to the Building Automation System and have associated graphics.

Packed pumps and specialties, skid mounted are preferred over field-assembled units with components from multiple manufacturers. Integration with Building Automation System (BAS) for monitoring, control and alarms shall follow the BAS Master Plan and the requirements listed in Division 25.



Test potable water systems per local code and utility requirements. Provide test and acceptance results to FM prior to occupancy or use.

Dielectric nipples are not allowed. On an independent chart (similar to the valve chart), all installed dielectric connections are to be documented. Laminate and post in closest mechanical room. Submit electronic version of posting in Excel and PDF during close-out.

All exterior utility tie-ins shall include a manhole for ease of operation, service and maintenance.

During design development, submit for compatibility review a complete manufacture points list for controlled equipment provided under this Division, indicating if points are monitor-only or capable of remote control. Point mapping to the existing BAS system is an owner requirement. Variances require concurrence of Facilities Management.

Include a complete description of technical control requirements such as handheld devices needed for field adjustment, software and licensing (proprietary or open source), or gateway requirements. Refer to Division 25 for building automation requirements.

VALVES

Valves used for isolation and control shall provide absolute shut-off to full ANSI Class ratings with pressure in either direction, allowing flexibility in system design and utility during system maintenance.

Stainless steel is preferred for valve bodies, seats, retainers and associated packing gland retainer studs. Bearings shall be stainless steel with PTFE/fiberglass mesh liner. Composite materials shall not be used.

Valve tags are to be installed down to one-inch pipe. Valve charts are to be laminated and kept accordingly in the closest mechanical rooms or floor service closets. Note that FM and University Housekeeping do not share access to the same service spaces.

During project closeout, the first fifteen (15) of sanitary and storm piping for all new roof and floor drains shall be bore scoped. Pipe condition documentation to be sent as a closeout submittal.

VALVES, BALL – 22 05 23.12

Valve selection criteria is chromium plated or stainless steel (full port) ball valve. Performance rating is minimum 400 psi CWS, 125 SWP with 600 WOG preferred and maximum temperature of 400F.



Where insulation is specified, provide factory installed extended stems to receive insulation. Service valves installed in systems below ambient temperature shall have Therma-Seal as manufactured by Apollo or approved equal.

Chain wheel operators shall be provided for all valves 2-1/2" or larger installed 72 inches or higher above finished floor. Extend chains to an elevation of 60 inches above finished floor.

Hand wheels fastened to valve stem shall be provided for valves other than quarter-turn types. Lever handles shall be provided for quarter turn valves 4" and smaller.

Gear drive operators shall be provided for quarter turn valves 6" and larger.

VALVES, BUTTERFLY – 22 05 23.13

Valve selection criteria is high performance positive shutoff on pressure or vacuum with zero leakage and bubble tight for all isolation valves over 2 inch. All shafts shall be one-piece construction.

VALVES, CHECK – 22 05 23.14

Standard swing check valves over 4" shall be rubber faced. Resilient coatings such as ethylene propylene diene monomer rubber (EPDM) or porcelain may also be appropriate.

Install check valve with a minimum of 5 (five) pipe diameters downstream from any flow disturbance (valve, pump, elbow or reducer) to reduce chatter and early valve failure.

VALVES, GATE – 22 05 23.15

Valve selection criteria is adjustable packing gland, blow out proof stem design, with polytetrafluoroethylene (PTFE) seats and ethylene propylene diene monomer rubber (EPDM) stem packing.

Standard steel wedge type gate valves should be outside screw and yoke, rising stem, non-rising hand wheel, and bolted bonnet.

Gate valves are to be used in specific installations only with prior approval from FM. Do not use where dirty surface medium may cause seating problems.

HEAT TRACING – 22 04 29

Integrate heat tracing into the Building Automation System as a start/stop status point and alarm on failure to operate based upon Outside Air Temperature (OAT).



COMMISSIONING OF PLUMBING SYSTEMS – 22 08 00

In addition to required startup and performance testing, plumbing systems shall follow the connectivity and alarm requirements as described in the Building Automation Master Plan and the FM Commissioning Plan. See Division 1, Section 01 91 13 and Division 25. Additional requirements by DC Green Code may also apply.

COMMERCIAL PLUMBING FIXTURES – 22 41 00, 22 42 xx

For residence halls and high-traffic areas, low-flow toilets must incorporate a pressure-assisted technology (as opposed to the standard gravity-fed option).

Automatic flush valves shall be hardwired, not battery or wireless. Turbine or electrically powered with battery backup are to be used.

All fixtures and appurtenances should be selected based upon having a local (DC Metro area) manufacturer's representative and supplier.

EMERGENCY PLUMBING FIXTURES - 22 45 00

The need to install a safety shower or eyewash is dependent upon the planned use of the space. All new construction and renovation projects that require installation of a safety shower or station must ensure that the equipment complies with the most recent ANSI Z358.1 standard. Final design approval should be obtained from the Risk Management office

All installations shall meet the following standards:

- ANSI Z358.1 (most recent publication)
- OSHA – 29 CFR 1910.151(c)
- Americans with Disability Act of 1990

DESIGN REQUIREMENTS

In an area where eyewash equipment is required, the eyewash station must be designed to the following specifications:

- The eyewash must be plumbed and provide potable, tempered water between 60°F and 100°F, with an ideal sustained temperature of 85°F.
- Equipment must be made of stainless steel and/or high impact plastic.
- The eyewash must be able to be activated in one second or less and stay activated without further use of the operator's hands. It must stay activated until manually shut off.



- Nozzles must have caps that protect them from airborne contaminants. The caps must automatically discharge upon activation without additional operator effort.
- The eyewash must deliver at least 0.4 gallons of water per minute.
- The water pressure should be 30 psi.
- Exposed piping subject to damage must have PVC jacketing.
- Outdoor units must be equipped with freeze protection

Hand-held emergency drench hoses are not acceptable alternatives to plumbed. It must stay opened without further use of the operator's hands. It must stay activated until manually shut off.

- The eyewash must deliver at least 20 gallons of water per minute.
- The water pressure should be 30 psi.
- At a height of 60 inches above the floor, the spray pattern must be at least 20 inches in diameter.
- Water service to the shower must be equipped with a ball valve and lever handle. The valve must be accessible with a 6-foot ladder to provide shut-off capability in order to service the fixture. The valve's handle shall be able to be turned/manipulated without the need for tools or equipment. A single valve shall serve to shut of both the hot and cold water.
- Exposed piping subject to damage must have PVC jacketing.
- Outdoor equipment must be equipped with freeze protection.

EMERGENCY SHOWERS – 22 40 00

An emergency shower is required in any area that contains or will contain more than 2.5 liters of caustics or corrosives that could cause injury to the skin or eyes. The product's Safety Data Sheets should be reviewed for any language that refers to the substance as an "injurious corrosive." Some examples of areas that require eyewash equipment are battery changing or charging stations, wet laboratories, pesticide mixing stations, chemical or pesticide storage areas, and fine art studios.

A sign shall be placed above each emergency shower that reads "Emergency – Safety Shower" and contains the safety shower symbol. The background may be white or green with black or white writing. The sign must be large enough and placed high enough above the station so that it can be easily seen and read from anywhere within the immediate space.



CONFIGURATION

- The shower may not be located directly over or within three feet of electric power sources such as outlets, switches or power supply panels, regardless of whether or not they are Ground-Fault Circuit Interrupted (GFI).
- The center of the showerhead must be at least 24 inches away from obstructions (walls, benches, etc.)
- The activation pull shall not be more than 69 inches from the floor.
- The activation pull must be located out of the normal pathway in the room to minimize the likelihood of accidental activation, preferably within two inches of a wall or bench.
- The shower may not be obstructed by other permanent or temporary structures.
- Strainers are recommended in the hot and cold water lines ahead of the tempering valves and eyewashes or showers.
- The showerhead shall be between 82 and 96 inches from the floor.
- It is preferred the shower be located near a floor drain, and the floor shall be sloped toward the drain. Floor drains with removable plugs are acceptable. For units not plumbed to a drain, the waste connection must point away from the wall.

EYEWASH EQUIPMENT – 22 45 16

An emergency eyewash station is required in any area that contains or will contain caustics or corrosives that could cause injury to the eyes. The product's Safety Data Sheets should be reviewed for any language that refers to the substance as an "injurious corrosive." Some examples of areas that require eyewash equipment are: battery changing or charging stations, wet laboratories, mechanical spaces, housekeeping storerooms, theater set design studios, photography dark rooms, chemical or pesticide storage areas, and fine art studios.

Hand-held eyewash bottles and self-contained eyewash stations are not acceptable alternatives to plumbed eyewash units.

In an area where eyewash equipment is required as stated above, the eyewash station must be placed as follows:

- Eyewashes should be accessible within 10 seconds from any point in the work area, with the maximum travel required being 50 feet.
- If the eyewash station cannot be reached within 10 seconds or 50 feet, whichever is less, another eyewash station must be installed.
- The eyewash station must be present within the same contiguous area as the hazard. It must be positioned such that the user does not have to travel to a different room to use.
- The eyewash unit may be combined with safety showers or sink-mounted, as long as it still meets the design requirements discussed below.

A sign shall be placed above each eyewash station that reads “Emergency – Eye Wash Station” and contains the eyewash symbol. The background may be white or green with black or white writing. The sign must be large enough and placed high enough above the station so that it can be easily seen and read from anywhere within the immediate space.



CONFIGURATION

- The eyewash may not be located directly over or within three feet of electric power sources such as outlets, switches or power supply panels, regardless of whether or not they are Ground-Fault Circuit Interrupted (GFI).
- The eyewash must be installed with sufficient space to allow the user to hold their eyelids open with both hands while the eyes are being rinsed
- Nozzles should be positioned between 33 and 45 inches from the floor, and at least 6 inches from the wall or nearest obstruction. The nozzles must be easily accessible to the operator with no obstructions. Combination drench hose/eyewash units must be positioned so that the eyewash can be activated without having to manipulate the drench hose.
- Strainers are recommended in the hot and cold water lines ahead of the tempering valves and eyewashes or showers.
- The eyewash should be located above a sink or floor drain. For units with a waste connection that is not plumbed to a drain, the waste connection should point away from the wall.

SELF-CONTAINED EYEWASH EQUIPMENT – 22 45 19



Self-contained eyewash equipment may not be used in new construction or major renovation projects. Self-contained eyewashes may only be used in areas that have changed occupancy but have not undergone renovation.

The University Safety and Security Services office must be notified prior to the installation of a self-contained eyewash station.

HAND HELD EMERGENCY DRENCH HOSES – 22 45 29

A hand-held emergency drench hose may serve as an additional piece of safety equipment, but may not replace an emergency shower where one is required. Refer to section 22 45 13 to determine if a safety shower is required.

DRINKING FOUNTAINS AND WATER COOLERS – 22 47 10, 22 47 13

All drinking fountains must accommodate a refillable water bottle. Fountains that accommodate reusable water bottles come at two price points, glass fillers and bottle filling stations. The filling stations have advantages with speed, visibility, sanitation, and vandalism-prevention; however, they are more expensive. Type, including cost and frequency of fillers, is a prime selection criterion. Water bottle filling units should have a filter alarm and show calculation of disposable containers avoided.

New buildings are required to have water bottle filling stations. During renovation projects, water fountains must either be replaced with filling stations or modified with glass fillers in low traffic areas.

Fillers must have a feature that shuts off the water supply if the filler is disconnected.

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DIVISION 22 – PLUMBING PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Bottle Filler (for existing water fountain)

1. Halsey Taylor Water Boost
2. Oasis Aqua Pointe

Copper Piping

1. Type "L" thickness or better

Domestic Water Exchangers

1. Alfa Laval (basis of design)

PVC Piping

1. Sanitary DWV Schedule 40
2. Water Schedule 80

Water Fountains

1. Elkay EZH2O series with bottle filler and counter

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to the following:

Backflow Preventer

1. Ames
2. Apollo
3. FEBCO
4. Watts
5. Zurn Wilkins

Emergency Shower

1. Spearman

Domestic Water Heater

1. A.O. Smith
2. Aerco
3. PVI

Domestic Water Pump

1. Armstong
2. Bell& Gossett
3. Grundfos



Domestic Water Packed Pump Systems

1. Spirax Sarco

Chemical Feeder

1. PPG Industries
2. Stranco

Facility and Storm Drainage Sump Pumps

1. Weil
2. Zoeller

Flush Valves – Toilet

1. Sloan Uppercut Manual or Dual Flush
2. Sloan Royal 116
3. Sloan Royal 186

Flush Valves – Urinal

1. Sloan WEUS-1000-1001-0.125

Plumbing Accessories, e.g grab bars, towel racks, and hooks

1. Bobrick
2. Scott,

Plumbing Faucets - Sinks

1. American Standard
2. Chicago
3. Delta
4. Moen, preferred

Plumbing Lavatories or Sinks

1. American Standard
2. Corian
3. Kohler

Plumbing Toilets

1. American Standard
2. Eljer
3. Kohler

Plumbing Urinals

1. American Standard
2. Eljer
3. Kohler



Pool Heater

1. Bell & Gosset

Pressure Reducing Valve

1. Cla-Val
2. Watts

Pump

1. Armstrong
2. Baldor
3. Bell & Gossett
4. PACO
5. Weinman

Pump Motor

1. Aurora
2. Baldor
3. Lincoln Motor

Valves – Ball

1. Apollo
2. Nibco
3. Jamesbury

Valves – Butterfly

1. Bray Series 70
2. McCannalok

Valves – Check

1. Crane
2. Stockham
3. Watts

Valves – Gate

1. Mueller
2. Stockham

Valves – Needle (PVC, CPVC)

1. Haywood
2. Marquest
3. Nibco

— END OF DIVISION 22 —



DIVISION 23 HEATING, VENTILATING AND AIR CONDITIONING

For all new construction and renovation projects, the Mechanical and HVAC design shall comply with local and state codes and with the latest codes and guidelines of the following organizations:

- a. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
- b. American National Standards Institute (ANSI)/ASHRAE 62.1-2010 Ventilation for Acceptable Indoor Air Quality (
- c. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Standards for Ductwork Design
- d. ANSI/American Industrial Hygiene Association (AIHA) Z9.5-1992 Laboratory Ventilation
- e. ANSI/ASHRAE 110-1985 Method of Testing Performance of Laboratory Fume Hoods
- f. American Society for Testing and Materials
- g. National Board of Fire Underwriters
- h. National Fire Protection Association (NFPA)
- i. National Electrical Code
- j. National Electrical Manufacturers Association
- k. Occupational Safety and Health Administration (OSHA)
- l. American Society of Mechanical Engineers (ASME)

DESIGN CRITERIA

The Consultant shall provide a written description of how the entire system is designed to operate. This Basis of Design (BOD) narrative also shall describe how project objectives are being met. It shall be provided in a format that can be easily understood by a layperson, the end user. The narrative shall identify items that specifically meet the Owners Project Requirements (OPR) and the most recent Facilities Management (FM) or department System Master Plan(s) and articulate a rationale for any variance.

For renovations, the systems selected shall be compatible with the existing building's mechanical systems. The integrity of the basic existing building system shall not be compromised, except where agreed to by the Owner. Work shall be designed and sequenced to minimize impact and interruptions in occupied buildings.

For site work, the Consultant shall indicate all existing underground work such as piping, valves, manholes, electric wiring and telephone, whether new connections are being



made or not. Profiles of all piping need to be shown to facilitate coordination with the crossing of other utilities. Planning and Project Management or the Project Manager will provide existing campus utility information so new work can be coordinated.

The Consultant shall incorporate any requirements from the University insurance carrier or Risk Management into the design and specifications.

The Consultant shall allow for normal expansion and contraction of the piping system. In addition to construction drawings, the project as-built drawings shall indicate expansion joints or pipe swings where designed or added.

All fluid systems shall be designed to be fully drainable.

Specialty HVAC equipment is to be purchased with an associated minimum two-year service contract. Examples include boilers, chillers, vacuum pumps, air compressors, etc.

Mechanical equipment rooms shall be placed preferably at ground level and away from occupied spaces to minimize transmission of noise vibrations into the building.

During design development, submit for compatibility review a complete manufacture points list for controlled equipment provided under this Division, indicating if points are monitor-only or capable of remote control. Point mapping to the existing BAS system is an owner requirement. Variances require concurrence of Facilities Management.

Include a complete description of technical control requirements such as handheld devices needed for field adjustment, software and licensing (proprietary or open source), or gateway requirements. Refer to Division 25 for building automation requirements.

MECHANICAL SYSTEMS AND ENERGY CONSERVATION

The minimum accepted standards for energy conservation as described in the District of Columbia Building Code will not only be met, but exceeded, where possible. Life cycle cost/present worth analysis that assesses the total cost of a system over its entire useful life will be used and is required on Capital Projects.

Building functions that require 24-hour-per-day operation, such as libraries, security stations, and laboratories, shall be served by a system separate from that of offices or classrooms, which may be subject to different operating schedules.

The Consultant will incorporate energy reduction strategies in place at American University into the design. These include, but are not limited to, demand control ventilation, occupied/unoccupied mode, automated demand response, and campus closure.



Heat recovery shall be incorporated for all systems with 100% outdoor air.

Areas with unique load off-season or beyond system loop piping capacity typically require supplemental cooling.

CHILLED WATER RELATED DESIGN CRITERIA

The desired cooling medium for air conditioning systems is chilled water, but the system should be applicable. American University currently does not have a central chilled water plant, but some mini chilled water loops support groups of buildings off the main quad or two or three buildings.

For renovation projects, the Consultant shall verify that the existing chilled water system will support the new load. Renovations to existing chillers and towers shall require careful and realistic scheduling so as to minimize system impact at the building.

New systems connecting to a campus chilled water loop shall use a plate and frame heat exchanger between the building and the central chilled water loop. Chilled water systems and related terminal equipment shall be designed for a minimum 12-degree temperature differential based upon 45-degree entering water temperature.

To meet winter cooling loads, a waterside economizer can be employed in some special applications where the use of 100% outdoor air is not possible. Plate and frame heat exchangers are strongly recommended for this application. Use of a side stream filter is strongly recommended for the cooling tower side of the system.

Special attention shall be paid to fresh air requirements for ventilation. Criteria for minimum fresh air shall follow the latest ASHRAE guidelines adopted by the District of Columbia. . Consideration should be given to "ON demand I.A.Q." such as CO2 sensors.

To satisfy system requirements for outdoor air, a minimum outside air louver shall be provided for air-handling units.

The location of outside air intakes shall be chosen for proper separation from any exhaust outlets to prevent cross contamination.

Air conditioning systems should make use of re-circulated air from spaces where no air contamination exists, such as offices and classrooms.

HEATING WATER RELATED DESIGN CRITERIA

American University owns and operates a Low Temperature Hot Water System (LTHW) that provides district heating for the Main Campus. The heating demand for any new construction or renovation shall be submitted to E&E for verification of whether the existing



LTHW distribution system will be adequate to meet the new demand and the nature of required piping and flow adjustments, system balancing and equipment recalibration.

New systems connecting to the main campus LTHW system are to be designed to work with low temperature hot water of 150 degree entering water temperature without the use of secondary heating systems.

MECHANICAL EQUIPMENT ROOMS

New mechanical equipment rooms (MER's) shall be designed to have access from the outside, via an opening large enough to facilitate the removal of the largest piece (or component) of equipment therein. It is desirable that access by truck be incorporated where possible.

American University requires that the Consultant minimize the visual impact of any equipment that must be located on building roofs. Where placement of such equipment is unavoidable, it shall be designed so that penetration of the roofing system is minimized. Adequate maintenance access shall be provided. Rooftop walkways, access to the roof by a service elevator and other necessary measures shall be included.

Consultant shall provide calculations to confirm structural adequacy from an engineer licensed by the District of Columbia and submit to Owner for review and Project Record. Equipment should not be installed above ceilings. Where this is unavoidable, or where units are installed in concealed locations, there should be auxiliary drain pans independently piped to drains and access panels to allow for full service and equipment removal. Auxiliary drain pans shall be independently supported.

Ample space shall be provided for service access to all equipment, including pulling tubes for converters, chillers and air-handling unit coils.

Lifting eyes shall be provided in equipment rooms in which the moving of heavy equipment is anticipated and for above ceiling equipment.

For renovation projects that involve small equipment rooms, direct access to the rooms from a corridor or a public space is required.

MER's shall be well lighted with LED lighting and be switched at each exit. All mechanical equipment rooms shall be equipped with duplex convenience outlets suitable for operating small tools and drop-cord trouble lights.

Floor drains are required. MER's above the lowest floor shall be curbed to prevent flooding. Provisions for domestic water services for maintenance purposes shall be provided.

Provide thermostatically controlled ventilation as required.



Mechanical equipment rooms above the lowest floor shall be curbed to prevent flooding.

The system design should be such that it meets the needs of the application. The Consultant shall select equipment that is consistent with the design and application of the system. Mechanical systems shall be designed to accommodate reasonable future functional space changes.

Paint equipment curb risers safety yellow.

The designer should review and incorporate supplemental information on specifics for type of room use found in the Facilities Management Space Needs document, listed in the References section of the Standards.

SOUND AND VIBRATION CONTROL

Outdoor equipment such as cooling towers, fans, and air-cooled condensers shall not produce noise levels that will be objectionable. The Owners Project Requirements will identify dB levels for both interior and exterior noise levels. The dB level required to meet this goal shall be specified and included on the project documents and drawing schedules.

HVAC equipment located in the building shall be carefully evaluated for sound level. If sound levels are expected to be higher than recommended in ASHRAE guidelines, sound control devices are required.

Room terminal units such as variable volume terminals shall be selected for low sound levels. Air supply diffusers and registers shall have sufficiently low air velocity to meet low sound criteria. Air noise from a supply outlet is not acceptable.

Appropriate vibration isolation of equipment, piping and ductwork shall be specified.

VALVES

Ball valves are to be used in lieu of butterfly valves, if size permits. For control valves use only ball valves that are characterized, equal percentage V-port.

Valves used for isolation and control shall provide absolute shut-off to full ANSI Class ratings with pressure in either direction, allowing flexibility in system design and utility during system maintenance.



Valve tags are to be installed down to one-inch pipe size. Valve charts are to be laminated and kept accordingly in nearest mechanical rooms or floor service closets. Note that FM and University Housekeeping do not share access to the same service spaces.

Stainless steel is preferred for valve bodies, seats, retainers and associated packing gland retainer studs. Bearings shall be stainless steel with PTFE/fiberglass mesh liner. Composite materials shall not be used.

VALVES, BALL – 23 05 23.12

Valve selection criteria is chromium plated ball or stainless steel (full port). Performance rating is minimum 400 psi CWS, 125 SWP with 600 WOG preferred and maximum temperature of 400F.

Where insulation is specified, provide factory installed extended stems to receive insulation. Service valves installed in systems below ambient temperature shall have Therma-Seal as manufactured by Apollo or approved equal.

Chain wheel operators shall be provided for all valves 2-1/2" or larger installed 72 inches or higher above finished floor. Extend chains to an elevator of 60 inches above finished floor.

Hand wheels fastened to valve stem shall be provided for valves other than quarter-turn types. Lever handles shall be provided for quarter turn valves 4" and smaller.

Gear drive operators shall be provided for quarter turn valves 6" and larger.

VALVES, BUTTERFLY – 23 05 23.13

Valve selection criteria is high performance positive shutoff on pressure or vacuum with zero leakage and bubble tight for all valves over 2 inch. All shafts shall be one-piece construction.

VALVES, CHECK – 23 05 23.14

Standard swing check valves over 4" shall be rubber faced. Special coatings such as ethylene propylene diene monomer rubber (EPDM) porcelain may also be appropriate.

Install check valve with a minimum of 5 (five) pipe diameters downstream from any flow disturbance (valve, pump, elbow or reducer) to reduce chatter and early valve failure.

VALVES, GATE – 23 05 23.15



Valve selection criteria is adjustable packing gland, blow out proof stem design, with polytetrafluoroethylene (PTFE) seats and ethylene propylene diene monomer rubber (EPDM) stem packing.

Standard steel wedge type gate valves should be outside screw and yoke, rising stem, non-rising hand wheel, and bolted bonnet.

Gate valves are to be used in specific installations only with prior approval from FM. Do not use where dirty surface medium may cause seating problems.

HEAT TRACE FOR HVAC – 23 05 33

Electric cables for freeze protection shall be on independent circuits and supplied by emergency power when available. System status shall be monitored by the building automation system and alarm based upon outside air temperature requirement when not energized.

IDENTIFICATION FOR HVAC – 23 05 53

Equipment naming and labeling shall be consistent with other University systems and used consistently throughout the project. Submit equipment schedule during design phase for confirmation of the FM AiM asset identification. Include on drawings across all disciplines. See Division 26 for required color-coding of labels for equipment and components based upon energy source and the references section of this document for the naming scheme. Coordinate with Section 25 55 00.13 for integrated automation control naming consistency.

COMMISSIONING FOR HVAC – 23 08 00

In addition to required startup and performance testing, HVAC systems shall follow the connectivity and alarm requirements as described in the Building Automation Master Plan and the FM Commissioning Plan. See Division 1, section 01 91 13 and Division 25. Additional requirements by DC Green Construction Code may also apply.

DDC SYSTEM FOR HVAC – 23 09 23, 23 09 93

American University has standardized its automated building control systems. The standard specifications shall be followed on all projects. The standardization of building control systems does not relieve the Consultant from providing schematic control diagrams and descriptions of the sequence of operation for all systems. Refer to and incorporate Division 25 requirements along with any supplemental information in the current Building Automation Master Plan and suggested control drawings with sequences.



HYDRONIC PIPING – 23 23 13

The use of t-drill as an installation method on 2 inch and larger piping is acceptable.

Pro-press as a connection is allowed in accessible areas only and shall be so noted on the as-built drawings. FM possesses a complete Pro-press kit for maintenance purposes up to 4-inch diameter, other manufactures will not be considered.

Do not design a system that uses Victaulic or similar gasketed pipe for primary or secondary heating or cooling distribution within the building. The exceptions are readily accessible mechanical areas, equipment connections and fire suppression.

The use of die-electric isolating nipples is not allowed.

HYDRONIC SYSTEM TREATMENT – 23 25 00, 25 25 13, 23 25 16

Compatibility with the current E&E treatment program is required. Information on treatment and tie-in requirements is in the References section of this document. System acceptance by FM will require verified flushing, passivation and treatment by the AU chemical contractor using components and supplies by the vendor.

ENERGY METERS – 23 0923

American University is committed to energy efficiency and confirming system performance. Thermal metering is required using equipment compatible with and integrating fully with the building automation system and the existing data collection program. Confirm specific requirements and placement with E&E Energy Manager.

AIR DUCT SPECIALTIES – 23 33 00

Contractor will have a third party inspect and verify that smoke and fire dampers are installed per manufacturer's requirements, are readily accessible for maintenance, and meet required performance. Third party inspector shall be ICB certified and acceptable to inspect and test smoke and fire dampers by the Authority Having Jurisdiction.

Inspect prior to acceptance at the 100% rate, no sampling allowed, with Commissioning Agent or University designee and at one-year interval as per NFPA 105 and NFPA 80 requirements. All dampers must pass inspection.

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DIVISION 23 –HVAC PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Air Flow Monitoring Station

1. Ebtron Gold

Corrosion Inhibitor

1. Nalco Taser Trac 107

Closed System Water Treatment

1. Nalco 3D Tracer System

Open Loop System Water Treatment

1. Nalco 3D Tracer System

Chemical Containment & Delivery System

1. Nalco Micro Plus or Micro Base Tank (size based on chemical volume)

Metering Device – BTU

1. Flexim Ultrasound

Variable Frequency Drive

1. ABB
2. Danfoss

Water Treatment Controller

2. Nalco 3D

Water Treatment Separators – Cooling Tower

1. Lakos

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to the following:

Air Conditioning System

1. Carrier
2. Daiken-McQuay
3. Mitsubishi
4. Trane
5. JCI-York

Air Compressor

1. Curtis
2. Ingersoll-Rand
3. Quincy
4. Speedaire

Air Conditioning Unit

1. Carrier
2. Liebert



3. JCI-York
4. Trane
5. JCI-York

Air Dryer

1. Hankison
2. Johnson Controls
3. Speedaire

Air Filter

1. Airflow
2. Purolator

Air Handler

1. Airtherm
2. Climate Master
3. Daikin-McQuay
4. Goodman
5. JCI-York
6. Trane

Air Handler Motor

1. Baldor
2. Dayton
3. Lincoln
4. Magnetek
5. USA Motors
6. WEG

Air Separator

1. Spirax Sarco
2. Spirotherm

Boilers

1. Aerco
2. Bryant
3. Burnham
4. Lochinvar
5. PVI
6. Weil-McLain

Chiller

1. Carrier
2. Daikin-McQuay
3. JCI-York
4. Liebert
5. Trane

Condenser Unit



1. Carrier
2. Liebert
3. Mitsubishi
4. Sanyo
5. Trane

Constant Volume Air Box

1. Trane

Cooling Tower

1. Baltimore Air Coil
2. Evapco

Dehumidifier

1. Dessert Aire

Dedicated Outside Air System

1. Nailor

Dry Cooler

1. Heatcraft

DX Units

1. Carrier
2. Daikin
3. JCI-York
4. Trane

Energy Wheel

1. Air Exchange

Evaporator

1. Bally

Exhaust Fan

1. Greenheck
2. Loren Cook

Exhaust Hood

1. Captive Aire

Expansion Tank

1. Armstrong

Fan

1. Loren Cook
2. Greenheck

Fan Box

1. Trane

Fan Coil Unit

1. Air Therm
2. American Standard
3. Carrier



4. Daikin
5. Trane

Fan Motor

1. Baldor
2. Parker

Filter, Cooling Tower

1. Lakos

Filter System, Water

1. Aqua-Pure
2. Rosedale
3. Scotsman

Furnace

1. Carrier
2. Trane
3. Daikin

Heat Exchanger

1. Alfa Laval (basis of design performance)
2. Spirax Sarco

Heat Pump

1. Climate Master
2. Daikin
3. JCI-York
4. Trane

Humidifier

1. Dristeem
2. Nortec

HVAC, Standalone with BACNetIP

1. Carrier
2. Honeywell
3. JCI-York

Metering Device – Water Flow Only

1. Flexim

Pressure Reducing Valve

1. Cla-Val
2. Watts
3. Zurn

Pump

1. Armstrong
2. Baldor
3. Bell & Gossett
4. Grundfos



5. PACO

6. Weinman

Pump Motor

1. Aurora

2. Baldor

3. Lincoln Motor

Refrigeration Compressor

1. Copeland

2. Tecumseh

Valves – Ball

1. Apollo

2. Nibco

3. Jamesbury

Valves – Butterfly

1. Bray Series 70

2. McCannalok

3. Milwaukee

Valves – Check

1. Crane

2. Stockham

3. Watts

Valves – Gate

1. Mueller

2. Stockham

Valves – Needle (PVC, CPVC)

1. Haywood

2. Marquest

3. Nibco

Variable Air Volume Box

1. Enviro-Tec

2. Nailor

3. Titus

4. Trane

Water Heater (gas)

1. State

— END OF DIVISION 23 —



DIVISION 25 INTEGRATED AUTOMATION

The Facility Management Energy and Engineering (E&E) unit has developed a Building Automation System (BAS) Master Plan that is comprised of the technical information and control strategies utilized at the University. Full control from the existing campus wide centralized system rather than monitoring or local control is the expected AU integration outcome.

As an aid to ensuring new or renovated facilities are successfully integrated into the existing campus wide control system, consultants are advised that the following sections contain AU specific information. Consultants and designers are expected meet the BAS Master Plan standard. Those who opt to not use the provided sections 'as is' must include a statement on compliance or variance with the Division 25 submittal during the design stage for Facilities Management review and concurrence.

The Building Automation unit of Energy and Engineering has also prepared equipment control drawings with sequences that meet the BAS Master Plan. These documents are available upon request to E&E from Planning and Project Management or the assigned Project Manager in either pdf or dwg format.

Building Automation Master Plan sections included in the combined document are:

- 25 08 00 Integrated Automation Commissioning
- 25 11 13 Integrated Automation
- 25 11 16 Network Routers Bridges Switches Hubs and Modems
- 25 14 13 Remote Control Panels
- 25 15 16 Software for Control and Monitoring of Networks
- 25 35 00 Instrumentation and Terminal Devices for HVAC
- 25 35 11 Actuators and Operators
- 25 35 16 Sensors and Transmitters
- 25 35 19 Control Valves
- 25 55 00 Control of HVAC
- 25 55 00.19 Control of HVAC_ObjectNamingConvention
- 25 95 00 Control Sequences for HVAC



SECTION 25 08 00 INTEGRATED AUTOMATION COMMISSIONING

PART 1. GENERAL

1.01 SECTION INCLUDES:

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

1.02 RELATED DOCUMENTS:

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details. Section 01 77 13 Closeout Procedures
- B. Section 01 91 3 – General Commissioning Requirements
- C. (This Section) Section 25 08 00 – Commissioning of Integrated Automation
- D. Section 25 11 13 - Integrated Automation Network Servers
- E. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- F. Section 25 14 13 - Integrated Automation Remote Control Panels
- G. Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks
- H. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- I. Section 25 35 13 – Integrated Automation Actuators and Operators
- J. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- K. Section 25 35 19 – Integrated Automation Control Valves
- L. Section 25 35 23 - Integrated Automation Control Dampers
- M. Section 25 55 50 – Integrated Automation Control of HVAC
- N. Section 25 95 00 – Integrated Automation Control Sequences for HVAC

1.03 GENERAL DESCRIPTION

- A. This section defines responsibilities of the BAS Contractor to commission the BAS.
- B. Refer to Div. 01 Section 01 91 13 for an overview of the commissioning process, entities involved in the process, training requirements, start-up requirements, and requirements for functional performance testing.



1.04 CONTRACTOR RESPONSIBILITIES

- A. All references to 'Contractor' in this Section infer one or multiple of the following; the BAS Contractor, the Contractor and any Installer, as these are defined in Section 25 55 00.
- B. Completely install and thoroughly inspect, startup, test, adjust, balance, and document all systems and equipment.
- C. Assist Commissioning Authority in performing verification and performance testing. This will generally include the following:
 - 1. Attend Commissioning (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. Demonstrate 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 Owner's Representatives as specified in Part III of this section.
- D. Compensate AU for additional functional performance testing site time used for failed tests or incomplete system/equipment installation. All testing failures that require on-site time for retesting will be considered actual damages to the Owner. The contract sum shall be reduced by contract modification at a rate of \$175/hr. per person of on-site time required to retest failures. All parties under contract with the Owner who are affected by the retesting shall be included in the contract modification.
- E. Provide a BAS Technician to work at the direction of Commissioning Authority for software optimization assistance for a minimum of 8 hours. Refer to Part 3 for a description of the software optimization.

1.05 SUBMITTALS

- A. Submit under provisions of Div. 01 Section(s) covering Submittal Procedures. All submittals shall comply with all Cx requirements as detailed in Section 01 91 13. The Contractor shall submit the following items directly to the CA and the GC:
 - 1. BAS Start-Up Report (reference section 3.01 below): Submit four (4) copies prior to scheduling of Functional Performance Testing.
 - 2. BAS Training Plan (defined below): Submit prior to scheduling BAS Demonstration.
 - 3. Trend and alarm logs as required during the Acceptance Period and Warranty Period.



PART 2. PRODUCTS

2.01 INSTRUMENTATION

- A. Instrumentation required to verify readings and test the system and equipment performance shall be provided by the Contractor and made available to Commissioning Authority. 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 12-month period. Certificates of calibration shall be made available when requested.

PART 3. EXECUTION

3.01 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 with them.
 2. Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.
 3. Verify integrity/safety of all electrical connections.
 4. Coordinate with TAB subcontractor to obtain the following control settings once TAB work is complete:
 - a) Optimum duct static pressure setpoints for VAV air handling units.
 - b) Minimum outside air damper settings for air handling units.
 - c) Optimum differential pressure setpoints for variable speed pumping systems.
 - d) Calibration parameters for flow control devices such as VAV boxes and flow measuring stations.
 - 1) BAS contractor shall provide portable device as a minimum to the TAB and CA to facilitate calibration. Connection for any given device shall be local to it (i.e. at the VAV box, wireless, or at the thermostat). Portable operator's terminal shall allow querying and editing of parameters required for proper calibration and start-up.
 5. Test, calibrate, and set all digital and analog sensing and actuating devices. Calibrate each instrumentation device by making a comparison between the BAS/Local Control Display and the reading at the device. Record the measured value and displayed value for each device in the Start-Up Report.



6. Check and set zero and span adjustments for all transducers and transmitters. Excessive signal buffering is not acceptable, span adjustments must be within 2% of their respective end points. (i.e. Do not control a 2-10vdc actuator with a 0-10vdc signal; worst-case signal should be 1.8-10.2vdc.)
7. 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.
8. 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.
 - d) For sequenced electronic actuators, calibrate per manufacturer's instructions to required ranges.
9. 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 Operator Interface display. Record the results for each device in the Start-Up Report.
10. For outputs to reset other manufacturer's devices (for example, VSDs) and for feedback from them, calibrate ranges to establish proper parameters. Coordinate with representative of the respective manufacturer and obtain their approval of the installation.
11. Verify proper sequences by using the approved checklists to record results and submit with Start-Up Report. Verify proper sequence and operation of all specified functions.
12. Verify that all safety devices trip at appropriate conditions. Adjust setpoints accordingly.
13. 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 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) in the control loop, tolerances shall be maintained according to those performance parameters defined in 25 55 00.



14. For interface and DDC control panels:
 - a) Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
 - b) Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
 - c) Check power supplies for proper voltage ranges and loading.
 - d) Ensure that 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 standalone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
 - g) Ensure that all outputs and devices fail to their proper positions/states.
 - h) Ensure that buffered and/or volatile information is held through power outage.
 - i) With all system and communications operating normally, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
 - j) Check for adequate grounding of all BAS panels and devices.
 - k) Thoroughly clean interior and exterior of control panel per manufacturer's instructions.
 15. For Operator Interfaces:
 - a) Verify that all elements on the graphics are functional and are 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 that the alarm printing and logging is functional and per requirements.
 - d) Verify that trends are archiving to disk and provide a sample to the Commissioning Authority and Owner for review.
 - e) Verify that paging/dial-out alarm annunciation is functional.
 - f) Verify the functionality of remote Operator Interfaces and that a robust connection can be established consistently.
 - g) Verify that required third party software applications required with the bid are installed and are functional.
 16. Verify proper interface with fire alarm system.
- B. Submit Start-Up Test Report: Report shall be completed, submitted, and approved prior to Substantial Completion.



3.02 SENSOR CHECKOUT AND CALIBRATION

- A. General Checkout: Verify that all sensor locations are appropriate and are 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 - Standard Application: 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 or gage) is within the tolerances specified for the sensor. If not, adjust offset and range, or replace sensor. Offset shall not exceed more than 5% of the sensor span. Where sensors are subject to wide variations in the sensed variable, calibrate sensor within the highest and lowest 20% of the expected range.
 - 2. Sensors with Transmitters - Standard Application: Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and control panel. Using manufacturer's resistance-temperature data simulate minimum desired temperature. Adjust transmitter potentiometer zero until the ammeter reads 4 mA. 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 or gage) 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 25 55 00.

3.03 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 Operator Interface, 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 temperature, 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.

3.04 VALVE STROKE SETUP AND CHECK

- A. For all valve and actuator positions checked, verify the actual position against the Operator Interface 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 the valve to various few intermediate positions. If actual valve position does not reasonably correspond, replace actuator.

3.05 VERIFICATION TESTING

- A. Perform the following verification tests (VT) for each control system to ensure that the described control system components are installed and functioning per this specification.
- B. Verification test procedures, testing and activities shall be developed and conducted so as not to cause personal injury, damage to components, damage to systems, or damage the building or other property.
- C. General Requirements:
 - 1. Intent of the VT procedure is to demonstrate that the exact functions of control systems meet requirements outlined by approved shop drawings and written Sequence of Operation.
 - 2. Verify each air handling unit, equipment system, steam and hydronic system in automatic mode of operation, utilizing actual field devices and final control elements. Tune each control loop.
 - 3. Indicate type and cause of failures, as well as required remedial actions, on test report. Requested tests, not outlined herein, will be evaluated for feasibility and impact on schedule and cost prior to implementation.
 - 4. Systems will not be accepted by the Owner, CA or A/E without approval of tests and required remedial action.
 - 5. Provide a schedule to the Owner for execution of the VT. The Owner shall participate in any or all of the contractor's VT at the Owner's discretion.
 - 6. Provide all necessary BAS equipment and field adjustments to ensure that the HVAC equipment in the expansion and the base building operates to meet or exceed the acceptance criteria specified herein during all operating modes and HVAC related failure modes of the facility.
- D. Control System Static Check
 - 1. Prior to static check of system, identify each CU by description, tag number, and address. Verify proper system communication with these devices, as well as values indicated.



2. Operational static check shall include verification of all field wiring associated with CUs. Include continuity testing between wiring from field device (sensor, actuator, or other components) to appropriate block on terminal strip in appropriate enclosure. Verify control loop wiring diagrams and panel wiring diagrams for the following:
 - a) Digital Inputs: Energize each digital input (smoke detector, end switch, control relay, flow switch, differential pressure switch, or other components) in field. Verify at panel.
 - b) Digital Outputs: Force on each digital output (solenoid valve, motor starter, control relay, or other components) at control panel. Field verify corresponding final element for proper stroke/status.
 - c) Analog Inputs: Compare field reading of each analog input (transmitters, thermistor, or other components) with that displayed on graphic screens, and auxiliary panels.
 - d) Analog Outputs: Force each analog output (I/P) to values of 0 percent, 25 percent, 50 percent, 75 percent and 100 percent. Field verify corresponding final element (valve or damper) positions from fully closed to open, based upon stated range.
 3. Calibration of Test Instruments: Use calibrated test instruments for all point checks as specified herein. The calibration of the test instruments shall be traceable to the National Institute of Standards and Technology (NIST) standards. A static system checkout shall be performed on a BAS instrument if the date of the test instrument calibration is within one year of the date of the check. Recalibrate test instruments annually and submit the NIST traceable instrument reports along with the static system checkout sheets.
 4. Performance Reports: Provide static system checkout sheets that list every physical point in the BAS in a tabular format. The list shall include the following fields: unique point identifier, software address, associated CU, associated room number (where applicable), check column indicating ID tag affixed and information is correct, actual value, initials of person performing verification, and date verification was completed successfully. The actual value is sensed by a testing instrument (for analog points) and visual indication (for digital points).
- E. Control System Dynamic Check
1. Operational dynamic check shall include verification that control system, including sensors and actuators, performed as specified while interconnected to the process.
 2. Verify proper system communication with controllers and the ability to reset setpoints remotely from operator workstations.
 3. Verify the operation of each air handling unit, equipment system, steam system and hydronic systems in automatic.
 4. Verify and demonstrate that operator workstation interface graphic screens are displayed consistent with the drawings. Verify the status



of each digital and analog value on every graphic screen is consistent with expected color convention and actual field device reading. Use only graphic screens accepted by the A/E and owner.

5. Test each control loop to verify that it indicates proper percent of scale and correct scaling of engineering units.
6. Verify stability of all control loops. Record and print graphical trends for each control loop to verify loop stability is within specified limits. Each trend shall be in 2-minute increments for no less than 12 hours.
7. Test system failures, start-up sequences for air handling units, exhaust fans, heat recovery units, and hydronic systems. Verify warnings and fail to start logic. Simulate power failure and restart software for controlled equipment and systems.
8. Submit Dynamic Performance Test Sheets indicating operating conditions after detailed dynamic checkout of the systems. The dynamic performance test sheets shall be in a tabular format and represent the contractor's sequence of operations and the tests described above. Each sequence of operations shall be tested, upon successful completion of the dynamic test the person performing verification shall initial and date verification test form adjacent to the test. Once all of the sequences and tests listed above are passed successfully, the test sheets shall be submitted for record.

F. Alarms

1. Test each alarm identified in the contract documents. Verify that control system displays proper indication. Test and verify proper acknowledgement of alarms from operator workstation.

3.06 DEMONSTRATION

- A. Demonstration of a complete commissioned system is a requirement for final completion as defined in Div. 01 Section(s) covering Closeout Procedures.
- B. Demonstrate the operation of the hardware, software, and all related components and systems to the satisfaction of the Commissioning Authority and Owner. Schedule the demonstration with the Owner's representative 1 week 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 Authority and Owner for re-demonstration, Contractor shall reimburse Owner for costs of subsequent Commissioning Authority site visits.
- C. 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.



- D. Demonstration shall typically involve small representative samples of systems/equipment randomly selected by the Owner and CA.
- E. 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 each workstation. 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 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 the Commissioning Authority and/or Owner 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 Authority 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 the Commissioning Authority and by the Owner. Demonstrate that access is sufficient to perform required maintenance.
 - 10. Demonstrate that required trend graphs and trend logs are set up per the requirements.
 - 11. Test each control loop display to verify that it indicates proper percent of scale and correct scaling of engineering units.
 - 12. Alarms: Test each alarm identified in Contract Documents. Verify that control system displays proper indication. Test and verify proper acknowledgement of alarms from supervisory station.
 - 13. For each system, demonstrate:



- a) Cold start.
- b) Sequence of operation.
- c) Seasonal control as applicable.
- F. Demonstration shall be completed and approved prior to Substantial Completion.
- G. Any tests successfully completed during the demonstration will be recorded as passed for the functional performance testing and will not have to be retested.
- H. After completed system balancing, verify all space control operation including temperature, humidity and flow/static pressure recovery operation.
- I. Provide complete demonstration of equipment or systems requiring seasonal operation, during operating season. Perform multiple demonstrations when required within six months.
- J. Indicate type and cause of failures, as well as required remedial actions, on test report. Start-up and testing will be witnessed and verified by A/E, Owner, and/or commissioning agent. Requested tests, not outlined herein, will be evaluated for feasibility and impact on schedule and cost.
- K. Systems will not be accepted by Owner and A/E without approval of tests and required remedial action.
- L. Provide signed verification reports to the Owner for each system tested.
- M. Provide system demonstration and instructions.

3.07 TREND LOGS

- A. Contractor shall configure and analyze all trends required under all specification sections.
- B. Record and print graphical trends for each control loop to verify loop stability is within specified performance limits. Each trend shall be for duration of no less than 12 hours.

1. PARAMETER	MAXIMUM ACCEPTABLE DEVIATION FROM SETPOINT
a) Duct Static Pressure	Plus or minus 0.05 In. W.C.
b) Space Temperature	Plus or minus 2 degrees F
c) Air Flow	Plus or minus 5%
d) Duct Relative Humidity	Plus or minus 5%
e) Space Relative Humidity	Plus or minus 5%

3.08 WARRANTY PERIOD:

- A. Warranty Period shall not commence until successful completion of the Demonstration.
- B. Trending: Throughout the Warranty Period, trend logs shall be maintained. Contractor shall forward archive trend logs to the Commissioning



Authority/Owner for review upon Commissioning Authority/ Owner request. Commissioning Authority/ Owner will review these and notify contractor of any warranty work required.

- C. Opposite Season Testing: Within 6 months of completion of the Acceptance Phase, Commissioning Authority/ Owner shall schedule and conduct Opposite Season functional performance testing. Contractor shall participate in this testing and remedy any deficiencies identified
- D. End of Warranty Visit: Commissioning Authority/ Owner will conduct an End of Warranty walkthrough prior to the end of the Warranty Period. Contractor shall participate in this walkthrough and remedy any deficiencies identified.

3.09 SOFTWARE OPTIMIZATION ASSISTANCE

- A. The Contractor shall provide the services of a Technician as specified above at the project site to be at the disposal of the Commissioning Authority/Owner. 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 Commissioning Authority/Owner 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 4-hour sessions, unless otherwise mutually agreed upon by Contractor, Commissioning Authority, and Owner. The Owner's representative shall notify contractor 2 days in advance of each day of requested assistance.
- B. The Technician provided shall be thoroughly trained in the programming and operation of the controller and workstation software. If the Technician provided cannot perform every software task requested by the Commissioning Authority/Owner in a timely fashion, contractor shall provide additional qualified personnel at the project site as requested by the Commissioning Authority/Owner, to meet the total specified requirement on-site.

3.10 OPERATOR TRAINING AND O&M MANUALS

- A. Documented Owner's training is a requirement for final completion per Div. 01 Section 01 7700 covering Closeout Procedures.
- B. Submittal of Owner O&M Manuals is also a requirement of Div. 01 Section 01 7823 Closeout Submittals.
- C. Contractor shall submit a Training Plan for the scope of training for which they are responsible. Training Plan shall be forwarded to the BAS Contractor who will compile, organize, format, and forward to the Owner for review. Training Plan is also a requirement of Div. 01 Section 01 7900 Demonstration and Training.
- D. On-Site Training: Provide services of BAS Contractor's qualified technical personnel for two 4-hour days minimum or as otherwise spelled out in the project specifications to instruct Owner's personnel in operation and



maintenance of BAS. Provide services of Contractor's qualified technical personnel for one 8-hour day to instruct Owner's personnel in operation and maintenance of Integrated Installer Control Sub-Systems, i.e. Chiller, Boiler, etc. 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 Owner. The Owner's representative shall notify contractor 1 week in advance of each day of requested training. The Contractor's designated training personnel shall meet with the Owner'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. Basic Operator Workstation (OWS) or Control Panel Interface Training
 - For all potential users of the OWS or Display:
 - a) Brief walk-through of building, including identification of all controlled equipment and condensed demonstration of portable controller and built-in operator interface device display capabilities
 - b) Brief overview of the various parts of the O&M Manuals, including hardware and software programming and operating publications, catalog data, controls installation drawings, and DDC programming documentation
 - c) Demonstration of login/logout procedures, password setup, and exception reporting
 - d) Demonstration of menu penetration and broad overview of the various features
 - e) Overview of systems installed.
 - f) Present all site-specific point naming conventions and points lists, open protocol information, configuration databases, back-up sequences, upload/download procedures, and other information as necessary to maintain the integrity of the system.
 - g) Overview of alarm features.
 - h) Overview of trend features.
 - i) Overview of reports and reporting
2. Hardware Training – For Maintenance and Control Technicians
 - a) Review of installed components and how to install/replace, maintain, commission, and diagnose them
3. Technician Training
 - a) Introduction to controller programming and overview of the programming application interface
 - b) General review of sequence of operation and control logic for the project site, including standalone and fail-safe modes of operation
 - c) Uploading/Downloading and backing up programs.
 - d) Network administration
 - e) Review of setpoint optimization and fine-tuning concepts



4. Advanced Training: Advanced BAS Training shall be provided for two individuals and be provided at an off-site training facility containing installations of the proposed system. Contractor shall pay training registration and materials fee and the Owner shall pay all employee expenses (travel, per diem, salary).
 - a) BAS Contractor shall provide the standard, advanced training offering on all Control Programming Applications.
 - b) BAS Contractor shall provide the standard, advanced training offering on Advanced Installation, Configuration, Maintenance, and Network Administration.
 - c) For Siemens projects, this shall include access to the Desigo CC Master Operator Training Path:
 - 1) Introduction to Desigo CC
 - 2) Desigo CC Workstation I
 - 3) Desigo CC Reports
 - 4) Desigo CC Workstation II
 - 5) Desigo CC Master Operator

- END OF SECTION -



SECTION 25 11 13 INTEGRATED AUTOMATION NETWORK SERVERS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

- Operator Workstations (OWS)
- Control System Servers (CSS)
- Portable Operator Terminal (POT)

1.02 RELATED DOCUMENTS:

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.
- B. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- C. Section 25 35 13 – Integrated Automation Actuators and Operators
- D. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- E. Section 25 35 19 – Integrated Automation Control Valves
- F. Section 25 35 23 – Integrated Automation Control Dampers
- G. Section 25 55 00 – Integrated Automation Control of HVAC
- H. (This Section) Section 25 11 13 - Integrated Automation Network Servers
- I. Section 25 14 13 - Integrated Automation Remote Control Panels
- J. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- K. Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks
- L. Section 25 95 00 - Integrated Automation Control Sequences for HVAC
- M. Section 25 08 00 - Commissioning of Integrated Automation

1.03 DESCRIPTION OF WORK:

Furnish and install software for Operator Interfaces and Control System Servers as required for the BAS functions specified. The manufacturer shall support all installed software for a period of two years after Substantial Completion at no additional cost to the Owner.

Refer to Section 25 55 00 for general requirements.



PART 2 PRODUCTS

2.01 OPERATOR WORKSTATION (OWS)

Hardware: Each OWS shall consist of the following:

1. BAS Contractor shall coordinate hardware and operating system requirements with the Owner to meet software and specification requirements.
2. BAS Contractor shall provide current Industry-standard hardware that shall exceed DDC system manufacturer's recommended hardware requirements specifications.
3. The hardware must meet response times specified in Section 25 55 00.
4. The minimum requirements shall be:
 - a. Current generation Intel processor
 - b. 500GB or larger SSD / SSD Hybrid
 - c. 16GB of RAM
 - d. Owner approved Windows operating system.
 - e. 1GB video card or better capable of supporting 1920 x1200 resolution with a minimum of 24-bit color.
 - f. 24-inch Widescreen LED LCD Monitor.
 - g. Keyboard, mouse, (4) USB ports, and (1) 100/1000MB IEEE 802.3 Ethernet port.

Each OWS shall be designated on the drawings network riser diagram with location indicated by room number or name. Coordinate with Owner for all LAN drops. See Section 25 55 00 for submittal and As-Built requirements.

2.02 CONTROL SYSTEM SERVER (CSS)

The CSS is a virtual machine provided by American University. Coordinate all software requirements with the AU BAS Department to ensure compatibility with the virtual machine operating system and resources.

2.03 PORTABLE OPERATORS TERMINAL (POT)

Hardware: Each POT shall consist of the same requirements as those listed for the OWS except for those items listed here;

1. The POT shall be a laptop type PC of Owner approved model type supported by the Owner.



2. The laptop shall include (3) USB ports.
3. The following equipment shall be included with the laptop;
 - a. A Port replicator or docking station
 - b. An extra power supply
 - c. A carrying bag that matches and fits the laptop

PART 3 EXECUTION

3.01 INSTALLATION

Install all software on the provided computers and verify that the systems are fully operational. Ensure licensing is provided for all software.

No components required for the legal use of the computer shall be withheld from the Owner.

All information required to install, configure, operate, diagnose and maintain the system shall not be withheld from the Owner.

Install all BAS and Computer Operation and Maintenance Manuals, Programming Guides, network configuration tools, AS-Built drawings etc. on each computer provided under this Section. Provide interface or shortcuts to guide user to the appropriate information.

The POT shall be configured as a mobile OWS. Install all software and verify that the system is fully operational. In this context a mobile OWS allows the user to have full access of the BAS from both directly connected to the Primary LAN and from a remote location connected to the Primary LAN via a well-defined access control protocol such as VPN across a high-speed internet connection.

Install systems and materials in accordance with manufacturer's instructions.

- END OF SECTION 25 11 13 -



SECTION 25 11 16 NETWORK ROUTERS, BRIDGES, SWITCHES AND HUBS

PART 1. GENERAL

1.01 SECTION INCLUDES:

- A. Network Connections
- B. Local Supervisory LAN Gateways/Routers
- C. Communication Wiring, Raceways, Cabling
- D. Integrated Installer Provided Control Sub-Systems

1.02 RELATED DOCUMENTS:

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.
- B. Section 25 08 00 - Commissioning of Integrated Automation
- C. Section 25 11 13 - Integrated Automation Network Servers
- D. (This Section) Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- E. Section 25 14 13 - Integrated Automation Remote Control Panels
- F. Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks
- G. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- H. Section 25 35 13 – Integrated Automation Actuators and Operators
- I. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- J. Section 25 35 19 – Integrated Automation Control Valves
- K. Section 25 35 23 - Integrated Automation Control Dampers
- L. Section 25 5 500 – Integrated Automation Control of HVAC
- M. Section 25 95 00 – Integrated Automation Control Sequences for HVAC

1.03 DESCRIPTION OF WORK:

- A. BAS Contractor shall provide all interface devices and software to provide an integrated system connecting BCs, AACs, ASCs and Gateways to the Owner's LAN.
- B. Refer to Section 25 55 00 for general requirements and definitions.
- C. Refer to Section 25 55 00 paragraph 2.04 for general requirements connecting third party control sub-systems to the BAS. This would include independent control systems associated with Chillers, Boilers, Heat Transfer Wheels, Laboratory Zone Controls, etc.



PART 2. PRODUCTS

2.01 NETWORK CONNECTIONS

- A. Owner's WAN: American University will provide an internetwork connecting the BAS across multiple structures with a CSS. The BAS Contractor is not required to configure any components of this WAN. The final BAS internetwork shall use this WAN as the Primary LAN.
- B. All new sub networks must be BACnet/IP or BACnet/MSTP. No new work may implement an FLN network.
- C. All projects that require BBMD management must use a dedicated hardware BBMD management device. No software BBMD management within a controller will be allowed.
- D. BAS connections to third-party BACnet objects must implement a virtual point bound to the object and not hard coded in the BAS software. Third-party BACnet object connections must be configured to allow for the fastest refresh rate available from the third-party vendor not to exceed 3 seconds at the BAS interface. Third-party BACnet object connections must maintain a continuous reliable connection to the BAS. The BAS contractor is responsible for adding hardware/software as necessary to accomplish this connectivity requirement.

If the BAS contractor determines they are not able to communicate with the vendors BACnet object to meet performance requirements defined in Division 25 an alternative communications method may be requested. The BAS contractor must request an alternative communication method via RFI to the Design Team and AU BAS Department.

2.02 LOCAL SUPERVISORY LAN GATEWAYS/ROUTERS

- A. The Supervisory Gateway shall be a BC that acts as a gateway/router between the Supervisory LAN CSSs and the Primary LAN.
- B. The gateway shall perform information translation between the Primary LAN and the Local Supervisory LAN, which is Ethernet TCP/IP and shall preferably use BACnet over IP.
- C. The gateway shall contain its own microprocessor, RAM, battery, real-time clock, communication ports, and power supply as specified for a BC in Section 25 55 00. Each gateway/router shall be mounted in a lockable enclosure.
- D. The gateway/router shall allow centralized overall system supervision, operator interface, management report generation, alarm annunciation, acquisition of trend data, and communication with control units. It shall allow system operators to perform the following functions from the CSS, OWSs, and POTs:
 - 1. Configure systems.
 - 2. Monitor and supervise control of all points.
 - 3. Change control setpoints.



4. Override input values.
 5. Override output values
 6. Enter programmed start/stop time schedules.
 7. View and acknowledge alarms and messages.
 8. Receive, store and display trend logs and management reports.
 9. Upload/Download programs, databases, etc. as specified.
- E. Upon loss of power to the Gateway, the battery shall provide for minimum 100-hour backup of all programs and data in RAM. The battery shall be sealed and self-charging.
- F. The Gateway shall be transparent to control functions and shall not be required to control information routing on the Primary LAN.

2.03 COMMUNICATION WIRING, CABLING AND RACEWAYS

- A. Wiring and Raceways
1. General: Provide copper conductors, plenum cable, and raceways as specified in the applicable sections of Division 26, and 25 5500. Where the documents conflict request clarification from the Owner.
 2. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.
- B. Fiber Optic Cable
1. Optical cable: Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.
 2. Connectors: Terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

2.04 INTEGRATED INSTALLER PROVIDED CONTROL SUB-SYSTEMS

- A. The Gateway defined in Article 2.03 shall perform information translation between the Primary LAN or the Local Supervisory LAN, which is 100 Mbps Ethernet TCP/IP, and the Installer Provided Control Sub-System.
- B. The Gateway and the Installer Provided Control Sub-System shall use the agreed upon communication protocol required to connect the control sub-system to the BAS. This protocol shall be agreed upon and as defined in Section 25 5500.
- C. The Gateway and the Installer Provided Control Sub-System shall support full bi-directional communication translation as defined by the applicable protocol implementation specification as defined in Section 25 5500.
- D. The Installer Provided Control Sub-System shall provide all objects, points, variables and any other configuration parameters defined by its protocol implementation conformance specification without any added network



protocol translation devices other than the BAS BC and its own control sub-system components. The following points shall be provided at a minimum: Edit the following list(s) as necessary to meet the project needs of the University based on equipment size and application.

1. The following Chilled Water System points shall be mapped as a minimum:
 - a) CHW Supply and Return Temperatures
 - b) CW Supply and Return Temperatures
 - c) Power Consumption (kW)
 - d) Percent of Power Consumption (compared to maximum)
 - e) Bearing Temperature
 - f) Suction and Head Pressures
 - g) Suction and Head Temperatures
 - h) All available alarms; common alarm as minimum
 - i) Chiller Status
 - j) Enable/Disable
 - k) Current Limit Percent
 - l) CHW Setpoint and Setpoint Reset
2. The following Hot Water System points shall be mapped as a minimum:
 - a) Boiler Supply Temperatures
 - b) Boiler Pressure
 - c) Call for Heat
 - d) Boiler Ignition On
 - e) All available alarms; common alarm as minimum
 - f) Boiler Status
 - g) Firing Rate
 - h) Enable/Disable
 - i) HW Setpoint and Setpoint Reset
3. The following Variable Frequency Drive points shall be mapped at a minimum:
 - a) Output Frequency
 - b) Motor Speed (RPM, %, or Engineering units)
 - c) Motor Current
 - d) Calculated Motor Torque
 - e) Calculated Motor Power (kW)
 - f) DC Bus Voltage
 - g) Output Voltage
 - h) kWh meter (resettable)
 - i) mWh meter



4. The following Computer Room Air Conditioner points shall be mapped as a minimum:
 - a) Space Temperature and Humidity
 - b) Change Filter
 - c) Humidifier Status
 - d) Unit Off Local / Off Remote
 - e) All available alarms; common alarm as minimum
 - f) Unit Status
 - g) Enable/Disable
 - h) Space Temperature and Humidity Setpoints.
5. All Lucid Meter Management points shall be mapped:
 - a) This requirement applies to projects with Nexus, Flexim, or Shark utilities meters monitored by Lucid Meter Management software.
 - b) Provide an interface to the management software and/or meter to collect utility for use by the BAS.
 - c) BAS connection to the utility meter must not interfere with the meter's operation or calibration.
 - d) BAS connection to the management software must not interfere with the software meter connection or data collection process.
 - e) Coordinate utility meter data management with AU before implementation.

PART 3. EXECUTION

3.01 INSTALLATION OF CONTROL SYSTEMS:

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.
- B. BAS Contractor shall provide leadership as the Integration Coordinator for all Installer Provided Control Sub-Systems. Contractor to coordinate work progress, see Section 25 55 00 for details.
- C. BAS Contractor shall coordinate and supervise all interface devices and software to provide an integrated system.
- D. BAS Contractor shall confirm all third party vendor connections meet Division 25 performance requirements. Provide a report to the Design Team and AU BAS Department for any connections that fail to pass performance requirements. This includes all BACnet/IP, BACnet/Ethernet, BACnet/MSTP, MODBUS and similar approved connections.
- E. BAS Contractor shall closely coordinate with the A/E to locate all required Ethernet ports and request IP address assignments from the Owner's IT department. The BAS Project Manager shall provide the required activation date for Ethernet ports and addresses at least 30 days in advance.



- F. The BAS network shall be connected to the permanent BAS Server prior to the start of TAB to ensure all TAB data is retained on the permanent server and available for review by the CxA and A/E prior to final completion and turnover.
- G. Temporary BAS Internetwork: Should the final network connection not be available during the commissioning phase of the project; the BAS Contractor shall install a temporary internetwork for the BAS until such time that the WAN is available. This network can be of any type and configuration as it is temporary in nature. The only restriction is to provide some level of access control to the network.

-END OF SECTION -



SECTION 25 14 13 REMOTE CONTROL PANELS

PART 1. GENERAL

1.01 SECTION INCLUDES:

- A. Building Controller (BC)
- B. Advance Application Specific Controller (AAC)
- C. Application Specific Controller (ASC)

1.02 RELATED DOCUMENTS:

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.
- B. Section 25 08 00 - Commissioning of Integrated Automation
- C. Section 25 11 13 - Integrated Automation Network Servers
- D. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- E. (This Section) Section 25 14 13 - Integrated Automation Remote Control Panels
- F. Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks
- G. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- H. Section 25 35 13 – Integrated Automation Actuators and Operators
- I. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- J. Section 25 35 19 – Integrated Automation Control Valves
- K. Section 25 35 23 - Integrated Automation Control Dampers
- L. Section 25 55 00 – Integrated Automation Control of HVAC
- M. Section 25 95 00 – Integrated Automation Control Sequences for HVAC

1.03 DESCRIPTION OF WORK:

- A. Furnish and Install DDC Control units and/or Smart Devices required supporting specified building automation system functions.
- B. Refer to Section 25 5500 for general requirements and definitions.

PART 2. PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Provide Building Controllers (BC), Advanced Application Controllers (AAC), Application Specific Controllers (ASC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance specified in Sections 25



55 00. Every INSTALLER(s) device that must integrate with the BAS which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135-2010 Annex L.

- B. All controller hardware shall be suitable for anticipated ambient conditions. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -20 to 140°F. Controllers used in conditioned spaces shall be mounted in dust-protective enclosures and shall be rated for operation at 32 to 120°F.
- C. Shorting an input or output point to itself, to another point, or to ground shall cause no controller damage. Input or output point contact with up to 24 V for any duration shall cause no controller damage.

2.02 STAND-ALONE FUNCTIONALITY

- A. General: These requirements clarify the requirement for stand-alone functionality relative to packaging I/O devices with a controller. Stand-alone functionality is specified with the controller and for each Application Category specified in Part 3. The BAS Contractor shall comply with Section 25 55 00 to select the appropriate controllers.
- B. Functional Boundary: Provide controllers so that all points associated with and common to one unit or complete system/equipment shall reside within a single control unit. The boundaries of a standalone system shall be as dictated in the contract documents. Generally, systems specified for the Application Category will dictate the boundary of the standalone control functionality. See related restrictions below. When referring to the controller as pertains to the standalone functionality, reference is specifically made to the processor. One processor shall execute all the related I/O control logic via one operating system that uses a common programming and configuration tool.
- C. The following configurations are considered acceptable with reference to a controller's standalone functionality:
 - 1. Points packaged as integral to the controller such that the point configuration is listed as an essential piece of information for ordering the controller (having a unique ordering number).
 - 2. Controllers with processors that allow plug in point modules as an integral part of the controller.
 - 3. I/O point expander boards, plugged directly into the main controller board to expand the point capacity of the controller.
 - 4. I/O point expansion devices connected to the main controller board via wiring for installation remote from the controller and that communicate via a sub-LAN protocol. To be considered standalone, such arrangement shall have a sub-LAN that is dedicated to that controller and include no other controller devices (AACs or ASCs). All wiring to interconnect the I/O expander board shall comply with 25 55 00 and be:



- a) Contained in the control panel enclosure; OR
 - b) Wiring shall only be accessible at the terminations.
- D. The following configurations are considered unacceptable with reference to a controller's standalone functionality:
- 1. Multiple controllers enclosed in the same control panel to accomplish the point requirement.
- E. Air terminal units for services indicated on Drawings shall be controlled by electronic controllers connected to a local communication bus.
- F. In normal operation, components comprising the BAS system shall communicate over its own independent Ethernet LAN. However, control panels and controllers shall function independently in stand-alone mode, in the event of management workstation, BAS-server, or LAN failure.
- G. BAS Local Area Network Level (LAN): The communication extension shall support a series of controllers and shall communicate bi-directionally with the peer-to-peer network for transmission of global data.

2.03 BUILDING CONTROLLER (BC)

- A. General Requirements:
- 1. The BC(s) shall provide fully distributed control independent of the operational status of the OWSs and CSS. All necessary calculations required to achieve control shall be executed within the BC independent of any other device. All control strategies performed by the BC(s) shall be both operator definable and modifiable through the Operator Interfaces.
 - 2. BCs shall perform overall system coordination, accept control programs, perform automated system functions, control peripheral devices and perform all necessary mathematical and logical functions. BCs shall share information with the entire network of BCs and AACs/ASCs for full global control. Each controller shall permit multi-user operation from multiple workstations and portable operator terminals connected either locally or over the Primary Controller LAN. Each unit shall have its own internal RAM, non-volatile memory, microprocessor, battery backup, regulated power supply, power-conditioning equipment, ports for connection of operating interface devices, and control enclosure. BCs shall be programmable from an operator workstation, portable operator's terminal, or hand held operating device. BC shall contain sufficient memory for all specified global control strategies, user defined reports and trending, communication programs, and central alarming.
 - 3. BCs shall be connected to a controller network that qualifies as a Primary Controller LAN.
 - 4. All BCs shall be protected from any memory loss due to a loss of power by one or a combination of the following:



- a) Volatile RAM shall have a battery backup using a lithium battery with a rated service life of fifty (50) hours, and a rated shelf life of at least five years. Self-diagnostic routine shall report an alarm for a low battery condition.
- b) EEPROM, EPROM, or NOVRAM non-volatile memory
5. BCs shall provide intelligent, standalone control of system or equipment functions. Each BC shall be capable of standalone direct digital operation utilizing its own processor, non-volatile memory, input/output, wiring terminal strips, A/D converters, real-time clock/calendar and voltage transient and lightning protection devices. Refer to standalone functionality specified above.
6. The BC shall provide for point (DI, DO, AI, AO) mix flexibility and expandability. This requirement may be met with a family of expander boards, modular input/output configuration, or a combination thereof. Refer to stand-alone functionality specified above.
7. All BC point data, algorithms and application software shall be modifiable from the Operator Workstation. Non-customizable algorithms are not acceptable.
8. Each BC shall execute application programs, calculations, and commands via a microprocessor resident in the BC. The database and all application programs for each BC shall be stored in non-volatile or battery backed volatile memory within the BC and will be able to upload/download to/from the OWS and/or CSS.
9. BC shall provide memory buffer for holding alarms, messages, trends etc.
10. Each BC shall include self-test diagnostics, which allow the BC to automatically alarm any malfunctions, or alarm conditions that exceed desired parameters as determined by programming input.
11. Each BC shall contain software to perform full DDC/PID control loops.
12. For systems requiring end-of-line resistors, those resistors shall be located in the BC.
13. Input-Output Processing:
 - a) Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturer's board is unacceptable). TRIAC outputs are not acceptable. Provide suppression to limit transients to acceptable levels.
 - b) Analog Inputs (AI): AI shall be 0-5 Vdc, 0-10 VDC, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable)



- unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 12 bits.
- c) Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board.
 - d) Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
 - e) Electronic Analog Outputs (AO): Voltage mode: 0-5 Vdc and 0-10 VDC; Current mode: 4-20 mA. Provide zero and span calibration and circuit protection. Pulse Width Modulated (PWM) analog via a DO is acceptable only with the Owner approval. Generally, these will not be allowed on loops with a short time constant such as discharge temperature loops, economizer loops, pressure control loops and the like. Where these are allowed, transducer/actuator shall be programmable for normally open, normally closed, or hold last position and shall allow adjustable timing. Each DO shall be discrete outputs from the BC's board (multiplexing to a separate manufacturers board is unacceptable). D/A converters shall have a minimum resolution of 10 bits.
 - f) Pulsed Inputs: Capable of counting up to 8 pulses per second with buffer to accumulate pulse count. Pulses shall be counted at all times.
14. A communication port for operator interface through a terminal shall be provided in each BC. It shall be possible to perform all program and database back up, system monitoring, control functions, and BC diagnostics through this port. Standalone BC panels shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems, printers, or workstations.
 15. Each BC shall be equipped with loop tuning algorithm for precise proportional, integral, derivative (PID) control. Loop tuning tools provided with the Operator Workstation software are acceptable. Tools to support loop tuning must be provided such that P, I, and D gains are automatically calculated. Once the loop has been tuned and the P, I, and D parameters are recorded; all software used to automatically tune the loop shall be disabled.
 16. All analog output points shall have a selectable out of range alarm. The BC shall be capable of maintaining this failure setpoint in the event of a system malfunction, which causes loss of BC control, or loss of output signal, as long as power is available at the BC. The failure setpoint shall be selectable on a per point basis.
 17. Slope intercepts and gain adjustments shall be available on a per-point basis.
 18. BC Power Loss:



- a) Upon a loss of power to any BC, the other units on the primary controlling network shall not in any way be affected.
- b) Upon a loss of power to any BC, the battery backup shall ensure that the energy management control software, the Direct Digital Control software, the database parameters, and all other programs and data stored in the RAM are retained for a minimum of fifty (50) hours. An alarm diagnostic message shall indicate that the BC is under battery power.
- c) Upon restoration of power within the specified battery backup period, the BC shall resume full operation without operator intervention. The BC shall automatically reset its clock such that proper operation of any time dependent function is possible without manual reset of the clock. All monitored functions shall be updated.
- d) Should the duration of a loss of power exceed the specified battery back-up period or BC panel memory be lost for any reason, the panel shall automatically report the condition (upon resumption of power) and be capable of receiving a download via the network, and connected computer. The system shall be able to upload the most current versions of all energy management control programs, Direct Digital Control programs, database parameters, and all other data and programs in the memory of each BC from the operator workstation via the local area network, or the local communications port automatically and manually.

19. BC Failure:

- a) Building Controller LAN Data Transmission Failure: BC shall continue to operate in stand-alone mode. BC shall store loss of communication alarm along with the time of the event. All control functions shall continue with the global values programmable to either last value or a specified value. Peer BCs shall recognize the loss, report alarm and reconfigure the LAN.
- b) BC Hardware Failure: BC shall cease operation and terminate communication with other devices. All outputs shall go to their specified fail position.

20. Each BC shall be equipped with firmware resident self-diagnostics for sensors and be capable of assessing an open or shorted sensor circuit and taking an appropriate control action (close valve, damper, etc.).

21. BCs may include LAN communications interface functions for controlling secondary controlling LANs.

22. BCs shall be mounted in packaged equipment enclosures or in locking wall-mounted enclosures.

23. BC must be capable of performing primary integration to third party BACnet devices and in this case comply as a BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE Standard 135-2008 Annex L.



24. Include multi-level user access control, password protected. At highest level of access, allow operator to select overrides and change database.
25. Maintain programming in non-volatile memory or 72-hour battery backed RAM. Each unit shall have an accurate real time clock that can be synchronized from a Supervisory Station or any controller on data highway.
26. Permit readout of variables, override of control, modification of attributes and scheduling changes while printing messages, trends, reports or alarms.
27. Each BC shall contain all input/output points necessary to provide control and monitoring of connected system in accordance with the sequence of operation.
28. BC units in system shall be connected by a common database. Permit access to any BC on data highway from any location. Include full read-write capability from operational and programming standpoint. Total system information shall be available simultaneously to all Supervisory Stations at any point on data highway. All setpoint and programming change requests shall be coordinated with the Facilities operator.
29. Data Sharing: BC units shall share appropriate point information such that control sequences or control loops, executed at one unit, receive input signals from appropriate sensors connected to other units within network. When data highway fails or other BC units malfunction, control loop shall continue to function using last value received from network.
30. Fail-Safe Operation:
 - a) Provide self-diagnostics that continuously monitor operation of BC. Automatically report malfunction of controller, distributed slave module, or associated communication link. Display failure condition with time and date.
 - b) Upon detection of a memory error, each processor shall correct error or halt to prevent erroneous operation. Report "halts" as an alarm at Operators Workstations. Likewise, upon loss of communication with any controller on the network shall initiate an alarm message. Upon communication being reconnected, a "Return to Normal" message shall be generated.
 - c) Upon power restoration after failure, provide automatic sequential restart of equipment based on current program time and program requirements without operator intervention. Provide prioritized restart of systems and equipment as defined in Sequences of Operation.
31. Alarm management:
 - a) Monitor and direct alarm information to operator devices. Each BC shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms,



- minimize network communications traffic, and prevent alarms from being lost. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of six priority levels shall be provided for each point.
- b) Direct alarms to Supervisory Station for annunciation or printout, as directed by Owner. Printer shall provide time and date of acknowledgment.
 - c) When alarm sent to the Supervisory Station is not acknowledged within a selected time, provide dial out alarm message to Owner supplied phone numbers.
32. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points documented in control descriptions.
33. Any point, physical or calculated may be designated for trending. Any point, regardless of physical location in the network, may be collected and stored in each BC point group. Two methods of collection shall be allowed: Either by a pre-defined time interval or upon a pre-defined change of value. Each BC shall have a dedicated RAM-based buffer for trend data and shall be capable of storing a minimum of 25,000 data samples.
34. Trend data shall be stored at the BC and uploaded to the supervisory station when retrieval is desired and scheduled. Uploads shall occur based upon either user-defined interval, manual command or when the trend buffers are full. All trend data shall be available for use in 3rd party personal computer software.
35. BC shall provide high resolution sampling capability for verification of control loop performance. Operator initiated automatic and manual loop tuning algorithms shall be provided for operator selected PID control loops. Provide ability to view or print trend and tuning reports.
- a) In automatic mode, controller shall perform a step response test with a minimum one-second resolution, evaluate trend data, calculate new PID gains and input these values into the selected loop.
 - b) For troubleshooting in manual mode, operator shall be able to select variables to override default values. Calculated PID gains shall then be reviewed before they are inserted into the selected loop.
 - c) Loop tuning shall be capable of being initiated either locally at BC, from a supervisory station or remote work station. For all loop-tuning functions, access shall be limited to authorized personnel through password protection.



2.04 ADVANCED APPLICATION SPECIFIC CONTROLLER (AAC) AND APPLICATION SPECIFIC CONTROLLER (ASC)

A. General Requirements:

1. AACs and ASCs shall provide intelligent, standalone control of systems and equipment. Each unit shall have its own internal RAM, non-volatile memory and will continue to operate all local control functions in the event of a loss of communications on the ASC LAN or sub-LAN. Refer to standalone requirements by application specified in Part 3 of this section. It shall be able to share information with every other BC and AAC /ASC on the entire network.
2. Each AAC and ASC shall include self-test diagnostics that allow the AAC /ASC to automatically relay to the BC, LAN Interface Device or workstation, any malfunctions or abnormal conditions within the AAC /ASC or alarm conditions of inputs that exceed desired parameters as determined by programming input.
3. AACs and ASCs shall include sufficient memory to perform the specific control functions required for its application and to communicate with other devices.
4. Each AAC and ASC must be capable of stand-alone direct digital operation utilizing its own processor, non-volatile memory, input/output, minimum 8-bit A/D conversion, voltage transient and lightning protection devices. All volatile memory shall have a battery backup of at least fifty (50) hours with a battery life of five years.
5. All point data, algorithms and application software within an AAC /ASC shall be modifiable from the Operator Workstation. Non-customizable algorithms are not acceptable.
6. AAC and ASC Input-Output Processing
 - a) Digital Outputs (DO): Outputs shall be rated for a minimum 24 VAC or VDC, 1 amp maximum current. Each shall be configurable as normally open or normally closed. Each DO shall be discrete outputs from the AAC/ASC's board (multiplexing to a separate manufacturer's board is unacceptable). TRIAC outputs are not acceptable. Provide suppression to limit transients to acceptable levels.
 - b) Analog Inputs (AI): AI shall be 0-5VDC, 0-10VDC, 0-20VDC, and 0-20 mA. Provide signal conditioning, and zero and span calibration for each input. Each input shall be a discrete input to the BC's board (multiplexing to a separate manufacturers board is unacceptable unless specifically indicated otherwise). A/D converters shall have a minimum resolution of 8-10 bits depending on application.
 - c) Digital Inputs (DI): Monitor dry contact closures. Accept pulsed inputs of at least one per second. Source voltage for sensing shall be supplied by the BC and shall be isolated from the main board. Software multiplexing of an AI and resistors may only be done in



- non-critical applications and only with prior approval of Architect/Engineer
- d) Universal Inputs (UI-AI or DI): To serve as either AI or DI as specified above.
 - e) Electronic Analog Outputs (AO) as required by application: voltage mode, 0-5VDC and 0-10VDC; current mode (4-20 mA). Provide zero and span calibration and circuit protection. D/A converters shall have a minimum resolution of 8 bits.
 - f) Analog Output Pneumatic (AOP), 0-20 psi: Pneumatic outputs via an I/P transducer or 0-10VDC to pneumatic transducer are acceptable. Multiplexed pneumatic outputs are unacceptable.
- B. Air Terminal Unit Controllers:
- 1. Terminal box controllers used in HVAC applications controlling damper positions to maintain a quantity of supply or exhaust air serving a space shall have an automatically initiated function that resets the volume regulator damper to the fully closed position on a scheduled basis. The controllers shall initially be set up to perform this function once every 24 hours. The purpose of this required function is to reset and synchronize the actual damper position with the calculated damper position and to assure the damper will completely close when commanded. The software shall select scheduled boxes randomly and shall not allow more than 5% of the total quantity of controllers in a building to perform this function at the same time. When possible the controllers shall perform this function when the supply or exhaust air system is not operating or is unoccupied.

PART 3. EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the BAS Contractor.

3.02 INSTALLATION OF CONTROL SYSTEMS:

- A. General: Install systems and materials in accordance with manufacturer's instructions, specifications roughing-in drawings and details shown on drawings. BAS Contractor shall install all controllers in accordance with manufacturer's installation procedures and practices.
- B. Mount BC and CUs adjacent to associated equipment on vibration free walls or freestanding angle iron supports. Do not mount on AHU housing. Provide nameplates for instruments and controls inside and identify associated system on face of cabinet. Provide mechanically fastened cabinet nameplates, using nomenclature matching that used for devices in the approved Div. 25 submittal. Mount a laminated copy of panel of As-Built drawing(s) inside each cabinet.



3.03 HARDWARE APPLICATION REQUIREMENTS

- A. General: The functional intent of this specification is to allow cost effective application of the control system while maintaining the integrity and reliability of the control functions. Specific requirements indicated below are required for the respective application.
- B. Standalone Capability: Each Control Unit (CU) shall be capable of performing the required sequence of operation for the associated equipment. All physical point data and calculated values required to accomplish the sequence of operation shall originate within the associated CU with only the exceptions enumerated below. Refer to Part 2.02 above for physical limitations of standalone functionality. Listed below are functional point data and calculated values that shall be allowed to be obtained from or stored by other CUs or SDs via LAN.
- C. Where associated control functions involve functions from different categories identified below, the requirements for the most restrictive category shall be met.
- D. Application Category 0 (Distributed monitoring):
 - 1. Applications in this category include the following:
 - a) Monitoring of variables that are not used in a control loop, sequence logic, or safety
 - 2. Points on BCs, AACs, and ASCs may be used in these applications as well as SDs and/or general-purpose I/O modules.
 - 3. Where these points are trended, BAS Contractor shall verify and document that the network bandwidth is acceptable for such trends and is still capable of acceptable and timely control function.
- E. Application Category 1 (Application Specific Controller):
 - 1. Applications in this category include the following:
 - a) Fan Coil Units
 - b) Airflow Control Boxes (VAV and Constant Volume Terminal Units)
 - c) Misc. Heating Units
 - d) Single Zone; Unitary equipment less than 15- ton Package Terminal AC Units, Package Terminal Heat Pumps, Split-System AC Units, Split-System Heat Pumps, Water-Source Heat Pumps
 - e) Induction Units
 - f) Variable Speed Drive (VSD) controllers not requiring safety shutdowns of the controlled device
 - 2. ASCs or BCs may be used for these applications.
 - 3. Standalone Capability: Only the following data (as applicable) may be acquired from other controllers via LANs. In the event of a loss of communications with any other controller, or any fault in any system hardware that interrupts the acquisition of any of these values, the CU shall use the last value obtained before the fault occurred. All points configured for trending shall continue to store data at the local module.



4. Mounting:
 - a) Refer to Section 25 55 00 for details of mounting enclosures.
 - b) CUs that control equipment located above accessible ceilings shall be mounted on the equipment in an accessible enclosure (36" clearance required) and shall be rated for plenum use.
 - c) CUs that control equipment mounted in a mechanical room may either be mounted in, on the equipment, or on the wall of the mechanical room at an adjacent, accessible location.
 - d) CUs that control equipment mounted outside the building envelope or in occupied spaces shall either be located inside the unit or in a proximate mechanical space.
 - e) The BAS Contractor may furnish CUs to the terminal unit manufacturer for factory mounting.
 5. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, inter-stage timing parameters, and mode settings. Application-specific block control algorithms may be used to meet the sequence of operations. The ability to customize the control algorithm is not required unless specifically indicated otherwise.
 6. Network Restrictions: Limit the number of nodes on the network to 80% of the maximum recommended by the manufacturer.
- F. Application Category 2 (General Purpose Terminal Controller)
1. Applications in this category include the following:
 - a) Unitary Equipment greater than or equal to 15- ton Air Conditioners, Heat Pumps, Packaged Heating/Cooling Units etc.
 - b) Small, Constant Volume Single Zone Air Handling Units
 - c) Constant Volume Pump Start/Stop
 - d) Misc. Equipment Start/Stop
 - e) Misc. Monitoring not directly associated with a control sequence and where trending is not critical
 2. All outputs must have manual override capability.
 3. BCs may be used in these applications.
 4. ASC's may be used in these applications provided the ASC meets all requirements specified below. This category requires a general-purpose ASC to which application-specific control algorithms can be attached.
 5. Standalone Capability: Only the following data (as applicable) may be acquired from other CUs via LANs. In the event of a loss of communications with any other CUs, or any fault in any system hardware that interrupts the acquisition of any of these values, the CU shall use the last value obtained before the fault occurred. All points configured for trending shall continue to store data at the local module.
 6. Mounting:



- a) Refer to Section 25 55 00 for details of mounting enclosures.
 - b) CUs that control equipment located above accessible (36" clearance required) ceilings shall be mounted on the equipment and shall be rated for plenum use.
 - c) CUs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the contractor) or in a nearby mechanical/utility room in which case it shall be enclosed in a locking enclosure.
7. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, inter-stage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. Application-specific block control algorithms may be used to meet the sequence of operations.
 8. Network Restrictions: Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 80% of the manufacturer's recommended maximum.
- G. Application Category 3 (Advanced Application Controller)
1. Applications in this category include the following:
 - a) Large Constant Volume Air Handlers
 - b) VAV Air Handlers {generally >5,000 and <10,000cfm}
 - c) Dual Duct Air Handlers {generally >5000 and <10,000 cfm}
 - d) Multi-Zone Air Handlers
 - e) Self-Contained VAV Units
 2. All outputs must have manual override capability.
 3. BCs may be used in these applications.
 4. AAC's may be used in these applications provided:
 - a) The AAC's meets all requirements specified below.
 - b) All control functions and physical I/O associated with a given unit resides in one AAC.
 - c) Input A/D is 10-bit. Exception: 8-bit input A/D can be used when matched with high accuracy sensors, the range of which meets the resolution requirements specified for the applicable sensor in Section 23 09 13.13.
 - d) Pulsed inputs required for the application can be monitored and accumulated effectively.
 5. Standalone Capability: Only the following data (as applicable) may be acquired from other CUs via LANs. In the event of a loss of communications with any other CUs, or any fault in any system hardware that interrupts the acquisition of any of these values, the CU shall use the last value obtained before the fault occurred. All points configured for trending shall continue to store data at the local module.



6. Mounting:
 - a) Refer to Section 25 55 00 for details of mounting enclosures.
 - b) CUs that control equipment located above accessible (36" clearance required) ceilings shall be mounted on the equipment and shall be rated for plenum use.
 - c) CUs that control equipment located in occupied spaces or outside shall either be mounted within the equipment enclosure (responsibility for physical fit remains with the Contractor) or in a nearby mechanical/utility room in which case it shall be enclosed in a locking enclosure.
 7. Programmability: Operator shall be able to modify all setpoints (temperature and airflow), scheduling parameters associated with the unit, tuning and set up parameters, inter-stage timing parameters, and mode settings. Operator shall be able to address and configure spare inputs for monitoring. Operator shall be able to program custom DDC control algorithms and specify trending parameters, which will be retained in memory in the event of a loss of communications. Application-specific block control algorithms may be used provided they meet the sequence of operations. The control algorithms shall be completely customizable.
 8. Network Restrictions: Each LAN which participates in the transfer of data between the CU and the local operator workstation shall be subject to the following criteria:
 - a) Limit the number of nodes servicing any one of these applications on the AAC/ASC LAN to 80% of the manufacturer's recommended maximum.
 - b) The building controller LAN shall be subject only to manufacturer's published LAN limitations.
- H. Application Category 4
1. Applications in this category include the following:
 - a) Central Cooling Plant
 - b) Central Heating Plant
 - c) Cooling Towers
 - d) Sequenced or Variable Speed Pump Control
 - e) Local Chiller Control (unit specific)
 - f) Local Free Cooling Heat Exchanger Control
 - g) Air Handlers over 10,000 cfm or serving critical areas
 - h) Variable Speed Drive (VSD) controllers for air handlers, exhaust systems and variable volume pumping
 2. All outputs must have manual override capability.
 3. BCs shall be used in these applications.



3.04 CONTROL UNIT REQUIREMENTS

- A. Refer to Section 25 55 00 for requirements pertaining to control unit quantity and location.

3.05 CONTROL MODULE INSTALLATION

- A. Building Controller (BC):
 1. The BAS Contractor shall follow the specifications shown in the manufacturer's hardware installation guide unless stated otherwise herein.
 2. Ensure proper shield grounding is applied on any RS485 connections, proper network repeaters are installed if necessary or any other network devices required to achieve the required network performance metric.
 3. Refer to Section 25 5500 for power supply requirements. Power shall enter the control panel at an internal junction box that includes a standard receptacle and switch for panel power.
- B. Field Bus Controllers (AAC/ASC):
 1. The BAS Contractor shall follow the specifications shown in the manufacturer's hardware installation guide unless stated otherwise herein.
 2. Controller Power shall have a separate disconnect (or fuse) for each controller.
 3. All digital outputs must be equipped with a relay rated to manage the connected load.
 4. Only two pair (incoming & outgoing) communication wires shall be connected to the communication terminal on the controller. (No "star" network configurations)
- C. Expansion Modules:
 1. The BAS Contractor shall follow the specifications shown in the manufacturer's hardware installation guide unless stated otherwise herein.
 2. The use of DCC Expansion Modules, including quantity, shall be pre-approved by the Owner. As a general rule no expansion device shall be used that does not represent itself as a unique physical device within the BAS System Profile.

- END OF SECTION -



SECTION 25 15 16 SOFTWARE FOR CONTROL AND MONITORING NETWORKS

PART 1. GENERAL

1.01 SECTION INCLUDES:

- A. System Software
- B. Programming Description
- C. Control Algorithms
- D. Energy Management Applications
- E. Password Protection
- F. Alarm Reporting
- G. Trending
- H. Data Acquisition and Storage
- I. Dynamic Color Graphics

1.02 RELATED DOCUMENTS:

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.
- B. Section 25 08 00 - Commissioning of Integrated Automation
- C. Section 25 11 13 - Integrated Automation Network Servers
- D. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- E. Section 25 141 3 - Integrated Automation Remote Control Panels
- F. (This Section) Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks
- G. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- H. Section 25 35 13 – Integrated Automation Actuators and Operators
- I. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- J. Section 25 35 19 – Integrated Automation Control Valves
- K. Section 25 35 23 - Integrated Automation Control Dampers
- L. Section 25 55 00 – Integrated Automation Control of HVAC
- M. Section 25 95 00 – Integrated Automation Control Sequences for HVAC



1.03 DESCRIPTION OF WORK:

- A. Fully configure systems and furnish and install all software and programming defined herein for a complete and fully functioning system as specified.
- B. Refer to Section 25 55 00 for general requirements and definitions.

1.04 LICENSING

- A. Include licensing for all software packages at all required workstations.
- B. All software used for the operator interface, programming environment, networking, database management and any other software used by the BAS Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided.
- C. All software should be available on all computers as defined in Section 25 55 00. Hardware and software keys to provide all rights shall be installed on all workstations as necessary to enable all purchased functions and capabilities. At least (2) USB drives shall be provided with backup software for all software provided including third party software's and operating system software's, so that the Owner may reinstall any software as necessary. Include all licensing for workstation operating systems, and all required third-party software licenses.
- D. Provide licensing and original software copies for each OWS and POT.
- E. Provide licensing and original software copies for each remote graphic workstation. Licenses for remote graphic workstations shall allow for access to any site and shall not be restricted to accessing only the LANs included in this project.
- F. Upgrade all software packages to the release (version) in effect at the end of the Warranty Period.
- G. All licensing shall be perpetual for the life of the system (no renewal requirement).

PART 2. PRODUCTS

2.01 GENERAL SOFTWARE REQUIREMENTS

- A. **Functionality and Completeness:** The BAS Contractor shall furnish and install all software and programming necessary to provide a complete and functioning system as specified. The BAS Contractor shall include all software and programming not specifically itemized in these Specifications, which is necessary to implement, maintain, operate, and diagnose the system in compliance with these Specifications.
- B. **Online Help:** The software shall support online, context-sensitive help, including an index, glossary of terms, and the capability to search help via keyword or phrase at each workstation user interface.
- C. **Software Rights:** No aspect of the control programming that executes the sequence of operations shall be considered proprietary. The University and



its representatives shall have full and unlimited access to all programming manuals, site specific programming at all levels, updates to all manuals, etc. Advanced programming training is specified. Properly trained individuals will be given applicable password access to view and modify control programming without consent or notification of the contractor. Any system in which control sequence programming is considered proprietary in any way will not be considered.

- D. All application software shall be user programmable based upon user access control privileges.
- E. Custom Software: Contractor shall be required to retain backup copies of custom software drivers and documentation of same for no less than ten years with free access to AU for the same period. If the backup is not available within the specified time frame, Contractor shall recreate the custom software at no charge to AU.

2.02 CONTROLLER SOFTWARE

- A. BC Software Residency: Each BC shall be capable of control and monitoring of all points physically connected to it. All software including the following shall reside and execute at the BC:
 - 1. Real-Time Operating System software
 - 2. Real-Time Clock/Calendar and network time synchronization
 - 3. BC diagnostic software
 - 4. LAN Communication software/firmware
 - 5. Direct Digital Control software
 - 6. Alarm Processing and Buffering software
 - 7. Energy Management software
 - 8. Data Trending, Reporting, and Buffering software
 - 9. I/O (physical and virtual) database
 - 10. Distributed Network Interface Communications software
- B. AAC/ASC Software Residency: Each AAC/ASC shall be capable of control and monitoring of all points physically connected to it. At a minimum, software including the following shall reside and execute at the AAC/ASC. Other software to support other required functions of the AAC/ASC may reside at the BC or LAN interface device as specified in Section 25 55 00 – Integrated Automation Control of HVAC with the restrictions/exceptions per application provided in Section 25 1413 – Integrated Automation Remote Control Panels:
 - 1. Real-Time Operating System software
 - 2. AAC/ASC diagnostic software
 - 3. LAN Communication software
 - 4. Control software applicable to the unit it serves that will support a single mode of operation



5. I/O (physical and virtual) database to support one mode of operation
- C. Stand Alone Capability: BC shall continue to perform all functions independent of a failure in other BC/AAC/ASC or other communication links to other BCs/AACs/ASCs. Trends and runtime totalization shall be retained in memory. Runtime totalization shall be available on all digital input points that monitor electric motors. Refer also to Section 25 5500 for other aspects of stand-alone functionality.
- D. Operating System: Controllers shall include a real-time operating system resident in ROM. This software shall execute independently from any other devices in the system. It shall support all specified functions. It shall provide a command prioritization scheme to allow functional override of control functions.
- E. Network Communications: Each controller shall include software that supports the networking of CUs on a common communications trunk that forms the respective LAN. Network support shall include the following:
 1. Building Controller/Primary LAN shall be a 100/1000MB IEEE 802.3 Ethernet network designed and optimized for control system communication. If a Primary LAN communications trunk is severed, BCs shall reconfigure into two separate LANs and continue operations without interruption or Operator intervention.
 2. Controller communication software shall include error detection, correction, and re-transmission to ensure data integrity.
 3. Operator/System communication software shall facilitate communications between other BCs, all subordinate AACs/ASCs, Gateways and LAN Interface Devices or Operator Workstations. Software shall allow point interrogation, adjustment, addition/deletion, and programming while the controller is on line and functioning without disruption to unaffected points. The software architecture shall allow networked controllers to share selected physical and virtual point information throughout the entire system.
- F. Diagnostic Software: Controller software shall include diagnostic software that checks memory and communications and reports any malfunctions
- G. Alarm/Messaging Software: Controller software shall support alarm/message processing and buffering software as specified.
- H. Application Programs: CUs shall support and execute application programs as specified:
 1. All Direct Digital Control software, Energy Management Control software, and functional block application programming software templates shall be provided in a 'ready-to-use' state, and shall not require (but shall allow) Owner programming.
- I. Security: Controller software shall support multiple level password access restriction as specified.
- J. Direct Digital Control: Controller shall support application of Direct Digital Control Logic. All logic modules shall be provided pre-programmed with



written documentation to support their application. Provide the following logic modules as a minimum:

1. Proportional-Integral-Derivative (PID) control with analog, PWM and floating output
 2. Two Position control (High or Low Crossing with dead-band)
 3. Single-Pole Double-Throw relay
 4. Delay Timer (delay-on-make, delay-on-break, and interval)
 5. High/Low Selection
 6. Reset or Scaling Module
 7. Logical Operators
 8. Mathematical Operators, Trigonometric Operators.
- K. Psychometric Parameters: Controller software shall provide preprogrammed functions in accordance with the current edition of ASHRAE "Handbook of Fundamentals", to calculate and report psychometric parameters (given dry-bulb temperature and relative humidity) including the following as a minimum: Enthalpy, Wet Bulb Temperature, Humidity Ratio, Dew Point Temperature, and Specific Volume.
- L. Updating/Storing Application Data: Site-specific programming residing in volatile memory shall be capable of being uploaded to and downloaded from an OWS or Central System Server connected locally, to the Primary LAN, to the Local Supervisory LAN and remotely via the internet. Initiation of an upload or download shall occur either manually or automatically upon detection of a loss or change.
- M. Restart: System software shall provide for orderly shutdown upon loss of power and automatic restart upon power restoration. Volatile memory shall be retained; outputs shall go to preprogrammed fail-safe (open, closed, or last) positions. Equipment restart shall include a user definable time delay on each piece of equipment to stagger the restart. Loss of power shall be alarmed at operator interface indicating date and time.
- N. Time Synchronization: Operators shall be able to set the time and date in any device on the network that supports time-of-day functionality. The operator shall be able to select to set the time and date for an individual device, devices on a single network, or all devices simultaneously. Automatic time synchronization shall be provided.
- O. Misc. Calculations: System software shall automate calculation of psychometric functions, calendar functions, kWh/kW, and flow determination and totalization from pulsed or analog inputs, curve-fitting, look-up table, input/output scaling, time averaging of inputs and A/D conversion coefficients.

2.03 ENERGY MANAGEMENT APPLICATIONS

- A. System shall have the ability to perform all of the following energy management routines via preprogrammed and selectable template



programs. As a minimum provide the following whether or not required in the software:

1. Time-of-Day Scheduling
2. Calendar-Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start/Optimal Stop based on space temperature offset, outdoor air temperature, and building heating and cooling capacitance factors as a minimum
6. Night Setback and Morning Recovery Control, with ventilation only during occupancy
7. Air Economizer Control (enthalpy or dry-bulb temperature)
8. Hydronic Economizer Control (wet-bulb temperature)
9. Peak Demand Limiting / Load Shedding
10. Lighting/Occupancy Control
11. Dead Band Control
12. Instantaneous kW and Daily, Monthly and Yearly kWh values.

- B. All programs shall execute automatically without the need for operator intervention, and shall be flexible enough to allow operator customization. Programs shall be applied to building equipment as described in Section 25 55 00 and in sequences of operations.

2.04 PASSWORD PROTECTION

- A. Multiple-level password access protection shall be provided to allow the Owners authorized BAS Administrator to limit workstation control, display and database manipulation capabilities as deemed appropriate for each authorized user, based upon an assigned user name with a unique password.
- B. All passwords for the system shall be provided to the Owner including administrator, vendor, or factory level passwords for the systems provided under this project.
- C. Passwords shall restrict access to all Control Units.
- D. Each user name shall be assigned to a discrete access level. A minimum of four levels of access shall be supported. Alternately, a comprehensive list of accessibility and functionality items shall be provided, to be enabled or disabled for each user.
- E. At no time during the course of the project will there be any generic access accounts used. Every user must have an account with selected account permissions.
- F. A minimum of 50 user names shall be supported and programmed per the Owners direction.



- G. Operators shall be able to perform only those commands available for the access level assigned to their user name.
- H. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving interface device software on-line.

2.05 ALARM AND EVENT MANAGEMENT REPORTING

- A. The BAS Contractor will implement Alarming for all alarm configurable points.
- B. The BAS Contractor will coordinate all alarming parameters with the Owner, or Owner's representative, prior to implementation of the database on the Central System Server (CSS).

For each project, each alarms and events shall be classified per the Owner's instruction for the proper category: Emergency, Life Safety, Security, Supervisory, Trouble, High, Medium, and Low.
- C. See Section 25 55 00 for the general requirements of control accuracy parameters.
- D. Alarm management shall be provided to monitor, buffer, and direct alarms and messages to operator devices and memory files. The CSS 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. At no time shall a BCs ability to report alarms be affected by either operator activity at an Operator Workstation or local handheld device, or by communications with other panels on the network. All alarms and events shall be routable to all Operator Workstations.
 - 1. Alarm Descriptor: Each alarm or point change shall include that point's English language description, the time and date of occurrence. The user shall be able to print, display and store all alarm information for future reference.
 - 2. Alarm Prioritization: The software shall allow users to define the handling and routing of each alarm by their assignment to discrete priority levels. A minimum of six priority levels shall be provided. For each priority level, users shall have the ability to enable or disable an audible tone whenever an alarm is reported and whenever an alarm returns to normal condition. Users shall have the ability to manually inhibit alarm reporting for each individual alarm and for each priority level. Contractor shall coordinate with the Owner to establish alarm priority definitions.
 - a) *Life Safety* – any life safety event (i.e. smoke detector)
 - b) *Emergency* – major system failure or damage possible (i.e. controller failure)
 - c) *High* – environmental sensors (i.e. out-of-range temperature)
 - d) *Medium* - energy waste (i.e. fighting valves)



- e) *Low-* maintenance message (i.e. runtime monitor, filter status)
 - f) *Supervisory* - control events (i.e. Totalization Resets, Scheduled Events Occurrence, etc.)
3. Alarm Report Routing: Each alarm priority level shall be associated with a unique user-defined list of operator devices including any combination of local or remote workstations, printers, email accounts, mobile devices, SMS accounts and workstation files. All alarms associated with a given priority level shall be routed to all operator devices on the user-defined list associated with that priority level. For each priority level, alarms shall be automatically routed to a default operator device in the event that alarms are unable to be routed to any operator device assigned to the priority level.
 4. Alarm Acknowledgment: For alarm priority levels that are directed to a workstation screen, an indication of alarm receipt shall be displayed immediately regardless of the application in use at the workstation, and shall remain on the screen until acknowledged by a user having a password that allows alarm acknowledgment. Upon acknowledgment, the complete alarm message string (including date, time, and user name of acknowledging operator) shall be stored in the CSS database.
- E. It shall be possible for any operator to receive a summary of all alarms, regardless of acknowledgement status, for which a particular recipient is enrolled for notification, based on current event state, based on the particular event algorithm (e.g., change of value, change of state, out of range, and so on), alarm priority, and notification class.

2.06 TRENDDING

- A. The software shall display historical data in both a tabular and graphical format. The requirements of this trending shall include the following:
1. Install ten minute historical trends for all physical (AI, AO) analog points, all physical digital points (DI, DO) and all virtual points used in any loop control algorithm
 2. The sample rate and data selection shall be selectable by the operator. The default sample rate shall be ten minutes for all trend capable points with data retention in the BC of 2 days and 365 days at the CSS.
 3. All established trends must be collected automatically by the CSS
 4. The trended value range shall be selectable by the operator.
 5. Workstations shall be able to display up to four simultaneous trend graphs with up to four data points per graph.
 6. The data points must be exportable from any operator interface in comma-separated values (CSV) or MS Excel format.
- B. Change of Value (COV) Trending: Each of the following shall be installed with a COV trend definition capable of supporting the same time requirements defined in 2.06.



1. Control Loop Performance Trends: Controllers incorporating PID control loops shall provide high resolution sampling of each variable contained in the loop with an established COV value equal to 0.5% of the controlled variables operating range.
 2. Pressure Gradient Values: All calculated values indicating a pressure, velocity, and flow shall be configured with COV trend definitions.
- C. Data Buffering and Archiving: Trend data shall be buffered at the CUs, and uploaded to CSS storage when archival is desired. All archived trends shall be transmitted to the CSS as applicable. Uploads shall occur based upon a user-defined interval, manual command, or automatically when the trend buffers become full.
- D. Time Synchronization: Provide a time master that is installed and configured to synchronize the clocks of all devices supporting time synchronization. All trend sample times shall be able to be synchronized. The frequency of time synchronization message transmission shall be selectable by the operator.

2.07 TOTALIZATION

- A. The software shall support totalizing analog, digital, and pulsed inputs and be capable of accumulating, storing, and converting these totals to engineering units used in the documents. These values shall generally be accessible to the Operator Interfaces to support management-reporting functions.
- B. Totalization of electricity use/demand (hourly, daily & monthly) shall allow application of totals to different utility tariff rate periods, which shall be user definable.
- C. When specified to provide electrical or utility Use/Demand, the BAS Contractor shall obtain from the local utility all information required to obtain meter data, including k factors, conversion constants, and the like.
- D. Detailed energy consumption reports for facility utilities, including but not limited to kWh for all motors, kWh for all heat recovery devices, Chilled Water Flow, EWT/LWT, Tons (hourly, daily & monthly), Ton-Hours, Steam Flow, and Condensate Flow shall be stored as their final calculated value on a daily, monthly and yearly basis. Archive of this data shall be for no less than one year.

2.08 SCHEDULING

- A. All schedules must use BACnet objects with read/write capability enabled. The schedule must allow monitoring and manipulation of the schedule through external BACnet software. No hard coded or proprietary schedule routines are allowed.
- B. Provide a graphic utility for user-friendly operator interface to adjust equipment-operating schedules.



- C. Scheduling feature shall include multiple day occupancy schedules, holiday schedules and override schedules, each with start time and stop time. Schedules shall be individually editable for each day and holiday.
- D. Scheduling feature shall allow for schedules to be applied to individual equipment units, floorplans, buildings and/or the campus.
- E. Schedules shall be hierarchical allowing all devices/systems below a given device/system to follow the same schedule.
- F. Timed override feature shall allow an operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given master schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time, or at the end of the scheduled occupied/unoccupied period, whichever comes first. A password level that does not allow assignment of master schedules shall allow a timed override feature.
- G. A yearly calendar feature shall allow assignment of holidays, and automatic reset of system real time clocks for transitions between daylight savings time and standard time.

2.09 OVERRIDES

- A. BAS shall provide an audit log report of all overrides currently active and historical overrides along with the user who initiated the override.
- B. Timed override feature shall allow an operator to temporarily change the state of scheduled equipment. An override command shall be selectable to apply to an individual unit, all units assigned to a given master schedule, or to all units in a building. Timed override shall terminate at the end of an operator selectable time, or at the end of the scheduled occupied/unoccupied period, whichever comes first. A password level that does not allow assignment of master schedules shall allow a timed override feature.
- C. Override shall be possible for analog or time clock values for a given period of time, until a user specified time or permanently. Overrides may be cleared at the user interface or through programmable user functions.

2.10 OBJECT STRUCTURING AND NAMING

- A. Object Definition: An object is any component in the BAS that requires naming using printable Standard English language characters in a format easily understood by the end user of the software. Examples of objects are:
 1. BAS Architecture Devices
 2. Zone and Event Definitions
 3. Schedule Definitions
 4. Report Definitions
 5. Dynamic Graphics and Graphic Background Drawings



6. Programs
 7. Points
- B. Refer to the Object Naming Guide in Section 25 55 00.13.
- C. All object names shall adhere to the format as established in the Object Naming Guide. Objects shall include all physical I/O points, calculated points used for standard reports, and all application program parameters. For each BAS object, a specific and unique object name shall be required.
- D. General: Name objects consistently across all facilities. The BAS Contractor shall configure the systems from the perspective of the entire WAN and attached BAS networks, not solely the local project. The Object Naming Guide shall be implemented as much as practical, and any deviations from the guide shall be pre-approved by the Owner or Owner's representative. The BAS Contractor must obtain the latest Object Naming Guide documents prior to developing their object database.
1. All tables defined below shall be provided in both hard copy and in electronic format (MS Excel and PDF).
 2. The BAS Contractor shall coordinate with Owner and compile and submit all proposed tables for review prior to any object programming or project startup.
 3. Project closeout documents shall include up-to-date and accurate completed versions of all tables. The BAS Contractor shall deliver to the Owner the final table versions prior to Substantial Completion of the system.
 4. See Section 25 55 00 for the general requirements for point control performance parameters.
- E. Point Name Summary Table
1. The term 'Point' is a generic description for the class of object represented by analog and binary inputs, outputs, and values.
 2. With each schematic, the BAS Contractor shall provide a Point Name Summary Table listing:
 - a) Building number and/or abbreviation
 - b) System Name
 - c) Device Name
 - d) Full point name (see Object Naming Guide)
 - e) Point description
 - f) Ethernet backbone network number,
 - g) Integration Network number
 - h) Integration Device ID
 - i) Integration Device MAC address
 - j) Integration Object ID (object type, instance number)
 - k) State Text
 - l) Change of Value Assigned



- m) Engineering Units
- 3. Point Name Summary Table shall illustrate Network Variables and Data Link Bindings when necessary.
- F. BAS Architecture Device Name Summary Table
 - 1. The term “Device” refers to an individual programmatic representation of a BAS controller in the facility.
 - 2. With each schematic the BAS Contractor shall provide a BAS Architecture Device Name Summary Table listing the names of all controllers that will be incorporated into the project.
 - 3. The table shall include the proposed location in the facility of the device.
 - 4. The table shall contain empty columns labeled as the following:
 - a) Host Name
 - b) DHCP Server Address
 - c) Default Gateway
 - d) Subnet Mask
 - e) IP Address
- G. Device Addressing Convention:
 - 1. All assignments of network numbers, TCP/IP addresses and Device Object IDs shall be coordinated with the Owner’s network manager.
 - 2. The BAS Contractor shall coordinate with the Owner to ensure that no duplicate Device Object IDs or names occur.
 - 3. Alternative Device ID schemes or cross project naming duplication, if allowed, shall be approved before project commencement by the Owner.

2.11 OPERATOR INTERFACE GRAPHIC SOFTWARE

- A. Graphic software shall facilitate user-friendly interface to all aspects of the System Software specified above. Provide a graphic package that provides for intuitive operation of the systems without extensive training and experience. It shall facilitate logical and simple system interrogation, modification, configuration, and diagnosis. Context sensitive help shall be provided within the user interface via a ‘help’ function.
- B. Graphic software shall support multiple simultaneous screens to be displayed and resizable in a ‘Windows’-like environment. All functions excepting text entry functions shall be executable with a mouse.
- C. Graphic software shall provide for multitasking such that third-party programs can be used while the OWS software is on line. Software shall provide the ability to alarm graphically even when operator is in another software package.
- D. The software shall allow for the user’s creation of user-defined, color graphic displays of geographic maps, building plans, floor plans, and mechanical and electrical system schematics. These graphics shall be



capable of displaying all point information from the database including any attributes associated with each point (i.e., engineering units, etc.). In addition, operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse

- E. Screen Penetration: The operator interface shall allow users to access the various system graphic screens via a graphical penetration scheme by using the mouse to select from menus or 'button' icons. Each graphic screen shall be capable of having a unique list of other graphic screens that are directly linked through the selection of a menu item or button icon.
- F. Dynamic Data Displays: Dynamic physical point values shall automatically update at a minimum frequency of 6 updates per minute without operator intervention. Point value fields shall be displayed with a color code depicting normal, abnormal, override and alarm conditions.
- G. Point Override Feature: Each displayed point shall be individually enabled/disabled to allow mouse-driven override of digital points or changing of analog points. Such overrides or changes shall occur in the control unit, not just in the workstation software. The graphic point override feature shall be subject to password level protection. Points that are overridden shall be reported as an alarm, and shall be displayed in a coded color. The alarm message shall include the operator's user name. A list of points that are currently in an override state shall be available through menu selection.
- H. Dynamic Symbols: Provide a selection of standard symbols that change in appearance based on the value of an associated point.
 - 1. Analog symbol: Provide a symbol that represents the value of an analog point as the length of a line or linear bar.
 - 2. Digital symbol: Provide symbols such as switches, pilot lights, rotating fan wheels, etc. to represent the value of digital input and output points.
 - 3. Point Status Color: Graphic presentations shall indicate different colors for different point statuses.
 - 4. Zone/Equipment Color: Floor plan graphics shall be color coded by the equipment served as follows; green = zone temperature within setpoint, blue/dark blue = zone temperature below setpoint, yellow/orange = zone temperature above setpoint, red = zone temperature/equipment in alarm range, white = equipment on normal, grey = equipment off normal.
- I. Graphics Development Package: Graphic development and generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
 - 1. The BAS Contractor shall use the BAS vendor's Standard Graphical packages when creating graphic backgrounds.
 - 2. All Graphics created shall use a common background template with which to base all custom graphical representations. The template shall contain the following attributes;



- a) Status Bar: A single bar across the bottom of every graphic containing hierarchical graphic links to other system graphics, general OA conditions and the current BAS system time.
 - b) Title Bar: A single bar across the top of every graphic containing the System Name the graphic represents. Additionally, where required the title bar shall contain the areas served by the System represented.
 - c) Mode Bar: A single bar just below the Title bar of equal dimensions to the Title bar. This bar is optional but must be included on all system graphics where the system contains programmatic modes of operation or distress modes. The Mode bar shall display the current operating mode and any other relevant information to mode operation.
3. The BAS Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components (e.g. fans, cooling coils, filters, dampers, etc.), mechanical system components (e.g., pumps, chillers, cooling towers, boilers, etc.), complete mechanical systems (e.g. constant volume-terminal reheat, VAV, etc.) and electrical symbols.
 4. The BAS Contractor shall provide libraries of pre-engineered charting and graphical display objects that can represent reporting output. Such Enhanced Graphical objects must be standard and free to use by all users.
 5. The Graphic Development Package shall use a mouse or similar pointing device to allow the user to perform the following:
 - a) Define symbols
 - b) Position items on graphic screens
 - c) Attach physical or virtual points to a graphic
 - d) Define background screens
 - e) Define connecting lines and curves
 - f) Locate, orient and size descriptive text
 - g) Define and display colors for all elements
 - h) Establish correlation between symbols or text and associated system points or other displays.
 - i) Create hot spots or link triggers to other graphic displays or other functions in the software.

PART 3. EXECUTION

3.01 SYSTEM CONFIGURATION

- A. BAS Contractor shall thoroughly and completely configure BAS system software, supplemental software, network communications, CSS, OWS, portable operator's terminal, printer, and remote communications.



3.02 SITE-SPECIFIC APPLICATION PROGRAMMING

- A. Provide all database creation and site-specific application control programming as required by these Specifications, national and local standards and for a fully functioning system. The BAS Contractor shall provide all initial site-specific application programming and thoroughly document programming. Generally, meet the intent of the written sequences of operation. It is the BAS Contractor's responsibility to request clarification on sequence issues that are unclear or subject to interpretation.
- B. All site-specific programming shall be fully documented and submitted for review and approval, prior to downloading into the panel, at the completion of functional performance testing, and at the end of the warranty period.
- C. All programming, graphics and data files must be maintained in a logical system of directories with self-explanatory file names. All files developed for the project will be the property of AU and shall remain on the workstation(s)/server(s) at the completion of the project.

3.03 PASSWORD SETUP

- A. Set up the following password levels to include the specified capabilities:
 - 1. Level 1: (BAS Administrator)
 - a) Level 2 capabilities
 - b) View, add, change and delete user names, passwords, password levels
 - c) All unrestricted system capabilities including all network management functions.
 - 2. Level 2: (System Engineers)
 - a) Level 3 capabilities
 - b) Configure system software
 - c) Modify control unit programs
 - d) Modify graphic software
 - e) Essentially unrestricted except for viewing or modifying user names, passwords, password levels
 - 3. Level 3: (Senior Maintenance Technician)
 - a) Level 4 capabilities
 - b) Override output points
 - c) Change setpoints
 - d) Change equipment schedules
 - e) Create Graphics
 - f) Exit BAS software to use third party programs
 - 4. Level 4: (Maintenance / Service Desk)
 - a) Level 5 capabilities
 - b) Build Reports



- c) Acknowledge alarms
- d) Temporarily override equipment schedules
- 5. Level 5: (Read Only)
 - a) Display all graphic data
 - b) Run Reports
 - c) Trend point data
- B. The BAS Contractor shall assist operators with assigning user names, passwords and password levels.

3.04 POINT PARAMETERS

- A. Provide the following minimum programming for each analog input:
 - 1. Name
 - 2. Address
 - 3. Engineering units
 - 4. State Text, custom State Text where required.
 - 5. Offset calibration and scaling factor for engineering units
 - 6. Alarm Configuration
 - 7. Remote Notification Setup
 - 8. Default value to be used when the actual measured value is not reporting. This is required only for points that are transferred across the primary and/or secondary controlling networks and used in control programs residing in control units other than the one in which the point resides. Events causing the default value to be used shall include failure of the control unit in which the point resides, or failure of any network over which the point value is transferred.
 - 9. Default Linked Graphic. All points shall be linked to a graphic, even if the point is not displayed on the graphic directly but is contained in the system that the graphic represents.
- B. Provide the following minimum programming for each analog output:
 - 1. Name
 - 2. Address
 - 3. State Text, custom State Text where required.
 - 4. Output updating frequency
 - 5. Engineering units
 - 6. Offset calibration and scaling factor for engineering units
 - 7. Remote Notification Setup
 - 8. Output Range
 - 9. Default Linked Graphic. All points shall be linked to a graphic, even if the point is not displayed on the graphic directly but is contained in the system that the graphic represents.



- C. Provide the following minimum programming for each digital input:
 - 1. Name
 - 2. Address
 - 3. Engineering units (on/off, open/closed, freeze/normal, etc.)
 - 4. State Text, custom State Text where required.
 - 5. Alarm Configuration
 - 6. Remote Notification Setup
 - 7. De-bounce time delay (Digital Filter)
 - 8. Message and alarm reporting as specified
 - 9. Reporting of each change of state
 - 10. Default Linked Graphic. All points shall be linked to a graphic, even if the point is not displayed on the graphic directly but is contained in the system that the graphic represents.
 - 11. Totalization of on-time (for all motorized equipment status points)

- D. Provide the following minimum programming for each digital output:
 - 1. Name
 - 2. Address
 - 3. State Text, custom State Text where required.
 - 4. Engineering units (on/off, open/closed, freeze/normal, etc.)
 - 5. Remote Notification Setup
 - 6. Direct or Reverse action selection
 - 7. Minimum on-time
 - 8. Minimum off-time
 - 9. Status association with a DI and failure alarming (as applicable)
 - 10. Reporting of each change of state, and memory storage of the time of the last change of state
 - 11. Default Linked Graphic. All points shall be linked to a graphic, even if the point is not displayed on the graphic directly but is contained in the system that the graphic represents.

3.05 TRENDS

- A. The BAS Contractor shall create, establish and store trend logs for all trend capable hardware points, virtual points and calculated setpoints.
- B. The Owner or his representative will analyze trend logs of the system operating parameters to evaluate normal system functionality. The BAS Contractor shall establish these trends and ensure they are being stored properly on the CSS.



1. 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 or single date stamp. 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 2-dimensional formats with time being the row heading and field name being the column heading.
- C. The BAS Contractor shall create standard graphical trends representing the setpoint and measured value for each system.
- D. The BAS Contractor shall demonstrate functional trends two weeks prior to Functional Performance Testing.
- E. The CSS shall be configured and/or upgraded as necessary to provide historical trend archiving for up to one year for all trend capable points on this project.

3.06 ALARMS

General: The BAS Contractor will be responsible for setting initial enhanced alarm parameters. No reporting actions will be initiated during construction unless directed by the Owner. See Section 25 5500 for the general requirements.

- A. Override Alarms: Any point that is overridden through the override feature of the graphic workstation software shall be reported as a Level 3 alarm.
- B. Analog Input Alarms: For each analog input, program an alarm message for reporting whenever the analog value is outside of the programmed alarm limits. Report a 'Return-to-Normal' message after the analog value returns to the normal range, using a programmed alarm differential. Contractor shall coordinate with the Owner for final values based on the following parameters:
 1. Space temperature, except as otherwise stated in sequence of operation: Level 3
 - a) Low alarm: 64°F
 - b) Low return-to-normal: 68°F
 - c) High alarm: 85°F
 - d) High return-to-normal: 80°F
 2. Controlled media temperature other than space temperature (e.g. AHU discharge air temperature, steam converter leaving water temperature, condenser water supply, chilled water supply, etc.): Level 3 (If controlled media temperature setpoint is reset, alarm setpoints shall be programmed to follow setpoint)
 - a) Low alarm: 3°F below setpoint
 - b) Low return-to-normal: 2°F below setpoint
 - c) High alarm: 3°F above setpoint
 - d) High return-to-normal: 2°F above setpoint.



3. AHU mixed air temperature: Level 4
 - a) Low alarm: 45°F
 - b) Low return-to-normal: 46°F
 - c) High alarm: 90°F
 - d) High return-to-normal: 89°F
 4. Duct Pressure: Level 2
 - a) Low alarm: 0.5" w.g. below setpoint
 - b) Low return-to-normal: 0.25" w.g. below setpoint
 - c) High alarm: 0.5" w.g. above setpoint
 - d) High return-to-normal: 0.25" w.g. above setpoint
 5. Space humidity: Level 3
 - a) Low alarm: 35%
 - b) Low return-to-normal: 40%
 - c) High alarm: 75%
 - d) High return-to-normal: 70%
 6. Air Quality CO₂: Level 1
 - a) High alarm: 1,300 ppm
 - b) High return-to-normal: 1,000 ppm
- C. BAS System Failure Alarm: Generate alarm that reads "BAS System Failure". Alarm shall be generated when communication is lost to any controller or when any controller is determined to be in an abnormal state.

3.07 GRAPHIC SCREENS

- A. General:
1. All Graphics shall be visible on all OWS displays in full screen mode without the use of scroll bars.
 2. All Graphics shall be printable with a blank/white background.
 3. All Graphics must have a unique background graphic, except Terminal Equipment Controllers.
 4. All Graphics must contain all setpoints for the system represented. All displayed setpoints must be adjustable from the graphic and may not be hard coded in software.
 5. All Graphics must contain all physical points comprising the system.
 6. All Graphics shall include outside air sensor data.
 7. All relevant systems Graphics must contain a unique Graphical Link to the As-Built Sequence of Operations.
 8. All Graphics shall contain a Dynamic Graphical Links to the contract document As-Built mechanical, electrical and complete BAS drawing(s) for the represented system.



9. All Graphics shall display any points that are currently in alarm with a graphical alarm representation that is consistent across all BAS projects to indicate the point is in alarm. All alarm points must be on a graphic.
 10. All animated Graphics shall accurately reflect the state of the equipment/device represented.
 11. Provide zone level environmental index and building performance dashboard.
 12. The main building/site graphic must include a software emergency shutdown button. The software emergency shutdown button will shut down all HVAC systems within the building/site as described in the Sequences of Operation. Activation of the software shutdown button will be user level restricted.
 13. New format (post Desigo CC) graphics must be provided for all Siemens projects. If the project is a renovation or expansion with existing Siemens graphics all existing graphics must be replaced with the new graphic format as part of the project.
- B. Floor Plan Screens: The contract document drawings will be used as the template for all floor plan graphic backgrounds.
1. Clearly display the building name and floorplan name at the top of each individual building floorplan graphic.
 2. Provide a campus map graphic (or edit existing graphic) to identify location of building(s) for this project with clickable links.
 3. Provide a per building floor plan graphic showing all thermographic color floorplans scaled to fit on one screen and designed to quickly evaluate building status. Include status off all major building systems and access to 'global' building setpoints.
 4. Provide two-dimensional thermographic color floor plan screens for each floor, wing, or tower of the building. Indicate the location of all equipment that is not located on the equipment room screens. Indicate all equipment zones with corresponding ON/OFF status. Indicate the location of temperature sensors associated with each temperature-controlled zone (i.e., VAV terminals, fan-coils, single-zone AHUs, etc.) on the floor plan screens. Display the space temperature point adjacent to each temperature sensor symbol. Use a distinct line or symbol to demarcate each terminal unit zone boundary. Use distinct colors to demarcate each air handling unit zone. Mechanical floor plan drawings will be made available to the user via a dynamic graphic link to the actual document. Indicate room numbers as provided by the Owner. Provide a drawing link from each space temperature sensor symbol and equipment symbol shown on the graphic floor plan screens to each corresponding equipment schematic graphic screen.
 5. Provide two-dimensional graphic floor plan screens for each mechanical equipment room and a plan screen of the roof. Indicate the



location of each item of mechanical equipment. Provide a drawing link from each equipment symbol shown on the graphic plan view screen to each corresponding mechanical system schematic graphic screen.

6. If multiple floor plans are necessary to show all areas, provide a graphic building key plan. Use elevation views and/or plan views as necessary to graphically indicate the location of all of the larger scale floor plans. Link graphic building key plan to larger scale partial floor plans. Provide links from each larger scale graphic floor plan screen to the building key plan and to each of the other graphic floor plan screens. The key here is to assure all graphics can be linked to another and found dynamically by viewing a hierarchical tree like structure that contains all graphics in the system.

C. System Schematic Screens:

1. Provide graphic system schematic screen for each controlled and monitored System and Sub-System.
2. System graphics shall include flow diagrams with status, setpoints, current analog input and output values, operator commands, etc. as applicable.
3. Operator adjustable points shall be adjustable through the graphic interface.
4. General layout of the system shall be schematically correct and in the point of view as if an Operator were standing beside the most important access point for the system as physically installed.
5. Input/output devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Verbose names (English language descriptors) shall be included for each point on all graphics.
6. Indicate all adjustable setpoints on the applicable system schematic graphic screen or, if space does not allow, on a supplemental linked-setpoint screen.
7. For each sub-system (i.e. VAV box) provide a link to all other systems serving that system (i.e. HW System, VAV AHU). Include pertinent data from the serving system on the sub-system graphic (i.e. VAV AHU supply temperature at VAV box primary air intake).
8. All valve and damper position indicators should read “xxx % open” or “xxx % closed” as applicable.
9. Indicate occupancy status and temperature (via color bar graphic) on each zone level equipment graphic.

- END OF SECTION -



SECTION 25 35 00 INSTRUMENTATION AND TERMINAL DEVICES FOR HVAC

PART 1. GENERAL

1.01 SECTION INCLUDES:

- A. Description of Work
- B. Products Furnished but Not Installed Under this Section

1.02 RELATED DOCUMENTS:

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.
- B. Section 25 08 00 - Commissioning of Integrated Automation
- C. Section 25 11 13 - Integrated Automation Network Servers
- D. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- E. Section 25 14 13 - Integrated Automation Remote Control Panels
- F. Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks
- G. (This Section) Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- H. Section 25 35 13 – Integrated Automation Actuators and Operators
- I. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- J. Section 25 35 19 – Integrated Automation Control Valves
- K. Section 25 35 23 - Integrated Automation Control Dampers
- L. Section 25 55 00 – Integrated Automation Control of HVAC
- M. Section 25 95 00 – Integrated Automation Control Sequences for HVAC

1.03 DESCRIPTION OF WORK:

- A. Furnish and Install DDC instrumentation and control devices required supporting specified building automation system functions as detailed herein and Section 25 55 00.
- B. Refer to Section 25 55 00 for general requirements and definitions.

1.04 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Control Valves: The Contractor shall install valves furnished under this Division, under the applicable piping Section and will be fully responsible for the proper installation of the valve. All concerns, proper installation, and



maintenance information will be supplied by the BAS Contractor or device manufacturer depending upon provider prior to installation.

- B. Control Dampers: The Contractor shall install dampers furnished under this Division, under the applicable duct work Section and will be fully responsible for the proper installation of the damper. All concerns, proper installation, and maintenance information will be supplied by the BAS Contractor or device manufacturer depending upon provider prior to installation.
- C. Taps: The Contractor shall install taps, wells, flow switches, meters, etc., furnished under this Section under the applicable piping and duct work Sections and will be fully responsible for the proper installation of all devices installed. All concerns, proper installation, and maintenance information will be supplied by the BAS Contractor or device manufacturer depending upon provider prior to installation.
- D. Furnish duct-mounted airflow stations and static pressure probes to Division 23 contractor for installation.
- E. Furnish air terminal device controllers, transformers, differential pressure (flow) transmitters and enclosure, along with control wiring and tubing diagrams for factory installation.

1.05 WIRING REQUIREMENTS

- A. Refer to Section 25 55 00 and Division 26 for general requirements and direction.
- B. For those systems that require 120 VAC and not furnished under 25 55 00, the Contractor shall provide the required electrical connections commensurate with manufacturer recommendations.

PART 2. PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. General: Provide Direct Digital Control products in sizes and capacities indicated, consisting of valves, dampers, thermostats, clocks, controllers, sensors, and other components as required for complete installation, reviewed, and approved by the Owner or the Owner's representative. Except as otherwise indicated, provide manufacturer's standard materials and components as published in their product information; designed and constructed as recommended by manufacturer, and as required for application indicated.
- B. Instrument Pipe and Tube
 - 1. Hydronic and Instruments
 - a) Connection to Main Piping: Provide ½ inch minimum size thread-o-let, ½" x 2 inch brass nipple, and ½" ball valve for connection to welded steel piping. Provide tee fitting for other types of piping.
 - b) Remote Instruments: Adapt from ball valve to specified tubing and extend to remote instruments. Provide a union or otherwise



- removable fitting at ball valve so that connection to main can be cleaned with straight rod. Where manifolds with test ports are not provided for instrument, provide tees with ¼" FPT branch with plug for use as test port. Adapt from tubing size to instrument connection.
- c) Line Mounted Instruments: Extend rigid piping from ball valve to instrument. Do not use close or running thread nipples. Adapt from ball valve outlet to instrument connection size. Provide a plugged tee if pipe makes 90 degree bend at outlet of valve to allow cleaning of connection to main with straight rod without removing instrument.
 - d) Instrument Tubing: Seamless copper tubing, Type K or L, ASTM B 88; with cast-bronze solder joint fittings, ANSI B1.18; or wrought-copper solder-joint fittings, ANSI B16.22; or brass compression-type fittings. Solder shall be 95/5 tin antimony, or other suitable lead free composition solder. Tubing OD size shall be not less than the larger of ¼" or the instrument connection size.
 - e) Rigid Piping for Line Mounted Instruments: Schedule 40 threaded brass, with threaded brass fittings.
2. Low Pressure Air Instrument Sensing Lines
- a) Connections: Use suitable bulkhead type fitting and static sensing tip for static pressure connections. Adapt tubing to instrument connection.
 - b) Tubing: Virgin polyethylene non-metallic tubing type FR, ASTM D 2737, and with flame-retardant harness for multiple tubing. Use compression or push-on brass fittings.
- C. Communication Wiring: All wiring shall be in accordance with manufacturer's requirements, Division 26 and Section 25 5500.
- 1. The Contractor shall supply all communication wiring as detailed in Section 25 55 00.
 - 2. Local Supervisory LAN: For any portions of this network required under this section of the specification, contractor shall use Fiber or Category 5e of standard TIA/EIA (100/1000BaseT). Network shall be run with no splices and in separate conduit from any other wiring.
 - 3. Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs per manufacturers recommendations for distances installed, with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any other wiring. Shield shall be terminated and wiring shall be grounded as recommended by BC manufacturer.
- D. Signal Wiring: Contractor shall run all signals wiring in accordance with National Electric Codes, Division 26 and Section 25 5500.
- 1. Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be per manufacturer's



- requirements. Signal wiring shall be run with no splices and separate from all other wiring above thirty (30) volts.
2. Signal wiring shield shall be grounded at controller end only unless otherwise recommended by the controller manufacturer.
- E. Low Voltage Analog Output Wiring: Contractor shall run all low voltage control wiring in accordance with National Electric Codes, Division 26 and Section 25 55 00. All wire insulation shall be color-coded and labeled for ease of identification.
1. Low voltage control wiring shall be per manufacturer's requirements. Low voltage control wiring shall be run with no splices separate from any wiring above thirty (30) volts.
- F. Control Panels: Provide control panels with suitable brackets for wall mounting for each control system. Locate panel adjacent to systems served.
1. Fabricate panels of 16-gage furniture-grade steel, or 6063-T5 extruded aluminum alloy, totally enclosed on four sides, with hinged door and keyed lock, with manufacturer's standard shop-painted finish and color.
 2. Provide UL-listed cabinets for use with line voltage devices.
 3. Control panel shall be completely wired prior to delivery and all electrical connections made to a labeled terminal strip. Control panel shall have standard manufacturer's color.
 4. All gauges and control components shall be identified by means of nameplates.
 5. All control tubing and wiring shall be run neatly and orderly in open slot wiring duct with cover.
 6. Complete wiring and tubing termination drawings shall be mounted in or adjacent to panel.
 7. Unitized cabinet type for each system under automatic control. Provide quantity of enclosures required to house all relays, transducers, solenoid valves, pneumatic devices and other interface controls. Mount temperature, humidity, airflow and pressure indicators, (or operator interface display with keypad), pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face. All transformers and power supplies shall be mounted outside of the central panel. Provide laminated nameplates for all devices utilizing tag name as submitted on shop drawings. Mechanically fasten nameplates to panel. Self-adhesive type nameplates are not acceptable.
 8. Provide NEMA-1 general-purpose enclosure for all applications where panel will be installed in relatively dust free and dry spaces. All control panels for use in mechanical rooms, wash-down locations or installed outdoors shall be rated NEMA-4. All cabinets shall use a common key. Provide means of storing control system instructions and drawings inside cabinet.



9. Finish: Factory applied enamel, except that panels in finished spaces shall be primed for field painting.
 10. Provide surface mounted or freestanding, steel supported types for mechanical equipment rooms. Provide fully recessed wall-mounted types elsewhere.
 11. All panels shall be fully recessed in walls in public spaces, where possible.
 12. Interior arrangement of control panel components shall be such that tubing and wire raceways shall be separated and aligned horizontally and vertically, in a fashion that allows for an organized appearance and a practical means for the tubing/wire to be exit the raceway to its intended component.
 13. All tubing shall enter the panel through standard bulkhead compression fittings. Poly tubing may be run in conduit and enter panels via conduit fittings. All tubing lines shall be labeled at both ends of the tubing.
 14. All wire shall enter panels via conduit fittings. All wires shall terminate on terminal blocks and then continue from the terminal block to the device. Direct connection to the device is not permitted. Use of wire nuts is not permitted, except in applications in which a control device is provided from the factory with "pigtails". All wires shall be labeled at both ends of the terminal blocks. All penetrations of the BAS or outboard gear panels in mechanical rooms shall be from the bottom of the enclosure with wire-way and conduit stubs from the wire-way up to the panel.
 15. Power Supplies:
 - a) Provide a regulated, protected power supply as required with the ability to produce at least 33 percent more current than required by the transmitters and controls being installed. Output regulation shall be less than 0.5 mV. There shall be no overshoot on turn ON or OFF. Operating temperature shall be minus 20 to plus 70 degrees C.
 - b) The BAS Contractor shall certify in writing at the time of shop drawing submittal that the DDC equipment provided will not cause, as a result of its operation, either directly or indirectly, electrical interference to be induced into the building's electrical power systems.
 16. Class II transformers shall be used.
- G. Refer to Sections 25 5500 and Division 26 for means, methods and materials. Provide 120 volt power wiring from dedicated circuit breakers in electrical panels to BAS control panels. Provide necessary transformers. Coordinate with Division 26. See Section 25 55 00 for power quality requirements of each Control Panel circuit.
- H. Control and Signal Circuits: Per NEC Article 725 (excluding thermocouple wiring). Control or signal circuits not run entirely in conduit, in areas



classified as plenum space and vertical shafts shall be energized from listed Class 2 power supplies and shall be installed in Type "CL2P" listed plenum cable exclusively. Plenum rated cable shall be permitted in applications above an accessible ceiling or in between drywall where there is no insulation.

- I. Provide all power and control wiring exposed outdoors, within rigid conduit properly labeled as BAS wiring. All power and control wiring above inaccessible ceilings within finished spaces, in drywall partitions with insulation or in block walls, in mechanical spaces and in vertical shafts shall be installed in electric metallic tubing (EMT).
- J. Classify line (120 volt) and low (below 120 volt) voltage wiring from BAS and other control panels to control devices as control wiring.
- K. Low Voltage Control Wiring: Wire shall be compatible with specific application and in accordance with Division 26.
- L. For Hazardous location circuits as delineated in the design documents, refer to NFPA Article 500 for installation requirements.
- M. All cables shall be run parallel with structure, properly bundled, mounted (J Hooks) and secured every five feet. Provide labels every 20 feet (minimum) to identify associated system (i.e., BAS)

PART 3. EXECUTION

3.01 INSPECTION:

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the BAS Contractor or Installer.

3.02 INSTALLATION OF CONTROL SYSTEMS:

- A. Refer to Section 25 55 00 for general installation requirements for all mechanical, electrical and controls work.
- B. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of National Electric Code and all applicable local codes.
- C. Plenum Wiring: All low-voltage wiring external to control panels shall be in conduit, unless pre-approved. Conduit type, sizing, and installation requirements shall conform to NEC, Division 26 and Section 25 5500.
 1. Installation of wiring shall generally follow building lines. Run in a neat and orderly fashion, bundled where applicable, and completely suspended (strapped to rigid elements or routed through wiring J rings) away from areas of normal access. Tie and support conductors neatly with suitable nylon ties. Conductors shall not be supported by the ceiling system or ceiling support system. Conductors shall be pulled tight and be installed as high as practically possible in ceiling cavities.



Wiring shall not be laid on any adjacent component or structure. Conductors shall not be installed between the top cord of a joist or beam and the bottom of roof decking. Contractor shall be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance. Under no circumstances will exposed splices be permitted.

3.03 NAMEPLATES

- A. Provide engraved phenolic or micarta nameplates for all equipment, components, and field devices furnished. Nameplates shall be 1/8 thick, black, with white center core, and shall be minimum 1" x 3", with minimum 1/4" high block lettering. Nameplates for devices smaller than 1" x 3" shall be attached to adjacent surface.
- B. Each nameplate shall at a minimum include the object name of the device or sensor.
- C. A complete nameplate and labeling schedule shall be provided to the Owner for approval prior to creating any label or nameplate.
- D. For all Variable Speed Drives (VSDs/VFDs), provide an additional engraved nameplate at the drive indicating the location of the controlled variable when the controlled variable is not adjacent to the drive.

3.04 TESTING EQUIPMENT

- A. Contractor shall test and calibrate all signaling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete testing successfully. Contractor shall be responsible for test equipment required to perform these tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g., if field device is +/-0.5% accurate, test equipment shall be +/-0.25% accurate over same range).

- END OF SECTION -



25 35 13 ACTUATORS AND OPERATORS

PART 1. GENERAL

1.01 SECTION INCLUDES:

- A. Description of Work
- B. Valve Actuators and Operators
- C. Damper Actuators and Operators

1.02 RELATED DOCUMENTS:

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.
- B. Section 25 08 00 - Commissioning of Integrated Automation
- C. Section 25 11 13 - Integrated Automation Network Servers
- D. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- E. Section 25 14 13 - Integrated Automation Remote Control Panels
- F. Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks
- G. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- H. (This Section) Section 25 3513 – Integrated Automation Actuators and Operators
- I. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- J. Section 25 35 19 – Integrated Automation Control Valves
- K. Section 25 35 23 - Integrated Automation Control Dampers
- L. Section 25 55 00 – Integrated Automation Control of HVAC
- M. Section 25 95 00 – Integrated Automation Control Sequences for HVAC

1.03 DESCRIPTION OF WORK:

- A. Furnish and Install DDC instrumentation and control devices required supporting specified building automation system functions as detailed herein and Section 25 55 00.
- B. Refer to Section 25 55 00 for general requirements and definitions.



PART 2. PRODUCTS

2.01 ACTUATORS

A. General:

1. Actuators shall be either modulating, 2-position or spring return as indicated in the applicable control sequence.
2. As indicated in the applicable specification, all fail-safe operations shall require mechanical spring return or capacitive power generation or UPS power delivery for operation during the fail-safe condition.
3. Size actuators and linkages to operate their appropriate dampers or valves with a single actuator with sufficient reserve torque or force to provide smooth modulating action or 2-position action as specified.
4. The Owner must preapprove multiple actuators for any single application.
5. Select spring-return actuators with manual override to provide positive shut-off of devices as they are applied.
6. Actuators relying on batteries for any operation are not acceptable.
7. All electronic actuators shall be UL listed.

B. Damper Actuators:

1. Ambient Operating Temperature Limits: -10 to 150°F (-12.2 to 66 °C)
2. Two Position Electric Actuators: Low voltage or line voltage with spring return.
3. Electronic Actuators: Provide actuators with spring return for two-position (24v), 0-5 VDC, 0-10 VDC, 2-10VDC, 4-20 mA, or PWM input (subject to restrictions) as required. Actuators shall travel full stroke in less than 90 seconds for non-critical applications and travel less than 3 seconds for fast acting critical applications. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed. Provide stroke indicator. Actuators shall have positive positioning circuit. When two actuators are required in parallel or in sequence, provide an auxiliary actuator driver. Actuators shall have current limiting motor protection. Actuators shall have manual override where indicated.
4. Close-Off Pressure: Provide the minimum torque required, and spring return for fail positioning (unless otherwise specifically indicated) sized for required close-off pressure. Required close-off pressure for two-way water valve applications shall be the shutoff head of associated pump. Required close-off rating of steam valve applications shall be design inlet steam pressure plus 50 percent for low-pressure steam, and 10 percent for high-pressure steam. Required close-off rating of air damper applications shall be shutoff pressure of associated fan, plus 10 percent.



5. Acceptable Manufacturers: Subject to compliance with requirements, approved manufacturers are as follows:
 - 1) Bray
 - 2) Siemens
 6. Substitutions: As allowed per Division 01.
- C. Quarter-Turn Actuators for Ball and Butterfly Valves and Air Valves:
1. Electric Actuation:
 - a) Motor: Suitable for 120 or 240 VAC single-phase power supply. Insulation shall be NEMA Class F or better. Motor shall be rated for 100 percent duty cycle. Motors shall have inherent overload protection.
 - b) Gear-Train. Motor output shall be directed to a self-locking gear drive mechanism. Gears shall be rated for torque input exceeding motor locked rotor torque.
 - c) Wiring: Power and control wiring shall be wired to a terminal strip in the actuator enclosure
 - d) Failsafe Positioning: Actuators shall be spring return type for failsafe positioning.
 - e) Enclosure: Actuator enclosure shall be NEMA-4 rated, and shall have a minimum of two threaded conduit entries. Provide an enclosure heater for actuators located outside of buildings.
 - f) Limit Switches: Travel limit switches shall be UL and CSA approved. Switches shall limit actuator in both open and closed positions.
 - g) Mechanical Travel Stops: The actuator shall include mechanical travel stops of stainless steel construction to limit actuator to specific degrees of rotation.
 - h) Manual Override: Actuators shall have manual actuator override to allow operation of the valve when power is off. For valves 4 inches and smaller the override may be a removable wrench or lever or geared hand-wheel type. For larger valves, the override shall be a fixed geared hand-wheel type. An automatic power cut-off switch shall be provided to disconnect power from the motor when the hand-wheel is engaged for manual operation.
 - i) Valve Position Indicator: A valve position indicator with arrow and open and closed position marks shall be provided to indicate valve position.
 - j) Torque Limit Switches: Provide torque limit switches to interrupt motor power when torque limit is exceeded in either direction of rotation.
 - k) Position Controller: For valves used for modulating control, provide an electronic position driver capable of accepting 4-20 mA, 0-10 VDC, 2-10 VDC, and 135-Ohm potentiometer.



- l) Ambient Conditions: Actuator shall be designed for operation from –140 to 150 °F ambient temperatures with 0 to 100 percent relative humidity.
- m) Timing: Actuators shall travel full stroke in less than 90 seconds for non-critical applications and travel less than 3 seconds for fast acting critical applications.
- n) Acceptable Manufacturers:
 - 1) Bray
 - 2) Siemens
 - 3) Substitutions: As allowed per Division 01

PART 3. EXECUTION

3.01 GENERAL:

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the BAS Contractor or Installer.
- B. Refer to Section 25 35 00 for general requirements.

3.02 INSTALLATION OF CONTROL SYSTEMS:

- A. Refer to Section 25 55 00 for general installation requirements for all mechanical, electrical and controls work.
- B. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of National Electric Code and all applicable local codes.
- C. Plenum Wiring: All low-voltage wiring external to control panels shall conform to NEC, Division 26 and Section 25 55 00.
 - 1. Installation of wiring shall generally follow building lines. Run in a neat and orderly fashion, bundled where applicable, and completely suspended (strapped to rigid elements or routed through wiring J rings) away from areas of normal access. Tie and support conductors neatly with suitable nylon ties. Conductors shall not be supported by the ceiling system or ceiling support system. Conductors shall be pulled tight and be installed as high as practically possible in ceiling cavities. Wiring shall not be laid on any adjacent component or structure. Conductors shall not be installed between the top cord of a joist or beam and the bottom of roof decking. Contractor shall be fully responsible for noise immunity and rewire in conduit if electrical or RF noise affects performance. Under no circumstances will exposed splices be permitted.
- D. Electric and Electronic Damper Actuators:
 - 1. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.



2. To compress seals when spring-return actuators are used on normally closed dampers, power actuators to approximately 5° open position, manually close the damper, and then tighten linkage.
 3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
- E. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. For steam applications, where possible, install with valve stem 45 degrees from vertical, but not below horizontal. For all other applications, where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible, or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down. Always refer to manufacturer's recommended installation best practices prior to installation.

- END OF SECTION -



25 35 16 SENSORS AND TRANSMITTERS

PART 1. GENERAL

1.01 SECTION INCLUDES:

- A. Description of Work
- B. General Field Device Requirements
- C. Sensors
- D. Meters
- E. Pneumatic Control Components (Gauges, switches, relays, etc.)
- F. Electric Control Components; Switches, EP Valves, Thermostats, Relays, Smoke Detectors, etc.
- G. Transducers
- H. Transmitters
- I. Voltage and Phase Monitors
- J. Air Flow Measuring Stations (AFMS)
- K. Current Switches

1.02 RELATED DOCUMENTS:

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.
- B. Division 23 – HVAC Equipment
- C. Section 25 08 00 - Commissioning of Integrated Automation
- D. Section 25 11 13 - Integrated Automation Network Servers
- E. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- F. Section 25 141 3 - Integrated Automation Remote Control Panels
- G. Section 25 151 6 - Integrated Automation Software for Control and Monitoring Networks
- H. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- I. Section 25 35 13 – Integrated Automation Actuators and Operators
- J. (This Section) Section 25 35 16 – Integrated Automation Sensors and Transmitters
- K. Section 25 35 19 – Integrated Automation Control Valves
- L. Section 25 35 23 - Integrated Automation Control Dampers
- M. Section 25 55 00 – Integrated Automation Control of HVAC
- N. Section 25 95 00 – Integrated Automation Control Sequences for HVAC



1.03 DESCRIPTION OF WORK:

- A. Refer to Section 25 55 00 for general requirements and definitions.
- B. Furnish and Install DDC instrumentation and control devices required supporting specified building automation system functions as detailed herein and Section 25 35 00.
- C. Refer to Section 25 55 00 and 25 35 00 for details on the ownership of the work results for this Section.

1.04 GENERAL FIELD DEVICE REQUIREMENTS

- A. First selection of manufacturer for any device shall be determined by the Owner's Design Standards. In any situation which the Standards do not include an applicable device, the Contractor is to submit the variance to the Owner for approval.
- B. Provide field devices for input and output of digital (binary) and analog signals into controllers (BCs, AACs, ASCs). Provide signal conditioning for all field devices as recommended by field device manufacturers, and as required for proper operation in the system.
- C. It shall be the BAS Contractor's responsibility to assure that all field devices are compatible with controller hardware and software.
- D. Field devices specified herein are generally 'two-wire' type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, or is not designed to work with 'two-wire' type transmitters, or if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the Contractor shall provide 'four-wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required. All such examples shall be coordinated and agreed upon with the BAS Contractor.
- E. For field devices specified hereinafter that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, Contractor shall furnish and install proper device, including 120V power as required. Such devices shall have accuracy equal to, or better than, the accuracy listed for respective field devices. All such examples shall be coordinated and agreed upon with the BAS Contractor.
- F. Accuracy: As stated in this Section, accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis. Refer to Section 25 55 00 for reporting performance requirements.



PART 2. PRODUCTS

2.01 TEMPERATURE SENSORS (TS)

- A. Sensor Range: When matched with A/D converter of BC, AAC/ASC, or SD. Where thermistors are used, the stability shall be better than 0.25°F over 5 years.
- B. Room Temperature Sensor: Shall be an element contained within a ventilated cover, suitable for wall mounting. Provide insulated base. Following sensing elements are acceptable:
 - 1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.
 - 2. Provide setpoint adjustment where indicated. The setpoint adjustment shall be a warmer/cooler indication that shall be scalable via the BAS (initial range of +/- 2°F).
 - 3. Provide an occupancy override button on the room sensor enclosure where indicated. This shall be a momentary contact closure
 - 4. Provide temperature indication via an LCD readout where indicated.
- C. Single-Point Duct Temperature Sensor: Shall consist of sensing element, junction box for wiring connections and gasket to prevent air leakage or vibration noise. Temperature range as required for resolution indicated in paragraph A.
 - 1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.2°F accuracy at calibration point
 - 2. For duct mounted installations, flange mount sensor to side of duct using manufacturer's standard recommendations and select probe lengths suitable for sensor location at center of duct.
- D. Averaging Duct Temperature Sensor: Shall consist of an averaging element, junction box for wiring connections and gasket to prevent air leakage. Provide sensor lengths and quantities to result in one lineal foot of sensing element for each three square feet of cooling coil/duct face area. Temperature range as required for resolution indicated in paragraph A.
 - 1. Sensing element shall be platinum RTD, or thermistor, +/- 0.2°F accuracy.
 - 2. For duct mounted installations, flange mount sensor to side of duct using manufacturer's standard recommendations and select minimum probe length of one linear foot per three square feet of cross sectional area. Install with sensor in serpentine fashion across duct area with no contact with other devices or coil surfaces.
- E. Liquid Immersion Temperature Sensor: Shall include brass thermowell, sensor and connection head for wiring connections.
 - 1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.



- F. Surface Mount Temperature Sensor: Shall include electrical utility box, sensor and connection head for wiring connections, and suitable for installation under insulation. Provide thermally conductive paste (compatible with pipe material) at pipe contact point. These may only be used where specifically indicated, typically on a temporary basis.
 - 1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.
- G. Outside Air Sensors: Shall consist of a sensor, sun shield, utility box, and watertight gasket to prevent water seepage. Temperature range shall be as require for resolution indicated in Paragraph A
 - 1. Sensing element shall be platinum RTD, thermistor, or integrated circuit, +/- 0.4°F accuracy at calibration point.
- H. Acceptable Manufacturers: BAPI, Johnson Controls, Schneider Electric, Siemens and Vaisala. Substitutions shall be allowed per Division 01.

2.02 HUMIDITY TRANSMITTERS

- A. Units shall be suitable for duct, wall (room) or outdoor mounting. Unit shall be two-wire transmitter utilizing bulk polymer resistance change or thin film capacitance change humidity sensor. Unit shall produce linear continuous output of 4-20 mA for percent relative humidity (% RH). A combination temperature and humidity sensor may be used for zone level monitoring. Sensors shall have the following minimum performance and application criteria:
 - 1. Input Range: 0 to 100% RH.
 - 2. Accuracy (% RH): +/- 2% (when used for enthalpy calculation, dew-point calculation or humidifier control) or +/- 3% (monitoring only) between 20-90% RH at 77°F, including hysteresis, linearity, and repeatability.
 - 3. Sensor Operating Range: As required by application
 - 4. Long Term Stability: Less than 1% drift per year.
- B. For duct mounted installations, flange mount sensor to side of duct using manufacturer's standard recommendations and select probe lengths suitable for sensor location at center of duct.
- C. Accessories: Duct-mounting plate, quick mount duct flange adapter, sensor dust filter, and single point calibrator for on-line/on-site calibration.
- D. Provide other accessories as required to protect sensors for up to 2500 fpm velocities.
- E. Acceptable Manufacturers: BAPI, Johnson Controls, Schneider Electric, Siemens and Vaisala. Substitutions shall be allowed per Division 01.

2.03 DIFFERENTIAL PRESSURE TRANSMITTERS (DP)

- A. General Purpose - Liquid:
 - 1. General: Loop powered two-wire transmitter.



2. Output: two-wire 4-20 mA output with zero and span adjustments.
 3. Overall Accuracy: less than 0.1% of span.
 4. Housing: Polymer housing suitable for surface mounting.
 5. Valve Bypass: Provide a five valve bypass kit for calibration. Kit shall include high and low pressure isolation valves, high and low pressure vent valves, and a bypass valve contained in a NEMA-1 enclosure. Enclosure shall be mounted no higher than 6 feet above floor level.
 6. Acceptable Manufacturers: Johnson Controls, Schneider Electric, Siemens, Setra, and Veris Industries. Substitutions shall be allowed per Division 01.
 7. Range: Select for specified setpoint to be between 25% and 75% full-scale.
- B. General Purpose Low Pressure Air: Generally, for use in static measurement of duct pressure or constant volume air velocity pressure measurement where the range is applicable.
1. General: Loop powered two-wire differential capacitance cell-type transmitter.
 2. Output: two-wire 4-20 mA output with zero adjustment.
 3. Overall Accuracy: Plus or minus 1%.
 4. Minimum Range: 0.1 in. w.c.
 5. Maximum Range: 10 inches w.c.
 6. Housing: Polymer housing suitable for surface mounting.
 7. Acceptable Manufacturers: Johnson Controls, Schneider Electric, Siemens, Setra, and Veris Industries. Substitutions shall be allowed per Division 01.
 8. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.
 9. Range: Select for specified setpoint to be between 25% and 75% full-scale.
- C. General Purpose Low Pressure/Low Differential Air: Generally, for use in static measurement of space pressure or constant volume air velocity pressure measurement where the range is applicable.
1. General: Loop powered, two-wire differential capacitance cell type transmitter.
 2. Output: Two-wire 4-20 mA output with zero adjustment.
 3. Overall Accuracy: Plus or minus 1%.
 4. Minimum Range: 0 in. w.c.
 5. Maximum Range: 0.1, 0.25, or 0.5 inches w.c.
 6. Housing: Polymer housing suitable for surface mounting.
 7. Acceptable Manufacturers: Johnson Controls, Schneider Electric, Siemens, Setra, and Veris Industries. Substitutions shall be allowed per Division 01.



8. Static Sensing Element: Pitot-type static pressure sensing tips similar to Dwyer model A-301 and connecting tubing.
 9. Range: Select for specified setpoint to be between 25% and 75% full-scale.
- D. VAV/CAV Velocity Pressure: Generally, for use to measure volume of air velocity pressure measurement where the range is applicable.
1. General: Loop powered two-wire differential capacitance cell type transmitter.
 2. Output: Two-wire, 4-20 mA output with zero adjustment.
 3. Overall Accuracy: Plus or minus 0.25%
 4. Minimum Range: 0 in. w.c.
 5. Maximum Range: 1-inch w.c.
 6. Housing: Polymer housing suitable for surface mounting.
 7. Range: Select for minimum range that will accept the maximum velocity pressure expected.
 8. Acceptable Manufacturers: Johnson Controls, Schneider Electric, Siemens, Setra, and Veris Industries. Substitutions shall be allowed per Division 01.

2.04 DIFFERENTIAL PRESSURE SWITCHES (DPS)

- A. General Service - Air: Diaphragm with adjustable setpoint and differential and snap acting Form C contacts rated for the application. Provide manufacturer's recommended static pressure sensing tips and connecting tubing
- B. General Service - Water: Diaphragm with adjustable setpoint, 2 psig or adjustable differential and snap-acting Form C contacts rated for the application. 60 psid minimum pressure differential range; 0°F to 160°F operating temperature range

2.05 PRESSURE SWITCHES (PS)

- A. Diaphragm or bourdon tube with adjustable setpoint and differential and snap-acting Form C contacts rated for the application. Pressure switches shall be capable of withstanding 150% of rated pressure.

2.06 PHASE-VOLTAGE-FREQUENCY MONITOR

- A. Monitoring shall be accomplished using a device capable of directly monitoring voltage (line to line, line to neutral, phase to phase), current (each phase), and instantaneous kW demand or a direct connection to the facility distributed electrical SCADA system via MODBUS TCP.

2.07 CURRENT SWITCHES (CS)

- A. Clamp-On Design Current Operated Switch (for Constant Speed Motor Status Indication)



1. Range: 1.5 to 150 Amps.
 2. Trip Point: Adjustable.
 3. Switch: Solid state, normally open, 1 to 135 VAC or Vdc, 0.3 Amps. Zero off state leakage.
 4. Lower Frequency Limit: 6 Hz.
 5. Trip Indication: LED
 6. Approvals: UL, CSA
 7. Max. Cable Size: 350 MCM
 8. Acceptable Manufacturers: Veris Industries, Senva. Substitutions shall be allowed per Division 01.
- B. Clamp-on Wire Through Current Switch (CS/CR) (for Constant Speed Motors): Same as CS with 24V command relay rated at 5A @ 240 VAC resistive, 3A @ 240 VAC inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable Manufacturers shall be Veris Industries Model # H938/735; or Senva C-2330. Substitutions shall be allowed per Division 01.
1. Where used for single-phase devices, provide the CS/CR in a self-contained unit in housing similar with override switch to Kele RIBX. Substitutions shall be allowed per Division 1.
- C. Clamp-On Design Current Operated Switch for Variable Speed Motor Status Indication
1. Range: 1.5 to 135 Amps.
 2. Trip Point: Self-calibrating based on VA memory associated with frequency to detect loss of belt with subsequent increase of control output to 60 Hz.
 3. Switch: Solid state, normally open, 1 to 135 VAC or VDC, 0.3 Amps. Zero off state leakage.
 4. Frequency Range: 5-75 Hz
 5. Trip Indication: LED
 6. Approvals: UL, CSA
 7. Max. Cable Size: 350 MCM
 8. Acceptable Manufacturers: Senva or Veris Industries. Substitutions shall be allowed per Division 01.
- D. Clamp-On Wire Through Current Switch (CS/CR) (for Variable Speed Motors): Same as CS with 24v command relay rated at 5A @ 240 VAC resistive, 3A @ 240 VAC inductive, load control contact power shall be induced from monitored conductor (minimum conductor current required to energize relay 5A, max. rating of 135A). Acceptable manufacturer shall be Senva or Veris Industries. Substitutions shall be allowed per Division 01.
- E. Variable Speed Status: Where current switches are used to sense the status for variable speed devices, the CT shall include on-board VA/Hz



memory to allow distinction between a belt break and subsequent ramp up to 60 Hz, versus operation at low speed. The belt break scenario shall be indicated as a loss of status and the operation at low speed shall indicate normal status.

2.08 CURRENT TRANSDUCER (CT)

- A. Clamp-On Design Current Transducer (for Motor Current Sensing)
 - 1. Range : 1-10 Amps minimum, 20-200 Amps maximum ; Range shall match application
 - 2. Trip Point: Adjustable
 - 3. Output: 4-20 mA.
 - 4. Accuracy: $\pm 0.2\%$ from 20 to 100 Hz.
 - 5. Acceptable Manufacturers: Senva or Veris. Substitutions shall be allowed per Division 01.

2.09 OUTDOOR AIR STATIC PRESSURE SENSING TIP

- A. Pressure sensor: Pressure sensing tip shall be designed to minimize the effects of wind and resulting velocity pressure up to 80 mph. Acceptable manufacturers shall be Dwyer Instruments, Inc. Substitutions shall be allowed per Division 01.
- B. Low Air Pressure Surge Dampener: 30-second time constant. Acceptable manufacturer shall be Amphenol Advanced Sensors. Substitutions shall be allowed per Division 01.

2.10 LIGHT SENSOR

- A. Units shall be suitable for wall (room) or outdoor mounting. Unit shall be three-wire transmitter. Unit shall produce linear continuous output of 4-20 mA for foot-candle (fc) reading. Sensors shall have the following minimum performance and application criteria:
 - 1. Input Range: 50 – 750 fc.
 - 2. Accuracy: +/- 1%.
 - 3. Operating Voltage: 12 – 24 VDC.
 - 4. Sensor Operating Range: As required by application

2.11 CONTINUOUS LEVEL TRANSMITTERS

- A. Capacitance Type
 - 1. Provide a loop powered, continuous capacitance type level transmitter with adjustable span and zero.
 - 2. Output: 4-20 mA.
 - 3. Probe: Fluoropolymer coated stainless steel rod or cable. Provide cable probe with end attachment hardware or weight.
 - 4. Electrical Enclosure: NEMA 4, 7.



5. Approvals: UL or CSA.
 6. Accuracy: $\pm 1\%$ of calibrated span.
 7. Process Connection: MPT or ANSI Flange as required.
- B. Ultrasonic Type
1. Provide a non-contacting, temperature compensating, narrow beam, ultrasonic type level transmitter with adjustable span and zero.
 2. Output: 4-20 mA.
 3. Transducer Materials: PC/ABS, Polypropylene, PVC and/or Teflon.
 4. Electrical Enclosure: NEMA-4X, Type 6.
 5. Approvals: UL, CE or CSA.
 6. Accuracy: $\pm 0.5\%$ of calibrated span.
 7. Acceptable Manufacturers: Flowline, Johnson Controls, Schneider Electric, and Siemens. Substitutions shall be allowed per Division 01.

2.12 INSERTION TYPE TURBINE METER FOR WATER SERVICE

- A. Turbine Insertion Flow Meter sensing method shall be impedance sensing (iron magnetic and non-photoelectric), with volumetric accuracy of $\pm 2\%$ of reading over middle 80% of operating range, and $\pm 4\%$ of reading over the entire operating range.
- B. Turbine Insertion Flow Meter shall have maximum operating pressure of 400 psi and maximum operating temperature of 200°F continuous (220°F peak).
- C. All wetted metal parts shall be constructed of 316-stainless steel.
- D. Flow meter shall meet or exceed all of the accuracy, head loss, flow limits, pressure and material requirements of the AWWA standard C704-70 for the respective pipe or tube size.
- E. Analog outputs shall consist of non-interactive zero and span adjustments, a DC linearly of 0.1% of span, voltage output of 0-10 V, and current output of 4-20 mA.
 1. Install in water systems with a minimum of 10 pipe diameters unobstructed flow.
 2. Acceptable Manufacturers: Onicon Corp. Substitutions shall be allowed per Division 01.

2.13 ULTRASONIC WATER SERVICE FLOW METER

- A. Clamp-On Ultrasonic Flow Meter: The ultrasonic flow meter shall be a transit-time non-invasive clamp-on type in which transducers clamp on the exterior surface of the pipe. The flow meter shall use Time-Domain Expansion Technology that allows for extremely accurate measurement of upstream and downstream arrival time differentials. The achievable field accuracy shall be 1% of rate or better. The repeatability of the flow meter



shall be 0.5% of rate. The flow meter shall be able to measure bi-directional velocities.

2.14 VORTEX SHEDDING FLOW METER FOR LIQUID AND GAS SERVICE:

- A. Output: 4-20 mA, 0-10 VDC, 0-5 VDC
- B. Maximum Fluid Temperature: 800 °F (427 °C)
- C. Wetted Parts: Stainless Steel
- D. Housing: NEMA 4X
- E. Turndown: 10:1 minimum.
- F. Accuracy: 0.5% of calibrated span for liquids, 1% of calibrated span for gases.
- G. Body: Wafer style or ANSI flanged to match piping specification.
- H. Acceptable Manufacturers: Foxboro 83 series, Onicon, and Rosemount. Substitutions shall be allowed per Division 01.

2.15 AIRFLOW MEASURING STATIONS (AFMS)

- A. Pitot Tube Grids: Provide an array of velocity pressure sensing elements with averaging manifolds and air straightening vanes packaged in a sheet metal casing. Distribute sensing elements in accordance with ASHRAE for traversing ducts. Provide taps to connect tubing from instrumentation. Label AFM with drawing number designation, design flow, velocity pressure, and pressure drop. Application of pitot grids shall be allowed only where minimum expected flow is greater than 30% or maximum flow
- B. Vortex Shedding Grid: Provide an array of vortex shedding elements designed to produce stable vortices that are linear with air velocity. Provide the electronics to totalize the pulses and output average velocity proportional to an output signal of 4-20ma.
 - 1. Sensor Accuracy: $\pm 2\%$
 - 2. Electronics Accuracy: $\pm 0.5\%$
 - 3. Range: Select minimum range to accommodate the expected flow range of the project
 - 4. Temperature Limits: 20-140°F
 - 5. Acceptable Manufacturer: Tek-Air Vortek VT series. Substitutions shall be allowed per Division 01.

2.16 AIR VELOCITY PRESSURE SENSORS (INSERTION TYPE)

- A. Single or Multi-Point Averaging (as indicated): Sensing tip shall be for insertion into duct with mounting flange and push on tube connections. Material shall be suitable to the application.



2.17 CO₂ SENSORS/TRANSMITTERS (CO₂)

- A. CO₂ sensors shall use silicon based, diffusion aspirated, infrared single beam, dual-wavelength sensor.
- B. Accuracy: $\pm 2\%$ full scale to 1400 ppm.
- C. Stability: 5% over 5 years.
- D. Output: 4-20 mA, 0-10 VDC or relay.
- E. Mounting: Duct or Wall as indicated.
 - 1. Acceptable Manufacturer: Johnson Controls, Schneider Electric, Senva, and Siemens. Substitutions shall be allowed per Division 01.

2.18 ELECTRIC CONTROL COMPONENTS

- A. Limit Switches (LS): Limit switches shall be UL listed, SPDT or DPDT type, with adjustable trim arm. Limit switches shall be as manufactured by Square D, Allen Bradley. Substitutions shall be allowed per Division 01.
- B. Low Temperature Detector ('Freezestat') (FZ): Low temperature detector shall consist of a 'cold spot' element which responds only to the lowest temperature along any one foot of entire element, minimum bulb size of 1/8" x 20' (3.2mm x 6.1m), junction box for wiring connections and gasket to prevent air leakage or vibration noise, DPST (4 wire, 2 circuit) with manual reset. Temperature range 15 to 55°F (-9.4 to 12.8°C), factory set at 38°F. Provide one thermostat for every 20 square feet of coil surface.
- C. Surface-Mounted Thermostat: Surface-mounted thermostat shall consist of SPDT contacts, operating temperature range of 50 to 150° F (10 to 65°C), and a minimum 10°F fixed setpoint differential.
- D. Low Voltage Wall Thermostat: Wall-mounted thermostat shall consist of SPDT sealed mercury contacts, operating temperature range of 50 to 90°F (10 to 32°C), switch rating of 24 VAC (30 VAC max.), and both manual and automatic fan operation in both the heat and cool modes.
- E. Control Relays: All control relays shall be UL listed, with contacts rated for the application, and mounted in minimum NEMA-1 enclosure for indoor locations, NEMA-4 for outdoor locations.
 - 1. Control relays for use on electrical systems of 120 volts or less shall have, as a minimum, the following:
 - a) AC coil pull-in voltage range of +10%, -15% or nominal voltage.
 - b) Coil sealed Volt-Amperes (VA) not greater than four (4) VA.
 - c) Silver cadmium Form C (SPDT) contacts in a dustproof enclosure, with 8 or 11 pin type plug.
 - d) LED pilot light indication of power-to-coil and coil retainer clips.
 - e) Coil rated for 50 and 60 Hz service.
 - f) Acceptable Manufacturers: Relays shall be IDEC or Functional Devices RIB. Substitutions shall be allowed per Division 01.



2. Relays used for across-the-line control (start/stop) of 120V motors, 1/4 HP, and 1/3 HP, shall be rated to break minimum 10 Amps inductive load. Relays shall be IDEC or Functional Devices RIB. Substitutions shall be allowed per Division 01.
 3. Relays used for stop/start control shall have low voltage coils (30 VAC or less), and shall be provided with transient and surge suppression devices at the controller interface.
- F. General Purpose Power Contactors: NEMA ICS 2, AC general-purpose magnetic contactor. ANSI/NEMA ICS 6, NEMA type 1 enclosure. Manufacturer shall be Square 'D', Cutler-Hammer or Westinghouse.
- G. Control Transformers: Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be US and CSA listed. Primary and secondary sides shall be fused in accordance with the NEC. Transformer shall be proper size for application not to exceed 100VA, and mounted in minimum NEMA-1 enclosure.
1. Transformers shall be manufactured by Westinghouse, Square 'D', or Jefferson. Substitutions shall be allowed per Division 01.
- H. Time Delay Relays (TDR): TDRs shall be capable of on or off delayed functions, with adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a dustproof enclosure.
1. TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.
 2. TDRs shall be UL and CSA listed.
- I. Electric Push Button Switch: Switch shall be momentary contact, oil tight, push button, with number of N.O. and/or N.C. contacts as required. Contacts shall be snap-action type, and rated for minimum 120 VAC operation.
- J. Pilot Light: Panel-mounted pilot light shall be NEMA ICS 2 oil tight, transformer type, with screw terminals, push-to-test unit, LED type, rated for 120 VAC.
- K. Electric Selector Switch (SS): Switch shall be maintained contact, NEMA ICS 2, oil-tight selector switch with contact arrangement, as required. Contacts shall be rated for minimum 120 VAC operation.
- L. Manual Time Switch: Switch shall be spring wound, manually set time switch for the control of electrical current. Contacts shall be rated for minimum 120 VAC operation.

2.19 REFRIGERANT MONITOR

- A. The refrigerant monitor shall be powered by a 115 V, 60Hz. Emergency Circuit.
- B. The monitor shall be a refrigerant sensitive infrared-based stationary refrigerant gas leak monitor system designed to continuously measure



refrigerants. The Refrigerant monitor system shall be provided to accomplish all sequences and functions described herein. The Refrigerant monitor shall be coordinated to detect refrigerants used in chiller equipment installed under Division 23. The alarm system shall comply with ANSI/ASHRAE 15 and local code requirements.

- C. The refrigerant monitor shall be capable of monitoring multiple refrigerant gas compounds at multiple locations in concentrations of 0 PPM to a minimum of 1000 PPM. The Monitor shall have a low range resolution of 1 PPM in the range of 1 PPM through 100 PPM. Readings above 100 PPM must be accurate to within $\pm 5\%$ of reading. Accuracy shall be maintained within ambient environmental ranges of 0°C through 50°C., (32°F. through 122°F.) and 5% through 90% relative humidity, non-condensing.
- D. Range: 0-300 ppm for R123 or 0-25% (Oxygen Depletion) for R134a.
- E. Controller shall be wall mounted and include audible alarm silence pushbutton.
- F. Provide local audible alarm (100db) and blue strobe alarm light for mounting at each chiller room door exit. At each chiller room entrance, provide a blue strobe alarm light. At chiller room main entrance provide two hand switches, one a hand-off-auto switch to be wired in parallel operation with chiller room ventilation exhaust fan wired to BAS system. Second switch shall be for an emergency shutdown of mechanical equipment in chiller room. Switch shall be wired to BAS and when activated shutdown all equipment in chiller room. Second switch shall be a push to activate with a key to reset switch. Provide a tamper-proof polycarbonate shield over switch to prevent accidental activation. Provide a nameplate on all the devices to clearly identify application.
- G. The refrigerant monitor shall automatically and continuously monitor the areas through a sample draw type tubular pick up system with an internal pump and filter. The installation of the monitoring control and the tubing shall be in strict accordance with the manufactures instructions. The location, routing, and final position of the sample tubes shall be submitted to the engineer with all necessary shop drawings and monitor specifications and installation instructions. Tubing size, tubing material and tube length limitations shall be within the specifications of the monitor manufacture. The location and method of tube support and hangers must be identified on the shop drawings. Each of the sampling tubes shall have end of line filters.
- H. The analyzer will be based on infrared detection technology, and will be factory tested and calibrated for the specified refrigerant or refrigerants. Factory certification of the calibrations shall be provided with the O&M manuals. The analyzer shall provide a menu driven or automatic method of checking both zero, span calibration for each sensor, and allow for adjustment.
- I. The monitor shall be equipped with 4 outputs. Three relays shall energize at an adjustable user defined set point based on refrigerant concentration levels. The relay threshold adjustment shall be protected by keyed or



password access controls. Adjustments and observations shall be made at the front panel operator interface. The relay threshold values can be viewed without a password. The digital display will continuously display the refrigerant concentration level and alarm status. The fourth output shall indicate a monitor malfunction alarm. The monitor shall also have an analog output that will provide a linear scaled reference to the refrigerant concentration in parts per million. The analog output signal shall be an industry standard DC voltage, or mA current signal.

- J. Provide an analog output (0-10 VDC or 4-20 mA) for remote indication to the BAS System.
- K. Provide local readout of each sensor sample in parts per million (PPM).
- L. Each sensor input (channel) shall have independent, user-adjustable high and low alarm set points, with each alarm level driving a relay containing Form C contacts rated for a minimum of 3A at 120 VAC.
- M. The monitor shall have a NEMA-4 moisture resistant enclosure with a sealed, hinged front cover. Conduits and tube connections shall be located on the bottom of the enclosure. The enclosure shall have a rust and corrosion resistant finish.
- N. The following alarm modes will be provided by the refrigerant monitor:
 - 1. ALARM LEVEL ONE – Low level of refrigerant concentration at one of the sampling points has detected the presence of a possible refrigerant leak. The initial alarm threshold shall be set to 5 PPM (adj.) and increased if there are nuisance alarms. This alarm level shall be displayed on the refrigerant monitor interface panel, indicating which sensor has triggered the alarm, and the associated concentration of refrigerant in PPM. This event will also send an Alarm Level One signal to the BAS through a digital output from the monitor relay. This alarm will remain active until the refrigerant concentration is reduced below set point.
 - 2. ALARM LEVEL TWO – This alarm shall indicate that one of the sensors has detected a refrigerant concentration that is approaching dangerous levels in the area being monitored. This alarm shall be set to 25% below the maximum calculated refrigerant level specified in ANSI/ASHRAE 15-1994 and ASHRAE 34-1992. This alarm will be displayed on the monitor interface, and will indicate which of the sensors has caused the alarm, and the highest concentration in PPM. This event will also activate the beacon and audible alarm mounted on the refrigerant monitoring enclosure. This alarm will also be sent to the BAS through the digital output of the relay. In this mode the audible alarm can be silenced, but the beacon shall remain active until the fault is cleared
 - 3. ALARM LEVEL THREE – This alarm shall be set at the maximum calculated refrigerant level specified in ANSI/ASHRAE 15 and ASHRAE 34 whichever is the lowest concentration. The refrigerant monitor interface will display which sensor has caused the alarm, and the associated concentration in PPM. This event will also activate the



beacon and audible alarm mounted on the refrigerant monitoring enclosure. If the audible alarm had been silenced by an earlier alarm, the activation of this level three alarm will cause the audible alarm to be activated again. The relay in the refrigerant monitoring panel shall activate the space ventilation system, and will disable all combustion or flame-producing equipment via hardwired control interlocks. In addition, this event and will de-energize the energy source for any hot surface (850°F or 454°C) located in the space. Interlocks must also be provided to close any normally open doors or openings to the space for proper ventilation and isolation during this alarm condition. This alarm level will also signal the BAS through the digital output through the same relay. In this mode, the audible alarm can be silenced, but the beacon shall remain active until the fault is cleared.

- O. All alarm conditions shall be reported to the BAS system as follows:
 - 1. ALARM LEVEL ONE - The lowest refrigerant alarm level shall detect the presence of refrigerant in low concentrations and energize a relay to signal a low-level alarm to the BAS operator terminal(s). The alarm shall display an alarm message stating that there is a potential refrigerant leak in the designated area.
 - 2. ALARM LEVEL TWO - The second refrigerant level alarm shall be a high refrigerant alarm alert. This alarm shall energize a relay to signal the BAS system indicating a high-level alarm on the BAS operator terminal(s). This BAS alarm shall state that high levels of refrigerant have been detected in the designated area.
 - 3. FAULT ALARM – Reports a high-level alarm to the BAS operator terminal(s) that there is a fault in the refrigerant monitoring alarm system.

2.20 ROOM STATIC PRESSURE MONITOR AND PROBE

- A. Provide flush or wall mounted room pressure monitor with room and reference pressure fittings to a remote pressure transducer with a 1 percent accuracy, 4-20ma analog output with a resolution of 0.001 inch w.c., red and green LEDs to alert operating personnel to the room pressure status and audible alarm horn with local silence button. Locate as shown on contract drawings. Alternates may include more descriptive display screens.
- B. Provide power circuit and control transformer to power each monitor.
- C. Provide factory calibration to NIST procedures with documentation.
- D. Acceptable manufacturers are Johnson Controls, Schneider Electric, Siemens and Setra. Substitutions shall be allowed per Division 01.



- 2.21 CONTROL TRANSFORMERS: UL-listed, class II with 120 VAC primary and 24 VAC secondary. Provide with integral manual reset circuit breaker. Provide in an enclosure.
- 2.22 OXYGEN DEPRIVATION, CARBON DIOXIDE, CARBON MONOXIDE OR NITROGEN DIOXIDE (DIESEL) MONITOR:
- A. General: Wall mounted, polycarbonate enclosure, UL Classified and CSA certified with multi-channel microprocessor-based controller gas monitoring system.
 - B. Provide visual three-digit display of concentration on front of sensor panel. Alarm shall be silenced by pressing button on wall in vicinity of room. Provide a single calibration kit.
 - C. Performance:
 - 1. Sensor Power 17 – 27 Vac, 20 – 38Vdc.
 - 2. Relay Output 1 DPDT relay, 5A @ 250Vac; 5A @ 30Vdc.
 - 3. Accuracy: +/-3% of full scale.
 - 4. Range: as required for application. Review with vendor (By Volume).
 - 5. Sensor Life Two Year minimum.
 - D. Communications: RS485 Modbus; BACnet MS-TP master.
- 2.23 HIGH STATIC PRESSURE SWITCH:
- A. Diaphragm operated to actuate a single pole, double throw, snap action switch.
 - B. Motion of diaphragm shall be restrained by a calibrated spring that can be adjusted to set exact pressure differential at which electrical switch will be actuated.
 - C. Set Point Adjustment: Screw type with set point indicated on a visual scale.
 - D. Select pressure switch range for specific fan application.
 - E. Provide switch with a manual reset function.
- 2.24 UNINTERRUPTIBLE POWER SOURCE
- A. Manufacturer: Eaton 3S 550. Substitutions shall be allowed per Division 01.
 - B. Provide at each stand-alone controller where indicated by control drawings.
 - C. Provide protection from power surges, spikes, blackouts and brownouts.
 - D. Provide immunity from electrical sags, surges, transients, noise, and outages.
 - E. Performance:
 - 1. Output Voltage Regulation: Plus or minus 10 percent.
 - 2. Output Frequency Regulation: 0.1 Hz.
 - 3. Output Overload Capability: 125 percent for 1 second causes shutdown without hardware damage.



4. Transient Suppression: Tested to IEEE 587.
 5. Battery Reserve: 15 minute typical at full load for controllers; 10-15 minutes with a typical PC load for Supervisory Stations.
 6. EMI/RFI: Complies with FCC Part 15J, Class A.
- F. Electrical:
1. Input Voltage: Single Phase, two-wire plus ground.
 2. Input Frequency: 50/60 Hz auto select.
 3. For Supervisory Stations, provide UPS with quantity of outlets for CPU, Monitor, and printers.
- G. Environmental:
1. Operating Temperature: 32 to 95 degrees F
 2. Relative Humidity: 0 to 90 percent non-condensing.
- H. Battery: Internal, sealed, captive electrolyte, non-corrosive, no flammable gases.
- I. Provided contacts for Low Battery and Trouble conditions signal to BAS.
- J. Provide a manual bypass switch permitting scheduled maintenance or UPS replacement without power disruption.

2.25 VICONICS ROOM CONTROLLER

- A. Manufacturer: Viconics Technologies, Inc.
- B. All provided Viconics devices must interface with the BAS through a BACnet/MSTP connection. The connection must allow read/write access to all sensor values and set points.
- C. Provide all hardware and software necessary to backup and restore all Viconic parameters.

PART 3. EXECUTION

3.01 GENERAL:

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the BAS Contractor or Installer.
- B. Refer to Section 25 35 00 for general requirements.

3.02 INSTALLATION OF CONTROL DEVICES:

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings. Install electrical components and use electrical products complying with requirements of National Electric Code and all applicable local codes.
Locate sensors in positions that most accurately represent the sensed medium. Ensure that single point sensors are positioned in a well-mixed medium position. Ensure that flow sensors are located in areas with



- minimal turbulence. Ensure that temperature and humidity sensors are located in a position that is remote from humidifiers and sufficiently downstream to ensure full moisture absorption.
- B. Averaging Temperature Sensors: Cover no more than three square feet per linear foot of sensor length except where indicated. Where flow is sufficiently homogeneous/adequately mixed at sensing location, consult AE for requirements.
 - C. Airflow Measuring Stations: The Contractor is to coordinate the installation with the relevant mechanical duct installer or unit manufacturer according to the AFMS manufacturer's recommendations in an unobstructed straight length of duct (except those installations specifically designed for installation in fan inlet). For installations in fan inlets, provide on both inlets of double inlet fans and provide inlet cone adapter as recommended by AFMS manufacturer.
 - D. Current Switches for Motor Status Monitoring: Adjust so that setpoint is below minimum operating current and above motor no load current.
 - E. Flow Switches: Where possible, install in a straight run of pipe at least 15 diameters in length to minimize false indications.
 - F. Fluid Flow Sensors: The Contractor is to coordinate the installation with the relevant mechanical pipe subcontractor to install per manufacturer's recommendations in an unobstructed straight length of pipe.
 - G. Low Temperature Detectors (Freezestats): Install LTDs in a serpentine fashion where shown on drawing. Provide one foot of element for each square foot of coil face area. Where coil face area exceeds required length of element, provide multiple devices, wired in parallel for normally open close on trip application. Adequately support with coil clips that will not conduct temperature from the mounting surface to the element.
 - H. Phase-Voltage-Frequency Monitor: Contractor shall install with coordination required by the BAS Contractor.
 - I. Pipe Surface Mount Temperature Sensor: Install with thermally conductive paste at pipe contact point. Pipe insulation shall be replaced in kind and adequately joined to existing undisturbed insulation. Maintain vapor barrier and finish to match. These should be temporary applications only, until a well may be installed for proper in flow measurement of temperature.
 - J. Refrigerant Monitors: Install in accordance with the manufacturer's instructions. Place sensing tips in locations to maximize effectiveness. Hard wire interlocks to the emergency ventilation and shutdown of combustion devices.
 - K. Relative Humidity Sensors: Provide element guard as recommended by manufacturer for high velocity installations. For high limit sensors, position remote enough to allow full moisture absorption into the air stream before reaching the sensor.
 - L. Space Temperature Sensors: Sensors shall be located as indicated on drawings.



1. Mount non-adjustable sensors with centerline 60" above finished floor. Sensors with adjustable setpoints and/or override switches must be mounted 48" above finished floor.
 2. Coordinate location of sensor with work of other trades so sensor does not conflict with or is obstructed by such items as blackboards, bleachers, bookcases, etc.
 3. Conceal all control wiring to sensors located in new-finished spaces; the use of wire-mold is prohibited unless specified.
 4. Thermostats located in Bathrooms, Locker Rooms, Common Rooms, Storerooms, and Corridors shall be flush mounted type.
- M. Supply Duct Pressure Transmitters:
1. General: Install pressure tips with at least 4 'round equivalent' duct diameters of straight duct with no takeoffs upstream. Install pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions. Locate the transmitter at an accessible location to facilitate calibration.
 2. VAV System 'Down-Duct' Transmitters: Locate pressure tips approximately 2/3 of the hydraulic distance to the most remote terminal in the air system. AE must approve final location.
- N. Test Ports: Provide test ports in ductwork at each temperature and humidity sensor location to facilitate sensor calibration. Test ports shall be 3/4" diameter minimum and accessible via a 2" x 4" junction box with insulated cover. Provide a test port for all pressure points in pipe work.
- O. Valve Bypass for Differential Pressure Sensors: Provide a five-valve bypass kit for protection of DP sensors where the static pressure on the pipe can potentially over-pressure one port with the other at atmospheric pressure. Kit shall include high and low pressure isolation valves, high and low pressure vent valves (five valve kit) and a bypass valve contained in a NEMA-1 enclosure. Enclosure shall be mounted no higher than 6 feet above floor level.

-END OF SECTION -



25 35 19 CONTROL VALVES

PART 1. GENERAL

1.01 SECTION INCLUDES:

- A. Description of Work
- B. Control Valve Requirements

1.02 RELATED DOCUMENTS:

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.
- B. Section 25 08 00 - Commissioning of Integrated Automation
- C. Section 25 11 33 – Integrated Automation Network Servers
- D. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- E. Section 25 14 13 - Integrated Automation Remote Control Panels
- F. Section 25 5 16 - Integrated Automation Software for Control and Monitoring Networks
- G. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- H. Section 25 35 13 – Integrated Automation Actuators and Operators
- I. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- J. (This Section) Section 25 3519 – Integrated Automation Control Valves
- K. Section 25 35 23 – Integrated Automation Control Dampers
- L. Section 25 55 00 – Integrated Automation Control of HVAC
- M. Section 25 95 00 – Integrated Automation Control Sequences for HVAC

1.03 DESCRIPTION OF WORK:

- A. Furnish and Install DDC instrumentation and control devices required supporting specified building automation system functions as detailed herein and Section 25 35 00.
- B. Refer to Section 25 55 00 for general requirements and definitions.

PART 2. PRODUCTS

2.01 CONTROL VALVES

- A. General:



1. Provide factory fabricated control valves of type, body material and pressure class indicated. Valves shall be two-way or three-way type for two-position or modulating service as scheduled, shown on drawings, or as specified in Sequence of Operations.
- B. Close-Off (differential) Pressure Rating: Valve actuator and trim shall be furnished to provide the following minimum close-off pressure ratings:
 1. Water Valves:
 - a) Two-way - 150% of total system (pump) head.
 - b) Three-way - 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 2. Steam Valves:
 - a) 150% of operating (inlet) pressure
- C. Water Valves:
 1. Body and trim style and materials shall be per manufacturer's recommendations for design conditions and service shown, with equal percentage ports for modulating service, except where stated otherwise.
 2. Sizing Criteria:
 - a) Two-position service: Full port line size.
 - b) Two-way modulating service: Pressure drop across the valve in a wide-open position, with full flow through the valve, shall be equal to 50% of the available pressure differential between the mains, with a minimum of 4 psi.
 - c) Three-way Modulating Service: Pressure drop across the valve in a wide-open position, with full flow through the valve, shall be equal to twice the pressure drop through the heat exchanger (load), with a 3-psi minimum. 3-way valves shall have linear flow characteristics.
 - d) 1-1/2 inch valves and smaller shall have screwed ends. 2 inch and larger shall have flanged ends.
 3. Construction Type:
 - a) Segmented or Characterized Ball Type:
 - 1) Body: Carbon Steel; Seat: Reinforced Teflon (PTFE); Ball: Stainless Steel; Stem: Stainless Steel
 - 2) Port: Segmented design with equal-percentage characteristic
 - 3) Cold Service Pressure: 200 psi WOG
 - 4) Acceptable Manufacturers: Bray, Johnson Controls, Schneider Electric, and Siemens. Substitutions allowed per Division 01.
 - b) Plug-Type Globe Pattern:
 - 1) Body: Bronze, screwed, 250 psi max (1/2" to 2"); Cast Iron, flanged, 125 psi max (2-1/2" and larger)



- 2) Stem: Stainless Steel; Seat: Brass; Plug: Brass, Bronze, or Stainless Steel
 - 3) Acceptable Manufacturers: Bray, Johnson Controls, Schneider Electric, and Siemens. Substitutions allowed per Division 01.
 - c) Butterfly Type:
 - 1) Body: Extended neck epoxy coated cast or ductile iron with full lug pattern; Seat: EPDM; Disc: Bronze or Stainless Steel, pinned or mechanically locked to shaft; Bearings: Bronze or Stainless Steel; Shaft: Stainless Steel
 - 2) Cold Service Pressure: 175 psi
 - 3) Close Off: Bubble-Tight shutoff to 150 psi
 - 4) Acceptable Manufacturers: Bray, Johnson Controls, Schneider Electric, and Siemens. Substitutions allowed per Division 01.
 - d) Ball Type:
 - 1) Body: Brass or Bronze, threaded ends; Seat: Reinforced Teflon; Ball: Stainless Steel; Stem: Stainless Steel
 - 2) Port: Standard or 'V' style
 - 3) Cold Service Pressure: 600 psi WOG
 - 4) Acceptable Manufacturers: Bray, Johnson Controls, Schneider Electric, and Siemens. Substitutions allowed per Division 01.
 4. Water valves shall fail as specified in the Control Sequences.
 5. Evaporative Cooler Drain and Fill Valves:
 - a) Valve normal position shall be as shown on the drawings.
 6. For systems containing fluids other than water, provide documentation that the valve components in contact with the fluid are compatible with it.
- D. Steam Valves:
1. Body and trim materials shall be per manufacturer's recommendations for design conditions and service, except stainless steel seats are required for all applications. Equal percentage ports for modulating service.
 2. Sizing Criteria:
 - a) Two-position Service - pressure drop 10 to 20% of inlet psig.
 - b) Modulating Service - 15 psig or less. Pressure drop 80% of inlet psig.
 - c) Modulating Service - 16 to 50 psig; Pressure drop 50% of inlet psig
 - d) Modulating Service - over 50 psig; Pressure drop as scheduled on plans



3. Steam valves shall fail normally open or closed as scheduled on plans or as follows:
 - a) Low pressure heating - normally open
 - b) Heating coils in air handlers - normally open.
 - c) Steam-to-water converters for heating water - normally closed.
 - d) Steam-to-water converters for domestic hot water - normally closed.
 - e) High-pressure applications - as scheduled

PART 3. EXECUTION

3.01 GENERAL:

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the BAS Contractor or Installer.
- B. Refer to Section 25 5500 for general requirements.

3.02 INSTALLATION OF CONTROL VALVES:

- A. Refer to Section 25 55 00 for general installation requirements for all mechanical, electrical and controls work.
- B. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.
- C. Control Valves: Install so that actuators, wiring, and tubing connections are accessible for maintenance. Where possible, install with valve stem axis vertical, with operator side up. Where vertical stem position is not possible, or would result in poor access, valves may be installed with stem horizontal. Do not install valves with stem below horizontal, or down. Always refer to manufacturer's recommended installation best practices prior to installation.

- END OF SECTION -



25 55 00 CONTROL OF HVAC

PART 1. GENERAL

1.01 SECTION INCLUDES

- A. Related Documents
- B. Approved Control Systems
- C. Contractor Responsibilities
- D. Description of Work
- E. Procurement
- F. BAS Quality Assurance and Performance Parameters
- G. Definitions and Functional Intent
- H. Submittal and Record Document Requirements
- I. System Architecture
- J. Warranty, Storage and Material Handling
- K. Construction Coordination Requirements
- L. Field Workmanship and Quality Control
- M. Wiring and Electrical Requirements
- N. Control Panels/Quantity and Location
- O. Demolition and Reuse of Existing Materials and Equipment
- P. Sequence of Work for Existing Systems Conversions

1.02 RELATED DOCUMENTS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.

The Sections below should be coordinated with other Project Sections

- B. Section 01 91 00 – General Commissioning Requirements
- C. Section 01 91 10 – Functional Test Procedures
- D. Section 25 08 00 - Commissioning of Integrated Automation
- E. Section 25 11 13 – Integrated Automation Network Servers
- F. Section 25 111 6 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- G. Section 25 14 13 - Integrated Automation Remote Control Panels



- H. Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks
- I. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- J. Section 25 35 13 – Integrated Automation Actuators and Operators
- K. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- L. Section 25 35 19 – Integrated Automation Control Valves
- M. Section 25 35 23 – Integrated Automation Control Dampers
- N. (This Section) Section 25 55 00 – Integrated Automation Control of HVAC
- O. Section 25 55 0.13 - Integrated Automation Control of HVAC -Object Naming
- P. Section 25 95 00 – Integrated Automation Control Sequences for HVAC

1.03 PROCUREMENT

- A. The BAS and digital control and communications components installed as work of this contract shall be an integrated distributed processing system of the following manufacturer(s).
- B. The following are approved control system suppliers, manufacturers, and product lines:

SUPPLIER	MANUFACTURER	PRODUCT LINE
Siemens Building Technologies, Inc.	Siemens	APOGEE (w/Desigo CC)

- C. Substitutions (Authorization required from AU Facilities Management's Director of Energy and Engineering on a per project basis): Automated Logic Corporation WebCTRL.

1.04 RESPONSIBILITIES

- A. BAS Contractor shall coordinate, manage and comply with all specifications defined herein to furnish and install a direct digital control Building Automation System (BAS).
- B. All BAS related interconnecting cabling, wiring, conduit, and associated support structures that would normally be installed to support the conduit, cabling, wire and BAS Field Enclosures shall be installed by the BAS Contractor.
- C. All wiring terminations as required to complete the installation of the BAS shall be performed by the BAS Contractor.
- D. The BAS Contractor shall be responsible for the installation of all devices that comprise the BAS system.



- E. The BAS Contractor shall provide all drawings and details to properly wire and terminate the BAS.
- F. The BAS Contractor shall be responsible for the coordination and guidance in all matters BAS related, including all electrical requirements that constitute the manufacturer's recommended installation best practices for a complete and fully operational BAS.
- G. The BAS contractor shall comply with all specifications detailed herein and agree to the management protocols dictated by the project contract documents.
- H. Refer to Division 01 requirements defining commissioning requirements for substantial completion. At a minimum and in coordination with Division 01, provide a letter of substantial completion indicating that all performance verification tests (PVTs) have been completed and the BAS is ready for 3rd party commissioning.
- I. The BAS Contractor shall assist the Owner and Engineer as needed with LEED credit qualification including utility metering trends, IAQ, and outside air delivery monitoring.

1.05 DESCRIPTION OF WORK

- A. The new BAS shall utilize electronic sensing, microprocessor-based digital control, and electronic and pneumatic actuation of dampers and valves as referred to in the sequence of operations to perform control sequences and functions specified. Refer also to control drawings, sequences of operation, and point lists.
- B. The distributed digital control (DDC) and building automation system (BAS) defined in this specification shall interface with an Ethernet network. Contractor shall provide all specified objects and services and have them configured/mapped as applicable.
- C. All control work shall be installed by the BAS contractor, unless specified otherwise. Certain building systems including but not limited to, electrical equipment, plumbing equipment, security systems, mechanical equipment and special systems are equipped with manufacturer furnished controls that must be integrated into the BAS for monitoring and control. All labor, materials, equipment, software, and services necessary for the installation of a complete integrated system shall be provided with the exception as noted in this specification.
- D. The proposed system must be entirely compatible with the existing building BAS. No system, even if supplied by the same manufacturer, may be installed as sole source if gateways or other means are required to interface with the existing system. In the exclusion of sole source, the project will be open bid to vendors with similar interface capabilities.



1.06 QUALITY ASSURANCE AND CONTROL

- A. **Product Line Demonstrated History:** The product line to be installed must comply with the design standards. The product line being proposed for the project must be the most current model and version as defined in the design standard and have an installed history of demonstrated satisfactory operation for a length of [2] years since date of final completion in at least [20] installations of comparative size and complexity. Proposed product lines whose current model and version are more than [4] years old must be pre-approved by the Owner. Documentation of this requirement with references shall be available upon request.
- B. **Installer's Qualifications:** The BAS contractor coordinating this project must demonstrate to the Owner the installing contractor's experience in DDC installation projects with point counts equal to this project and systems of the same complexity as those of this project. Experience starts with awarded Final Completion of previous projects. Documentation of this requirement with references shall be available upon request.
- C. **Installer's Experience with Proposed Product Line:** The BAS contractor coordinating this project must demonstrate specialization in and be experienced with the installation of the proposed product line for not less than [2] years from date of final completion on at least [5] projects of similar size and complexity. Submittals shall document this experience with references.
- D. **Installer's Field Coordinator and Sequence Programmer Qualifications:** Individual(s) shall specialize in and be experienced with control system installation for not less than [3] years. Proposed field coordinator shall have experience with the installation of the proposed product line for not less than 3 projects of similar size and complexity. Installer shall submit the names of the proposed individual and at least one alternate for each duty. Submittals shall document this experience with references. The proposed individuals must show proof of the following training:
 - 1. **Product Line Training:** Individuals overseeing the installation and configuration of the proposed product line must provide evidence of the most advanced training offered by the Manufacturer on that product line for installation and configuration.
 - 2. **Programming Training:** Individuals involved with programming the site-specific sequences shall provide evidence of the most advanced programming training offered by the vendor of the programming application offered by the Manufacturer.
- E. **Installer's Service Qualifications:** The installer must be experienced in control system operation, maintenance and service. Installer must document a minimum 5-year history of servicing installations of similar size and complexity. Installer must also document at least a one-year history of servicing the proposed product line.
- F. **Installer's Response Time and Proximity**



1. Installer must maintain a fully capable service facility within an 80-mile radius of the project site. Service facility shall manage the emergency service dispatches and maintain the inventory of spare parts.
 2. Emergency response times are listed below in this section. Installer must demonstrate the ability to meet the response times.
- G. Installer's Quality Assurance Plan
1. Installer must provide a description of their quality assurance operations from contract award through final delivery. The description shall include organizational responsibilities for each department represented within the execution of this document from installers to engineers, service technicians and management.
- H. Performance Parameters: The communication speed between the controllers, LAN interface devices, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall reconfigure LAN and programming as necessary to accomplish these performance requirements (see Integrated Automation Software for Control and Monitoring Networks Section for alarm definitions):
1. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.
 2. 10 seconds between a Level 2 alarm occurrence and enunciation at operator workstation.
 3. 20 seconds between and a Level 3-5 alarm occurrence and enunciation at operator workstation.
 4. 3 seconds between an operator command via an operator interface to change a setpoint and the subsequent change in the controller.
 5. 3 seconds between an operator command via an operator interface to start/stop a device and the subsequent command to be received at the controller.
 6. 10 seconds between a change of value or state of an input and it being updated on an operator interface.
 7. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least 10 points.
 8. 2 seconds for any point being used across the LAN for control between 2 Field Panels at any level of the architecture.
 9. Programmable Controllers: Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
 10. Multiple Alarm Annunciations: Each workstation on the network shall receive alarms within 5 sec of other workstations.



11. Reporting Accuracy: System shall report values with minimum end-to-end accuracy listed in Table 1.
12. Control Stability and Accuracy: Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	±0.15°C (±0.25°F)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm

- Note 1: Accuracy applies to 10% - 100% of scale
 Note 2: For both absolute and differential pressure
 Note 3: Not including utility-supplied meters



Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.)	50 Pa -1.5 kPa (0.2-6 in. w.g.)
	±0.25% of Full Scale (Devices for Setpoint Control BSL and LAB)	±63 Pa around setpoint (±0.25 in. w.g.)
	±50 Pa (±0.2 in. w.g.)	-1.5 kPa - -50 Pa (-6.0 to -0.2 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±2.0°F)	
Humidity	±5% RH(Office) ±2% RH(Lab,BSL)	
Fluid Pressure	±10 kPa (±1.5 psi)	MPa (1-150 psi)
	±250 Pa (±1.0 in. w.g.)	0-12.5 kPa (0-50 in. w.g.) differential

The following codes and standards must be updated and edited to suit the project by the A/E.

1.07 CODES AND STANDARDS

- A. Work, materials, and equipment shall comply with the most restrictive of local, state, and federal authorities' codes and ordinances or these plans and specifications. As a minimum, the installation shall comply with current editions in effect 30 days prior to receipt of bids of the following codes:
 - 1. National Electric Code (NEC)
 - 2. International Mechanical Code (IMC)
 - 3. International Building Code (IBC)
 - a. Section 719 Ducts and Air Transfer Openings
 - b. Section 907 Fire Alarm and Detection Systems
 - c. Section 909 Smoke Control Systems
 - d. Chapter 28 Mechanical
- B. The following codes and standards apply to this and all related Sections.
- C. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)



1. ANSI/ASHRAE Standard 135-2008 BACnet - A Data Communication Protocol for Building Automation and Control Networks
- D. Electronics Industries Alliance
1. EIA-709.1-B-2002: Control Network Protocol Specification
 2. EIA-709.3-99: Free-Topology Twisted-Pair Channel Specification
 3. EIA-232: Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 4. EIA-458: Standard Optical Fiber Material Classes and Preferred Sizes
 5. EIA-485: Standard for Electrical Characteristics of Generator and Receivers for use in Balanced Digital Multipoint Systems.
 6. EIA-472: General and Sectional Specifications for Fiber Optic Cable
 7. EIA-475: Generic and Sectional Specifications for Fiber Optic Connectors and all Sectional Specifications
 8. EIA-573: Generic and Sectional Specifications for Field Portable Polishing Device for Preparation Optical Fiber and all Sectional Specifications
 9. EIA-590: Standard for Physical Location and Protection of Below-Ground Fiber Optic Cable Plant and all Sectional Specifications
- E. Underwriters Laboratories
1. UL 916: Energy Management Systems.
 2. UUKL 864: UL Supervised Smoke Control
- F. NEMA Compliance
1. NEMA 250: Enclosure for Electrical Equipment
 2. NEMA ICS 1: General Standards for Industrial Controls.
- G. NFPA Compliance
1. NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
 2. NFPA 70 National Electrical Code (NEC)
 3. NFPA 72 National Fire Alarm and Signaling Code
- H. Institute of Electrical and Electronics Engineers (IEEE)
1. IEEE 142: Recommended Practice for Grounding of Industrial and Commercial Power Systems
 2. IEEE 802.3: CSMA/CD (Ethernet – Based) LAN
 3. IEEE 802.4: Token Bus Working Group (ARCNET – Based) LAN

1.08 DEFINITIONS

- A. Accuracy: Accuracy shall include combined effects of nonlinearity, non-repeatability and hysteresis. See other Division 25 Sections for details specific to devices and applications.



- B. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application specific applications.
- C. American University (AU): Owner of all facilities and systems.
- D. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).
- E. Application Specific Controller (ASC): A device with limited resources relative to the Advanced Application Controller (AAC). It may support a level of programming and may also be intended for application-specific applications. .
- F. BAS Contractor: Contractor responsible for the installation, programming, commissioning, training, and warranty service of the new building automation system.
- G. Binding: In the general sense, binding refers to the associations or mappings of the sources network variable and their intended or required destinations.
- H. Building Automation System (BAS): The entire integrated management and control system
- I. Building Controller (BC): A fully programmable device capable of carrying out a number of tasks including control and monitoring via direct digital control (DDC) of specific systems, acting as a communications router between the LAN backbone and sub-LANs, and data storage for trend information, time schedules, and alarm data.
- J. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount (ASHRAE/ANSI 135-2010).
- K. Client: A device that is the requestor of services from a server. A client device makes requests of and receives responses from a server device.
- L. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).
- M. Contractor: Within this specification, all references to “Contractor” shall mean the contractor that holds the construction contract that incorporates the BAS. This contractor would normally be called the General Contractor, or Construction Management contractor, but ultimately, it is the contractor that is responsible for and owns the construction contract.
- N. Controller or Control Unit (CU): Intelligent stand-alone control panel. Controller is a generic reference and shall include BCs, AACs, and ASCs as appropriate.



- O. Control Systems Server (CSS): This shall be a computer (or computers) that maintain the systems configuration and programming database. This may double as an operator workstation.
- P. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic.
- Q. Ethernet: Reference to the campus Information Technology network, used for normal business-related e-mail and Internet communication. IEEE 802.3 based network connecting multiple facilities with a central data warehouse and server, accessible via standard web-browser or client installed software.
- R. Functional Profile: A collection of variables required to define the key parameters for a standard application. As this applies to the HVAC industry, this would include applications like VAV terminal, fan coil units, and the like.
- S. Gateway (GTWY): A device, which contains two or more dissimilar networks/protocols, permitting information exchange between them (ASHRAE/ANSI 135-2008).
- T. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.
- U. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the BAS
- V. Local Area Network (LAN): General term for a network segment within the architecture. Various types and functions of LANs are defined herein.
- W. Local Supervisory LAN: Ethernet-based LAN connecting Primary Controller LANs with each other and OWSs and CSSs. See System Architecture below. This LAN can function as the Primary Controlling LAN.
- X. Master-Slave/Token Passing (MS/TP): Data link protocol as defined by the BACnet standard. (ASHRAE/ANSI 135-2010).
- Y. Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database developed. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.
- Z. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.
- AA. Operator Workstation (OWS): The user's interface with the BAS system. As the BAS network devices are stand-alone, the OWS is not required for communications to occur.
- BB. Point-to-Point (PTP): Serial communication as defined in the BACnet standard.



- CC. Portable Operators Terminal (POT): Laptop PC used both for direct connection to a controller and for remote dial up connection.
- DD. Primary Controlling LAN: High speed, peer-to-peer controller LAN connecting BCs and optionally AACs and ASCs. Refer to System Architecture below.
- EE. Router: A device that connects two or more networks at the network layer.
- FF. Secondary Controlling LAN: Subordinate LAN connecting AACs and ASCs to the Primary Controlling LAN. Refer to System Architecture below.
- GG. Server: A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.
- HH. SQL: Standardized Query Language, a standardized means for requesting information from a database.
- II. Smart Device (SD): A control I/O device such as a sensor or actuator that can directly communicate with the controller network to which it is connected. This differs from an ASC in that it typically deals only with one variable.

1.09 FUNCTIONAL INTENT

- A. Throughout Division 25 detailed requirements are specified, some of which indicate a means, method or configuration acceptable to meet that requirement. Contractor may submit products that utilize alternate means, methods, and configurations that meet the functional intent in coordination with the BAS contractor. However, the Owner will only allow these with prior approval.
- B. The BAS Contractor shall submit an Exception List with their bid to include any alternative products or product configurations and any items for which the BAS Contractor cannot explicitly confirm to a requirement of this specification. The listing shall be indexed to match the structure of these specifications. The list shall include the section, part, item, and subparagraph number, of the specification requirement to which the exception is taken. A description of the alternate method of meeting the functional intent shall be provided.

1.10 SUBMITTALS

- A. Design engineer shall concurrently review all submittals along with the Owner's Engineering/IT/Facilities Departments and incorporate all comments into a final review document. All submittals shall comply with all Cx requirements as detailed in Division 01 and each relevant Division's commissioning section.
- B. Electronic Submittals: Control submittals and O&M information shall be provided electronically in Adobe PDF format. Control drawings shall be electronically provided in Adobe PDF and AutoCAD (format to match current Owner standard) in a size no less than 11"x17". Documents will be



developed in a preferred format or converted from their native electronic format directly to a preferred format. Any documents scanned as images must be converted to a searchable text format using OCR (Optical Character Recognition) and reduced in size prior to submission. O&M manual shall include electronic versions of the project Mechanical and Electrical design drawings.

- C. Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate item above. Include QA/QC plan for all phases (design, install, commission, warranty) along with documentation of industry standard QA/QC practices followed.
- D. Product Data: Submit manufacturer's technical product data for each control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics including compliance with grounding and power conditioning requirements, and material finishes. Also include installation and start-up instructions.
- E. Shop Drawings: Submit shop drawings for each control system, including a complete drawing for each air handling unit, system, pump, device, etc. with all point descriptors, addresses and point names indicated. Each shop drawing shall be provided in Adobe PDF and AutoCAD format and contain the following indexes:
 - 1. System Architecture, System Layout, Risers:
 - a) One-line diagram indicating schematic locations of all control units, workstations, LAN interface devices, gateways, etc. Indicate network number, device ID, drawing reference number, and controller type for each control unit. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the diagram. Indicate relevant communication protocol on each network segment.
 - b) Indicate device instance and MAC address for each CU. Indicate media, protocol, baud rate, and type of each LAN.
 - c) Provide floor plans locating all control units, LAN interface devices, gateways, etc. Include all WAN and LAN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Wiring routing as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately reflect accurate, actual installed conditions.
 - d) Indicate network number, device ID, address, MAC address, drawing reference number, and controller type for each control unit. Indicate media, protocol, baud rate, and type of each LAN. All optical isolators, repeaters, end-of-line resistors, junctions, ground locations etc. shall be located on the floor plans.
 - e) For renovation projects, the system diagram shall clearly show all new and modified connections to existing networks and controllers.



2. PI&D Schematic flow diagram of each air and water system showing fans, coils, dampers, valves, pumps, heat exchange equipment and control devices. Include narrative description of sequence of operation, as it will be applied by the proposed control system (providing verbatim copy of contract documents is not acceptable). Indicate which items will be installed by others. Where applicable, provide a diagram for factory-controlled equipment detailing the BAS interface.
3. All physical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses identified as listed in the point summary table.
4. With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). See Section 25 55 00 - Part 3 for additional requirements.
5. Label each control device with set point and range of adjustable control.
6. Label each controller input and output with the appropriate range.
7. Label each control device with the relevant detail drawing number.
8. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
9. Provide a Control Valve Schedule listing valve and actuator information including: size, C_v , design flow, design pressure drop, manufacturer, model number, close off rating, control signal, line size, line pressure, ANSI class rating, tag number, system service, valve type, material construction of body, stem, disc, etc. Indicate normal positions of automatic return valves.
10. Provide a Control Damper Schedule listing damper and actuator information including: size, material, blade arrangement, manufacturer, model number, control signal, close off rating, etc. Indicate normal positions of automatic return dampers.
11. Provide an Air Flow Monitoring Station Schedule listing the following information: size, material, manufacturer, model number, control signal, CFM, velocity, etc.
12. Provide a Metering Device Schedule listing the following information: Flow range, fluid type, mechanical input type (magnetic, wheel, ultrasonic), Manufacturer, Model, Purpose, Location.
13. Indicate all required electrical wiring. Electrical wiring diagrams shall include both ladder logic type diagram for motor starter, control, and safety circuits and detailed digital interface panel point termination diagrams with all wire numbers and terminal block numbers identified. Provide panel termination drawings on separate drawings. Clearly



differentiate between portions of wiring which are existing, factory-installed and portions to be field-installed.

14. Provide details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations and allocated service clearances. Provide panel layout drawing including power supply, control unit(s) and wiring terminals.
 15. Sheets shall be consecutively numbered.
 16. Each sheet shall have a title indicating the type of information included and the system controlled.
 17. A Table of Contents shall list sheet titles and sheet numbers followed by a symbol legend and list of abbreviations.
 18. BACnet Protocol Implementation Conformance Statement (PICS) for each submitted type of controller and operator interface.
- F. Control Logic Documentation
1. Submit control logic program listings to document the control software of all control units.
 2. Include written description of each control sequence.
 3. Include a test plan for each unique control program. The test program must mirror the control program.
- G. Operation and Maintenance Materials:
1. Submit documents under provisions of Division 01. Documents shall be provided electronically as described for electronic submittals.
 2. Submit maintenance instructions and spare parts lists for each type of control device, control unit, and accessory.
 3. Include all submittals (product data, shop drawings, control logic documentation, hardware manuals, software manuals, installation guides or manuals, maintenance instructions and spare parts lists) in maintenance manual; in accordance with requirements of Division 01. Only include sections for equipment and software used on this project. Do not provide entire catalog of product data with extraneous information, cross out or draw a single line thru non-related data.
 4. Submit BAS User's Guides (Operating Manuals) for each controller type and for all workstation hardware and software and workstation peripherals.
 5. Submit BAS advanced Programming Manuals for each controller type and for all workstation software.
- H. Training Materials
1. Provide course outline and materials for each class at least six weeks before first class. Training shall be furnished via instructor-led sessions, computer-based training, or web-based training. BAS Engineer will



modify course outlines to match installed project. Provide a minimum of 4 copies of training materials and one electronic copy.

- I. Schedule
 1. Schedule of work provided within one month of contract award, indicating;
 - a) Intended sequence of work items
 - b) Start date of each work item
 - c) Duration of each work item
 - d) Planned delivery dates for ordered material and equipment and expected lead times
 - e) Milestones indicating possible restraints on work by other trades or situations
 2. Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.
- J. Panel Control Drawings

Provide laminated control drawings within each control panel for the CUs and devices controlled from that panel. System control schematics shall be mounted adjacent to key pieces of equipment for that system. Panel termination drawings shall be mounted in or adjacent to respective panels.
- K. System Conversion Planning
 1. Submit schedule of work with respect to equipment outages and/or occupancy/work schedules.
 2. Provide details of control panels, including controls and instruments impacted. Provide scale panel layout drawing including power supply, control unit(s) and wiring terminals impacted.
 3. Provide details of additional power source connections required beyond those provided in existing system.
- L. Controls contractor shall provide Owner with all product line technical manuals and technical bulletins, to include new and upgraded products, by the same distribution channel as to dealers or branches throughout the warranty period of the project.
- M. Manufacturers Certificates: For all listed and/or labeled products, provide certificate of conformance.
- N. Product Warranty Certificates: Coordinate and submit manufacturers product warranty certificates covering the hardware provided once approved by the Owner. Provide a written one-year guarantee showing the starting and ending dates as noted in Division 01. List the local offices and the representatives to perform routine and emergency maintenance on system components.



- O. Re-Submittals: Include cover letter that specifically responds to all previous submittal comments and explains how they are addressed in the current re-submittal.

1.11 PROJECT RECORD DOCUMENTS

- A. Submit documents under provisions of Division 01 Closeout Procedures. Documentation shall be provided electronically as defined for electronic submittals.
- B. As-Built copies of product data and control shop drawings updated to reflect the final installed condition.
- C. As-Built copies of approved control logic programming and database uploaded and stored on the project BAS server. Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of shop drawings and including changes to programs made during specified testing.
- D. As-Built copies of approved project specific graphic software stored on the Owner's BAS server.
- E. As-Built copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring.
- F. As-Built copies shall include the final riser diagram showing the location of all controllers.
- G. As-Built copies shall include ALL control drawings revision history to reflect the As-Built date. No drawing, Document nor database shall be provided without the final As-Built revision date and comment attached.
- H. All As-Built documents shall be provided electronically and copied to the BAS CSS. Links to this documentation shall be provided on each equipment graphic for access to the as-built shop drawings, point lists, and sequences of operation.
- I. Confirm AU BAS Supervisor is able to access all record documentation once uploaded to CSS.

1.12 SYSTEM ARCHITECTURE

- A. The system provided shall incorporate hardware resources sufficient to meet the functional requirements of this project. The Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these contract documents.
- B. The system shall be configured as a distributed processing network(s) capable of expansion.



- C. The system architecture shall consist of an Ethernet-based, wide area network (WAN), a single Local Area Network (LAN) or multi-levelled LANs that support BCs, AACs, ASCs, Operator Workstations (OWS), Smart Devices (SD), and Remote Communication Devices (RCDs) as applicable. The BAS network shall be able to seamlessly communicate using the standard protocols, MODBUS and BACnet, at all network levels. The following is a functional description of the BAS structure.
1. WAN: Internet-based network connecting multiple facilities with a central data warehouse and server, accessible via standard web-browser. This is an existing infrastructure and contractor is not required to configure any components of this WAN. Refer to Section 25 11 16 for requirements.
 2. Local Supervisory LAN: The Local Supervisory LAN is an extension of the WAN. Contractor will be provided specific ports dedicated for control module/interface device connectivity. The LAN is IEEE 802.3 compliant with switches and routers that support 100 Mbps minimum throughput. Contractor may not extend this network without prior approval from the Owner. Power-line carrier communication shall not be acceptable for communications.
 - a) The Contractor is responsible for the installation of a temporary Ethernet network that will serve the purpose of the Local Supervisory LAN until such time as the permanent Local Supervisory LAN is available. Should the temporary network be required, the BAS Contractor is responsible for the coordination and implementation of the Local Supervisory LAN to conform to the eventual permanent LAN's settings and addresses for the BAS.
 3. Primary Controller LAN ('Primary LAN'): High-speed, peer-to-peer communicating LAN used to connect Building Controllers (BCs) and communicate control information. Acceptable technologies are:
 - a) Ethernet (IEEE802.3)
 - b) ARCNET (IEEE802.4)
 4. Secondary Controller LAN ('Secondary LAN'): Network used to connect AACs, ASCs or SDs. These can be BACnet MS/TP or MODBUS, in addition to those allowed for Primary Controller LANs. Network speed versus the number of controllers on the LAN shall be dictated by the response time and trending requirements (see the Integrated Automation Remote Control Panels Section).
- D. Dynamic Data Access: Any data throughout any level of the network shall be available to and accessible by all other devices, Controllers and OWS, whether directly connected or connected remotely.



- E. Remote BAS Access: Coordinate remote access connectivity with the Owner. The system shall support the following methods of remote access to the building data.
 - 1. Browser-based access: A remote user using a standard browser shall be able to access all control system facilities and graphics with proper password. BAS contractor shall coordinate the required server side internet connection with the Owner. The following is acceptable for browser-based access:
 - a) Native browser-based user interfaces that do not require browser extension. The user interface must be compatible with the most current stable version of the supporting software without requiring the user to downgrade to a lesser version.
- F. Communication Interruptions: Interruptions or fault at any point on any Primary Controller LAN shall not interrupt communications between other nodes on the network. If a LAN is severed, separate networks shall be formed and communications within each network shall continue uninterrupted.
- G. Communication Devices: All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication (see also Network Bandwidth Management).
- H. Control Systems Server (CSS): The CSS is a virtual machine that maintains the systems configuration, programming database, and historical trend data. The BAS software shall be platform independent and capable of residing on Owner's specific operating system with virtualization software.

It shall hold backup files of information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers. It shall also act as a control information server to non-control system based programs. It shall allow secure multiple-user access to the control information. Refer to Section 25 1113 – Integrated Automation Network Servers for its requirements.

 - 1. Operator Interfaces shall provide for overall system supervision, graphical user interface, management report generation, alarm annunciation, and remote monitoring. Refer to Section 25 1113 – Integrated Automation Network Servers.
 - 2. During construction and prior to acceptance by the Owner new BAS projects will reside on their respective QA (Quality Assurance) server. This server operates separately from the primary CSS to prevent construction phase work from impacting existing systems. The CSS QA will be configured to match the primary CSS capability and allow testing of all CSS functions including historical trending and alarm reporting.
- I. Field Panel Independence: The BCs, AACs, ASCs, and SDs shall monitor, control, and provide the field interface for all points specified. Each BC,



AAC, or ASC shall be capable of performing all specified energy management functions, and all DDC functions, independent of other BCs, AACs, or ASCs and operator interface devices as more fully specified in Section 25 1413 - Integrated Automation Remote Control Panels.

- J. Touch Screen Kiosk: A single touch screen interface (Eco-Screen Sustainability Kiosk; other) showing general building conditions and utility usage shall be installed as shown on the contract documents. This interface will provide all capabilities of an OWS excluding modification of any parameters, schedules, programming, graphics or access to the underlying operating system.

1.13 WARRANTY MAINTENANCE

- A. All references in this Article 1.14, to the term 'Contractor' shall mean both the BAS Contractor and contractors providing installation services.
- B. Contractor shall warrant all BAS products and labor for a period of two years after substantial completion as defined in Division 01.
- C. The Owner reserves the right to make changes to the BAS during the warranty period. Such changes do not constitute a waiver of warranty. The Contractor shall warrant parts and installation work regardless of any such changes made by the owner, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the BAS. Any disagreement between the Owner and the Contractor on such matters shall be subject to resolution through the contract 'Disputes' clause.
- D. Maintenance Services: During the warranty period, the Contractor shall provide maintenance services for software and hardware components as specified below, at no additional cost. The AU BAS department will be the Owner's authorized representative for all service requests:
 - 1. Maintenance services shall be provided for all devices and hardware specified in Division 25 and supplied by the BAS Contractor. Service all equipment per the manufacturer's recommendations. All devices shall be calibrated within the last month of the warranty period. An update to the points Information Block detail of the points definition in the CSS shall be added indicating the date of calibration and initials of the technician performing calibration.
 - 2. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in patient impact, property damage or loss of comfort control shall be corrected and repaired following notification by the Owner to the Contractor.
 - a) Response by telephone to any request for service shall be provided within one hour of the Owner's initial telephone request for service.



- b) In the event that the malfunction, failure, or defect is not corrected through telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the Owner's site within two hours of the initial telephone request for such services, as specified.
 3. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of comfort control shall be corrected and repaired following telephonic notification by the Owner to the Contractor.
 - a) Response by telephone to any request for service shall be provided within two working hours (contractor specified 40 hours per week normal working period) of the Owner's initial telephone request for service.
 - b) In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the Owner's site within two working days of the initial telephone request for such services, as specified.
 4. Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers to call in the event of a need for service. At least one of the lines shall be attended at any given time. Once contacted, a technician shall respond to calls within 15 minutes.
 5. Technical Support: Contractor shall provide technical support by telephone throughout the warranty period.
 6. Preventive Maintenance: Preventive maintenance shall be provided throughout the warranty period in accordance with the hardware component manufacturer's requirements.
 7. Product Updates: Provide updates to operator workstation or web server software, project-specific software, graphic software, database software, and firmware that resolve Contractor-identified software deficiencies at no charge during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Owner's written authorization

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials indoors, within manufacturer's specified environmental conditions and protect from construction work, weather and theft.



1.15 LISTING AND LABELING

- A. The BAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.
- B. Portions of the BAS utilized for fire/smoke management, stairwell pressurization controls and monitoring shall be listed by Underwriters Laboratories (UUKL 864).

1.16 OWNERSHIP OF PROPRIETARY MATERIAL

- A. Project specific software and documentation shall become the Owner's property. This includes, and is not limited to:
 - 1. System database structure project files.
 - 2. System custom code project files.
 - 3. System graphic project files.
 - 4. Record Drawings of all file types, including the Design File Format of all project drawings.
 - 5. Documentation

PART 2. PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. Materials shall be new, the best of their respective kinds without imperfections or blemishes and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where drawings or specifications specifically allow existing materials to remain in place or be reinstalled.
- B. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.02 UNIFORMITY

- A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same OEM manufacturer.

2.03 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Section 25 35 16 - Integrated Automation Sensors and Transmitters
 - 1. Airflow measuring stations
 - 2. Flow meters
 - 3. Flow switches
 - 4. Pressure sensor wells and sockets
 - 5. Temperature sensor wells and sockets
- B. Section 25 3519 - Integrated Automation Control Valves
 - 1. Control Valves



- C. Section 25 3513 - Integrated Automation Control Dampers
 - 1. BAS Automated Dampers
- D. Division 23: HVAC Equipment
 - 1. Air Terminal Units; VAV and CAV terminal Controls
 - 2. AHU, Heating, Ventilation Unit Controls
 - 3. Unitary, Convection, and Radiant Unit Equipment Controls and Humidifier Controls

2.04 PRODUCTS NOT FURNISHED NOR INSTALLED BUT INTEGRATED WITH WORK OF THIS SECTION

- A. Coordination Meetings: The Contractor shall coordinate meetings between the BAS Contractor and the Installers(s) furnishing each of the following products to coordinate the details of the interface between these products and the DDC network. The Owner or his representative shall be present at every coordination meeting. Submittals for these products shall not be approved prior to the completion of this meeting. Any issues identified during these meetings must also be resolved satisfactorily and with agreement between the BAS Contractor and the Installer(s) prior to the submittal being approved. Each Installer shall provide the Owner and BAS Contractor and all other Installers with the details of the proposed interface including the following;
 - 1. BACnet PICS
 - 2. Point List
 - 3. Wiring Requirements
 - 4. Communication Specifications for speed, type etc.
 - 5. Required Network Accessories
 - 6. (3) Past Examples of Integration to the proposed BAS at the Field Panel (BC) communication Level of the Architecture.
 - 7. Network Identifiers
- B. Heating Boilers
 - 1. Boiler Controls: The boiler vendor shall furnish boilers with an interface to the control and monitoring points specified in Section 25 95 00. These specified points shall be the minimum acceptable interface to the boiler. The connection to these points shall be of the following methods determined during the coordination meetings:
 - a) Hardwired connection such as relay, 0-10VDC, or 4-20mA
 - b) BACnet/IP network connection
 - c) MODBUS network connection.
 - d) BACnet MS/TP network connection
- C. Central Cooling Equipment



1. Chiller Controls: The chiller vendor shall furnish chillers with an interface to the control and monitoring points specified in Section 25 95 00. These specified points shall be the minimum acceptable interface to the chiller. The connection to these points shall be of the following methods determined during the coordination meetings:
 - a) Hardwired connection such as relay, 0-10VDC, or 4-20mA
 - b) BACnet/IP network connection
 - c) BACnet MS/TP network connection
- D. Central HVAC Equipment-Customized AHU
 1. Packaged AHU or Evaporative Cooler Controls: Unit shall be furnished configured to accept control inputs from an external building automation system controller as specified in Section 25 95 00. Factory mounted safeties and other controls shall not interfere with this controller.
- E. Decentralized HVAC Equipment
 1. Unit Ventilators, Unit Heaters, Fan Coils, etc.: Unit ventilators, unit heaters, fan coils, cabinet heaters, convective or fin tube heaters, zone reheat, and similar terminal units. These units shall be furnished configured to accept control inputs from an external building automation system controller as specified in Section 25 95 00. Factory mounted safeties and other controls shall not interfere with this controller.
- F. Variable Frequency Drives
 1. Variable Frequency Drives: The variable frequency drive (VFD) vendor shall furnish all VFDs with an interface to the control and monitoring points specified in Section 25 95 00. These specified points shall be the minimum acceptable interface to the VFD. The connection to these points shall be of the following methods determined during the coordination meetings:
 - a) Hardwired connection such as relay, 0-10VDC, or 4-20mA
 - b) BACnet/IP network connection
 - c) BACnet MS/TP network connection
- G. Communications with Third Party Equipment:
 1. Any additional integral control systems included with the products integrated with the work of this section shall be furnished with a BACnet/IP interface for integration into the Direct Digital Control system described in this section.

PART 3. EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Installer.



- B. Inspect site to verify that equipment can be installed as shown. Report discrepancies, conflicts, or omissions to Engineer for resolution before starting rough-in work.
- C. Examine drawings and specifications for work of others. Report inadequate headroom or space conditions or other discrepancies to Engineer and obtain written instructions for changes necessary to accommodate Section 25 55 00 work with work of others. Controls Contractor shall perform at his expense necessary changes in specified work caused by failure or neglect to report discrepancies.

3.02 PROTECTION

- A. BAS Contractor shall protect against and be liable for damage to work and to material caused by the BAS Contractor's work or employees.
- B. Contractor shall be responsible for work and equipment until inspected, tested, and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects. Prevent any item or equipment from theft while on the site for the duration of the project.

3.03 CONSTRUCTION COORDINATION

- A. Site and Schedule Coordination:
 - 1. Contractor shall assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
 - 2. Contractor shall coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
 - 3. Contractor shall integrate all facets of the BAS installation into the project construction schedule.
 - 4. Contractor shall coordinate schedule updates and changes with the BAS Contractor.
- B. Test and Balance:
 - 1. BAS Contractor Support:
 - a) The BAS Contractor shall provide the Test and Balance Contractor a single set of tools necessary to interface with the control system for testing and balancing.
 - b) The BAS Contractor shall train the Test and Balance Contractor to use control system interface tools.
 - c) The BAS Contractor shall provide a qualified technician to assist with testing and balancing the first 10 terminal units.



2. The Test and Balance Contractor shall return tools undamaged and in working condition at completion of testing and balancing.
- C. Electrical Coordination:
1. The BAS Contractor shall coordinate all facets of the BAS installation.
 2. The BAS Contractor shall validate the accuracy, fit and finish of all installed BAS Electrical work results in comparison to the BAS Design documents, during the course of the project.
- D. Third Party Coordination:
1. The BAS Contractor shall be the systems integrator for all third party control systems that must interface with the BAS.
 2. Each supplier shall comply with the communication media, software and equipment as specified in Section 25 5500.
 3. Each supplier of a controls product shall configure, program, start up, and test that product to meet the sequences of operation regardless of where within the contract documents those products are described.
 4. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
 5. BAS Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the contract documents.

3.04 GENERAL WORKMANSHIP

- A. Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings and within the Owner's Design Standard.
- B. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- C. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility
- F. Refer to additional requirements in other sections of this specification.

3.05 FIELD QUALITY CONTROL

- A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances as identified in the Section Codes and Standards.



- B. Continually monitor field installation for code compliance and workmanship quality.
- C. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work as required.

3.06 WIRING

- A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of the BAS specification differ from Division 26, provide written notification to A/E of discrepancy and request direction.
- B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.
- C. Low-voltage wiring shall meet NEC Class 2 requirements. Sub-fuse low-voltage power circuits as required to meet Class 2 current limit.
- D. Limit connected loads to 80% of rated capacity.
- E. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- F. Install wiring in raceway where subject to mechanical damage and at levels below 3 m (10ft) in mechanical, electrical, or service rooms.
- G. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- H. Do not install wiring in raceway containing tubing.
- I. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 3 m (10 ft) intervals.
- J. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- K. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- L. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- M. Include one pull string in each raceway 1.8 cm (3/4 in.) or larger.
- N. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.



- O. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 in.) between raceway and high-temperature equipment such as steam pipes or flues.
- P. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
- Q. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- R. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- S. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
- T. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code.
- U. Make terminations in boxes with fittings. Do not make terminations in boxes with bushings.
- V. Do not make splices unless absolutely necessary. All wiring is to as much as practical remaining uniform from termination to termination.
- W. Do not make splices in plenum wire.
- X. All splices made shall be placed within a box or enclosure and labeled as a BAS splice on the cover.
- Y. All raceways will be labeled as BAS.
- Z. Verify wire integrity by proving continuity; end to end and toward ground, of all wire prior to terminating.

3.07 COMMUNICATION WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.



- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths. Comply with Article 3.7 (Wiring) for labeling and splice management.
- G. Label communication wiring to indicate origination and destination.
- H. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to;
 - 1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot).
 - 2. The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
 - 3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
 - 4. An MS/TP EIA-485 network shall have no T connections.
- I. All IEEE 802.3 communication wiring used in the BAS shall be addressed and directed within the Division 27 specification.
- J. All BC's, and Third Party Integration Devices (e.g. All BACnet/IP devices) shall be provided an Ethernet connection point.

3.08 WARNING LABELS

- A. Affix permanent warning labels to equipment that can be automatically started by the control system.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows:

C A U T I O N

This equipment is operating under automatic control and may start or stop at any time without warning.

Switch disconnect to "Off" position before servicing.
- B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows:



CAUTION

This equipment is fed from more than one power source with separate disconnects.

Disconnect all power sources before servicing.

3.09 IDENTIFICATION OF HARWARE AND WIRING

- A. Label wiring and cabling, with control system identification information, at each end within 5 cm (2 in.) of termination.
- B. Permanently label or code each point of field terminal strips to show instrument or item served.
- C. Label control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
- D. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- E. Label room sensors related to terminal boxes or valves with nameplates. Ensure the nameplate is aesthetically pleasing and unobtrusive to the room sensors functionality or design.
- F. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- G. Label identifiers shall match record documents.

3.10 CONTROL PANELS, CONTROLLER QUANTITY AND LOCATION

- A. Control panels shall consist of one or multiple controllers to meet requirements of this specification. Control panels shall be wall mounted within mechanical equipment rooms. Electrical equipment rooms may be used with prior Owner approval. In no case shall panels, other than terminal unit controllers, be located above ceilings.
- B. Restrictions in applying controllers are specified in Section 25 14 13 - Integrated Automation Remote Control Panels. If the BAS contractor wishes to further distribute panels to other locations, the Contractor is responsible for extending power to that location also. Furthermore, the Contractor is responsible for ensuring adequate locations for the panels that do not interfere with other requirements of the project and maintain adequate clearance for maintenance access.
- C. It is the BAS Contractor's responsibility to provide enough controllers to adequately accomplish the sequence of operations and the required point lists plus an added 20% of each of the available point types, AI, AO, BI, BO. No controller installed shall exceed 80% of point capacity of each of the 4 point types, AI, AO, BI, BO. This does not apply to those controllers on the Secondary Controller LAN.



- D. Point expansion modules shall be considered an extension of the controller they are connected to and as such are integral to that controller. Point expansion modules shall comply with the same installation rules as the controller they are connected to regardless of the actual LAN they are communicating upon.
- E. For rooftop AHUs and ERUs, controllers rated for use outside the building envelope shall be mounted inside the unit casings. If adequate space is not available for installation of the controllers per the manufacturer's recommendations, they shall be installed in NEMA4X enclosures adjacent to the unit served. For all other controllers serving rooftop equipment, coordinate with the AE and Owner for control panel location.
- F. Controllers for terminal equipment:
 - 1. For equipment located in the conditioned space, controllers shall be mounted inside the unit enclosure. Where sufficient mounting space is not available inside the unit enclosure, a control panel shall be installed above the ceiling, inside the room, as close to the room space sensor as possible with the exception of spaces with impenetrable hard ceilings, in which case the controller shall be mounted above the ceiling in an adjacent hallway as close to the equipment served as possible. Coordinate with the AE and Owner to clarify acceptable mounting locations.
 - 2. For equipment located above dropped ceilings, controllers shall be unit mounted within a plenum rated enclosure. Provide adhesive backed ceiling labels, affixed to ceiling grid below all ceiling concealed controllers, affix to ceiling panel access door for solid ceilings.
- G. Control drawings, including system control schematics, sequences of operation and panel termination drawings, shall be provided in panels for major pieces of equipment. Terminal unit drawings shall be located in the central plant equipment panel or mechanical room panel.

3.11 CONTROL POWER SOURCE AND SUPPLY

- A. Contractor shall extend all power source wiring required for operation of all equipment and devices included within the BAS.
- B. General requirements for obtaining power include the following:
 - 1. All control panels shall be served by dedicated power circuits. BC control panels served by stand-by power circuits shall additionally be provided with one of the following;
 - a) As Primary selection, a dedicated available UPS circuit from the buildings UPS system to meet the requirements for BC power failure operation in Section 25 1413 - Integrated Automation Remote Control Panels.
 - b) As Secondary selection, an external UPS power supply to meet the requirements for BC power failure operation in Section 25 14 13 - Integrated Automation Remote Control Panels.



Control panel shall be labeled with electrical panel name & circuit number.

2. Where a controller controls multiple systems with varying levels of power reliability (normal, stand-by, and/or interruptible), the controller shall be powered by the highest level of reliability taking into account the space restrictions mentioned above.
 3. For all controlled equipment operating with an available stand-by generator the control panel must be powered from the same power source including the same automatic transfer switch for normal or stand-by power.
 4. Standalone Functionality: Refer to Section 25 14 13 - Integrated Automation Remote Control Panels.
 5. Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same MCC or panel. Where equipment is powered from a 460V source, obtain power from the electrically most proximate 120 VAC source fed from a common origin.
 6. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and of the correct voltage to supply the controls it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls provide separate transformer.
- C. Power Supplies: Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.

3.12 SURGE PROTECTION

- A. The Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all BCs, AAC/ASCS operator interfaces, routers, gateways and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10% above or below measured nominal value, with no effect on hardware, software, communications, and data storage. CUs and panels shall have suppressors to protect against lightning damage, induced voltage from other equipment, and RF interference as applicable.

3.13 DEMOLITION AND REUSE OF EXISTING MATERIALS AND EQUIPMENT

- A. Contractor shall assume that existing equipment that is specifically indicated to be reused is in good condition and is operable. Contractor during the course of work, shall inspect these devices and determine if any devices are in need of replacement or repair. Contractor shall prepare an itemized list of suggested repairs/replacement. This repair/replacement will



- be at the discretion of the Owner and will be accomplished under separate contract.
- B. Existing wire, conduit, and control panel cabinets may be reused at the contractor's discretion, but only if such materials or equipment comply with the applicable specification for new materials and equipment. Such materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service. Materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service. The University does not guarantee the suitability of any such existing materials or equipment for reuse in accordance with the requirements for new materials and equipment.
 - C. Where such materials are reused, the contractor's shop drawings shall reflect the existing wiring designation. If existing labeling is illegible or otherwise does not comply with the applicable specification for labeling, wiring runs shall be relabeled in accordance with the requirements specified elsewhere.
 - D. Existing control modules that will be replaced as part of this project are to be turned over to AU BAS department. All other existing control devices and panels that will not be reused are to be removed from the site.
 - E. Existing electrical service to control panels or devices that will not be reused must be properly terminated and secured per NEC requirements. Label wire with the panel and circuit breaker it is served by. Label wire as "HOT" if circuit cannot be deenergized.
 - F. Existing pneumatic tubing located between the existing BAS panels and the pneumatic operators shall not be reused; however, conduit for such tubing may be reused. All other pneumatic tubing may be reused, but only if such materials comply with the applicable specification for new materials. Materials shall not be reused if visibly damaged or otherwise unsuitable for the intended service.
 - G. The existing pneumatic main air supply system shall be modified as required and reused to serve existing pneumatic controls that are to remain, and shall be extended as necessary to serve new pneumatic controls. Where existing pneumatic controls are removed, main air piping shall be removed back to the point of connection to the main air supply which remains in use, and shall be capped or plugged.
 - H. Existing valves and dampers and their operators shall be reused, except where noted to be removed or provided as new. If an existing valve or damper actuator is not serviceable the actuator will be replaced with an equivalent electronic model. If an electronic model is not available the entire assembly, valve and actuator must be replaced. Contractor shall lubricate all damper linkages of dampers being controlled under this project.
 - I. Other materials and equipment not specifically mentioned herein may be reused only if specifically allowed by indications on the drawings.
 - J. For HVAC systems which are indicated to receive a new BAS, all existing materials and equipment associated with the existing pneumatic system



and BAS shall be removed unless otherwise specified or indicated to remain, or unless reused in accordance with the above requirements, except for the following: 1) conduit and electrical boxes (but not wiring within conduit) may remain in place if not reused; 2) inaccessible pneumatic tubing may remain in place if not reused. Existing materials and equipment to be removed shall be removed subject to the requirements in paragraph "Sequence of Work". For systems that are not to receive new BAS, the existing system shall remain fully functional.

- K. Where existing wall mounted devices are removed in finished spaces, comply with the requirements of Division 01.
- L. Removed materials and equipment shall be subject to the requirements of Division 01.
- M. For systems with existing workstation graphics, the existing graphic must be entirely removed from the system including all links and references and replaced with a new graphic meeting all requirements of these BAS Sections. If renovation is only partial, the entire system graphic must be replaced including devices and equipment that will be reused.
- N. Existing system points shall be released. Partial system renovations shall not be split between old and new points. All points shall be created or recreated to meet the requirements of these BAS Sections.

3.14 SEQUENCE OF WORK

- A. General: All work involving changeover of control functions from existing systems to the new BAS shall be performed in accordance with the following sequence in order to minimize the duration of equipment outages. The following descriptions are intended to indicate the sequence in which the work shall be performed, not to define fully the scope of the work.
- B. Install construction server, operator's terminal, peripherals, graphic software, and LAN prior to placing any equipment under the control of the new BAS.
- C. Work which requires shutting down a pump motor, fan motor, or chiller shall be considered a utility shutdown and shall be subject to the restrictions specified in Division 01.
- D. The following sequence applies to an individually controlled HVAC subsystem, such as an air handling unit. Only one such system shall be placed under manual control (as described below) at any given time.
 - 1. Install CUs adjacent to (or within) existing control panel. Programming shall be complete (except for loading and debugging) prior to installation. Install all field devices which do not require interruption of the existing system.
 - 2. Install all conduit, wiring, and pneumatic tubing which does not require interruption of the existing system.
 - 3. Remove existing controls including wiring, conduit, and tubing (except materials to be reused in accordance with provisions specified



elsewhere) which must be removed to facilitate installation of new BAS materials and equipment.

4. Remove existing digital points. Install and calibrate remainder of new BAS materials and equipment for this subsystem. Load CU software. Connect CU(s) to LAN.
5. Perform all field testing and calibration that does not require connection of permanent pneumatic outputs.
6. Notify the contracting officer prior to this step. Place the system under the control of the new BAS equipment. Conclude field testing and submit field-testing report prior to placing the next subsystem under control. The owner shall be given a password with a priority level that allows monitoring (but not control until notification of substantial completion has been approved).
7. Remove remaining existing materials and equipment (except materials to be reused in accordance with provisions specified elsewhere). All existing equipment for those subsystems that have not yet been converted shall remain intact, on-line, and fully functional.

3.15 CLEANING

- A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
- B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt, and debris.
- C. On completion of work, Contractor is to check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

3.16 BAS START UP, COMMISSIONING AND TRAINING

- A. Refer to Section 01 91 13 and 25 08 00 for Commissioning requirements.

3.17 SEQUENCE OF OPERATION

- A. Refer to 25 9500 and Drawings for specific requirements.

END OF SECTION



25 55 00 .13 CONTROL OF HVAC OBJECT NAMING CONVENTION

PART 1. GENERAL

1.01 SECTION INCLUDES:

- A. Outline of the naming requirements for all BAS objects.

1.02 RELATED DOCUMENTS:

- A. Section 25 5 00 – Integrated Automation Control of HVAC

1.03 DEFINITIONS

- A. Object: Any named software or hardware component contained in the BAS.
- B. Object Descriptor: A 16-character free text attribute of a BAS object.

PART 2. PRODUCTS

2.01 GENERAL:

- A. This object naming convention is to be applied to the project BAS and all integrated systems.
- B. Its design and modifications are wholly owned and approved by the Owner.
- C. The object naming convention applies to those objects with unique naming requirements within the BAS and any integrated system. The BAS contractor is always the systems integrator for third party control systems and as such owns the responsibility to ensure all objects conform to the naming convention prior to implementation.
- D. The naming of objects shall be consistent in the project documents, drawings, specifications, equipment labeling and graphics.
- E. Any variance as required to perform a particular function with any project application shall be reviewed and approved during that projects BAS review period.
- F. The BAS Contractor should submit periodic proposals for updates to include new system and device names as they may apply to any project.

2.02 OBJECT NAMING CONVENTION

A. General:

1. All objects shall conform to the following convention;
 - a) BUILDING.MACROLEVELSYSTEM.SUBSYSTEM.DEVICEDESC
RIPTOR



2. Each object name segment shall conform to the specific requirements defined herein.
3. The maximum character limit is 30 characters including all period (.) characters.
4. All object names shall be defined using all capital characters.
5. Only the period (.) character shall be used to delimit the segments of the object name.

2.03 CHANGE CONTROL

A. General:

1. When adding new list objects to this standard object naming convention the standard format in the list is:
 - a) OBJECTLISTITEMTEXT; Description
 - b) The semi-colon is not part of the object list item text.
2. Update the Revision Number at the beginning of this document by one for each new version of the document published to the Standards Library.
3. All modifications shall be placed in alphabetically correct order.

2.04 OBJECT NAME SEGMENTS

A. CAMPUS Segment:

1. The first segment of the object name.
2. This should not be more than 3 characters in length.

B. BUILDING Segment:

1. The second segment of the object name
2. This segment should not be more than 3 characters in length.
3. There shall be no period (.) character contained within the BUILDING segment.
4. This segment shall not be more than 5 characters in length, including a trailing period (.) character

C. MACROLEVELSYSTEM Segment:

1. The second segment of the object name
2. This segment is to describe the system containing the devices in the building.
3. This segment should not be more than 10 characters in length, including a trailing period (.) character providing consideration for overall object naming consistency.
4. Only MACROLEVELSYSTEMS contained in the MACROLEVELSYSTEMS List are permitted.



5. Any MACROLEVELSYSTEM can be succeeded by a numeral to indicate the sequence number for the system being given the name. The numeral is not delimited with a period (.).

D. SUBSYSTEM Segment:

1. The third segment of the object name
2. This segment is to describe the subsystems within the MACROLEVELSYSTEM segment in the building.
3. This segment should not be more than 8 characters in length, including a trailing period (.) character providing consideration for overall object naming consistency.
4. Only SUBSYSTEMS contained in the SUBSYSTEMS List are permitted.
5. Any SUBSYSTEM can be succeeded by a numeral to indicate the sequence number for the system being given the name. The numeral is not delimited with a period (.).

E. DEVIDEDESCRIPTOR Segment:

1. The fourth and last segment of the object name
2. This segment is to describe the devices that are contained within a MACROLEVEL system in the building.
3. This segment should not be more than 8 characters in length providing consideration for overall object naming consistency.
4. Only DEVIDEDESCRIPTORS contained in the DEVIDEDESCRIPTORS List are permitted.
5. Any DEVIDEDESCRIPTOR can be succeeded by a numeral to indicate the sequence number for the system being given the name. The numeral is not delimited with a period (.).
6. Combining multiple DEVIDEDESCRIPTORS is permitted and shall not be delimited with a period (.) character.
7. When combining DEVIDEDESCRIPTORS it is expected the order of combining be dictated by the actual real English Language pronunciation of the device. Approve all device names during project application of the object naming convention and prior to any implementation.

2.05 CAMPUSNAME LIST

1. MAN; Main Campus
2. TEN; Tenley Campus



2.06 BUILDING NAME LIST

Building Coding Schematic	
Building Code	Building Name
AH	Anderson Hall
ASB	Asbury Building
BCC	Media Production Center
BE	Beeghly Building
BL	Bender Library
BP	Butler Pavilion & Arcade
BT	BATTELLE-TOMPKINS
BW	Brandywine Building
CB	Constitution Bldg.
CDC	Child Development Ctr.
CH	Capital Hall
CK	Clark
CN	Centennial Hall
CO	Congressional Hall
CS	Costume Shop
DH	Dunblane House
FA	Financial Aid Bldg.
FH	Federal Hall
GR	Gray Hall
HA	Hamilton
HF	Hockey Field
HH	Hughes Hall
HU	Hurst
KA	Katzen Art Center
KE	Kerwin
KB	Kogod School of Business
KR	Kreeger
KS	Kay Spiritual Life Ctr.
LTH	Letts Hall
LH	Leonard Hall
MCB	McCabe
MGC	Mary Graydon Center
MH	McDowell Hall
MK	McKinley



MPF	Multi-Purpose Field
MS	Tenley Maintenance Shop
NH	Nebraska Hall
NLH	New Lecture Hall
NMA	New Mexico Ave.
OS	Osborn
PB	Presidents Building
PR	President Residence
PS	Public Safety
RB	Rockwood Bldg.
RH	Roper Hall
SC	Sports Center/Bender Arena
SCA	Sports Center Annex
SIS	School of International Service
SV	Washington College of Law
TB	Transmitter Building
VM	Vehicle Maintenance Shop
WA	Watkins
WCB	Ward Circle Building 1998
WCL	Washington College of Law
WIS	4200 WISCONSIN AVENUE
WS	Wesley Seminary

2.07 MACROLEVELNAME LIST

1. AHU#; Air Handling Units
2. ALN#; Automation Level Network
3. ATS#; Transfer Switch Systems
4. BLDG#; Building Systems
5. BLN#; Building Level Network
6. BLR#; Boiler Systems
7. CABHT; Cabinet Heaters
8. CAS#; Control Air Systems
9. CHLR#; Chiller Systems
10. CHP#; Chilled Water Pump



11. CHW#; Chilled Water Systems
12. CDP#; Condenser Water Pump
13. CDW#; Condenser Water Systems
14. CHM#; Chemical Treatment Systems
15. CPS#; Condensate Pump Systems
16. CRU#; Computer Room Unit
17. CT#; Cooling Tower System
18. CUH#; Cabinet Unit Heater
19. CW#; Condenser Water System
20. DCW#; Domestic Cold Water Systems
21. DHW#; Domestic Hot Water Systems
22. DWP#; Domestic Hot Water Pump
23. DX#; Direct Expansion Systems
24. EDH#; Electric Duct Heater
25. EF#; Exhaust Fan Systems
26. FAN#; Miscellaneous and General Purpose Fan Systems
27. FA#; Fire Alarm Systems
28. FCW#; Fan Coil Units with water coil
29. FCX#; Fan Coil Units with DX cooling
30. FLH#; Floor Heating System
31. FLN#; Floor Level Network
32. FTR#; Fin Tube Radiator
33. GEN#; Emergency Generator
34. HRC#; Heat Recovery Systems
35. HX#; Heat Exchanger System
36. HWP#; Hot Water Pump
37. HWS#; Hot Water Systems
38. KW#; Electric and Electric Metering Systems
39. LT#; Lighting
40. LP#; Lighting Panel
41. MAU#; Make-up Air Systems
42. MER#; Mechanical Equipment Room Systems
43. REF#; Relief Fan
44. RF#; Return Fan
45. RM#; Room Objects (Where # is the room number)
46. SC#; Security
47. SDP#; Sand Pump
48. SF#; Supply Fan



- 49. SPR#; Sprinkler Room
- 50. SUMP#; Sump Pump Systems
- 51. TNK#; Tank Systems
- 52. UH#; Unit Heaters
- 53. ZN#; Zone Systems

2.08 DEVIDEDESCRIPTOR LIST

A. General List

- 1. #; NUMBERS
- 2. AC; AIR COMPRESSOR
- 3. AFM#; AIR FLOW METERING DEVICES
- 4. ALM#; ALARM
- 5. ALN#; AUTOMATION LEVEL NETWORK
- 6. AVG#; AVERAGE
- 7. BLN#; BUILDING LEVEL NETWORK
- 8. BPV#; BYPASS VALVE
- 9. BSP#; BUILDING STATIC PRESSURE
- 10. BTU; BRITISH THERMAL UNIT
- 11. CAD#; COMBUSTION AIR DAMPER
- 12. CAV#; Constant Air Volume Terminal Box Control Systems
- 13. CCV#; COOLING VALVE
- 14. CDD#; COLDDECK DAMPER
- 15. CLS#; CLOSE
- 16. CMD#; COMMAND
- 17. CO#; CARBON MONOXIDE
- 18. CO2#; CARBON DIOXIDE
- 19. CUR#; AMPS
- 20. CW#; CONDENSER WATER DEVICES
- 21. DEW; DEWPOINT
- 22. DIV#; DIVERTING VALVE
- 23. DLK#; MAGNETIC DOOR LOCK
- 24. DP#; DIFFERENTIAL PRESSURE DEVICES
- 25. DPV#; DIFFERENTIAL PRESSURE VALVE
- 26. DSP#; DIFFERENTIAL PRESSURE SWITCH
- 27. DXS#; DX COOLING STAGE
- 28. EAD#; EXHAUST AIR DAMPER
- 29. ECON#; ECONOMIZER DEVICES
- 30. EMS#; EMERGENCY STOP SWITCH



31. ENB#; ENABLE/DISABLE COMMAND
32. ENTH#; ENTHALPY
33. EPO#; EMERGENCY POWER OFF BUTTON
34. ESW#; END SWITCH
35. FBD#; FACE BYPASS DAMPER
36. FC; FREE COOLING STATUS
37. FCV#; FLOW CONTROL VALVE
38. FF#; FLAME FAILURE
39. FIL#; FILTER STATUS (use State Text)
40. FIRE#; FIRE ALARM
41. FLN#; FLOOR LEVEL NETWORK
42. FLOW#; WATER OR AIR FLOW
43. GPM#; GALLONS PER MINUTE
44. H2#; HYDROGEN
45. HCV#; HEATING COIL VALVE
46. HDD#; HOTDECK DAMPER
47. HDP; HEAD PRESSURE
48. HLS#; HIGH/LOW SPEED COMMAND WITH FEEDBACK
49. HOA#; HAND-OFF-AUTO (Use state text)
50. HOUR#; TIME HOURS
51. HSP#; HIGH STATIC PRESSURE CUTOUT
52. HTS#; HEAT STAGE
53. HUV#; HUMIDITY VALVE
54. ILV#; INLET VANE
55. ISD#; ISOLATION DAMPER
56. ISV#; ISOLATION VALVE
57. L#; ADDITIONAL LEVEL INDICATOR
58. LGT#; LIGHTS
59. LL#; LEAD/LAG TOGGLE (Use enumerator)
60. LSP#; LOW STATIC PRESSURE CUTOUT
61. LTD#; LOW TEMPERATURE DETECTOR
62. LVL#; LEVEL SENSOR
63. LWT; LEAVING WATER TEMPERATURE
64. MAD#; MIXED AIR DAMPER
65. MAH#; MIXED AIR HUMIDITY
66. MAT; MIXED AIR TEMPERATURE
67. METR#; METERS (FLOW, KW)
68. MOIST#; MOISTURE SENSOR



69. MOT#; MOTION SENSOR
70. MXV#; MIXING VALVE
71. N2#; NITROGEN
72. NG#; NATURAL GAS
73. O2#; OXYGEN
74. OAD#; OUTSIDE AIR DAMPER
75. OAE#; OUTSIDE AIR ENTHALPY
76. OAH; OUTSIDE AIR HUMIDITY
77. OAT; OUTSIDE AIR TEMPERATURE
78. OPN; OPEN
79. PHO#; PHOTOCELL
80. PNT; PAN TEMPERATURE
81. PPM#; PARTS PER MILLION
82. PRF#; PROOF
83. PWR#; POWER
84. PWRFAIL#; ON POWER RETURN POWERFAIL POINT FOR PANELS
85. RAD#; RETURN AIR DAMPER
86. RAE; RETURN AIR ENTHALPY
87. RAH; RETURN AIR HUMIDITY
88. RAT; RETURN AIR TEMPERATURE
89. RCD#; RETURN AIR CARBON DIOXIDE
90. REF#; REFRIGERANT
91. RF#; RETURN (AIR) FAN
92. RMT; ROOM TEMPERATURE
93. RSD#; RETURN SMOKE DETECTOR
94. RSP#; ROOM STATIC PRESSURE
95. RWH#; ROOM HUMIDITY
96. RWT#; RETURN WATER TEMPERATURE
97. SAD#; SUPPLY AIR DAMPER
98. SAT#; SUPPLY AIR TEMPERATURE
99. SCD#; SUPPLY AIR CARBON DIOXIDE
100. SET#; SETPOINT
101. SF#; SUPPLY FAN
102. SFD#; SMOKE/FIRE DAMPER
103. SLT#; SLAB TEMPERATURE
104. SSP#; SUPPLY STATIC PRESSURE (Where # is for multiple sensors)
105. SS#; START/STOP



- 106. SSD#; SUPPLY SMOKE DETECTOR
- 107. START#; START (COMMAND ONLY)
- 108. STATUS#; STATUS
- 109. STB#; STROBE
- 110. SW#; SWITCH
- 111. SWT; SUPPLY WATER TEMPERATURE
- 112. TEC#; TERMINAL EQUIPMENT CONTROLLER
- 113. TECUP#; TEC UPDATE TRIGGER (used with Field Panel system name)
- 114. VAV#; Variable Air Volume Terminal Box Control Systems
- 115. VEP#; VELOCITY PRESSURE
- 116. VSD#; VARIABLE FREQUENCY DRIVE
 - a.) ALM; DRIVE FAULT/ALARM
 - b.) SPD; SPEED COMMAND (%)
 - c.) FBK; SPEED FEEDBACK (Hz)
 - d.) SS; START/STOP WITH STATUS
 - e.) PRF; RUN STATUS
- 117. ZCD#; ZONE CARBON DIOXIDE
- 118. ZN#; ZONE

2.09 SPECIAL CASES

- A. UserNames: UserName assignment shall be based upon the requirements of a tenant. Approved and/or acceptable variations to the object naming standard shall be approved by the Owner prior to implementation.
- B. Siemens Program (PPCL) Naming Convention
 - 1. PPCL naming shall STRICTLY follow the object naming.
 - 2. All PPCL names shall be of the format convention;
 - a) PANELNAME.PPCL
 - b) PANELNAME is defined below and will be strictly adhered to.
- C. Field Panel Naming Convention
 - 1. Field Panels shall always be Ethernet connected devices to the FCE provided WAN/LAN.
 - 2. The HostName and IP parameters of the device on the TCP/IP network shall be provided by the FCE IT Department. See the General BAS Specification for details.
 - 3. The Siemens System Name for the Field Panel shall follow the object naming standard as follows with the except of limited to 25 characters;
 - a) CAMPUSNAME.BUILDINGNAME.RM#.PNL#
 - b) RM# can also be MER# if the panel is located in a Mechanical Space as opposed to a Room with a number.



- D. Terminal Equipment Controllers Naming Convention
 - 1. All TEC equipment types (air boxes, fume hoods, lab controllers, etc. essentially all devices that reside on a floor level network) shall follow the object naming convention as detailed herein.
- E. Graphic Naming Convention
 - 1. All graphic names shall follow the object naming convention.
 - 2. SYSTEMNAME is equal to the SYSTEMNAME used by the majority of the objects the graphic contains.
 - 3. All background graphic files shall be named as follows;
 - a) CAMPUSNAME.BUILDINGNAME.SYSTEMNAME.dsf
 - 4. All Dynamic Graphics shall be named as follows, where (?) is variable;
 - a) CAMPUSNAME.BUILDINGNAME.SYSTEMNAME.?.GRA
 - 5. It is worthy to note here; the name of the graphic is not the name that Siemens would necessarily use when linking to the graphic as defined in the graphic specification of the Master BAS Specification. Graphic linking shall be descriptive and easily navigated.
- F. Report Naming Convention
 - 1. All reports created by Siemens shall follow the object naming convention
 - 2. All reports shall be named as follows, where (?) is variable;
 - a) CAMPUSNAME.BUILDINGNAME.SYSTEMNAME.?.RPT
- G. Network Naming Conventions
 - 1. All Networks shall have a full English Language description at the CSS.
- H. CU Naming Convention
 - 1. The HostName and IP parameters of the device on the TCP/IP network shall be provided by the Owner. See the General BAS Specification for details.
- I. Zone and Event Naming Convention
 - 1. All zones and events shall be named as follows;
 - a) CAMPUS.BUILDING.MACROLEVELNAME.ZN#
 - b) CAMPUS.BUILDING.MACROLEVELNAME.EV#

PART 3. EXECUTION

3.01 EXAMPLES

- A. Point Names;
 - 1. Anderson, Air Handling Unit 3, Discharge Air Sensor.
 - a) System Name: MAN.AH.AHU03.SAT
 - 2. McKinley, Air Handling Unit 2, down duct static sensor
 - a) System Name: MAN.MK.AHU02.SSP



3. Kerwin, cooling tower 3 fan speed feedback.
 - a) System Name: MAN.KE.CT03.VFD.FBK
4. Hughes, boiler system 2, pump 4 start/stop.
 - a) System Name: MAN.HH.BLR02.HWP04.SS
5. Gray, building differential pressure sensor.
 - a) System Name: MAN.GR.BDP
6. Clark, exhaust fan 4, start/stop.
 - a) System Name: MAN.CK.EF04.SS

-END OF SECTION-



25 95 00 CONTROL SEQUENCES FOR HVAC

PART 1. GENERAL

1.01 SECTION INCLUDES

- A. Description of Work
- B. Control Sequences General Requirements
- C. System Specific Control Sequences

1.02 RELATED DOCUMENTS

- A. The General Conditions of the Contract, Supplementary Conditions, and General Requirements are part of this specification and shall be used in conjunction with this section as part of the contract documents. See Division 01 for details.

The Sections below should be coordinated with other Project Sections

- B. Section 01 91 00 – General Commissioning Requirements
- C. Section 01 91 10 – Functional Test Procedures
- D. Section 25 08 00 - Commissioning of Integrated Automation
- E. Section 25 11 13 – Integrated Automation Network Servers
- F. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems
- G. Section 25 14 13 - Integrated Automation Remote Control Panels
- H. Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks
- I. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC
- J. Section 25 35 13 – Integrated Automation Actuators and Operators
- K. Section 25 35 16 – Integrated Automation Sensors and Transmitters
- L. Section 25 35 19 – Integrated Automation Control Valves
- M. Section 25 35 23 – Integrated Automation Control Dampers
- N. Section 25 55 00 – Integrated Automation Control of HVAC
- O. Section 25 55 00.13 - Integrated Automation Control of HVAC -Object Naming
- P. (This Section) Section 25 95 00 – Integrated Automation Control Sequences for HVAC



1.03 DESCRIPTION OF WORK

- A. This Section defines the manner and method by which controls operate and sequence the controlled equipment.
- B. Included in this section are general requirements and logic strategies that supplement the specific sequences shown on the drawings and included in this Section and its sub-sections.
- C. Refer to the control drawings for specific sequences for individual systems.
- D. Refer to Section 25 55 00 for general requirements, definitions, and abbreviations.

1.04 SUBMITTALS

- A. Refer to Section 25 5500 and Division 01 for submittal requirements for control shop drawings and what is to be contained in them.

1.05 GENERAL REQUIREMENTS

- A. Sequences specified herein indicate the functional intent of the systems operation and may not fully detail every aspect of the programming that may be required to obtain the indicated operation. Contractor shall provide all programming necessary to obtain the sequences/system operation indicated.
- B. Refer to the control drawings for system and application specific sequences.

1.06 PROGRAMMING REQUIREMENTS

- A. Unless specified otherwise, throttling ranges, proportional bands, and cycle differentials shall be centered on the associated setpoint. All modulating feedback control loops shall include the capability of having proportional, integral, and derivative action. Unless the loop is specified "proportional only" or "P+I", Contractor shall apply appropriate elements of integral and derivative gain to each control loop which shall result in stable operation, minimum settling time, and shall maintain the primary variable within the specified maximum allowable variance.
- B. All timing devices, alarm set points and control set points shall be adjustable. Set points listed herein for duct/room static pressure control, differential pressure control for discharge/intake isolation dampers, outside airflow control, return fan airflow tracking volume, and static pressure safeties are initial starting values.
- C. There are several control parameters (e.g. temperature, humidity, etc.) which are required to be maintained within a specified control tolerance. All specified control tolerances shall be met or exceeded.



- D. See Sections 25 55 00 for Control Accuracy and Reporting Performance Parameters for alarming configuration unless this Section provides specific values for any particular alarmable point.
- E. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands shall be staggered by 5 second (adj.) intervals to minimize inrush current.
- F. Alarm messages specified throughout the sequences are assigned to discrete priority levels. Priority levels dictate the handling and destination of alarm reports, and are defined in Section 25 15 16.
- G. Wherever a value is indicated as adjustable (adj.), it shall be modifiable, with the proper password level, from the operator interface or via a function block menu. For these points, it is unacceptable to have to modify programming statements to change the setpoint.
- H. All initial setpoints, ranges, flow coefficients and variables shall be written into the programming for each control system zone as comments and placed on the relevant graphic.
- I. All analog control values, regardless of physical range, i.e. 0-10V, 4-20mA, etc., shall be configured to present a value between 0-100% where 0% is always closed and 100% is always open.
- J. All values that represent a number less than zero shall be represented with a minus sign in front of the number. An example, all exhaust static setpoints and pressures shall be negative.
- K. Whenever the BAS system senses the status of an operating component, whether the command is initiated or not, for instance if a drive is commanded to hand locally, the BAS shall operate all control loops.
- L. Wherever a value is indicated to be dependent on another value (i.e.: setpoint plus 5°F) BAS shall use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points shall be provided. One to store the parameter (5°F), one to store the setpoint, and one to store the value which is the result of the equation.
- M. All calculations that require establishing the state of a static pressure sensor shall perform the following:
 - 1. A failed sensor shall indicate as zero in the calculation.
 - 2. If multiple sensors are measuring a common system duct, the calculation shall not include the failed sensor.
 - 3. Failed sensor(s) shall be an alarm condition.
 - 4. A virtual point definition shall exist in the controller that requires the static status, not the controller providing the status. For example, an exhaust status point shall be defined in the supply controller and the programming setting its value shall reside in the exhaust controller.
- N. All variable geometry discharge dampers (VGDD's) shall be programmed per the following logic. All parameters to calculate and validate airflows



shall be available, adjustable and initial settings hard coded in programming. The calculation to determine the proper control shall be as follows;

1. Loop Input: Fan Flow in CFM * Current Discharge Opening in square feet.
 2. Loop Output: VGDD signal, scaled to 0-100% where zero is minimum.
 3. Loop Setpoint: EF Discharge Stack Flow Setpoint, initial value of 3500 feet per minute.
- O. To calculate the points required for proper chiller staging, use the following formulas;
1. Excess Capacity: This is equal to the rated tonnage of all online chillers minus the actual plant tonnage. The actual plant tonnage is equal to the sum of each chillers actual tonnage.
 2. Chiller Actual Tonnage: Chiller Tonnage NamePlate Rating*Chiller Current Load Value. The Chiller Current Load Value is determined by the chiller control panel and provided to the BAS via the hard-wired Chiller Load point. This value is received and displayed as a percentage, but for this calculation, it shall be converted to a decimal.
- P. Sensor Control: The required standards for programming to address a sensors ability to be disabled from control while in maintenance mode or failed shall be as follows;
1. Virtual AI = (Sensor Status)*(Sensor Maintenance Mode)*(Sensor Actual Value)
 - a) Virtual AI is the virtual analog input value used for any calculation or input control. In some cases, for example exhaust static sensors, the minimum of a number of these values would be used as the input for control.
 - b) Maintenance Mode is a Virtual BO so its value is always zero or one.
 - c) Sensor Status is always either Failed (value = 0) or Normal (value = 1).
- Q. Access Control to Laboratories, Vivarium and Museums Variables:
1. All setpoints, operational mode points, control points shall be placed on the zone/space parameters graphic and protected from change by the highest level of operator access control.

1.07 SCHEDULING TERMINOLOGY

- A. When a control system is scheduled throughout the day, the following defines the terminology used:
1. Occupied Period: The period of time when the area served by the specific control system or zone is in use and occupied. Unless indicated otherwise, this is the default period and is defined as 6:00 AM to 6:00 PM 7 days per



week. Exclude all Federal holidays. Generally, systems will be fully operational throughout this period and ventilation air shall be continuously introduced. Initial space temperature setpoints shall be applied per the American University Temperature Policy. Request the current AU Temperature Policy parameters from the AU BAS Department prior to entering set points.

2. Unoccupied period: The period of time when the area served by the specific control system or zone is not in use and unoccupied.
3. Preoccupancy Period: A time span prior to the Occupied period. Examples are AHU warm-up and cool-down. AHU Economizers will function normally. The duration and start time of this period shall be determined by an optimum start strategy unless otherwise specified.
4. Setback Period: This period will typically start with the end of the occupied period and end with the start of the preoccupancy period, however it shall be provided with its own schedule. Generally, systems will be off except to maintain a “setback” temperature.
5. Demand Response Period: This period is available during all other periods. When activated the control systems is placed into a shutdown mode in order to reduce energy consumed.

1.08 RESET STRATEGIES

- A. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated on the drawings, one of the following methods shall be employed:
 1. Contractor shall determine a fixed reset schedule that shall result in stable operation and shall maintain the primary variable within the specified maximum allowable variance.
 2. A floating reset algorithm shall be used which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary variable setpoint. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance.
- B. Where a supply air temperature setpoint is specified to be reset by the space temperature of the zones calling for the most cooling/heating, the following method shall be employed:
 1. A floating reset algorithm shall be used which increments the secondary variable, supply air temperature setpoint, on a periodic basis to maintain primary variable (e.g. space temperature) setpoint. The reset increment shall be determined by the quantity of “need heat” or “need cool” requests from individual Terminal Control Units. A TCU’s “need heat” virtual point shall activate whenever the zone’s space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A TCU’s “need cool” virtual point shall activate whenever the zone’s space temperature rises above the currently



applicable (occupied, unoccupied, or economy) cooling setpoint throttling range. The recalculation time and reset increment shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. Reset range maximum and minimum values shall limit the setpoint range.

- C. Where a duct pressure, or differential water pressure setpoint is specified to be reset by valve or damper position of the zone or zones calling for the most cooling/heating, the following method shall be employed:
 1. A floating reset algorithm shall be used which increments the secondary variable (e.g., pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g. cooling valve, heating valve, damper position) setpoint of 85% open. The reset increment shall be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. The recalculation time, reset increment and control device position influence shall be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. The BAS analog output value shall be acceptable as indicating the position of the control device.
 2. Alternatively, to continuously calculating the average of the quantity of worst valve/damper positions, a method similar to the one described above may be employed whereby the “need heat” or “need cool” virtual point shall increment by one unit each time a zone’s valve/damper position rises to greater than 95%. The quantity of “need heat” or “need cool” points shall then be the basis for reset.

1.09 PROOF STRATEGIES

- A. Where “prove operation” of a device (generally controlled by a digital output) is indicated in the sequence, it shall require the BAS, after an adjustable time delay after the device is commanded to operate (feedback delay), confirm that the device is operational via the status input.
- B. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (chatter delay) while the device is commanded to run, an alarm shall be enunciated audibly and via an alarm message at the operator interface and print at the alarm printers. A descriptive message shall be attached to the alarm message indicating the nature of the alarm and actions to be taken. Contractor shall provide messages to meet this intent.
- C. Upon failure, the run command shall be removed, and the device shall be locked out until the alarm is manually acknowledged unless specified otherwise.



PART 2. PRODUCTS

2.01 NOT USED

PART 3. EXECUTION

3.01 PROJECT SYSTEM NAMING

- A. All objects contained within the BAS shall use the Object Naming specification. See Section 25 5500.13 for details.

3.02 GENERAL

- A. Emergency Shutdown is a special software switch that when activated must command all air moving equipment OFF and exterior dampers (outside air, exhaust air, relief air) CLOSED. Coordinate integration of this network point with all fans and dampers under BAS control for this project.

Provide building level software button for all systems to shutdown per building, and campus level software button for all system on campus to shutdown. Integrate manual shutdown button in central plant with campus level shutdown sequence.

- B. Outside air sensor backup programming: Whenever the local building outside air sensor is determined to have failed or be unreliable by the BAS the BAS shall automatically connect to a remote outside air sensor for outside air data.
- C. Zone temperature adjustment: Provide a means for the BAS operator to adjust space temperature set points per space, per floor, or per building. For example, there shall be a means for the BAS operator to change all of the space temperature set points in a building from a single operation and not require the operator to change the set point at each space separately.

3.03 AIR HANDLER UNITS

- A. When an air handling unit is not in operation, control devices shall remain in their “off” positions. “Off” positions may differ from the “normal” (meaning failed) position. Except as specified otherwise, “off” and “normal” positions of control devices shall be as follows:

Device	“Off” Position	“Normal” Position
Heating coil valves	Closed/controlling	Open
Cooling coil valves	Closed	Closed
Outside air damper	Closed	Closed
Return air damper (Mixed air damper)	Open	Open



Exhaust/relief air damper	Closed	Closed
Var. Freq. Drive	Off	Min. Speed

- B. Logic Strategies: The BAS shall fully control the air handlers. Generally, the BAS shall energize the AHU (start the fans and activate control loops) as dictated for each air handler. The following indicates when and how the BAS shall energize the AHUs and control various common aspects of them:
1. Scheduled Occupancy: BAS shall determine the occupancy periods (occupied, unoccupied, preoccupancy, and setback) as defined above. The following details the common control aspects related to the scheduled occupancy.
 - a) Occupied Period: BAS shall energize the AHU during all occupied periods. Note that the beginning of the occupancy period shall be set sufficiently before the actual start of occupancy to obtain the required building component of ventilation per ASHREA 62. Minimum OA flow setpoint shall be as scheduled on the drawings. "Normal" setpoints shall apply.
 - b) Unoccupied Period: Minimum OA flow shall be 0 CFM or the minimum OA damper position shall be 0%. If during the unoccupied period there is a request for occupancy override, the occupancy mode shall become active for an adjustable period. The unoccupied period and the preoccupancy period will typically overlap.
 - c) Setback Period: the BAS shall deenergize the unit except as required to maintain a setback temperature as indicated in the individual sequences with a 5°F cycle differential. Generally, where setback temperatures apply in multiple zones, the worst zone shall control the system. Setback setpoints generally apply except during preoccupancy [and night purge]. If during the unoccupied period there is a request for occupancy override, the occupancy mode shall become active for an adjustable period.
 - d) Preoccupancy: BAS shall energize the AH continuously during the preoccupancy period. Minimum OA flow shall be 0 CFM or the minimum OA damper position shall be 0%. "Normal" setpoints shall apply. Preoccupancy duration shall be one of the following as specified by reference:
 - 1) Fixed: The duration of the preoccupancy period shall be fixed as scheduled by the operator.
 - 2) Optimum: The duration of the morning warm-up period shall vary according to outside air temperature and space temperature such that the space temperature rises to



occupied period heating setpoint at the beginning of, but not before, the scheduled occupied period. The duration of the cool-down period shall vary according to outside air temperature and space temperature such that the space temperature falls to the occupied period cooling setpoint at the beginning of, but not before, the scheduled occupied period

2. Minimum OA Control: BAS shall maintain minimum ventilation during the occupied period. The following strategies may apply:
 - a) **Balanced Position:** During the occupied period, applicable mixing and OA dampers shall never be positioned less than the position set for the required minimum OA ventilation rate. If the air handler has a single OA damper that is capable of economizer, the minimum position output shall be determined by the balancer. If the AH has a two-position minimum OA damper, that position shall be fully open to its balanced position. This logic strategy is only applicable to constant volume AHs.
 - b) **Reset Balanced Position:** During the occupied period, applicable mixing and OA dampers shall never be positioned less than the minimum position. Minimum position shall be reset between limits of a position delivering system exhaust make-up air CFM and the design minimum position delivering design minimum CFM to maintain a CO₂ setpoint of 400 ppm (adj.) above the outdoor air CO₂ level. Loop shall be a “sample and bump” or dynamic proportional only loop tuned for the slow response. The balancer shall determine the minimum position outputs at both extreme points. This logic strategy is only applicable to constant volume AHUs.
 - c) **Damper Controlled Fixed:** During the occupied period, applicable mixing dampers shall be modulated to maintain an OA flow rate of no less than the minimum ventilation requirement (MVR) as dictated in the design and required by code. Setpoint flow rates shall be provided by the A/E.
 - d) **Damper Controlled Reset:** During the occupied period, applicable mixing dampers shall be modulated to maintain an OA flow rate setpoint. Setpoint shall be reset between limits of system exhaust make-up air CFM and the design minimum CFM to maintain an RA CO₂ setpoint of 900 ppm (adj.). Loop shall be a “sample and bump” or dynamic proportional only loop tuned for the slow response. Setpoint flow rates shall be provided by the A/E.
 - e) **Mixed Air Temperature Control:** Minimum position of the OA damper shall be set to obtain the design required minimum OA. This balanced minimum position shall remain fixed. Whenever the minimum loop is active BAS shall control the dampers to maintain



- a mixed air temperature setpoint that will be 2°F below AHU discharge air temperature cooling setpoint (adj.).
3. VAV Return Fan Capacity Control: BAS shall control the output of the return fan as follows:
 - a) Flow Tracking: The return air fan shall run to maintain a return flow setpoint of the supply flow minus an offset value. The offset value shall be determined as follows.
 - 1) Fixed Differential: It shall be fixed at the design minimum OA value.
 - 2) Differential Reset From RA CO₂: It shall be reset between limits of system exhaust make-up air CFM and the design minimum CFM to maintain an RA CO₂ setpoint of 900 ppm (adj.). Loop shall be a “sample and bump” or dynamic proportional only loop tuned for the slow response. Setpoint flow rates shall be provided by the A/E.
 - 3) Differential Reset From Measured OA to Maintain Fixed OA: It shall be reset to maintain the measured minimum OA flow at the design value any time the economizer mode is inactive. Whenever it is inactive, it shall be set to the value that existed when the unit became active.
 - 4) Differential Reset From Measured OA to Maintain Reset OA: When the economizer mode is inactive, it shall be reset to maintain the measured OA flow setpoint. The OA setpoint shall be reset between limits of system exhaust make-up air CFM and the design minimum CFM to maintain a CO₂ setpoint of 900 ppm (adj.). Loop shall be a “sample and bump” or dynamic proportional only loop tuned for the slow response. Setpoint flow rates shall be provided by the A/E. Whenever the economizer is active, it shall be set to the value that existed when the unit became active.
 - b) Rescaled Output Capacity Control: The output for the return fan capacity control shall be rescaled from the output of the to the supply device such that the design minimum OA flow is maintained at both maximum and 50% flow conditions. The balancing contractor shall determine the coordinated output.
 4. Airside Economizer: BAS shall modulate the mixing dampers to provide “free cooling” when conditions merit. The free cooling shall generally be staged before any mechanical cooling. While conditions merit, dampers shall be modulated in a DA PID loop to maintain mixed air temperature at a setpoint as specified for the individual unit. Economizer logic shall remain enabled during setback cooling where applicable. The following strategy shall be used to enable the economizer mode:



- a) Dry Bulb Switch: Economizer mode shall be active while the unit is energized AND when outside air temperature falls below the switching setpoint of 55°F (adj.) (with 5°F cycle differential). Economizer mode shall be inactive when outside air temperature rises above switching setpoint, dampers shall return to their scheduled minimum positions as specified above.
5. Sequenced Heating and Cooling: BAS shall control the heating and cooling coils and air side economizer as detailed for the AH. Program logic shall directly prohibit the heating and cooling valves as well as the heating valve and economizer damper to be open (or above minimum) simultaneously. This does not apply to cooling and reheat valves that are used simultaneously for dehumidification.
6. Mixed Air Low Limit Override: BAS shall override the signal to the OA damper via a proportional only loop to maintain a minimum mixed air temperature of 45°F (adj.) (loop shall output 0% at 45°F which shall be passed to the output via a low selector).
7. Freeze Safety: Upon operation of a freezestat the following sequence shall occur:
 - a) The unit fans shall be deenergized. Typically supply and return fans where applicable shall be deenergized via a hardwired interlock, and an indication of the operation shall be displayed by the BAS.
 - b) All hot water valves and chilled water valves will be commanded to 100% open. Steam preheat valves shall modulate to maintain minimum preheat/mixed air plenum temperature.
 - c) All hot water coil pumps and chilled water coil pumps will be commanded to run.
 - d) Outside air dampers shall fully close and return air dampers shall fully open.
 - e) BAS shall enunciate appropriate alarm and remove and lock out the start command, which shall initiate "fan failure" alarms.
8. Smoke Safety: Upon indication of smoke by a smoke detector, FAC shall override all AH control. FAC shall not rely on BAS for implementation of smoke control sequences unless specifically approved. Smoke detector shall notify the fire alarm system and BAS, shut down the fans, and close the smoke dampers via hard-wired interlock.
9. Smoke Pressurization Cycle: When pressurization is commanded by the interface to the fire alarm system, supply fan shall start and deliver 100% outside air to the space. Return fan shall remain off. Hardwired interlock from safeties may still interrupt fan operation. (See damper



and heating valve sequences for additional sequences associated with pressurization.).

10. Smoke Exhaust Cycle: when exhaust is commanded by the interface to the fire alarm system, return fan shall start and shall exhaust 100% return air from the space. Supply fan shall remain off. (See damper and heating valve sequences for additional sequences associated with pressurization.)
 11. High or Low Pressure Safety: Upon activation of a high or low pressure safety switch, AH shall be deenergized, fans shall be deenergized via a hard wired interlock, and an indication of the operation shall be sensed by the BAS. BAS shall enunciate appropriate alarm and remove and lock out the start command, which shall initiate "fan failure" alarms.
 12. Vibration Safety (Applicable To Units >50,000 cfm): Upon activation of a vibration safety switch, respective fan shall be deenergized, fan shall be deenergized via a hard wired interlock and an indication of the operation shall be sensed by the BAS. BAS shall enunciate appropriate alarm and remove and lock out the start command.
- C. The detailed "logic strategies" above shall be required by reference to them in each of the individual sequences specified.

3.04 AIR HANDLING UNIT DIAGNOSTICS

- A. Diagnostic Strategies: In addition to the standard alarm limits specified for all sensed variables the BAS monitor and diagnose anomalies in the operation of the air handlers. The following "diagnostic strategies" shall be included by reference with each air handler with any specific clarifications required:
1. Run Time Limit: BAS shall accumulate the runtime of the status of associated rotating equipment and enunciate an alarm to indicate that the unit is in need of service.
 2. Filter Monitoring: BAS shall monitor the differential pressure transmitter across the filter bank(s). An alarm shall be reported when pressure drop exceeds the transmitter's setting.
 3. Start Monitoring: BAS shall accumulate the starts of cycling equipment. BAS shall further enunciate an alarm when the number of starts exceeds the specified value within the specified time period. (ie: more than 3 starts in a 30 min period).

3.05 ENERGY CURTAILMENT CONTROL

- A. BAS shall monitor kW demand over a 15-minute sliding period.
- B. The operator (with appropriate password level) at the OWS shall manually enable demand limiting. Demand limiting shall remain enabled until manually disabled by the operator at the OWS.



- C. On a rise in kW to within 200 kW (adj.) of setpoint, a Level 4 alarm shall be enunciated and BAS shall begin to make one “load shed” command every 10 minutes (adj.). On a fall in kW to 200 kW less than the demand setpoint, BAS shall begin to broadcast one “load restore” command every 5 (adj.) minutes on a first shed, first restored basis.
Automatic load shedding shall be limited to a maximum of two (adj.) load shed commands. Once the maximum automated load shed has been reached and demand still exceeds the demand, setpoint the operator will be notified via Level 3 alarm that additional load shedding will require manual intervention.
Operators with required user access shall be able to manually initiate additional load shed commands.
- D. Coordinate which loads are available for shedding with the Owner.
- E. Load shedding commands priority:
 - 1. The first load shed command shall reset terminal level equipment space temperature set points to their set back values over a [5] minute (adj.) period.
 - 2. The second load shed command shall reset VAV air handler down duct static set points to their minimum value over a [10] minute (adj.) period.
 - 3. The third load shed command shall reset central plant equipment to their minimum capacity set points over a [30] minute (adj.) period.
- F. On a rise in kW to within 50 kW (adj.) of setpoint, a Level 3 and Level 4 alarm shall be enunciated.

3.06 GENERAL PRIMARY/SECONDARY CHW SYSTEMS CONTROL

- A. General: BAS shall fully control the chilled water systems and equipment and shall provide monitoring and diagnostic information for management purposes. The following logic strategies are referenced in the individual sequences and expand on the requirements:
- B. Cooling Enable: As indicated on the drawings for the specific system.
- C. Chilled Water Load Determination:
 - 1. Chilled water load shall be calculated instantaneously from the flow and temperature difference of the following loops:
 - a) Primary loop total.
 - b) Individual chiller circuits.
 - c) Individual secondary circuits (as applicable)
 - 2. Chilled water load for the purposes of the staging the chillers shall be calculated as the 10 min average of the secondary circuit loads.
- D. Chiller Staging: Chiller shall be staged as specified below.



- E. Proof of Chiller Operation: BAS shall prove the operation of the chillers via chiller status and alarm points. When a chiller is assessed as failed, the run command shall be locked out and shall require manual acknowledgment at the operator interface before it is restarted. BAS shall then start the next chiller in rotation. The following conditions shall result in the assessment that the chiller has failed:
 - 1. Loss of chiller status for more than 15s (adj.) while it is requested.
 - 2. Closure of chiller failure input.
 - 3. Leaving chilled water temperature exceeds chiller setpoint plus 8°F for 10 min. continuously.
 - 4. Chiller environment is unacceptable for 10 min. as specified below.
- F. Chiller Environment Monitoring: BAS shall monitor the “environment” of all active (not starting or stopping) chillers and remove the run command when the environment is assessed as unacceptable. An unacceptable environment will include any of the following:
 - 1. Loss of status on the associated primary pump (pump proof debounce time shall not apply).
 - 2. Condenser water entering temperature below CHW supply plus 12°F or above 100°F.
 - 3. Condenser water flow below a minimum setpoint GPM where such flow is measured.
 - 4. Chilled water flow below a minimum setpoint GPM.
- G. When the environment is assessed as unacceptable, the BAS shall enunciate an alarm, remove chiller run command (not the chiller request; all supporting equipment shall continue to operate) and start a timer. If the environment is still unacceptable after 10 min. (adj.), fail the chiller.
- H. Chiller Request: A chiller request is the request for a chiller and the associated equipment. A chiller request is issued before the actual run command to the chiller, which is the closure of the physical point that enables the chiller.
- I. Chilled Water Temperature Control: The chilled water temperature shall be controlled as specified below.

3.07 CHILLER STAGING (T ON L OFF)

- A. BAS shall control the starting and stopping of chillers to meet the demands of the secondary chilled water systems (SCHW). Whenever cooling is requested, a minimum of one chiller shall be requested. Chillers shall be started per the chiller start sequence and stopped per the chiller stop sequence specified below. Once the conditions merit starting or stopping a chiller, BAS shall complete the starting or stopping sequence regardless of temperature fluctuations



during the sequence. Additional chillers shall be started based on SCHW supply temperature as follows:

1. For the purposes of chiller staging control, a virtual point called “average secondary chilled water supply temperature” (ASCHWST) shall be continuously calculated and displayed. This value shall be the 10-minute average of the instantaneously sensed secondary chilled water supply temperature.
2. An additional chiller shall be requested and started per the chiller start sequence specified below when:
 - a) The ASCHWST rises more than 4°F above the secondary chilled water supply setpoint for 5 min. (adj.) continuously, AND
 - b) More than 30 min. (adj.) has elapsed since the start of the last chiller.
3. Chillers shall be stopped, per the chiller stop sequence specified below, based on the averaged cooling load as follows:
 - a) One chiller shall be stopped when the load falls below (Total Nominal Capacity-(Nominal Capacity of Last Chiller) * 1.2), AND
 - b) A minimum of 15 min. has elapsed since a chiller has been stopped, AND
 - c) A minimum of 30 min. has elapsed since this chiller has been started.

3.08 CHILLER STAGING (LOAD)

- A. BAS shall control the starting and stopping of chillers to meet the demands of the [secondary] chilled water systems. Whenever cooling is requested, a minimum of one chiller shall be requested. Chillers shall be started per the chiller start sequence and stopped per the chiller stop sequence specified below.

Once the conditions merit starting or stopping a chiller, BAS shall complete the starting or stopping sequence regardless of temperature fluctuations during the sequence. Additional chillers shall be started based on SCHW load as follows:

1. An additional chiller shall be requested and started per the chiller start sequence specified below when:
 - a. The average cooling load rises above 90% of the nominal capacity of the active chillers for 5 min. (adj.) continuously, AND
 - b. More than 30 min. (adj.) has elapsed since the start of the last chiller.
2. Chillers shall be stopped, per the chiller stop sequence specified below, based on the averaged cooling load as follows:
 - a. One chiller shall be stopped when the load falls below (Total Nominal Capacity-(Nominal Capacity of Last Chiller) * 1.2), AND



- b. A minimum of 15 min. has elapsed since a chiller has been stopped, AND
- c. A minimum of 30 min. has elapsed since this chiller has been started.

3.09 CHILLER STAGING (CHILLER AMPS)

- A. BAS shall control the starting and stopping of chillers to meet the demands of the secondary chilled water systems. Whenever cooling is requested, a minimum of one chiller shall be requested. Chillers shall be started per the chiller start sequence and stopped per the chiller stop sequence specified below.

Once the conditions merit starting or stopping a chiller, BAS shall complete the starting or stopping sequence regardless of temperature fluctuations during the sequence. Additional chillers shall be started based the amperage drawn by the chiller as follows:

1. An additional chiller shall be requested and started per the chiller start sequence specified below when:
 - a) The average percent amperage drawn by the active chillers rises above 95% of the nominal full load amperage of the active chillers for 5 min. (adj.) continuously, AND
 - b) More than 30 min. (adj.) has elapsed since the start of the last chiller.
2. Chillers shall be stopped, per the chiller stop sequence specified below, based on the averaged cooling load as follows:
 - a) One chiller shall be stopped when the load falls below (Total Nominal Amperage-(Nominal Amperage of Last Chiller) * 1.2), AND
 - b) A minimum of 15 min. has elapsed since a chiller has been stopped, AND
 - c) A minimum of 30 min. has elapsed since this chiller has been started.

3.10 PRIMARY CHW PUMP CONTROL (ONE PUMP/CHILLER)

- A. Primary pumps shall be started to serve their respective chiller when it is requested to run per the chiller start and stop sequences specified below. Pumps shall run continuously when the respective chiller is requested. BAS shall prove operation of the pump.

3.11 SECONDARY CHW PUMP (WITH VFD) CONTROL

- A. Secondary pumps shall run continuously whenever cooling is requested from the system it is serving or when system is enabled by the operator. BAS shall prove operation of the pump. BAS shall vary the speed of the pumps to maintain the lowest differential pressure setpoint across any of



the applicable differential pressure sensors. The differential pressure setpoint shall either be fixed at 10 psi (adj.) or reset between 5 psi (adj.) and 15 psi (adj.) based on one of the following as indicated specifically on the drawing sequences:

1. Valve position, OR
2. Cooling requests from the applicable secondary terminals.

3.12 CONDENSER WATER PUMP CONTROL (ONE PUMP/CHILLER)

- A. Pumps shall be started per the chiller start and stop sequences specified below to serve their respective chiller when the chiller is requested to run. Pumps shall run continuously when their chiller is requested. BAS shall prove operation of the pumps.

3.13 COOLING TOWER BYPASS VALVE CONTROL

- A. BAS shall control the bypass valve via a PID control loop to maintain a minimum mixed condenser water temperature of 65°F when systems are in mechanical cooling mode.

3.14 CHILLER PRIORITY SELECTION (EQUAL SIZE AND EFFICIENCY CHILLERS)

- A. BAS shall automatically prioritize the chillers for starting order. One of the following methods shall be employed to rotate and re-prioritize the chillers:
 1. The chiller with the least run time shall be started first and the chiller with the greatest runtime shall be stopped first.
 2. The BAS shall provide a graphic screen to support the manual selection of chiller priorities.
 3. The chiller priorities shall be rotated based on a predetermined schedule. Owner shall dictate a regular schedule for the priorities to be switched.
- B. Operators shall be able to lock out chillers in "Maintenance Mode. This means that the requests for this chiller and associated appurtenances shall be bypassed. This shall be done through a graphic icon associated with a virtual point indicating whether the maintenance mode is active or via a property associated with the chiller icon.

3.15 CHILLER START SEQUENCE

- A. On a request for a chiller to start as specified above under "Chiller Staging," the following sequence shall occur:
 1. Wait thirty seconds (adj.).
 2. Enable additional cooling towers as specified above (if applicable). This shall enable the bypass valve control loop if it is not already enabled. Then command the isolation valves to open. The travel rate of the tower isolation valves shall be limited to ease the shock on the tower water



system leaving temperature during cold weather. For systems that allow tower piping to drain when the system is off, upon start up fully close bypass valve for 30 seconds (adj.) to prime the system and eject air when the system is first started.

3. Gradually reset the demand limit to all active chillers from 100% to 50% (adj.) of maximum amps.
4. Request the start of the applicable condenser water pump and prove operation.
5. After condenser pump operation is proven, BAS shall start the applicable primary chilled water pump and prove operation. Concurrently with the starting of the chilled water pumps, BAS shall open the chiller isolation valve (if applicable) at a limited rate of travel to minimize the shock to other operational chillers.
6. Wait a maximum of 5 min. after the command to start the condenser pump for the chiller environment as specified above to be acceptable. As soon as the environment is assessed as acceptable, continue the start sequence. If after 5 min. the environment is not acceptable, fail the chiller and start the next chiller.
7. Command the chiller to start under its own control.
8. Monitor chiller status and prove operation. If status is not indicated within 3 minutes (adj.) of a command to start, annunciate an alarm, disable and lock out chiller.
9. After status is proven, gradually reset current limit to all active chillers to 100%.

3.16 CHILLER STOP SEQUENCE

- A. When a chiller is no longer needed as specified in chiller staging, the following sequence shall occur:
 1. Remove chiller run command.
 2. Wait for status to clear and for the chiller to stop under control.
 3. Wait 1 min. (adj.). Then, where applicable, begin to modulate closed the isolation valve. At mid-stroke stop associated PCHW pump.
 4. Where applicable, begin to stroke the condenser isolation valve closed and at mid stroke, stop the condenser pump.
 5. Close applicable tower isolation valves and, if this is the last chiller running on the circuit, close the applicable bypass valve.

3.17 GENERAL HEATING WATER SYSTEMS CONTROL

- A. General: BAS shall fully control the hot water systems and equipment and provide monitoring and diagnostic information for management purposes.



The following logic strategies are referenced in the individual sequences and expand on the requirements.

- B. Heating Enable: Heating shall be enabled as indicated on the drawing sequence.
- C. Hot Water Load Determination
 - 1. Hot water load shall be calculated instantaneously from the flow and temperature difference of the following loops:
 - a) Primary loop total.
 - b) Individual boiler circuits.
 - c) Individual secondary circuits.
 - 2. Hot water load for the purposes of the staging the chillers shall be calculated as the 10 min average of the secondary circuit loads.

3.18 CENTRAL PLANT MONITORING AND MANAGEMENT

- A. General: The BAS shall monitor various aspects of the heating and cooling systems and calculate parameters as specified below to facilitate plant operations and management.
- B. Trending: The BAS shall continuously monitor, calculate, and display the following parameters at the intervals indicated. These values shall be stored initially in the buffer of the controlling control unit, and then be uploaded periodically and stored on a specified hard disc. Contractor shall format reports from this data to support one of the following data formats:
 - 1. Quote (text strings) and Comma delimited.
 - 2. Microsoft EXCEL.
 - 3. Microsoft ACCESS.
- C. Parameters to be Trended:
 - 1. Load on the secondary systems in MBH per the following equation: $(\text{Return Temp} - \text{Supply Temp}) * (\text{GPM}) / .5$. This shows cooling as a positive heat load and heating as a negative heat load. Note that multipliers on this value to accommodate the BAS processors are acceptable as long as they are clearly indicated. This value shall be trended and stored every two hours.
 - 2. All temperature sensors at 15-minute intervals.
 - 3. All relative humidity sensors at 15-minute intervals.
 - 4. All pressure sensors at 15-minute intervals.
 - 5. All run requests and statuses on a change in value.
 - 6. All analog loop outputs on 15-minute intervals.
 - 7. Calculated enthalpies in 2-hour intervals.
 - 8. Summed cooling and heating requests on 2-hour intervals.



3.19 VARIABLE FREQUENCY DRIVES

A. Coordinate the following requirements with the VFD vendor:

1. All drives shall include a communications ability or microprocessor that can provide all internal variable values to the BAS. This can be BACNET MS/TP or BACNET/IP.
2. Drive shall be configured for auto-restart on power return when the run command is indicated.
3. Drive shall be configured to start into a forward or backward rotating fan wheel when the run command is indicated. Drive shall catch the wheel at its speed and accelerate directly to the indicated reference speed.
4. Drive shall be configured to stop the fan at the fastest, mechanically safest possible rate to assure as low a static pressure as possible during the turndown period.
5. Drive shall be configured such that upon loss of BAS speed reference signal the drive shall stop.
6. Preset speed signal shall be set up to limit the operating speed of the drive to an adjustable parameter (typically 25 Hz) when there is an open contact across it. This value shall be adjusted during Cx to ensure smooth transitions into an operating header and a safe pressure against the dead head of the dampers.
7. Drive shall be configured to stop when any load side disconnect switch is placed in the OPEN position. The drive shall be allowed to return with normal operations when all load side disconnect switches are placed in the CLOSED position.
8. Drive shall be configured to initiate a common alarm to the BAS whenever there is a fault detected.
9. All TAB established drive programming shall be included on a BAS CSS Graphic for informational purposes. Each value shall include the default value and the custom programming value with a brief description of the customization's purpose.
10. Each VFD shall open all AHU dampers in parallel in accordance with the following:
 - a) In VFD Mode: Upon a run command from the BAS, the drive shall start the fan into closed dampers. It shall start at 0 Hz and accelerate per drive settings (typically 1 Hz per second). When the drive speed exceeds an adjustable speed threshold (typically 20 Hz) the drive shall issue an open command to the fans OA damper



and the supply discharge damper via a “drive running” output. The drive shall limit the speed of the fan to the safe preset speed (programmed in the drive) until all dampers are proven open. Once the damper end switches prove open dampers, the drive shall allow the fan to accelerate at the controlled rate to the BAS drive reference signal that is sent via hard-wired interface from the BAS.

- b) In HAND Mode: The same logic shall apply as VFD Mode when the drive speed signal is in HAND mode and manually controlled through the VFD panel. Preset speed limit shall apply whenever the Inverter is active.

- END OF SECTION -



DIVISION 26 ELECTRICAL

GENERAL

American University's utilities on Campus are owned, operated and maintained by the University. Electrical service to each facility is by connection to the University's electrical distribution system that is managed by Facilities Management (FM). All electrical designs must be reviewed and approved by the FM Director Energy and Engineering and/or a designated representative.

All electrical designs shall comply with national, state and local codes. The Consultant shall incorporate into the design, as a minimum, the industry standards and design criteria in the following references:

- a. National Fire Protection Association (NFPA) Standard 70 National Electrical Code
- b. American National Standards Institute (ANSI) Standard C2 National Electrical Safety Code
- c. Standard Handbook for Electrical Engineers
- d. American Electricians Handbook
- e. NFPA 20 Installation of Centrifugal Fire Pumps
- f. NFPA 30 Flammable and Liquid Combustible Code
- g. NFPA 37 Stationary Combustion Engines and Gas Turbines
- h. NFPA 72 Fire Alarm Systems
- i. NFPA 78 Lightning Protection Code
- j. NFPA 101 Life Safety Code
- k. NFPA 110 Emergency and Backup Power System
- l. National Electrical Manufacturers Association (NEMA) standards for Materials and Products
- m. ANSI standards
- n. Underwriters Laboratories (UL) Fire Resistive Directory
- o. D.C. Building Code
- p. D.C. Division of Facility Service Guidelines



The Consultant shall provide a written description of how the entire system is designed to operate. This Basis of Design (BOD) narrative also shall describe how project objectives are being met. It shall be provided in a format that can be easily understood by a layperson, the end user. The narrative identifies items that specifically meet the Owners Project Requirements (OPR) and the most recent Facilities Management (FM) or department System Master Plan(s) and articulate a rationale for any variance.

For renovations, the systems selected shall be compatible with the existing building's electrical systems. The integrity of the basic existing building system shall not be compromised, except where agreed to by the Owner. Work shall be designed and sequenced to minimize impact and interruptions in occupied buildings.

For site work, the Consultant shall indicate all existing underground work such as piping, valves, manholes, electric wiring and telephone, whether new connections are being made or not. Profiles of all piping need to be shown to facilitate coordination with the crossing of other utilities.

The Consultant shall incorporate any requirements from the University insurance carrier or Risk Management into the design and specifications.

Projects using BIM modeling shall detail all manufacturer's requirements for equipment service clearances.

Life cycle cost/present worth analyses that assess total costs of certain electrical components over their useful life may be required on selected projects.

ELECTRICAL SYSTEMS DESIGN CRITERIA

The Consultant shall be guided by the following principles when creating the design and when specifying equipment, methods and materials:

- design shall meet all Owner objectives
- equipment and materials specified shall be well-suited for the specific application



- equipment and materials shall be high-quality products from approved manufacturers, selected for ease of installation, durability, low maintenance and high reliability
- electrical systems shall be sized to accommodate future loads
- electrical system components shall be energy efficient when compared to standard products by the same manufacturer
- all conductors are to be copper

LABELING

Label electric circuits using proper AU identification format using the following electrical labeling color scheme:

White letters on black for normal power. This is the standard identification for building systems and equipment.

White letters on orange for critical power. This is for building systems and equipment (legally required) critical and optional emergency power.

White letters on red. This is for life safety systems or emergency powered equipment only.

Submit panel directories in electronic form title by panel number. Install a printed copy of the panel schedule upon completion of the work. Include existing and new work. Hand written panel schedules are not allowed.

ENERGY CONSERVATION

American University is committed to energy efficiency and conservation. Conformance with IECC requirements, NEMA premium motors, University efficiency initiatives and the minimum standards for energy conservation as set forth by the District of Columbia shall be exceeded, wherever possible.

DC Green Code 2013 requirements should be incorporated into the design. This includes switched receptacles shall have the switched symbol designation on the plate



cover and utilize green colored receptacles and switches where available for classrooms, conference, auditoriums and common areas.

Metering, compatible with and integrated into the existing university collection and software systems is required for new buildings. Sub-metering may be required for high load, billable or efficiency monitoring.

CALCULATIONS

All circuits shall be sized for the load to be served. Panel board schedules shall show the load on each circuit, as well as sizing calculations (including connected load, spare capacity and demand factors) used to calculate panel or switchboard size.

All power riser and one-line diagrams shall show the available short circuit currents at the service and each distribution point in the system. Switchboard and panel schedules shall indicate the available short circuit at the equipment.

On large projects where continuity of service is a critical issue, the Consultant shall provide the Owner with a selective coordination study. The study will show (using time current curves) the coordination among all main, feeder and branch circuit over current protection equipment.

The addition of equipment or circuits to a building emergency generator may require a load test to determine if capacity exists. Designer to submit power requirements to FM Master Electrician for review.

PRODUCT STANDARDS

All equipment and materials shall be certified as conforming to industry standards by a third-party laboratory service approved by the District of Columbia. These shall include but not be limited to the following:

- Underwriters Laboratories
- Electric Testing Laboratory
- National Electrical Manufacturers Association



- American National Standards Institute
- Certified Ballast Manufacturers
- Institute of Electrical and Electronic Engineers

All equipment and material shall bear the mark of the respective third-party laboratory service. Generally, provide NEMA 1 enclosures indoors and NEMA 3R enclosures outdoors.

ELECTRICAL DESIGN CRITERIA

GENERAL

All Electrical Work performed on campus must be permitted in accordance with DCRA requirements and under a DCRA provided Electrical Permit.

All projects on campus involving electrical work (regardless of voltage) shall be coordinated with the University's Master Electrician and AU's Commissioning Coordinator.

Projects performed under the Master Electrician's Operations and Maintenance permit shall not proceed from engineering to procurement and construction without the approval of AU's Master Electrician and Director of Energy and Engineering.

The Consultant shall coordinate with the AU's Project Manager for specific information concerning those items and work to be provided under the Contract Documents.

Sources, Connections and Outages for Temporary Lighting and Power shall be coordinated with the AU's Master Electrician. Refer to TEMPORARY LIGHT AND POWER (01 51 13) & (01 51 26)

Planning and Project Management (PPM) Division must pre-approve the placement of any equipment that will be visible from outside the facility.



The primary system is rated at 13, 200volts, 3-phase wire. Additions to the system are installed and maintained by Facilities Management

INSTALLATION OF ELECTRICAL SYSTEMS

Install wires and cables according to the NECA's "Standard of Installation."

Remove existing wire from raceway before pulling in new wire and cable.

Wiring at Outlets: Install with at least 12 inches (300 mm) of slack conductor at each outlet.

Remove existing abandoned wiring & conduit designated as obsolete by AU authorities.

Firestop all penetrations through floors, walls and ceilings according to rating.

Outdoors Wiring Methods shall be as follows:

- Exposed: Rigid steel or intermediate metal conduit.
- Concealed: Rigid steel or Intermediate metal conduit or EMT
- Underground, Single Run: Rigid nonmetallic conduit.
- Underground, Grouped: Rigid nonmetallic conduit, concrete encased.
- Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid or Motor-Driven Equipment): Liquid-tight flexible metal conduit, not exceeding 24" length.

Indoors Wiring Methods (e.g. raceways) shall be as follows:

- Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid or Motor-Driven Equipment): Flexible metal conduit, except in wet or damp locations use liquid tight flexible metal conduit, not exceeding 24" length. Use conduit, tubing, or MC cable in applications allowed by NEC.
- Damp or Wet Locations: Rigid steel, PVC, or Intermediate metal conduit.



- Exposed (including unfinished interior spaces): Electrical metallic tubing, or Rigid metallic conduit.
- Concealed: Electrical metallic tubing, rigid metallic conduit or MC cable except as otherwise indicated.
- Concealed Connections from JBox in Ceiling Space to Light Fixtures Not exceeding 6 feet length: MC cable, or flexible metal conduit.

Conceal wiring, unless otherwise indicated, within finished walls, ceilings, and floors.

Boxes and Enclosures: In damp or wet locations, use NEMA 250, Type 3, Type 4, stainless steel.

Use raceway fittings compatible with raceway and suitable for use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings, unless otherwise indicated.

Raceways Embedded in Slabs: Install in middle third of the slab thickness where practical, and leave at least 1-inch (25-mm) concrete cover.

Install exposed raceways parallel to and at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.

Join raceways with fittings designed and approved for the purpose and make joints tight. Use bonding bushings or wedges at connections subject to vibration. Use insulating bushings to protect conductors.

Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb (90-kg) tensile strength. Leave not less than 12 inches (300 mm) of slack at each end of the pull wire.

Install raceway sealing fittings where required by the NEC and at wiring entrances to refrigerated spaces. Locate at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.



Stub-up Connections for Equipment: Extend conductors to equipment with [rigid steel] [intermediate metal] conduit; flexible metal conduit may be used 6 inches (150 mm) above the floor.

Install a separate green ground conductor in all raceways and conduits.

LOW VOLTAGE ELECTRICAL POWER AND CONDUCTORS - 26 05 19

All circuits abandoned or not used are to be located, identified, disconnected, and taken back to the source.

WIRES AND CABLES

Conductors: Copper.

Building Wires: Type THHN/THWN or XHHW, minimum conductor size #12 for branch circuits.

Armored Cable up to No.2 AWG: Type MC with green insulated copper ground conductor.

Cable No. 1 AWG and Larger: In conduit or EMT with green insulated copper ground conductor.

Connectors and Splices: Wiring connectors of size, ampacity rating, material, and type and class for application and for service indicated.

Single Conductor Plenum Coaxial: 75-ohm characteristic impedance, solid bare copper central conductor, foamed PTFE dielectric, 100 percent coverage copper, double-braid shield, PTFE jacket, suitable for installation in air-handling spaces.

Twisted-Pair Plenum: No. 24 AWG, 7-strand, copper conductors; PTF insulation; overall aluminum/polyester shield and No. 22 AWG copper drain wire; PTFE jacket; suitable for use in air-handling spaces.

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS - 26 05 26



All electrical equipment, devices and raceways shall form a continuously grounded system. Neutral and ground shall be bonded only at the service entrance or at the secondary side of a separately derived system.

Every feeder and branch circuit raceway shall contain a green insulated copper equipment grounding conductor.

All emergency power systems shall be configured and grounded as separately derived systems.

Electrical boxes and enclosures shall be bonded to ground double locknuts and ground bushings.

Each wiring device shall be grounded by means of a separate code-size copper conductor connecting the device ground terminal to the branch circuit panel board ground bus. The conduit system shall not be relied upon for grounding.

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS - 26 05 29

Lighting fixtures shall be tied (with tie wire) to deck above ceiling, supported at diagonal, opposing corners.

MINERALLAC STRAPS

Minerallac straps ARE NOT ACCEPTABLE; one-hole straps are acceptable.



RACEWAYS AND BOXES FOR ELECTRICAL WORK - 26 05 33

RACEWAYS

Wire ways: Screwed cover type, with manufacturer's standard finish

Surface Metal Raceway Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating suitable for painting.

Surface Nonmetallic Raceway: Two-piece construction, manufactured of rigid PVC compound with matte texture and manufacturer's standard color.

Outlet and Device Boxes: Sheet metal boxes, except use cast-metal boxes at exterior, interior exposed, and interior damp locations.

BOXES

Floor Boxes: Cast metal or Sheet metal, fully adjustable, rectangular

Pull and Junction Boxes: Sheet metal boxes, except use nonmetallic, cast aluminum or cast steel boxes with gasketed covers at exterior and interior damp locations.

UNDERGROUND DUCTS AND RACEWAYS - 26 05 43

AU does not permit Medium Voltage electrical distribution overhead or exposed on campus. All Medium Voltage electrical distribution systems shall be installed underground in duct banks.

All other electrical distribution shall be concealed in conduit or as otherwise approved.

No cabling shall be direct buried. The FM Project Manager shall coordinate actual routing and installation outside the buildings with AU's Master Electrician and Director of Energy & Engineering.



LOW VOLTAGE TRANSMISSION AND SERVICE - 26 21 00

Provide only one service entrance per building, except where otherwise specifically permitted by the Owner. Service entrance equipment shall be switchboard, panel board.

Overcurrent protection for the entire building shall be by single main device.

Service entrance switchboards shall have at least 20% spare breaker spaces, each fully provisioned and sized for estimated future loads.

Service entrance panel boards shall have at least 20% spare 3-pole spare breaker spaces, each fully provisioned and sized for one-half of estimated future loads.

If ground fault protection is provided on the main over current protection device, ground fault also shall be provided on devices in the same switchboard or panel board. All ground fault equipment shall be adjustable. (Initial settings shall be 20% of device rating, with 6-cycle time separation between main and feeder devices.)

Over current protection, devices with ground fault will be circuit breaker only.

LOW-VOLTAGE TRANSFORMERS, DISTRIBUTION TRANSFORMERS 26 22XX

Transformers shall be the standard product of an approved transformer manufacturer. They shall be of live front, loop-feed configuration and pad-mounted design with voltage taps and a 4-position switch conforming to the Owner's standard specification.

DRY-TYPE TRANSFORMERS

Insulation shall be NEMA ST20 Standard for 220 degrees C. UL component recognized insulation system. For transformers rated 112.5 KVA and below, the insulation shall be rated 115 degrees C. rise above 40 degrees C. ambient. For transformers rated over 112.5 KVA, the insulation shall be rated 80 degrees C. rise above 40 degrees C. ambient.



Transformer enclosures shall be indoor-type, completely enclosed with drip-proof ventilated openings, steel with factory standard finish. Transformers less than 30 KVA three-phase or 25 KVA single-phase may have non-ventilated enclosures. Provide a concrete housekeeping pad, minimum 4" thick.

PRODUCTS

MANUFACTURED UNITS

General-Purpose, Dry-Type Transformers, 600 V or less:

- Comply with NEMA ST 20 and list and label as complying with UL 1561.
- Two winding type, three-phase units using one coil per phase in primary and secondary.
- Enclosure: Indoor, ventilated, Outdoor, ventilated, rain tight, NEMA 250, Type 3R.
- Wall-Mounting Brackets: Manufacturers standard for units up to 75 kVA.
- Taps: Standard; for transformers 25 kVA and smaller, provide 2 taps 5 percent below rated high voltage.

EXECUTION

INSTALLATION

Arrange equipment to provide adequate spacing for access and for cooling air circulation. Mount transformers larger than 75 kVA on concrete bases or 6" steel channels.

All wiring terminations are to be high-pressed type.

TESTING AND ADJUSTING

Perform visual and mechanical inspections and electrical tests stated in NETA ATS.

Adjust taps after installation to obtain indicated secondary voltage.



SWITCHBOARDS - 26 24 13

Motor branch circuits shall be 480-volt, three-phase, wherever possible. Provide disconnect switches near the motor and motor controller. Individual combination starters are not permitted. Motor control centers shall have combination starters.

All motor circuits shall be dedicated circuits, except for small fractional horsepower exhaust fans that can be easily served and controlled from local lighting and power circuits.

PANEL BOARDS - 26 24 16

REQUIREMENTS

Manufactures: Cutler-Hammer, General Electric, or Square-D
Flush and/or Surface mounted.

Load Capacity: Main breaker capacity and number of circuit breakers that panel will accommodate shall be made clear on Drawings.

Front: Shall be secured to box with concealed trim clamps, or hinged to box with standard door within hinged cover.

Doors: Shall have concealed hinges, flush catches, and tumbler locks, all keyed alike.

Bus: Shall be hard drawn copper of 98 percent conductivity.

Molded-Case Circuit Breakers: NEMA AB 1, bolt-in, full module type. Single handle for multipole circuit breakers. Appropriate for application, including Type SWD for repetitive switching lighting loads and Type HACR for heating, air-conditioning, and refrigerating equipment.

Fusible Switches: NEMA KS 1, Type HD, with [rejection] clips to accommodate indicated fuses, handle lockable.



Motor Controllers: NEMA ICS 2, Class A combination controllers.

Contactors: NEMA ICS 2, Class A combination contactors.

INSTALLATION

Install panel boards and accessory items according to NEMA PB 1.1. Indicate installed circuit locations on typed directory.

Mounting Heights: Top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated. Revise or delete paragraph below to suit Project.

Future Circuit Provisions at Flush Panel boards: Stub four empty 3/4-inch (19-mm) conduits from panel board into accessible or designated ceiling space and four empty conduits into raised floor or space below floor.

Wiring in Panel Board Gutters: Arrange conductors into groups bundle and wrap with wire ties.

Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL486B.

Perform visual and mechanical inspections and electrical tests stated in NETA ATS.

MOTOR CONTROL CENTERS - 26 24 19

SECTION REQUIREMENTS

Submittals: Product Data.

Coordinate features of controllers and accessory devices with pilot devices and control circuits to which they connect.



Coordinate features, accessories, and functions of each motor controller with the ratings and characteristics of the supply circuit, the motor, the required control sequence, and the duty cycle of the motor and load.

PRODUCTS

CONTROLLERS AND ACCESSORIES

Manual Motor Controllers: NEMA ICS 2, general purpose, Class A with toggle action and overload element, in each phase. Hand-off-automatic switch and "on" pilot light in cover.

Magnetic Motor Controllers: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated; with integral control transformer. Hand-off-automatic switch and "on" pilot light in cover. Combination Controller: Factory-assembled combination controller and fusible disconnect switch.

Overload Relay: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect, adjusted for duty cycle.

Multispeed-Motor Controller: Match controller to motor type, application, and number of speeds. Provide speed selector switch.

Reduced-Voltage Motor Controllers: Matching type of motor and load with appropriate (e.g. star-delta, part winding, other) type controller.

Pilot Lights and Selector Switches: NEMA ICS 2, heavy-duty type.

All Motor Control Centers to have an electronic power meter. Manufacturer: Electro Industries (Shark, or Nexus), factory installed and fully integrated with existing American University electricity collection equipment and software.

EXECUTION INSTALLATION



Use manual controllers for fractional-horsepower single-phase motors, unless otherwise indicated. Install independently mounted motor-control devices.

Install indicated fuses in each fusible switch.

Connect selector switches to bypass only the manual and automatic control devices that have no safety functions when switch is in the hand position.

Connect selector switches with motor-control circuit in both hand and automatic positions for safety-type control

Devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

TESTING

Perform visual and mechanical inspections, and electrical tests stated in NETA ATS.

LOW-VOLTAGE DISTRIBUTION EQUIPMENT – 26 27 00

For new buildings, the power distribution system shall have separate life safety and emergency lighting. Power and mechanical loads into dedicated panel boards shall have dedicated originating from the service entrance equipment.

WIRING DEVICES – 26 26 26

GENERAL

SECTION REQUIREMENTS

- Submittals: Product Data
- Comply with NEMA WD 1
- Comply with NEC

PRODUCTS

DEVICES



General: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

Color: Ivory unless otherwise indicated.

Receptacles: Heavy Duty grade, NEMA WD6, Configuration 5-20R unless otherwise indicated.

Ground-Fault Circuit Interrupter Receptacles: Feed-through type, with integral duplex receptacle; for installation in a 2-3/4-inch- (70-nuu-) deep outlet box without an adapter, Configuration 5-20R.

Transient Voltage Surge Suppressor Receptacles: Duplex type, with integral TVSS in line to ground, line to neutral, and neutral to ground; meets IEEE C62.41 Category B test with nominal transient-suppression clamp level of 500 V and minimum single transient pulse energy dissipation of 140 J line to neutral, and 70 J line to ground and neutral to ground.

Snap Switches: Heavy-duty, quiet type, 277 Volts rated.

Incandescent Lamp Dimmers: Modular, 120 V, 60Hz with audible and electromagnetic noise filters and continuously adjustable slide, single-pole with soft tap or other quiet switch, min. 600 Volts rated.

Fluorescent Lamp Dimmers: Modular, compatible with dimmer ballasts, with audible and electromagnetic noise filters and capable of consistent dimming to a maximum of 10 percent of full brightness. Include trim potentiometer.

Dimming System: Factory assembled dimming/relay panel, NEMA 1 grade, and low voltage control stations and interface panel. Dimmers to provide a smooth and continuous "square law" dimming curve throughout the entire dimming range. Dimming ballasts will be provided with the fixtures.

Wall Plates, Finished Areas: Satin-finish stainless steel, fastened with metal screws having heads matching plate color. Provide standard-size Type 304 stainless



steel wall plates that are compatible with the switches. Provide Stainless steel screws for securing the devices to the wall plates.

Wall Plates, Unfinished Areas: Satin-finish stainless steel with metal screws.

Floor Service Fittings: Modular, above-floor, dual-service units suitable for wiring method used.

Multi-outlet Assemblies: Components produced by a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles. Metallic raceway with No. 12 AWG wire. One receptacle per 12 inches (300 mm).

AUTOMATIC WALL SWITCH shall:

- be Manufactured by Novitas or Watt Stopper
- be Ivory-colored, decorator-style, low profile, UL-listed automatic light switch which replaces and fits into a single-gang wall switch outlet box.
- have the following features:
 - 277-volt AC, manual-on, 60 to 1200 watt (ballast load), single level lighting control with 180- degree coverage for 900 (maximum) square feet.
 - Digital time-delay adjustable covering at least the interval from 90-seconds to 30-minutes.
 - Adjustable unit sensitivity from 20-percent to 100-percent.
 - Integrated Light Level Sensor.
 - LED for sensitivity calibration.
 -
 - Compatible with electronic ballasts.

CEILING-MOUNTED ULTRA-SONIC DETECTORS shall:

- be White-colored, 24-volt, AC, 20-milliampere, UL-listed sensor for use with companion relay/power supply.



- be configured such that where the ultrasonic signals of one sensor can interfere with the operation of an adjacent unit; provide detector units with different operating frequencies.
- have the following features:
 - 360-degree single-directional, 1000 square-foot coverage.
 - Temperature and humidity resistant solid-state, crystal-controlled 25-kilohertz detector.
 - Logic Key/On by-pass.
 - Adjustable time delay covering at least 30-seconds to 12-minutes.
 - Adjustable sensitivity

DUAL TECHNOLOGY OCCUPANCY SENSORS shall:

- be White-colored, 24 VDC, 28-milliampere, UL and CUL listed for use with power pack.
- have the following features:
 - PIR and Ultrasonic technologies
 - Integrated light level sensor 2.5 to 430 foot coverage
 - Single pole, double-throw isolated relay
 - 40kHz +/- 0.006% frequency ultrasonic
 - Adjustable time-delay of 15 sec. to 15 min.
 - LED indicator for both technologies
 - Adjustable sensitivity

COMBINATION RELAY/POWER SUPPLY shall:

- be Junction box mounted, UL-listed, 277-volt primary, 24-volt DC secondary, 100-milliampere secondary, Self-contained transformer/relay unit.
- have relay contacts rated 277-volts, shall open when the room is unoccupied, and close when the room is occupied.

WALL PLATES

- a. Where unit sensor and manual wall switch are located side-by-side, provide common wall plate and barrier switchbox.



- b. Where wall plate cover is not specifically listed, cover to be stainless.

EXECUTION

- **INSTALLATION**

- Install devices and assemblies plumb and secure.
- Mount devices flush, with long dimension vertical, and grounding terminal of receptacles on top unless otherwise indicated. Group adjacent devices under single, multigang wall plates.
- Protect devices and assemblies during painting.
- Install wall plates when painting is complete.
- Install wall-mounted devices vertically and in accordance with NEC and recognized industry practices. Mounting heights shall be as noted on the contract Drawings for switches. Ceiling-mount sensors to back plates secured to ceilings.
- Where automatic wall switches are shown adjacent to wall switches, the automatic switch (indicated as OS) shall be connected to control all of the lighting in the room. The manual switch shall be connected between the output leg of the occupancy sensor switch and the switched leg to the outside-lamp ballasts and act as an override-to-off switch. The inside lamp ballasts shall be connected directly to the output of the occupancy sensor.
- In rooms with ceiling-mounted occupancy sensors (indicated as OSI) and suspended ceilings, surface mount the occupancy sensors to the center of ceiling tiles. Connect the power supply/relay unit to the normal power source, and connect the relay contacts in series with the line side of both wall switches for the inside and outside lamp ballasts. The switches shall act as "override-to-off."
- Wiring from ceiling-mounted sensors to relay/power supplies shall be with plenum-rated, limited-energy, three-conductor, and #18 through #22 copper conductors. Coordinate with other work, including ceiling installation, painting, wiring and box installation. Notify the Owner's Representative of location discrepancies before roughing-in device and then obtain a new location as necessary.
- Wall-mounted devices shall be installed after wiring is complete.
- Install cover-plates and devices after painting is complete.
- Install wall-mounted devices and combination relay/power supplies to electrical boxes which are clean and free of building material, dirt and debris.



- Provide electrically continuous, tight ground connections for the automatic switches.
- Ground the hex green grounding screw of the switching device to the ground wire of the branch circuit.

TESTING

- Test all automatic switches and all sensors for proper operation. Adjust sensitivity and time-delay of all sensors and demonstrate adjustment and operating procedures to Owner.

LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES – 26 28 00

ENCLOSURES

- a. Hinged-Cover Enclosures: NEMA 250, steel enclosure with continuous hinge cover and flush latch. Finish inside and out with manufacturer's standard enamel.
- b. Cabinets: NEMA 250, Type 1, unless otherwise indicated.

CIRCUIT BREAKERS - 26 28 16

- Manufacturer: Cutler-Hammer, General Electric, or Square-D
- Enclosed, Molded-Case Circuit Breaker: NEMA AB 1, with lockable handle and thermal-magnetic trip unless otherwise indicated.
 - Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated.
 - Interrupting Rating: Exceeds available fault current.
 - Thermal-Magnetic Circuit Breakers, 225 A and Larger: Trip units [interchangeable within frame size] [with adjustable magnetic trip].
 - Electronic Trip Unit Circuit Breakers, 400A and Larger: Field-adjustable, short time and continuous-current [and ground-fault trip] settings.
 - Current-Limiting Trips: Let-through ratings less than NEMA FU 1, Class RK-5.
 - Enclosure: NEMA AB 1, Type 1, unless otherwise specified or required to meet environmental conditions of installed location.



- Circuit breaker to be bolt-in type.
- Perform visual and mechanical inspections and electrical tests stated in NETA ATS.

ENCLOSED SWITCHES - 26 28 16.16

Enclosed, Non-fusible Switch: NEMA KS 1, Type HD, with lockable handle.
Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, clips to accommodate specified fuses, enclosure consistent with environment where located, handle lockable with 2 padlocks, and interlocked with cover in closed position.

LIGHTING – 26 50 00

Refer to the detailed recommendation standard develop by AU to meet efficiency goals and maintenance standards for LED Lighting 26 5522.

LIGHTING BRANCH CIRCUITS

- Wherever possible, lighting branch circuits shall be 277-volt, single-phase. When 120/208 voltages are used, provide separate circuits for lighting loads only.
- Lighting branch circuits may be arranged as three-phase conductors, one neutral conductor and one grounding conductor for each home run.

INSTALLATION

- Set units, level, plumb, and square with ceiling and walls, and secure.
- Support for Recessed and Semi-recessed Grid-Type Fluorescent Fixtures: Install ceiling support system rods or wires at a minimum of 2 rods or wires for each fixture, located not more than 6 inches (!50 mm) from fixture comers.
- Support for Suspended Fixtures: Brace pendants and rods over 48 inches (1220 mm) long to limit swinging. Support stem-mounted, single-unit, suspended fluorescent fixtures with twin-stem hangers. For continuous rows, use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of chassis, including one at each end.
- Air-Handling Fixtures: Install with dampers closed.



- Lamping: Where specific lamp designations are riot indicated, lamp units according to manufacturer's written instructions.

INTERIOR LIGHTING - 26 51 00

The Designer shall match existing fixtures and luminaires currently in use on campus where possible. This assists in repair and response time.

INTERIOR FIXTURES, LAMPS AND BALLASTS - 26 51 13

Submittals: Product Data for each luminaire, including lamps.

- Fixtures, Emergency Lighting Units, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- Coordinate ceiling-mounted luminaires with ceiling construction, mechanical work, and security and fire-prevention features mounted in ceiling space and on ceiling.

GENERAL

- Metal Parts: Free from burrs, sharp corners, and edges. Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit re-lamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during re-lamping and when secured in operating position.
- Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.
- Lighting fixtures shall be selected and designed to meet requirements of ASHRAE Standard 90.1-2010 for lighting power densities (in watts per square foot) and in accordance with the recommendations of the Illuminating Engineering Society of North America (IESNA). Lighting design levels should not exceed power density or IES standards. These standards are readily available and take



into account the type of visual activity in a space, and the age range of the users of the space.

- Incandescent lamps are prohibited unless explicitly approved by the university. Suitable replacements can usually be found among the many varieties of compact fluorescent lamps. Varieties are now available which approach the color of incandescent light.
- Use electronic ballasts and T8 lamps in fluorescent light fixtures. They combine the best quality of light with the most energy savings.
- Not all electronic ballasts, light fixtures and controls are created equal. Compare manufacturer's warranties and include required information for Owner to maximize warranty.
- Occupancy sensors should be considered where spaces are occupied intermittently. They can be inexpensively installed in individual offices, classrooms, and small to moderate size conference rooms.
- Lighting design shall emphasize accessibility for re-lamping, cleaning and maintenance. The location of fixtures over hazardous chemicals, mechanical equipment and laboratory benches shall be avoided. Special provisions shall be made for lamps located in high-ceiling areas for lowering or otherwise solving the maintenance problem.

LUMINAIRES

Fixture Type: Designer shall provide a fixture schedule with a description or manufacturers and model numbers.

Life safety, exit and night lighting fixtures shall not be equipped with switches. All other light fixtures shall be switched or controlled. Office, conference and other administrative or presentation spaces shall have dual-level switching.

Source low-mercury lamps for indoor and outdoor fixtures as well as both hard-wired and portable fixtures. Mercury-containing lamps shall contain no more than 90 picograms per lumen hour, with a target of 70 picograms per lumen hour or less where available. Where less than 90 picograms per lumen hours is unavoidable, using an across the building or project calculation may be acceptable, code permitting.



CFLs should comply with the voluntary industry guidelines for maximum mercury content published by the National Electrical Manufacturers Association (NEMA).

EMERGENCY LIGHTING – 26 52 00

- Life safety power circuits shall include fire alarm, warning systems and emergency communication systems.
- Life safety lighting circuits shall include emergency exit lighting and exit signs. An emergency generator shall provide backup power.
- In facilities with emergency generators, provide separate dedicated wiring circuits.
- Light fixtures with in-fixture battery/inverter packages shall be prominently marked.
- Life safety, exit and night lighting fixtures shall not be equipped with switches.

EXIT SIGNS – 26 53 00

- Exit signs are to be LED.
- General Requirements – Comply with UL 924 and the following:
- Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack. Sealed, maintenance-free, nickel-cadmium battery and fully automatic, solid-state charger with sealed transfer relay.
- Manufacturer: Lithonia Lighting
- Model: LX W 3 R EL N
- Sign material: Steel
- Sign colors: White single stencil, red lettering
- Lettering Size: $\frac{3}{4}$ " stroke X 6" high.

EXTERIOR LIGHTING - 26 56 00

- New construction may include some outside area lighting for landscape and security. All street and parking lot lighting, including fixture selection, and placement will be approved by the Project Manager, AU's Master Electrician and a representative from University Safety and Security Services. Designer should match



existing parking lot light, emergency phone poles, and exterior building lighting to current campus fixtures.

- To make utility connections, the Project Manager will schedule all interruptions of services.
- Walkway lights are Spring City “Washington Standard” LED. Color Temperature shall be 5,000 Kelvin.
- Site lighting circuits shall be served by PVC conduit with THHN/THWN copper wire.
- Circuits shall be buried a minimum of 18 inches deep.
- Poles and fixtures shall be grounded.
- Building entrances, walkways and parking areas shall be properly illuminated for safety and security. Exterior lighting fixtures shall utilize the American University standard fixture to the extent possible on the Campus grounds. Small exterior auxiliary or service spaces may be illuminated with fluorescent fixtures equipped with cold weather ballasts.
- Exterior light fixtures shall be selected to avoid light pollution, including shielded and low wattage fixtures as per LEED and code requirements
- Separate circuits controlled by a photocell shall serve exterior and site lighting fixtures. Parking lot and other area lighting fixtures shall be circuited separately from stairway, porch or canopy lights; however, the same photocell may control both kinds of lighting.

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DIVISION 26 – ELECTRICAL PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Concrete Vaults - Electrical

1. S&C Electric Trenwa

Emergency Generator

1. Cummins w/matching AFS

Imbiber Beads

1. Inhibitive Technologies

Metering Device – Main Distribution

1. Nexus 1500

Metering Device - Sub meter

1. Nexus Shark

Transfer Switch

1. Cummings Power

Transformer – Medium Voltage

1. Howard

Underground Switchgear

1. S&C Electric Vistas

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to the following:

Automatic Wall Switch

1. Wattstopper

Circuit Breakers

1. Cutler Hammer
2. General Electric
3. Square D

Dimmer Controls

1. Lutron
2. N-Light

Dimmer Switch

1. Bryant
2. Pass & Seymour



Electric Service Switch

1. Cutler Hammer
2. Siemens
3. Square D

Electric Panels

1. Cutler Hammer
2. Siemens
3. Square D
4. Westinghouse

Motor Control Center

1. General Electric
2. Siemens
3. Westinghouse

Panel Boards

1. Cutler Hammer
2. General Electric
3. Square D

Transformer

1. Siemens
2. Square D
3. Westinghouse

— END OF DIVISION 26 —

26 32 1x GENERATORS

PART 1 - GENERAL

SCOPE

- A. Provide complete factory assembled generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, digital voltage regulator, and all auxiliary systems required for automatic operation.
- B. Provide factory testing, on-site startup by a supplier authorized by the equipment manufacturers, and on-site testing of the system.
- C. The generator set manufacturer shall warrant all equipment provided under this section, so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator set.

CODES AND STANDARDS

The generator set installation and on-site testing shall conform to the requirements of the following codes and standards, as applicable.

- A. The generator set shall include necessary features to meet the requirements of these standards.
 - i. IEEE 446 - recommended practice for emergency and standby power systems for commercial and industrial applications.
 - ii. NFPA 37 standard for the installation and use of stationary combustion engines and gas turbines.
 - iii. NFPA 70 - national electrical code. Equipment shall be suitable for use in systems in compliance to articles 700, 701, and 702.
 - iv. NFPA 110 emergency and standby power systems. The generator set shall meet all requirements for level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit. Component level type tests will not be allowed to substitute for this requirement.
- B. The generator set and supplied accessories shall meet the requirements of the following standards:
 - i. NEMA publication mg1, part 32 - the alternator shall comply with the requirements of this standard.
 - ii. UL1236 - battery charger.
 - iii. UL 2200 - the generator set shall be listed under UL 2200 or submit evidence of an independent third party certification process to verify compliance as furnished.
 - iv. Diesel and gas engines shall be EPA tier 3 certified all engines diesel or gas shall include a valid EPA engine certificate of compliance.

C. The control system for the generator set shall comply with the following requirements:

- i. En 50082-2, electromagnetic compatibility generic immunity requirements, part 2: industrial.
- ii. En 55011 limits and methods of measurement of radio interference characteristics of industrial, scientific and medical equipment
- iii. Fcc part 15, subpart b.
- iv. IEC 8528, part 4 - control systems for generator sets.
- v. IEC std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
- vi. UL 508 - the entire control system of the generator set shall be UL 508 listed and labeled.
- vii. UL 1236 - battery chargers.

D. The generator set manufacturer shall be certified to ISO 9001 international quality standard and shall have third party certification VERIFYING QUALITY ASSURANCE IN design/development, production, installation, and service, in accordance with ISO 9001.

ACCEPTABLE MANUFACTURER

A. Manufacturer shall be Cummins power generation, no substitutes.

SUBMITTALS

Submittals shall be clear and legible and shall include the following

A. DESIGN REVIEW

- i. Submit three copies of each shop drawing.
- ii. A maximum of two marked copies will be returned to the manufacturer, or one additional reproducible copy may be submitted to be marked and returned for manufacturer's use.
- iii. Identify each item submitted using applicable specification section number and paragraph reference.
- iv. Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.
- v. Maintenance requirements.
- vi. Warranty with copy of manufacturer and/or component requirements.
- vii. Manufacturer's certification of prototype testing.
- viii. Manufacturer's installation instructions.

B. O&M SUBMISSION

C. Manufacturer's emergency power system operating and maintenance instruction manuals

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- D. Operating and maintenance instruction manuals covering the entire emergency power system including the transfer scheme.
- E. Framed operating instructions shall be mounted on or near the unit.
- F. Executed warranty documents
- G. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
- H. Interconnection wiring diagrams showing all external connections required, with field wiring terminals marked in a consistent point-to-point manner.

SERVICE AND SUPPORT

- A. The manufacturer of the generator set shall maintain service parts inventory at a central location that is accessible to the service location 24 hours per day, 365 days per year.
- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.
- C. The manufacturer shall maintain model and serial number records of generator set provided for at least 20 years.

WARRANTY

- A. The generator set and associated equipment shall be warranted for a period of not less than 5 years or 1500 hours from the date of commissioning against defects in materials and workmanship.
- B. The warranty shall be comprehensive. No deductibles will be allowed for travel time, service hours, repair parts cost, etc.

TRAINING:

- A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided.
- B. The training program shall be not less than 4 hours in duration, the class size shall be limited to 5 persons, and the training shall occur at the owner's site.
- C. The training shall be videotaped.
- D. Training date shall be coordinated with the facility owner through commissioning.

PART 2 - PRODUCT REQUIREMENTS

GENERATOR SET

A. RATINGS

- i. The generator set shall operate at project design voltage at 1800 rpm and shall be three phase, 4 wire and 60 hertz.
- ii. The generator set shall be sized for project load (kwh), operating at 0.8 pf, standby rated, based on site conditions of: altitude 1000 ft., and ambient temperatures up to 104 degrees F. These ratings shall be increased if necessary to carry full continuous and motor starting loads of the actual equipment provided. Any other changes necessitated by a change in generator capacity shall also be made.
- iii. The generator set rating shall be based on emergency service.

B. PERFORMANCE

- i. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
- ii. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
- iii. The diesel engine-generator set shall accept a single step load of 100 percent nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- iv. Motor starting capability shall be a minimum of 105% of design load.
- v. The generator set shall be capable of recovering to a minimum of 90 percent of rated no load voltage following the application of the specified kva load at near zero power factor applied to the generator set. Maximum voltage dip on application of this load, considering both alternator performance and engine speed changes shall not exceed 15 percent.
- vi. The alternator shall produce a clean ac voltage waveform, with not more than 5 percent total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3 percent in any single harmonic, and no third order harmonics or their multiples. Telephone influence factor shall be less than 40.
- vii. The generator set manufacturer to be shall be certified by the engine suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.

C. CONSTRUCTION

- i. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
- ii. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3r enclosure. There shall be no exposed points in the control enclosure (with the door open) that operate in excess of 50 volts.

D. CONNECTIONS

- i. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical terminations. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.
- ii. Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.
- iii. Generator set control interfaces to other system components shall be assembly. Made on a permanently labeled labels describing connection terminal block point functions shall be provided.

ENGINE AND ENGINE EQUIPMENT

- A. The engine shall be diesel, 4 cycle, radiator and fan cooled. Minimum displacement shall be 661 cubic inches (10.8 liters), with 6 cylinders. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable.
- B. Generator exhaust should be ducted to discharge above the roof at a location remote from any air intakes. In special applications, exhaust discharge can be located at ground level in a protected manhole away from pedestrian traffic.
- C. Fuel oil tanks for emergency generators shall be mounted above ground.
- D. Engine accessories and features shall include:
 - i. An electronic governor system shall provide automatic isochronous frequency regulation.
 - ii. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, and accelerating to rated speed.
 - iii. The governing system shall include a programmable warm up at idle and cool down at idle function. While operating in idle state, the control system shall disable the alternator excitation system.
 - iv. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees f ambient as measured at the alternator air inlet.
 - v. Radiator fan shall be suitable for use in a system with 0.5-inch h₂O static restriction. Radiator shall be sized based on a core temperature that is 20 degrees f higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/ fan operation in a controlled environment.
 - vi. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50 ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental contact.
 - vii. Electric starter shall be capable of three complete cranking cycles without overheating.

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- viii. Lubrication oil pump shall be positive displacement, mechanical, full pressure type.
- ix. Lubrication oil filters shall be full flow type with replaceable spin-on canister elements and dipstick oil level indicator.
- x. Fuel pump shall be an engine driven, mechanical, positive displacement type.
- xi. Fuel filter shall include a replaceable spin- on canister element.
- xii. A fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified, shall be provided if required for operation due to the design of the engine and the installation.
- xiii. Air filter shall be replaceable dry element type with restriction indicator.
- xiv. Supply and return fuel lines shall be flexible type.
- xv. Engine mounted battery charging alternator, shall be 40-ampere minimum, with solid-state voltage regulator.
- xvi. Coolant heater
 - a. Provide engine mounted thermostatically controlled, coolant heater for engine. Heater voltage shall be 208 volts, single phase.
 - b. The coolant heater shall be ul 499 listed and labeled.
 - c. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall include provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. Quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
 - d. The coolant heater shall be provided with a dc thermostat, installed at the engine thermostat housing. An ac power connection box shall be provided for a single ac power connection to the coolant heater system.
 - e. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 104 degrees f in a 40 degrees f ambient, in compliance with NFPA 110 requirements, or the temperature required for starting and load pickup requirements of this specification.
 - f. Provide vibration isolators as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.
 - g. Starting and control batteries shall be lead acid type, 24-volt dc, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40 degrees f ambient temperature when fully charged.
 - h. Provide critical grade exhaust silencer for engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The exhaust system shall be installed inside the genset enclosure according to the engine manufacturer's recommendations and applicable codes and standards.

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- i. Exhaust system shall include a minimum 18 inch long flexible steel exhaust connection for each
- j. Exhaust outlet to silencer.
 - a. Exhaust silencer shall reduce noise 25-35 decibels as compared to the generator's open exhaust.
 - b. Provide a threaded drain hole.
- k. Provide an ul listed 10-amp voltage regulated battery charger. The charger may be located in the automatic transfer switch, or may be wall mounted, at the discretion of the installer. Input ac voltage and dc output voltage shall be as required. Charger shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form c contacts rated at 4 amps, 120 volts ac, 30 volts dc for remote indication of:
 - a. Loss of ac power - red light.
 - b. Low battery voltage - red light.
 - c. High battery voltage - red light.
 - d. Power on - green light (no relay contact).
- l. Charger shall include an analog dc voltmeter and ammeter, 12 hour equalize charge timer, and ac and dc fuses.

AC GENERATOR

- A. The ac generator shall be: synchronous, four pole, 2/3-pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA mg1 temperature limits for class h insulation system and shall be ul 1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees centigrade.
- B. The generator shall be capable of delivering rated output (kva) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
- C. A permanent magnet generator (pmg) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The pmg and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300 percent of rated current for not more than 10 seconds.
- D. The sub transient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

GENERATOR SET CONTROL

- A. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and

control of the generator set, and remote monitoring and control as described in this specification.

- B. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.
- C. The generator set mounted control shall include the following features and functions:
 - a. Control switches
 - i. Mode select switch: the mode select switch shall initiate the following control modes. When in the run or manual position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the off position the generator set shall immediately stop, bypassing all time delays. In the auto position, the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - ii. Emergency stop switch: switch shall be red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
 - iii. Reset switch: the reset switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - iv. Panel lamp switch: depressing the panel lamp switch shall cause the entire panel to be lighted with dc control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
 - b. Generator set ac output metering: the generator set shall be provided with a metering set including the following features and functions:
 - i. Digital metering set, 1 percent accuracy, to indicate generator rms voltage and current, frequency, output current, output kw, kwh, and power factor. Generator output voltage shall be available in line-to-line and line- to-neutral voltages, and shall display all three-phase voltages (line to neutral or line-to-line) simultaneously.
 - ii. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 100 percent of rated load, in 10 percent increments. The control shall display hours of operation at less than 30 percent load and total hours of operation at more than 90 percent of rated load.
 - iii. The control system shall log total number of operating hours, total kWh, and total control on hours, as well as total values since reset.
 - c. Generator set alarm and status display
 - i. The generator set control shall include led alarm and status indication lamps. The lamps shall be high intensity led type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
 - ii. The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown

- function monitored by the genset. They shall also be configurable for color, and control action (status, warning, or shutdown).
- iii. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
 - iv. The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.
 - v. The control shall include an amber common warning indication lamp.
- d. The generator set control
- i. Shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:
 - 1. Low oil pressure (warning)
 - 2. Low oil pressure (shutdown)
 - 3. Oil pressure sender failure (warning)
 - 4. Low coolant temperature (warning)
 - 5. High coolant temperature (warning)
 - 6. High coolant temperature (shutdown)
 - 7. High oil temperature (warning)
 - 8. Engine temperature sender failure (warning)
 - 9. Low coolant level (warning)
 - 10. Fail to crank (shutdown)
 - 11. Fail to start/over crank (shutdown)
 - 12. Over speed (shutdown)
 - 13. Low dc voltage (warning)
 - 14. High dc voltage (warning)
 - 15. Weak battery (warning)
 - 16. Low fuel (warning)
 - 17. High ac voltage (shutdown)
 - 18. Low ac voltage (shutdown)
 - 19. Under frequency (shutdown)
 - 20. Over current (warning)
 - 21. Over current (shutdown)
 - 22. Short circuit (shutdown)
 - 23. Over load (warning)
 - 24. Emergency stop (shutdown)
 - e. Four (4) configurable conditions
 - f. Provisions shall be made for indication of 4 customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

ENGINE STATUS MONITORING

- A. The following information shall be available from a digital status panel on the generator set control:
- i. Engine oil pressure (psi)
 - ii. Engine coolant temperature (degrees f)
 - iii. Engine oil temperature (degrees f)
 - iv. Engine speed (rpm)
 - v. Number of hours of operation (hours)
 - vi. Number of start attempts
 - vii. Battery voltage (dc volts)
 - viii. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

Engine control functions

- A. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and number of cycles. Initial settings shall be for cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
- B. The control system shall include an idle mode control, which allows the engine to run in idle mode in the run position only. In this mode, the alternator excitation system shall be disabled.
- C. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
- D. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
- E. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.
- F. The control system shall be equipped with dry contacts that receive power from the battery system and that are controlled to provide 24-volt output to a solenoid valve in the fuel oil supply line from the fuel oil tank. Contacts shall provide power to energize and open the solenoid valve and allow fuel oil flow when generator receives start signal and remove power to de-energize the solenoid valve to stop fuel oil flow when generator shuts down.

ALTERNATOR CONTROL FUNCTIONS

- A. The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from disoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The

voltage regulation system shall be equipped with three- phase rms sensing and shall control buildup of ac generator voltage to provide a linear rise and limit overshoot.

- B. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric led readout to indicate setting level.
- C. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110 percent of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA 70, article 445.
- D. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA 70, article 445.
- E. Controls shall be provided to monitor the kw load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load-shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
- F. An ac over/under voltage monitoring system that responds only to true rms voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110 percent of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130 percent. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85 percent for more than 10 seconds.

OTHER CONTROL FUNCTIONS

- A. A battery monitoring system shall be provided which initiates alarms when the dc control and starting voltage is less than 25 volts dc or more than 32 volts dc. During engine cranking (starter engaged), the low voltage limit shall be disabled, and dc voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

CONTROL INTERFACES FOR REMOTE MONITORING

- A. The control system shall provide 4 programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control. The relays shall be configured to indicate: (1) generator set operating at rated voltage and frequency, (2) common warning, (3) common shutdown, (4) load shed command.
- B. A fused 10 amp switched 24 volt dc power supply circuit shall be provided for customer use. Dc power shall be available from this circuit whenever the generator set is running. (3) A fused 10-amp 24-volt dc power supply circuit shall be provided for customer use. Dc power shall be available from this circuit at all times from the engine starting/control batteries.

OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET

- A. The generator set shall be provided with a connection box for free conductors to three individually mounted circuit breakers outside of generator enclosure, no generator mounted circuit breaker is required.
- B. Outdoor weather-protective sound attenuated enclosure:
 - i. The generator set shall be provided with an outdoor sound attenuated enclosure, with the entire package listed under ul 2200. Sound rating not to exceed 75.8 dba at 7 meters. The package shall comply with the requirements of the national electrical code for all wiring materials and component spacing. The total assembly of generator set, including the enclosure shall be designed to be lifted into place using spreader bars. Housing shall provide ample airflow for generator set operation at rated load in an exterior ambient temperature of 100 degrees f. The housing shall have hinged access doors as required to maintain easy access for all operating and service functions. All doors shall be lockable and include retainers to hold the door open during service. Enclosure roof shall be cambered to prevent rainwater accumulation. To limit access of rodents openings shall be screened into the enclosure. All electrical power and control interconnections shall be made within the perimeter of the enclosure.
 - ii. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two-step electro coating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating that meets the following requirements:
 - a. Primer thickness, 0.5 to 2.0 mils

- b. Top coat thickness, 0.8 to 1.2 mils
 - c. Glossy per astm 0523-89i 80 percent plus or minus 5 percent
 - d. Gloss retention after one year shall exceed 50 percent
 - e. Crosshatch adhesion, per astm 03359-93, 4b-5b
 - f. Impact resistance, per astm 02794-93, 120-160 inch- pounds
 - g. Salt spray, per astm b117-90, 1000 plus hours
 - h. Humidity, per astm 02247-92, 1000 plus hours
 - i. Water soak, per astm 02247-92, 1000 plus hours
- iii. Painting of hoses, clamps, wiring harnesses, and other non-- metallic service parts will not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work.
 - iv. Enclosure shall be constructed of minimum 12-gauge steel for framework and 14-gauge steel for panels. All hardware and hinges shall be stainless steel.
 - v. A factory-mounted exhaust silencer shall be installed inside the enclosure. The exhaust shall exit the enclosure through a rain collar and terminate with a rain cap. Exhaust connections to the generator set shall be through seamless flexible connections.
 - vi. The enclosure shall include the following maintenance provisions:
 - a. Flexible coolant and lubricating oil drain lines, that extend to the exterior of the enclosure, with internal drain valves
 - b. External radiator fill provision

Sequence of operation

- A. Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control.
- B. The generator set shall complete a time delay start period as programmed into the control.
- C. The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:
 - i. The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate "fail to crank" shutdown.
 - ii. The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate, "Fail to start."
 - iii. The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded

programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

- iv. On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous state.
- v. When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.
- vi. On completion of the time delay stop period, the generator set control shall switch off the excitation system and shall shut down.
- vii. Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

PART 3 – EXECUTION

FACTORY TESTING

- A. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided and reviewed as described in the project documents. Equipment supplied shall be fully tested at the factory for function and performance.
- B. Factory testing may be witnessed by the owner and/or the owner's representative. Costs for travel expenses will be the responsibility of the owner and/or representative or as described in the project documents. Manufacturer shall provide two weeks' notice prior to factory testing.
- C. Generator set factory tests on the equipment shall be performed at 100 percent rated load and rated power factor for four hours. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady- state governing, single step load pickup, and function of safety shutdowns.

- End of Section 26 23 1.x -



SECTION 26 55 22 LED LIGHTING

This document is provided as a reference for the design professionals working for American University. This document should not be used directly as written project specifications. This document does not define products for maintenance replacement purposes, but rather should be used for renovation and new construction projects.

PART 1 – GENERAL

1.0 Summary

- A. This Section includes lighting design criteria, interior, exterior and emergency luminaires, as well as related installation guidelines.

2.0 Regulatory Agencies

- A. Lighting design should conform to the applicable requirements of the following agencies' most current edition of regulations and standards, unless otherwise stated:
 1. American National Standards Institute (ANSI)
 2. American Society for Testing Materials (ASTM)
 3. Environmental Protection Agency (EPA)
 4. Federal Communications Commission (FCC)
 5. Illuminating Engineering Society of North America (IESNA)
 6. National Electrical Manufacturers Association (NEMA)
 7. National Fire Protection Association (NFPA)
 8. Underwriter's Laboratories (UL)
 9. U.S. Green Building Council (USGBC)
 10. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 11. International Building Code (IBC)
 12. International Energy Conservation Code (IECC)

3.0 Record Drawings

- A. Lighting fixture record drawings shall be provided to the University in the form of standard catalog cuts and/or factory assembly drawings, and shall indicate the following:
 1. Luminaire type correlated to lighting plans



2. Luminaire and LED wattage and voltage
 3. Complete photometric data
 4. Manufacturer's name and catalog number including all fixture options
 5. LED and driver types and manufacturer's name
 6. LED/driver and fixture
 7. Warranty information for fixtures/LEDs and drivers
 8. LED equivalent or correlated color temperature (CCT), color rendering index (CRI), and beam spread when applicable
 9. LED and Ballast Rated Life
- B. Lighting control record drawings shall include the following:
1. Single line diagram showing all control components and associated wiring
 2. Load schedule indicating circuit and zone number, light fixture types, LED source, and load per circuit or zone
 3. Catalog cut sheets of control system components
 4. Lighting control narrative describing control intent for programmable lighting system
- C. Full size manufacturer's drawings should be provided for custom designed light fixtures.

4.0 Submittals

- A. Product Data: Arrange in order of luminaire designation. The submittals shall include data on features, ratings, listings, certifications, accessories, finishes, dimensions, emergency components, photometric data, and luminaire efficiency data.
- B. Installation, Operation, and Maintenance Manuals.

5.0 Substitutions

- A. Substitutions for light fixtures not specified in the Contract Documents shall be coordinated with the University's project manager and Facilities Management stakeholders.
- B. All fixture substitutions must be requested via a product substitution request in accordance with the Universities Design and Construction Standards and Division 1 requirements of the contract. If substitutions



are requested, the University is under no obligation to accept them.

PART 2 - DESIGN CRITERIA

1.0 Illuminance Levels

Academic Building Areas	Illuminance Level (Foot-candles)
Computer Lab	30 fc
Conference Rooms	30 – 40 fc ³
Environmental Rooms- Workspace	50 - 60 fc ⁴
Environmental Rooms - Storage	15 fc
File/Mail	30 - 50 fc
Laboratories	50 - 60 fc ⁴
Libraries - General/Stacks	30 fc
Libraries - Reading Rooms	50 fc
Mechanical/Electrical rooms	20 fc
Offices	35 - 50 fc ⁴
Restrooms	15 fc
Storage areas	15 fc
Theaters ⁵	30 fc
Museums ⁶	20 fc

Residential Building Areas	Illuminance Level (Foot-candles)
Hallways	10 fc
Dining Areas	20 fc
Dormitory Rooms - General	10 fc
Dormitory Rooms - Desk	30-50 fc ⁵
Kitchens	50 fc



Laundry Rooms	30 fc
Lounges	30 c

Athletic Facilities	Minimum Horizontal Illuminance Level (Foot-candles) ⁶	Maximum Uniformity Ratio (Maximum: Minimum)
Baseball		
Infield	100	2.5:1
Outfield	70	2.5:1
Basketball (Indoor)	125 fc	1.7:1
Football ⁷	100 fc	1.7:1
Locker rooms	20 fc	N/A
Soccer	150 fc	2.5:1
Tennis	100 fc	2.5:1
Track & Field	50 fc	2.5:1
Training Facilities	50 fc	N/A

¹ Higher values may be required if the space is used for videoconferencing.

² On work plane, including task lighting.

³ On aisle, entrance and exit corridors as well as general work levels on stage. Theatrical lighting will be evaluated separately.

⁴ On aisles, entrance and exit corridors. Exhibit lighting should be evaluated and located based on the needs and type of installation and be designed to meet IESNA recommendations based on the specific use and function of the exhibit.

⁵ Includes task lighting.

⁶ Reading taken at 36" above ground unless otherwise noted.

⁷ Readings taken at grade.



If sports and athletic facilities are required to be used for televised events, the lighting designed in these facilities must meet IESNA and NCAA guidelines based on the type of facility and the broadcast category. Consideration must be given to both horizontal and vertical illumination for all areas intended to be included in the televised event.

Special and High Risk Use Areas such as wood shops, machine shops, work-shops should be designed to allow for both general lighting levels and elevated lighting levels where tasks are performed. Lighting positions should be coordinated with the location of equipment and levels should meet IESNA standards for the specific tasks performed in each area.

3.0 Energy Efficiency & Conservation

- A. Lighting Power Density – All interior spaces should comply with the Lighting Power Density (LPD) defined by the most current edition of ASHRAE 90.1. LPD is expressed in terms of watts/square foot. Standards can be evaluated based on the “building method” or the “space method.”
- B. Building designs and fenestration shall be configured to provide the maximum advantage to daylight harvesting control schemes. Daylight harvesting control schemes shall be employed in all instances where the fenestration area of the room is equal to or exceeds 250 sq. ft.

4.0 Sustainable Design & Energy Conservation

- A. The USGBC Leadership in Energy and Environmental Design (LEED) Building Rating System should be used as a guideline for project lighting design. The Rating System (New Construction, Commercial Interiors, Core & Shell, etc.) most appropriate to the project type should be followed.
 - 1. If the New Construction (NC) rating system is deemed most appropriate, reference in particular the following credit sections; however additional sections may apply.
 - a. Sustainable Sites Credit 8 - Light Pollution
 - b. Energy & Atmosphere Credit 1 - Optimize Energy Performance
 - c. Indoor Air Quality Credit 6.1 - Controllability of Systems – Lighting
 - d. Indoor Air Quality Credit 8.1,2 - Daylighting & Views



- B. Projects shall meet energy and control requirements outlined in the most current version of ASHRAE 90.1 or referenced in the LEED guidelines as described above.
- C. The application of natural light is encouraged to minimize electric lighting requirements.
 - 1. Appropriate glare control must be provided on all windows and skylights. Automatic daylight harvesting (reducing electric lighting load when available daylight is sufficient for lighting requirements) is encouraged.
 - 2. Daylight harvesting utilizing continuous (i.e. not stepped) dimming should always be used in regularly occupied spaces, such as offices and classrooms, to prevent disruption to occupants. Daylight harvesting utilizing on/off switching is acceptable in transient spaces, such as lobbies, atriums, etc.
- D. A lower general light level is recommended in office or other spaces where under cabinet or desk mounted adjustable task lighting is installed. Such that the net illumination level (as per above tables) is achieved as a result of combined room and task light sources.
- E. High reflectance finishes are recommended for all ceiling and wall surfaces to minimize required energy usage.
- F. Lighting systems should be designed to achieve the above recommended illuminance levels while minimizing energy consumption.
- G. Locate interior and exterior luminaires to minimize light trespass and glare to adjoining properties.
- H. Lighting levels in unoccupied public spaces such as lobbies with exterior views or dorm room corridors must at a minimum meet emergency access and egress levels. Consideration should be given to include the illumination of selected walls and vertical surfaces to provide the appearance of occupancy while maintaining the reduced energy levels.

5.0 Controls

- A. American University requires that interior spaces meet the control requirements defined by the currently recognized version of ASHRAE 90.1.



- B. Ceiling mounted occupancy sensors are preferred and should be used as a default approach to lighting control. Ceiling mounted sensor(s) should be placed in a space such that detection area(s) cover the entire space. When a corner or wall mounted sensor(s) is used it should be located on the “door wall” in the corner farthest from the door. Wall switch sensors will be considered for small spaces with the approval of the Facilities Management department.
- C. When available, occupancy sensors should be specified with isolated relays for future use by non-lighting systems (i.e. local HVAC VAV).
- D. Occupancy sensors shall be specified as the control method in all private offices, restrooms, classrooms, conference rooms, storage rooms and other enclosed areas of intermittent use.
 - 1. Override switches or dimmers should be incorporated in offices, conference rooms, and classrooms.
 - 2. Dual Technology (infrared and ultrasonic/microphonic) sensors should be used in private offices, conference rooms, and classrooms.
 - 3. Ultrasonic sensors are acceptable in restrooms without floor to ceiling partitions.
 - 4. Follow manufacturer's recommendations for coverage specification and sensor placement.
 - 5. Wireless sensors are allowed when battery life meets or exceeds a 10-year rated life and provide a low battery indicator.
 - 6. No lighting controls should be used in mechanical spaces with electrical distribution equipment, motors, pumps, shop equipment or other devices that without appropriate light levels would create a safety hazard.
- E. Where rooms are used for a variety of functions, provide multi-level switching, fixture zoning, or dimming to accommodate light level flexibility for occupants
- F. Where rooms are used for a variety of functions, provide multi-level switching, fixture zoning, or dimming to accommodate light level flexibility for occupants.



- G. Digital time switches with adjustable time setting should be provided for utility spaces containing large equipment.
- H. Consider the design of load shedding for lighting controls in larger new construction to provide feedback to central monitoring system at OCC.
- I. Lighting control systems should be tested and calibrated by the Contractor and shall be sample tested by the Commissioning Agent for all projects.
- J. Interior lighting controlled by relay panels for code required automatic shut-off shall have local override switches.
- K. Programming of preset lighting control systems shall be coordinated with the University's project manager and building occupants. A record of the settings shall be provided to building occupants.
- L. Acceptable manufacturers shall be by the following manufactures or equal approved by the A/E of record and Facilities Management:
 - 1. Sensor Switch/Light
 - 2. Hubbell
 - 3. Lutron
 - 4. Wattstopper
 - 5. Cooper Controls
 - 6. Leviton

PART 3 – PRODUCTS

1.0 Drivers

- A. LED drivers shall be electronic-type, labeled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15, and comply with NEMA SSL 1 "Electronic Drivers for LED Devices, Arrays, or Systems". LED drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.
- B. Dimmable LED drivers shall be 0-10V type. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker across their full dimming range.



2.0 Luminaires

- A. Luminaires should be constructed and installed to allow easy access for luminaire maintenance. Lenses, reflectors, and connectors should be captive to fixture where practical.
- B. Lighting fixtures shall be of specification grade and listed or labeled by Underwriters Laboratories (UL) or an approved Nationally Recognized Testing Laboratory (NRTL).
- C. LED fixtures shall comply with the following: UL Standard 8750 "Light Emitting Diode Equipment for Use in Lighting Products", IES Standard LM-79 "Electrical and Photometric Measurements of Solid-State Lighting Products", IES Standard LM-80 "Measuring Lumen Maintenance of LED Light Sources", and IES Standard TM-21 "Projecting Long Term Lumen Maintenance of LED Light Sources".
- D. ANSI C78.377 "Specifications for the Chromaticity of Solid State Lighting Products" with LEDs binned within a maximum three-step Mac Adam Ellipse to ensure color consistency amongst luminaries of the same type.
- E. Provide lighting fixtures in accordance with the Fixture Schedule.
- F. Provide only LED fixtures with a Design Lights Consortium (DLC) listing, a U.S. Department of Energy (DOE) "LED Lighting Facts" label or a U.S. Environmental Protection Agency (EPA) ENERGY STAR label, which have demonstrated third-party testing verification.
- G. Recessed lighting fixtures shall be thermally protected.
- H. LED fixtures shall be modular and allow for separate replacement of LED lamps and drivers. User serviceable LED lamps and drivers shall be replaceable from the room side.
- I. Dimmable LED fixtures shall have either a 0-10 volt, 3-wire dimming driver, or a two-step (50%-100%) line voltage, two switch
- J. Interior Lighting
 - 1. Fixture types previously typically specified with incandescent or compact fluorescent lamp sources (i.e. recessed downlights) should use dimmable LED technology. American University prefers fixtures manufactured with replaceable LED "lamps" when possible to avoid potential fixture mismatching upon failure. The design



professional must ensure that the specified dimming control is proven to work with the specific LED utilized for a given switch circuit and for typical replacement LED's and drivers likely to be used.

2. The University will consider acceptance of fixtures manufactured for incandescent lamps paired with LED replacement lamps meeting University Insurer's Certification standards (e.g. UL, FM, etc.). In these instances, the design professional must insure that the specified dimming control is proven to work with the specific LED lamp utilized and for the quantity designed for a given switch circuit.
3. Acceptable dimming protocols include 0-10V and Lutron standards. DALI, DMX or other dimming protocols must be specifically requested or approved by AU's Facility Management.
4. Mounting of luminaires above stairs and in locations that are higher than single floor ceiling heights shall be identified and actively coordinate with the University's Facility Management to confirm access to the fixtures is possible with available maintenance equipment.
5. Luminaires must be hard-wired. Flexible cord (SJO) connectors are not acceptable. MC cable is permitted.
6. Where luminaires from manufacturer's standard product lines do not meet the requirements of the project or application, custom designed fixtures are acceptable with approval by the University provided they meet the following criteria:
 - a. The fixture shall utilize commonly available LED, driver & lens types, preferably those used elsewhere on the project.
 - b. The entire fixture assembly must be listed by U.L. or other Nationally Recognized Testing Laboratory standards.
 - c. The lamp and ballast must be easily accessible for maintenance without major disassembly of the fixture.
7. Where required, luminaires should have low iridescent reflectors, baffles, and louvers.
8. Adjustable luminaires shall be capable of being locked into



position with a legible aiming angle for consistency between fixtures. These luminaires should have the ability to maintain focus position during lamp changes.

9. Luminaires shall bear U.L. label or other Nationally Recognized Testing Laboratory (NRTL) tested to U.L. standards.
10. Where luminaires utilize flat lenses, 100% UV stabilized virgin acrylic with minimum 0.125" thickness shall be specified. When lensed fixtures are specified in areas where the fixtures are subject to damage, polycarbonate lenses shall be specified in lieu of acrylic.
11. Luminaires with painted components should be painted after fabrication.
12. Fixtures using linear fluorescent lamps and electronic ballasts should use lamps and ballasts specified in the lamps and ballasts section of this document.
13. LED technology luminaires should have the following performance specifications:
 - a. Consider LED sources based on durability, energy efficiency, and reduced maintenance. The use should be approved by Planning and Project Management and Facilities Management prior to specification.
 - b. LED fixtures are to be provided by manufacturers with a minimum (8) years' experience and provide minimum (5) years warranty on all electrical parts.
 - c. LED components and fixtures shall comply with ANSI chromaticity standards, LM79 and IES LM-80 lumen maintenance testing standards.
 - d. Dimmable LEDs will utilize Constant Current Reduction or Pulse Width Modulation controls. The design professional is responsible for ensuring performance compatibility between specific LED fixtures and controls.
 - e. LED lighting systems with unmatched drivers and power supplies will not be considered.
 - f. Lumen packages sufficient to meet space design



requirements including: maximum watts/square foot allowed by current energy code uniformity ratios no greater than 5:1 (excluding non-critical lighting locations) and minimum IESNA light levels for the applicable space type. The assumed Driver mA rating should be indicated when reporting initial delivered lumens of a specified fixture.

- h. Lumen/Watt performance greater than 80, assuming Lumens are measured as delivered lumens @ 35-degree Celsius multiplied by a 90% Light Loss Depreciation Factor and Watts are the total system watts of the fixture. Lumen/Watt performance meeting or exceeding 100 is the University's goal.
- i. Rated life of 50,000 when lumens depreciated to 90% of initial rating using IESNA TM-21 testing methodology and data extrapolation. This is commonly referred to L90 rated life.
- j. DLC certification recommended and preferred.
- k. Color Rendering Index equal or greater than 80.
- l. Correlated Color Temperature of 3,500. Color changing LED luminaires shall provide full spectrum color changing capability through the use of red, blue, green and white (amber) LED's.
- m. Design professionals are required to provide LED fixtures that are compatible with existing or newly specified dimming controls.
- n. Facilities Management must approve any exceptions to the above specifications.

K. Exterior Lighting

- 1. Mission Statement: The University's primary mission for exterior lighting of the campus is to enhance safety. In the process, lighting should improve the appearance of the campus, be energy efficient, utilize long life sources to minimize maintenance and minimize light pollution. Lighting must be adaptable for future campus development and changing technologies and be responsive to input from campus users.



2. All measures should consider matching the University's existing campus exterior lighting LED standard. LED luminaires are rapidly evolving as the chosen source for illumination of all new pathway and drive lane lighting on AU's campus.
3. Exterior pathway light poles shall be either of the following existing fixtures. Any deviations must be pre-approved by the Planning and Project Management.
 - a. Washington Gas-Light Standard matching existing in style and specifications.
 - b. Shoebox type, of heavy-duty construction (noting that sheet metal base covers are not acceptable), matching existing in style and specifications.
4. Poles shall be spaced a maximum of thirty (30) feet on center.
5. Luminaires should be either located or specified to prevent possible damage from vandalism.
6. Exterior luminaires and poles shall have the ability to withstand wind speeds of 80 miles per hour.
7. Exterior wall packs, both new and replacement units, shall utilize induction or LED lamping. Fixtures shall have superior glare control with lighting directed downward. Fixtures with light distribution above 90 degrees shall not be acceptable.

D. LED Replacement Lamps

1. Approved Manufacturers: Philips, Osram Sylvania and GE
2. Consider LED sources based on durability, energy efficiency, and reduced maintenance. Planning and Project Management and Facilities Management should approve the use prior to specification.
3. LED lamps are to be provided by manufacturers with a minimum (8) years' experience and provide minimum (2) years warranty on all electrical parts.
4. LED components and fixtures shall comply with ANSI chromaticity standards, LM79 and IES LM-80 lumen maintenance testing



standards.

5. Dimmable LEDs will utilize Constant Current Reduction or Pulse Width Modulation controls.
6. Design professionals are required to provide LED lamps that are compatible with existing or newly specified dimming controls.
7. LED lighting systems with unmatched drivers and power supplies will not be considered.
8. Lumen packages, beam spreads and main beam candlepower sufficient to meet space design requirements. The assumed Driver mA rating should be indicated when reporting initial delivered lumens of a specified fixture.
9. Lumen/Watt performance greater than 80, assuming Lumens are measured as delivered lumens @ 35-degree Celsius multiplied by a 90% Light Loss Depreciation Factor and Watts are the total system watts of the fixture.
10. Rated life of 25,000 when lumens depreciated to 90% of initial rating using IESNA TM-21 testing methodology and data extrapolation. This is commonly referred to L90 rated life.
11. DLC certification recommended and preferred
12. Color Rendering Index equal or greater than 80
13. Correlated Color Temperature of 3,500. Color changing LED luminaires shall provide full spectrum color changing capability through the use of red, blue, green and white (amber) LED's.
14. Design professionals are required to provide LED fixtures that are compatible with existing or newly specified dimming controls.
15. The Facilities Management department must approve any exceptions to the above specifications.
16. Retrofit LED lamps shall comply with NEMA SSL 4 "SSL Retrofit Lamps: Suggested Minimum Performance Requirements".

E. Emergency Lighting



1. A dedicated Emergency Lighting Inverter System or Emergency Generator shall provide all emergency lighting. The use of Emergency Battery Ballasts installed in lighting fixtures should not be considered.
2. Provide self-contained emergency lighting units in all generator, switchgear, ATS, and UPS rooms, regardless of whether or not generator power is available on the project.
3. All new exit signs shall utilize LED lamping.
4. Self-powered exit signs should be provided with sealed maintenance-free batteries (with at least a 10-year warranty inclusive of battery life) and self-diagnostics.
5. When generator power is unavailable, self-contained emergency battery units are acceptable for code required egress lighting. Coordinate with the Planning and Project Management and Facilities Management.
6. Radioactive self-luminous exit signs are not acceptable. Self-luminous exit signs that are toxin free may be considered on a case-by-case basis.
7. Emergency lighting levels shall meet National Fire Protection Association (NFPA) 101 and International Building Code (IBC) requirements.
8. Identified Egress Paths (i.e. corridors, stairwells & assembly areas) must meet both currently adopted code requirements for minimum illumination levels and sufficient directional signage when normal power is not available.

F. WARRANTY

1. For non-LED lighting fixtures and components, provide a complete warranty for parts and labor for a minimum of one year from the date of Substantial Completion.
2. For LED fixtures, lamps, drivers, and components, provide a complete warranty for parts and labor for a minimum of five years from the date of Substantial Completion.



PART 4 – EXECUTION

- A. All luminaires recessed or suspended from the ceiling shall be supported by the structure above the ceiling at a minimum of two locations for every four feet of fixture length.
- B. The Contractor shall provide a list of Luminaire (fixture, LED and driver) types used on the project with the associated installation locations noted.
- C. All adjustable interior and exterior light fixtures should be aimed by the Contractor to the satisfaction of the A/E and the University.
- D. The contractor will be responsible for the coordination for programming of programmable lighting control systems. This includes providing factory trained technicians for programming and commissioning of the systems as well as training of personnel responsible for the upkeep of the systems as well as arranging a time conducive to both client and design team to meet and provide direction to the programmer.

-END OF SECTION 26 52 22 -



DIVISION 27 COMMUNICATIONS

GENERAL

Contact American University Office of Information Technology (OIT) before beginning work on the design of a renovation or new facility. OIT will coordinate data and voice communications for the project.

Designer should be aware of the requirements and provisions of the OIT construction master plan and standards.

American University has many different voice, data and video requirements that rely on a high quality, reliable and flexible wiring infrastructure to meet the ever-changing demands of its faculty and staff.

During the planning and implementation stages for any facility or renovation, you will meet one or several representatives from American's communication service group within OIT.

For ease of coordination, please contact one of the American University OIT analysts or the project manager. In turn, they will coordinate a team of communication engineers, technicians and support personnel to meet the scope of the project. It is extremely important that the analyst be contacted during the early planning stages to insure all aspects of communication requirements are met.

The diversified options vary from building to building and require a great deal of planning. This team will work with the occupants, contractors, and project managers during the planning stages, provide them with the space requirements for communication room, distribution design assistance/approval, and cost estimates. They will also be responsible for the coordination of all communication wiring and equipment.

All communications wiring will be supplied by American University (AU) and installed by AU OIT unless otherwise stated. Wiring, connectors and terminations will be provided by and installed by American OIT and these costs will be budgeted by AU into the project by the office of the Planning and Project Management.

OIT will not take occupancy of any space until it is completed, commissioned, punch list complete and cleaned per OIT standards for installation of communications equipment.

The consultant shall identify equipment requiring emergency power during development of the Owners Program Requirements and incorporate emergency power for required communications to include necessary building support systems.



BUILDING COMMUNICATIONS SERVICE ENTRANCE

All communications cabling on the American campus is installed in underground ducts encased in concrete. This duct system follows a master plan developed several years ago with Facilities Management (FM) and is placed in designated utility corridors. During the process of schematics, OIT will specify the route and building entrance location. At that time, OIT will assist in developing the best size and number of conduits to anticipate ultimate requirements for service and emergency needs.

Construction drawings shall provide for an equal number of conduits extending from a manhole 5'-0" outside the building and will terminate in the building's main entry communications room (BCR) as described later in this booklet. In this room and as close to the entrance conduit as possible, a minimum of one (1) #4 copper ground cable is required.

Where the entrance conduits penetrate the foundation, footings or outside walls, rigid metallic conduit shall be used. Plaster fiber ducts or aluminum conduit will not be accepted. At the point of exit, a minimum of 2'-0" ground cover must be maintained.

If existing conditions should alter this setup, an OIT Communications Analyst should be notified and alternatives worked out.

COMMUNICATION ROOMS

A single communications room or Main Distribution Frame (MDF) may serve a floor area as large as 20,000 square feet provided it serves only the telephone and data needs on the same floor and that additional satellite rooms or Intermediate Distribution Frames (IDF) are provided on other floors. Connecting conduit is required to ensure that the greatest distance from any communications outlet to the nearest communication room does not exceed 300 linear feet

Minimum space requirements for communication rooms are listed below along with general notes to be taken into account during planning and design. Please note each project is different and larger space requirements may be needed for communication rooms because of the user's expanded voice/data requirements or size of the facility. Once again, early consultation with the American OIT communications analyst is a must to ensure size of communication rooms are adequate to meet user and facility needs.

MAIN DISTRIBUTION FRAME (MDF)

The MDF shall be:

- A. A minimum of 150 sq. ft. (minimum width 6') and will provide a 2 ft clearance on each side for telephone equipment 19" racks on which data electronics and power equipment are normally mounted. This room size will provide service to approximately 20,000 square feet of building.



- B. A single, solid door 3'-0" in width with a 180-degree hinge shall be provided and mounted to swing outside the room if possible by code.
- C. Located off a corridor or an area not associated with business offices and other high activity areas.
- D. A well-sealed tile floor is required. (Absolutely no carpeting)
- E. Open, non-finished ceiling spaces are preferred. HVAC ducts, plumbing lines (water, soil, or steam), sprinkler heads and piping installed through this space will not be acceptable. No utilities except those serving the room may occur in or above this room.
- F. All internal wall surfaces shall be lined with unpainted pressure treated fire retardant 3/4" plywood 8' high.
- G. Fluorescent light fixture(s) will be required. See Division 26 electrical.
- H. If emergency power is available in the building, these circuits shall be connected to this power source and labeled. Contractor shall indicate on drawings whether emergency power is a generator or a UPS.
 - I. Conduits entering these spaces shall penetrate the closet walls at a height above the plywood panels and extend only far enough to install bushings. Overhead ladder racks shall be designed, provided and installed by American OIT to support wiring.
- J. Fire stops around cables will be sealed or plugged with fiberglass one inch (1") thick topping of water plug cement or equivalent. Unused conduits will be plugged and capped for fire proofing as specified above or as required for fire code rating. Additional fire stop or other requirements by the University insurance provider shall be followed.
- K. A minimum of 15,000 BTU of cooling is required and the room shall be positive with respect to corridor or area adjoining these rooms. Auxiliary air conditioning units may be required in closets with a large number of data/phone electronics devices.
- L. Tie-in to the Building Automation System typically is required, see Division 25 for control and/or monitoring and alarm requirements.
- M. Supply a ground connection from a cold water pipe or building ground system utilizing a minimum #6 bare copper conductor. Leave 6' coil in each room.

Caution: Room square footage is dependent on equipment serving the building. Contact American University OIT for exact footage required.



INTRA-BUILDING DISTRIBUTION SYSTEM

In all buildings at American University, communication horizontal and vertical distribution systems are an absolute necessity in meeting and in keeping pace with the occupants' voice, data, and video communications needs.

HORIZONTAL

New buildings should be designed to include a means for an open cable tray communication distribution system. Due to the different styles and types of cable tray systems available minimum standards require the tray to be a minimum of 12" wide and 4" deep. Tray shall be open on top and suspended from the ceiling by supporting rods in the middle of the tray or as recommended by the manufacturer. No rod threads should be exposed in the cable tray due to easy damage of cable when being pulled.

To deter the use of plenum cable, open wire-ways can only be used in air return spaces for very special cases.

A minimum of one-inch (1") conduit shall be used from the cable tray to the user's communication outlet to house communications cabling.

Renovation projects are very different in nature and require very early consultation with an AU Tele/Video Communications analyst to insure all existing and future requirements are met for communication distribution systems in consultation with the Project Manager.

VERTICAL

New multi-level buildings should be designed with communication rooms (IDF's) placed one above the other in a vertical fashion to facilitate vertical distribution systems. The size and quantity of conduit between each of the communication rooms will depend on the size and functionality of the building. Early consultation with an e-operations analyst is required to insure all requirements are met.

- END OF DIVISION 27 -



DIVISION 28 ELECTRONIC SAFETY AND SECURITY

DESIGN CONSIDERATIONS

The Consultant shall provide a written description of how the entire system is designed to operate. This Basis of Design (BOD) narrative also shall describe how project objectives are being met. It shall be provided in a format that can be easily understood by a layperson, the end user. The narrative identifies items that specifically meet the Owners Project Requirements (OPR) and the most recent University Safety and Security Services (USSS), Facilities Management (FM) department System Master Plan(s) and articulate a rationale for any variance.

For renovations, the systems selected shall be compatible with the existing building's electronic safety and security systems. The integrity of the basic existing building system shall not be compromised. Work shall be designed and sequenced to minimize impact and interruptions in occupied buildings.

For site work, the Consultant shall indicate all existing underground work such as piping, valves, manholes, electric wiring and telephone, whether new connections are being made or not. Profiles of all piping need to be shown to facilitate coordination with the crossing of other utilities.

New buried cabling shall have location detection added per Division 26 requirements.

Provide extended service and maintenance options with every new project. Local vendors shall list and verify compliance response times for planned routine maintenance, urgent schedule repairs and emergency service as required in the OPR.

The Consultant shall incorporate any requirements from the University insurance carrier or USSS into the design and specifications.

SECURITY SYSTEMS

The American University (AU) USSS has established security standards and emergency notification standards for all University buildings. These standards encompass the technology and physical security features required to protect the AU community and buildings.



While the standards reflect best business practice and represent industry standards, they are applied based on security assessments of plans for newly constructed buildings and major renovations and take into account planned uses of each facility and its occupants. These assessments and the application of these standards are intended to foster a uniform level of security associated with university structures, both within and exterior to the buildings.

The standards or variations of the standards, for each project are applied based on recommendations of the USSS.

INTERIOR ACCESS CONTROL, MONITORING, AND CCTV

AU's electronic security program is comprised of three primary sub-systems; access control, intrusion detection and close circuit television systems. All systems are managed by USSS. All security design documentation and security equipment shall require prior approval by the AUPD physical security manager and be furnished by the security contractor unless otherwise noted.

All security and emergency notification system designs for new buildings and major renovations are prepared in partnership with the Planning and Project Management department. Application of these standards to existing buildings/locations on campus will be at the direction of the USSS based on a risk and threat analysis.

The AUPD unit also maintains lists of approved security hardware and will provide the information upon request. This hardware is standardized across campus and the USSS Physical Security Manager must approve variations from the list.

DETAILS

Contractor shall provide typical installation drawings prior to the commencement of any work for approval by the physical security manager. The contractor shall also provide as-built drawings after the installation is complete.

CONTACTS

Questions concerning the University's security management system guidelines should be addressed to Physical Security Manager (202) 885 2527.

ACCESS CONTROL SYSTEMS – 28 13 00



USSS is responsible for all integration and daily management of the Software CCure 9000 Management System for academic, administrative and housing facilities. This includes termination, installation, maintenance and monitoring of all equipment associated with this system. This also includes providing all card reader equipment.

The Consultant or Project Manager should consult with the USSS Physical Security Manager during the design and construction phases of any project that includes card readers.

ACCESS CONTROL HARDWARE DEVICES – 28 15 00

EXTERIOR DOOR CONTROL AND MONITORING

Provide conduit path from door area to security panel closet or equivalent for card readers, door contacts and associated equipment. This applies to all exterior doors. All security design documentation and security equipment shall require prior approval by the USSS Physical Security Manager and be furnished by the security contractor unless otherwise noted.

DOOR SECURITY

The design should provide 3/4" conduit from the door area to a designated location in a communications closet. The Contractor is to pull the wire specified or provided by the USSS from the security panel closet to door area. In security panel closet, contractor is to provide and install 3/4" fire-rated plywood on wall where the Access Control panel will be mounted.

If the security panel closet is separate from the telephone entry room, provide 2" conduit connecting them. Provide 1" conduit from the security panel closet to the fire alarm control panel.

In security panel closet, provide one dedicated 120-volt duplex receptacle for required power. This power is to be on the emergency generator for the building if a generator is present. Refer all questions or concerns to the USSS Physical Security Manager.

The light fixture in the security panel closet is to be on the emergency generator if a generator is present. Refer all questions or concerns to the AU Master Electrician.



All buildings requiring electronic security locking hardware must be Fail Secure in functionality unless otherwise noted. The physical security manager must approve all work prior to installation.

VIDEO SURVEILLANCE CLOSED CIRCUIT CAMERA SYSTEM – 28 20 00

USSS is responsible for the integration and daily management of the Genetec Security Desk/Omicast video management system. This includes termination, installation, maintenance and monitoring of all equipment associated with this system.

The Consultant or Project Manager should consult with the university's physical security manager during the design and construction phases of any project that includes a requirement for video monitoring equipment.

INTRUSION DETECTION – 28 31 00

The Project Manager should consult with the USSS Physical Security Manager during the design and construction phases of any project to determine the intrusion detection requirements for the project.

FIRE ALARM SYSTEMS – 28 46 21.1x

The Fire Alarm system is maintained by Facilities Management Energy & Engineering Department. It is a campus wide system monitored 24/7 by AUPD.

Refer to separate section 28 46 21.1x for university fire alarm system requirements. Address questions or concerns to the AU Master Electrician.

REFRIGERANT MONITORING – 28 44 00

See product requirements at end of this division.

See also monitoring, graphic and alarm notification and integration requirements to the Building Automation Systems in Division 25.

MASS NOTIFICATION SYSTEMS – 28 47 00



The Emergency Notification Systems are comprised of two sub systems: A system that permits USSS to make public announcements of emergencies affecting the university, and a system that allows individuals to contact USSS to report an emergency.

Each mass notification must be tested and/or undergo integrated commissioning at the 100% device level.

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EQUIPMENT NUMBERING SCHEME

- First Identifier** – Identifier for the building that the equipment is associated with. This will be consistent with the established computerized maintenance management (AiM) building identifier codes existing in the AiM system.
- Second Identifier** – Floor location of the equipment if the building is multi-level, having more than a basement and a first floor.
- Third Identifier** – Type of equipment that is being identified. Abbreviated equipment type code consistent with existing AiM established codes.
- Fourth identifier** – This will indicate the incremental number of the item according to the location. The incrementing should begin with the lowest physical level of the building.

Examples of Asset Codes for AiM:

If there are 3 VAV units on the first floor and 3 on the third floor and 2 Fan coil units on the first floor and 5 on the third floor in Anderson Hall the AiM asset numbering codes will be:

AH-01-VAV001	VAV BOX
AH-01-VAV002	VAV BOX
AH-01-VAV003	VAV BOX
AH-03-VAV004	VAV BOX
AH-03-VAV005	VAV BOX
AH-03-VAV006	VAV BOX
AH-01-FCU001	FAN COIL UNIT
AH-01-FCU002	FAN COIL UNIT
AH-03-FCU003	FAN COIL UNIT
AH-03-FCU004	FAN COIL UNIT
AH-03-FCU005	FAN COIL UNIT
AH-03-FCU006	FAN COIL UNIT
AH-03-FCU007	FAN COIL UNIT



Refer to the document Schematic Equipment and Building Codes for existing identifiers. Consult with the Facilities Management Planned Maintenance Manager prior to assigning equipment identifiers the contract documents. List AiM number on building documents including equipment schedule. Equipment shall be labeled consistently across all disciplines.

Resolution of equipment not associated with buildings.

There are some items identified as equipment that are not associated with any building. These are equipment items for the Grounds Maintenance Operation (mowers, tillers, clippers, etc.). Other items are unique to the housekeeping operation (vacuums). Equipment that is affixed to the facility or requires special connections shall be identified in the project documents by the corresponding AiM equipment asset identification.



DIVISION 28 ELECTRONIC SAFETY AND SECURITY PRODUCTS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Fire Alarm System

1. Siemens XLS

Card Access System

1. CCure

Refrigerant Monitor

1. Sherlock with infrared refrigerant sensors

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to the following:

All products in this Division require integration into existing systems. No exceptions. New product use only with Departmental approval.

-END OF DIVISION 28 -



SECTION 28 46 21.1x FIRE ALARM SYSTEMS

This document is provided as a reference for the design professionals working for American University (AU). This document should not be used directly as written project specifications. This document does not define products for maintenance replacement purposes, but rather should be used for renovation and new construction projects.

The American University Facilities Management Life Safety Manager/Master Electrician has established standards for fire alarm systems to protect the AU community and buildings. While the standards reflect best business practice and represent industry standards, they are applied based on assessments of plans for newly constructed buildings and major renovations and take into account planned uses of each facility and its occupants. These assessments and the application of these standards are intended to foster a uniform level of protection and notification associated with university structures, both within and exterior to the buildings. The standards, or variations of the standards, are applied based on recommendations to Facilities Management developed through the Life Safety Master Plan and in consultation with University Safety and Security (USSS) and the university insurance provider.

The USSS Physical Security Unit also maintain lists of approved security hardware and will provide the information upon request. This hardware is standardized across campus and the physical security manager must approve variations from the list.

All security and emergency notification system designs for new buildings and major renovations are prepared in partnership with the Planning and Project Management department. Application of these standards to existing buildings/locations on campus as of May 2016 will be at the joint direction of Facilities Management and University Safety and Security Services based on objectives in the current departmental Master Plans and a detailed risk and threat analysis. The Designer shall consult with Facilities Management and Safety/Security requirements for commissioning in accordance with NFPA 3 Standard Commissioning of Fire Protection and Life Safety Systems and NFPA 4 Standard for Integrated Fire Protection and Life Safety System Testing.

American University fire alarm systems campus-wide are Siemens only, hard wired. Refer to MANUFACTURERS later in this document.

PART 1 – GENERAL

RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Provisions of Division 26 Electrical including labeling, wiring practices, fire stop, and general provisions, apply to this Section.



SUMMARY

- A. The system shall include all wiring, raceways, terminal cabinets, pull boxes, outlet and mounting boxes, initiating devices, alarm indicating devices, annunciators, printers, control equipment, and all other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described.
- B. Related Standards: The following standards contain requirements that relate to this Section: "Fire Protection" for water-flow, pressure, or tamper switches connected to fire alarm system.

DEFINITIONS

- A. Alarm-Initiating Device: A manual station, smoke detector, heat detector, flame detector, or sprinkler water-flow switch.
- B. Alarm Signal: Signifies a state of emergency requiring immediate action. Pertains to signals such as the operation of a manual station and the operation of a sprinkler system flow switch.
- C. Class A Wiring: Circuits arranged and electrically supervised so a single break or single ground fault condition will be indicated by a trouble signal at the fire alarm control panel (FACP) and the circuit will continue to be capable of operation for its intended service in the faulted condition no matter where the break or ground fault condition occurs.
- D. Class B Wiring: Circuits electrically supervised such that a single break or a single ground fault condition will be indicated by a trouble signal at the FACP no matter where the break or ground fault condition occurs.
- E. Hard-Wired System: Alarm, supervisory, and initiating devices directly connected, through individual dedicated conductors, to a central control panel without the use of multiplexing circuits or devices.
- F. Multiplex System: One using a signaling method characterized by the simultaneous or sequential transmission, or both, and the reception of multiple signals in a communication channel, including means for positively identifying each signal.
- G. Supervisory Signal: Indicates abnormal status or need for action regarding fire suppression or other protective system.
- H. Trouble Signal: Indicates that a fault, such as an open circuit or ground, has occurred in the system.
- I. Zone: A building area, which has all initiating devices located within it programmed to initiate an alarm and to give a common visual location indication on the system annunciator.

SYSTEM DESCRIPTION

- A. General: This specification intends to describe an integrated fire detection and voice evacuation system to be intelligent device addressable, analog detecting, low-voltage and modular with multiplex communication techniques in full compliance with all applicable codes and standards. The features described in this



specification are a requirement for this project and shall be furnished by the successful contractor.

- B. Signal Transmission: Multiplex signal transmission dedicated to fire alarm service only.
- C. Audible Alarm Indication: By sounding of voice evacuation via speakers.
- D. System connections for alarm-initiation and alarm-indicating circuits: Class B wiring.
- E. Functional Description: The following are required system functions and operating features:
 - i. Priority of Signals: Accomplish automatic response functions by the first zone initiated. Alarm functions resulting from initiation by the first zone are not altered by subsequent alarms. The highest priority is an alarm signal. Supervisory and trouble signals have second- and third-level priority. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.
 - ii. Non-interfering: Zone, power, wire, and supervise the system so a signal on one zone does not prevent the receipt of signals from any other zone. All zones are manually re-settable from the FACP after the initiating device or devices are restored to normal. Systems that require the use of batteries or battery backup for the programming function are not acceptable.
 - iii. The system shall monitor all alarm initiating and supervisory devices, initiate audible and visual alarm, supervisory and trouble signals, initiate automatic elevator recall, de-energize magnetic door holders, initiate shutdown of air handling units whether in automatic or hand operation, close respective fire/smoke dampers, operate smoke control systems, operate smoke relief hatches, provide alpha/numeric display of alarm, supervisory and trouble conditions at the fire alarm control panel, provide a hard copy record of system events, provide LED annunciation at all remote annunciators, and transmit required signals to a remote central station.
 - iv. Silencing at FACP: Switches provide capability for acknowledgment of alarm, supervisory, trouble, and other specified signals at the FACP; and capability to silence the local audible signal and light a light-emitting diode (LED). Subsequent zone alarms because the audible signal to sound again until silenced in turn by switch operation. Restoration to normal of alarm, supervisory, and trouble conditions extinguish the associated LED and cause the audible signal to sound again until the restoration is acknowledged by switch operation.
 - v. Loss of primary power at the FACP sounds trouble signal at the FACP and indicates at the FACP when the system is operating on an alternate power supply.
 - vi. Annunciation: Manual and automatic operation of alarm- and supervisory-initiating devices is annunciated both on the FACP and on the annunciator, indicating the location and type device.



- vii. FACP Alphanumeric Display: Displays plain-language description of alarms, trouble signals, supervisory signals, monitoring actions, system and component status, and system commands.
 - viii. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACP causes the selection of specific addressable smoke detectors for adjustment, display of their status and sensitivity settings, and control of changes in those settings. The same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors. The system printer records sensitivity adjustments and sensitivity adjustment schedule changes.
- F. Recording of Events: Record all alarm, supervisory, and trouble events by means of the NCC-WAN printer. Printouts are by zone, device, and function. When the FACP receives a signal, the alarm, supervisory, and trouble conditions are printed. The printout includes the type of signal (alarm, supervisory, or trouble) the zone identification, date, and the time of the occurrence. The printout differentiates alarm signals from all other printed indications. When the system is reset, this event is also printed, including the same information concerning device, location, date, and time. A command initiates the printout of a list of existing alarm, supervisory, and trouble conditions in the system.
- i. Permissible Signal Time Elapse: The maximum permissible elapsed time between the actuation of any fire alarm or fire-detection system alarm-initiating device and its indication at the FACP is ten seconds.
 - ii. Circuit Supervision: Indicate circuit faults by means of both a zone and a trouble signal at the FACP. Provide a distinctive indicating audible tone and (LED) indicating light. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP is 200 seconds.

SYSTEM OPERATION:

- A. Activation of any system fire, security, supervisory, trouble, or status-initiating device shall cause the following actions and indications in the Fire Command Center at University Safety and Security Services in the NCC Network Command Center. The USSS command center is located on East Campus, lower level of the Don Meyers Technology and Innovation Building.
- B. Fire Alarm Condition:
 - i. Sound an audible alarm and display a custom screen/message defining the building in alarm and the specific alarm point initiating the alarm.
 - ii. Log to the system history archives all activity pertaining to the alarm condition.
 - iii. A simultaneous message shall be delivered via all alarm speakers including those installed in stairways and elevators informing occupants of the imminent shutdown of elevator circuits and the expected high traffic load in the stairwells.



- iv. An automatic announcement or tone evacuation signal shall be capable of interruption by the operation of the system microphone to give voice evacuation instructions overriding the pre-programmed sequences.
 - v. Status lights next to speaker selection switches on the control panel shall indicate speaker circuit selection.
 - vi. Audible signals shall be silenced from the fire alarm control panel by an alarm silence switch. Visual signals shall be programmed to flash until system reset or alarm silencing, as required by the local District of Columbia Fire Marshal or designated authority having jurisdiction (AHJ).
 - vii. A signal dedicated to sprinkler system water flow alarm shall not be silenced while the sprinkler system is flowing at a rate of flow equal to a single head.
 - viii. Activation of any smoke detector in a single elevator lobby or an elevator equipment room shall cause the recall of that bank of elevators to the 1st floor and the lockout of controls. In the event of recall initiation by a detector in the first floor lobby, the recall shall be to the alternate floor as determined by the AHJ. Furthermore, any single device activation in a Residence Hall will trigger this same "lobby" recall response.
 - ix. Where indicated on drawings heat detectors in elevator shaft and machine rooms shall activate an elevator power shunt trip breaker. The heat detectors shall be rated at a temperature below the ratings of the sprinkler heads in respective locations to insure that the power shall be shut off before activation of sprinkler system.
 - x. Remote LCD annunciators shall display the alarm condition via unique messages as required by the system owner. LED type annunciator displays, conventional and graphic style shall indicate alarm zoning as specified.
 - xi. System operated duct detectors as per local requirements shall accomplish HVAC shut down.
 - xii. Door closure devices shall operate by floor or by local requirements.
 - xiii. Activation of Stairwell pressurization, Smoke purge, and damper control shall be as required and operated as per local requirements.
 - xiv. Print alarm conditions on NCC-WAN printer located at the USSS office at East Campus.
- C. Supervisory Condition:
- i. Display the origin of the supervisory condition.
 - ii. Activate supervisory audible and dedicated visual signal.
 - iii. Audible signals shall be silenced from the control panel by the supervisory acknowledge switch.
 - iv. Record within system history the initiating device and time of occurrence of the event.
 - v. Print supervisory condition to system printer.
 - vi. Remote LCD annunciators shall display the supervisory condition via unique messages as required by the system owner. LED type annunciator displays, conventional and graphic style shall indicate alarm zoning as specified.
- D. Trouble Condition:



- i. Display the origin of the trouble condition.
- ii. Activate trouble audible and visual signals at the control panel and as indicated on the drawings.
- iii. Audible signal shall be silenced from the fire alarm control panel by a trouble acknowledge switch.
- iv. Trouble reports for primary system power failure to the master control shall be automatically delayed for a period equal to 25% of the system standby battery capacity to eliminate spurious reports because of power fluctuations.
- v. Record within system history, the occurrence of the event, the time of occurrence and the device initiating the event.
- vi. Print trouble condition to system printer.
- vii. Remote LCD annunciators shall display the trouble condition via unique messages as required by the system owner. LED type annunciator displays, conventional and graphic style shall indicate alarm zoning as specified.

SUBMITTALS

- A. No substitutions of equipment or materials shall be allowed.
- B. Submittals must be signed by NICET Level IV Senior Engineering Technologist employed by Siemens Industry, Inc., 6435 Virginia Manor Road, Beltsville, MD 20705.
- C. Provide six (6) sets of complete submittals which shall include drawings of all annunciator panel graphics, schematic wiring drawings of the control panel showing internal and external control panel wiring and all devices. Sequence of operation, annunciator wiring and faceplate drawings, specification sheets for all equipment, all devices, and battery calculations shall be provided. Drawings of the control panel and graphic annunciator panel(s) shall be done on 30" x 42" sheet size. Partial submittals will not be accepted.
- D. Submittals shall be provided in accordance with project submittal schedule as outlined in the Division 1 General Requirements of the contract or the contract project manual.
- E. If re-submittals are required, they shall be provided within two (2) weeks after the date of notification. If re-submittals are not received by the Engineer in two (2) weeks, the supplier will be considered non-responsive and subsequent submittals from the supplier will not be reviewed. The Contractor shall then provide submittals from another equipment supplier within two (2) weeks as directed by the Owner at no change in contract price.
- F. The cost of review of any submittals after two (2) submittals have been disapproved shall be paid by the Contractor to the Engineer. The Contractor shall then deliver a purchase order to the Engineer before any submittals will be reviewed.

RECORD DOCUMENTS

- A. The As-Built drawings shall include one (1) complete set of 30" x 42" contract base sheet drawings with any and all changes included and noted. The approved contract panel drawings and graphic annunciator panel drawings shall also be



- provided in PDF format. The Conduit Plan shall show the device address for all intelligent/analog initiating devices. The electrician in charge of the system installation shall keep the As-built drawings up to date continuously. These drawings shall be reviewed on a weekly basis for accuracy and completeness.
- B. The Operation and Maintenance Manual shall include a complete set of equipment, component and device specification and data sheets as well as a reduced size paper copy (11" x 17") of the complete set of system drawings described in the specification section A copy of the NFPA 72 Test Report/Certificate, the printer record of all test activity including the sensitivity readings for all intelligent/analog smoke detectors, the required system and component warrantee papers, and the name and address of the installer shall be included. The manual shall be bound in a black three-ring loose-leaf binder with dividers and a table of contents. Four (4) duplicate sets are required or as otherwise required in the contract documents.
 - C. Six (6) sets of keys to all locks shall be provided at occupancy with each set of keys properly and legibly marked and tagged. Loose keys will not be accepted. Transmit to Facilities Management Material Supply Manager and Life Safety Manager jointly for acceptance at occupancy.
 - D. All documents and items described above shall be submitted for approval and turnover prior to the final testing and system certification with the exception of the NFPA 72 Test Report/Certificate that shall be delivered by hand to the Owner within two (2) days of the actual test and acceptance.

QUALITY ASSURANCE

- A. Qualifications of the Installer: an electrical contractor experienced in the installation of fire alarm systems shall install the system. A minimum of five years verifiable installation of fire alarm systems is required for both the firm and the site supervisor.
- B. The name of the electrician who will be responsible for the fire alarm system installation shall be submitted for the Owner's approval before any work is started on the system. The qualifications and experience of the proposed individual shall also be included. The Owner-approved fire alarm installation electrician shall remain on this project until the fire alarm system is accepted by the Owner.
- C. The services of a technician who has been trained and certified by the manufacturer of the equipment being supplied shall be provided to supervise the installation, adjustments, tests and final connections and certification of the system.
- D. The system control panel, annunciators, devices specified, and their installation and operation shall conform to the most stringent applicable requirements of the following publications and this specification unless otherwise noted:
 - i. NFPA 70 The National Electric Code
 - ii. NFPA 72 The National Fire Alarm Code
 - iii. NFPA 90A
 - iv. BOCA
- E. The control panel, annunciators, all initiating and indicating devices and all other devices connected to the system shall be UL Listed as provided and shall bear UL



and Construction Standards (archived) for applicable specification requirements.
The equipment shall be Siemens type MXLV.

— END OF 28 41 21.1x —



DIVISION 31 EARTHWORK

GENERAL

American University views the campus site as an integral piece of the University mission and takes advantage of the unique urban setting to provide students, faculty, staff and the local community direct involvement in sustainability initiatives. The Arboretum Master Plan underscores the dedication to environmental and social responsibility while providing for needed infrastructure. The Project Manager and Designer will:

- Develop site designs that complement the existing campus landscape
- Minimize impact on existing trees and amenities through protection or relocation
- Consult with American University Landscape Architects
- Consult with American University Energy and Engineering
- Contain erosion control, including runoff reduction and sediment control
- Include site specific Facilities Management Master Plan requirements

DESIGN CONSIDERATIONS

Dewatering discharge shall be at approved locations only.

Store and stockpile materials at approved locations only. Do not reuse removed materials unless specifically approved by the University.

Warning tape, color coded for type of service, is required for all buried work. Drawings submitted for record must reference elevations as required by the design team.

EXECUTION

Contractor will protect existing site and restore any damage to the satisfaction of the University. This includes, but is not limited to sidewalks and pavers, existing vegetation and irrigation, roadways, utility poles, drains and covers, and street signs.

Product selections by the Designer will be included in the Basis of Design for Facilities Management review and concurrence.

- END OF DIVISION 31 -



DIVISION 32 EXTERIOR IMPROVEMENTS

GENERAL

American University views the campus site as an integral piece of the University mission and takes advantage of the unique urban setting to provide students, faculty, staff and the local community direct involvement in sustainability initiatives. The Arboretum underscores the dedication to environmental and social responsibility while providing for needed infrastructure. The Project Manager and Designer will:

- Develop site designs that complement the existing campus landscape
- Minimize impact on existing trees and amenities through protection or relocation
- Consult with American University Landscape Architects
- Contain erosion control, including runoff reduction and sediment control
- Include site specific Facilities Management Master Plan requirements
- Consult with Planning and Project Management on ADA requirements

DESIGN CONSIDERATION

The Designer shall make every attempt to utilize products that conform, match or are similar to existing American University (AU) site designs.

Designer shall include sustainable elements.

Selection criteria for exterior site products includes maintenance and upkeep requirements. For example, avoid using fences and gates that require cyclic painting.

Consult the AU Arboretum and Landscape Architects for tree and plant selection.

Designer is to avoid invasive plant materials in species selection.

Confirm pavement markings with University Safety and Security Services for campus consistency.



Contractor will provide a maintenance plan as a submittal prior to installation of plants. Coordination with Facilities Management Grounds department is required for plant maintenance or replacements during the warranty period.

EXECUTION

Contractor will protect existing site and restore any damage to the satisfaction of the University. This includes, but is not limited to sidewalks and pavers, existing vegetation and irrigation, roadways, utility poles, drains and covers, and street or informational signs.

Relocate or transplant existing trees, shrubs and other plants per the direction of the project Facilities Management Grounds and the American University Landscape Architects. Design specification and scope of work is to include specific direction on required protection, moving instructions and replanting directions.

Hand watering may be required if the irrigation system is not operable or is not incorporated into the design. Contractor to develop watering schedule respond within 24-hours of notice for extra watering during the warranty period.

Product selections by the Designer not listed herein will be included in the Basis of Design document for Facilities Management Grounds and Landscape Architect to review and comment.

PLANTING IRRIGATION – 32 84 00

Design irrigation system to integrate with existing Rain Bird system. Include one (1) year service including labor and materials for new or renovated irrigation systems.

Irrigation systems are integrated with the existing Rain Bird Irrigation control system and where appropriate the Building Automation System. A CAT6 network data drop is a requirement.

A backflow preventer is required on the irrigation system. Certify backflow preventer not less than one week before Substantial Completion or temporary occupancy whichever comes first. Transmit certificate to Facilities Management via formal project submittal.

New systems require a DC water meter for sewer credit.



TURFS AND GRASSES – 32 92 00

Facilities Management Grounds has an established mowing and maintenance schedule for turf and grass that accommodates the University event schedule. Contractor to incorporate these requirements into service and maintenance plan.

Turf soil preparation shall be verified by Landscape Designer and Grounds staff prior to seeding or installation of sod.

PLANTS - 32 93 00

Landscape designer and Grounds staff shall jointly review and approve bed and container preparation prior to placement of plants.

Plants considered invasive or in obviously poor condition (damaged, diseased, disfigured, et.) will be rejected and replaced at the Contractors expense.

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Division 32 – Exterior Improvements

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

Concrete – Walkways

1. Davis Colors Sandstone #5237, scored as designed

Curbs – High Visibility Areas and Plazas

1. Mount Airy Granite DC street curb

Irrigation System

1. Rain Bird

Pavers – Entrances, Plazas and High Visibility Areas

1. Hanover Presto® Brick Classic Series Matrix # B91763 Tudor Finish, herringbone pattern with soldier course border
2. Bluestone Select Blue 2'X3'

Pavers – Walkways Fire Lane

1. EP Henry Coventry Stone 1, Harvest and Dakota mix blend

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to, the following:

N/A if product meets Owners Program Requirements (OPR) and design criterion.

- END OF DIVISION 32 -



DIVISION 33 UTILITIES

GENERAL

American University views the campus site as an integral piece of the University mission and Facilities Management (FM) Energy and Engineering takes care to ensure reliability and continuity of needed campus wide services to enable University success in this endeavor. The design of the current campus utility distribution system provides the cost effective needed infrastructure for today's needs and tomorrows anticipated demand. The Project Manager and Designer for new utility work will:

- Consult with FM Energy and Engineering on design and selection
- Include site specific Facilities Management Master Plan requirements
- Protect existing utilities during new work
- Minimize impact of outages for new service tie-in

The designer may include project specific underground utility work in Divisions 22, 23 or 26 provided scope and execution meets the intent of Division 33.

DESIGN CONSIDERATIONS

The Designer shall include life cycle cost including installed price, maintenance and operations, and utility use as selection criteria for major campus infrastructure projects. Include payback criteria for option selection by American University. The university may elect to use the analysis in a more general basis to determine thresholds for using specific material types, installation methods, etc. on a project-by-project basis.

The cost of annual maintenance and upkeep requirements shall be included in the selection criteria for utility products on the distribution system. FM will identify such information during the Owners Project Requirements for incorporation into the Basis of Design. See the control and monitoring, integration, compatibility and similar American University requirements in appropriate system division.



American University does not permit overhead utility distribution. This includes permanent utilities for the Main Campus, East Campus and Washington College of Law. Off-campus buildings on a single site to follow District of Columbia requirements.

The Consultant shall provide a written description of how the entire system is designed to operate. This Basis of Design (BOD) narrative also shall describe how project objectives are being met. It shall be provided in a format that can be easily understood by a layperson, the end user. The narrative identifies items that specifically meet the Owners Project Requirements (OPR) and the most recent Facilities Management (FM) or department System Master Plan(s) and articulate a rationale for any variance. Changes in the BOD that differ substantially from the original conceptual submission shall be updated prior to issued-for-construction (IFC) documents.

For renovations, the systems selected shall be compatible with the existing building's mechanical systems. The integrity of the basic existing building system shall not be compromised, except where agreed to by the Owner. Work shall be designed and sequenced to minimize impact and interruptions in occupied buildings.

For site work, the Consultant shall indicate all existing underground work such as piping, valves, manholes, electric wiring and telephone, whether new connections are being made or not. Profiles of all piping need to be shown to facilitate coordination with the crossing of other utilities.

EXECUTION

Contractor shall protect existing site and restore any damage to the satisfaction of the University. This includes, but is not limited to sidewalks and pavers, existing vegetation and irrigation, roadways, utility poles, drains and covers, and street or informational signs.



Relocate or transplant existing trees, shrubs and other plants per the direction of the project Facilities Management Grounds and the American University Landscape Architects. Design to include specific direction on required protection, moving instructions and replanting directions. Site and tree protection requirements are project specific.

Product selections by the Designer not listed herein will be included in the Basis of Design document for Facilities Management Energy and Engineering to review, comment and concur.

Contractor shall secure work zone and demark per contract documents. Include alternative directions, signs, and road/crowd control in work plan. Submit to Project Manager prior to start of work for internal American University review, concurrence and campus notification.

Contractor is responsible for any damage stemming from uncoordinated interruption of existing utilities and building services.

STORMWATER PERMITS

Contractor is responsible for obtaining any required stormwater permits to perform underground utility work. Consultant will provide design drawings to be used to obtain the stormwater permit and will include a minimum of one revised set based upon stormwater permit review comments. Refer to Division 1.

COMMON WORK RESULTS FOR UTILITIES – 33 05 00

Refer to Divisions 22, 23 and 26 for common work results.

Inactive utilities are not to be abandoned unless approved by the Owner. When approved by the Owner, abandoned utilities shall be filled with flowable fill and piping capped or plugged with it or compatible material.

New underground utility vaults shall be precast unless approved otherwise by the Owner. Penetrations shall be made watertight using Linkseal or approved equal. Vaults shall be provided with integral sump, two manway openings and stainless steel ladder(s). Include vaults to scale in utility profile drawings.



Integrity testing and associated fill, flush, passivation or chlorination/ treatment shall be consistent for exterior and interior wet utilities and/or tie-in to campus systems. In no case shall the new work allow untreated hydronic systems to interconnect with campus utilities. See Division 22 Plumbing and Division 23 Mechanical.

Dry utilities shall not be energized until the AU stakeholder (E&E Master Electrician, Office of Technology, or University Safety and Security Services) have confirmed the new work. See Division 26 Electrical.

STORMWATER CONVEYANCE – 33 42 00

Place structures where access by maintenance personnel and equipment will minimize damage to existing site amenities. Consider pedestrian walk paths and repair or service impact duration in final layout.

Pumped systems, not including sump pumps in vaults, require monitoring and alarms to the Building Automation System as described in Division 25. Heat Trace requirements may also apply.

SUB DRAINAGE – 33 46 00

The Designer should consider and suggest sustainable reuse or avoidance alternatives to discharge volume for American University to receive a DC Water sewer credit.

The remainder of this page is intentionally blank.



Division 33 – UTILITIES PRODUCTS AND MANUFACTURERS

Subject to compliance with project requirements, basis-of-design manufacturer(s) (and model number if applicable) shall be:

N/A – Project specific

Subject to compliance with project requirements, acceptable manufacture(s) include, but are not limited to, the following:

N/A – Project specific

Acceptable products include, but are not limited to, the following:

- Water: Main - Ductile Iron, C900
 Laterals – copper, fused HDPE

- Sewer: Main - SDR 26 PVC, Ductile Iron
 Laterals – Schedule 40/80 pvc, Ductile Iron

- Storm: Double/triple wall HDPE, Sanitite Polypropylene,
 Gasketed Reinforced Concrete, Ductile Iron

- END OF DIVISION 33 -



AMERICAN UNIVERSITY
DESIGN STANDARDS - REFERENCES

Appliance	Location	Company	Model	Dimensions	Energy Star?	Finish	Note
Dishwasher	Staff Apartment	GE	GDT580SSFSS	34" x 23.75" x 24"	Yes	Stainless Steel	hidden controls
Dryer	Staff Apartment	Whirlpool	WED72HEDW	31"D x 38.75"H x 27"W	N/A	White	stand alone
Microwave Oven	ADA Staff Apartment	GE Profile	PEB7226SFSS	14" x 24.125" x 19.75"	N/A	Stainless Steel	countertop
Microwave Oven	ADA Student Apartment/McDowell Suites	GE Profile	PEB7226DFWW	14" x 24.125" x 19.75"	N/A	White	2.2 cu ft, counter top
Microwave Oven	Staff Apartment	GE Profile	PVM9179SFSS	16.25" x 29.875" x 15.5"	N/A	Stainless Steel	1.7 cu ft., over-the-range type, w/ convection
Microwave Oven	Student Apartment	GE Profile	PVM9195DFWW	16.5" x 29.75" x 15.5"	N/A	White	1.9 cu ft, over-the-range
Microwave Oven	Traditional Student Lounges	Sharp	R21LVF	16"D x 12.125"H x 20.5"W	No	Stainless Steel	Ordered from Microwave Specialties, Touch pads have braille
Oven & Range	Staff Apartment	GE	JD630SFSS	27" x 28.5", 31.25"	N/A	Stainless Steel	ADA, drop-in type, special cabinet required
Oven & Range	Student Apartment and Lounges	GE	JB450DFWW	47" x 29.875" x 34.675"	N/A	White	Freestanding, ADA, 12 hour automatic shut off
Range Exhaust Hood	ADA Student Apartment	GE	JV347HWW	5.5" x 29.875" x 17.5"	No	White	Convertible- ducted or recirculating, 3 fan speeds
Range Exhaust Hood	Staff Apartment	GE	JVE40STSS	19.5"D x 5.94"H x 29.88"W	Yes	Stainless Steel	
Range Exhaust Hood	Student Apartment	GE	JVE40DTWW	18.88"D x 18"H x 36"W	Yes	White	
Range Exhaust Hood	Student Lounges	GE	JVE40STSS	19.5"D x 5.94"H x 29.88"W	Yes	Stainless Steel	
Refrigerator	Staff Apartment	GE	GDE20GSHSS	66.5" x 29.75" x 34.625"	Yes	Stainless Steel	Bottom freezer, 20.3 cu ft, icemaker
Refrigerator	Student Apartment	GE	GDE20GGHWW	66.5" x 29.75" x 34.625"	Yes	White	Bottom freezer, 20.3 cu ft, icemaker
Television	Student Lounges	Toshiba	50L2400U	8.5"D x 27.6"H x 44.1"W	N/A	Black	LED backlit LCD; 1080p-120Hz
Washer	Staff Apartment	Whirlpool	WFW72HEDW	33.13"D x 38.75"H x 27"W	High-Efficiency	White	stand alone
Washer/Dryer	Staff Apartment	GE	GTUN275EMWW	75.5" x 30.75" x 27"	Yes	White	stacked unit (I think we wanted to switch to non-stackable, though)

The equipment listed above is typical in residence halls. Confirm make and model number is available. Changes or replacements require approval from Housing and Residence Life.

AU Electrical Labeling Color Scheme

Color	Example	Use
white letters on black	Normal power	Standard identification for building systems and equipment
white letters on orange or black letters on orange	Critical power Critical Power	Critical and optional (legally required) emergency power
white letters on red	Emergency power	Life safety systems

Note: Labeling for all equipment should match source of power.

AU Site Design Standards

Paving

Building entrances, plazas and high visibility areas

2'x3' Select Blue Bluestone border and accents

Hanover Prest® Brick Classic Series Matrix # B91763 Tudor Finish Infill in a herringbone pattern with soldier course border.



Walkways Fire lanes

Other pavers on campus are EP Henry Coventry Stone 1 mixture of sizes. Color Harvest and Dakota blend mix. These are used to border asphalt walkways of lesser importance.



Concrete walkways

Colored concrete Davis Colors Sandstone #5237. Scored as designed.



Curbs

High visibility areas and plazas Mount Airy Granite DC Street curb with split face



Other less important areas concrete curb



Garden areas Granite cobble curbs



Railings

Barrier Railings



Hand Rails

J Blum #6930 Stainless Steel top rail Satin finish

1 1/4" Galvanized square post with #368 galvanized post flange

<http://www.juliusblum.com/products.html>

Building Identification Signs

Rubble stone veneer mixture of Dove Gray and 50% Sterling Silver available from Luck Stone. Precast concrete caps and sign panel with cast letters in Garamond font. – color Buff available from Hoyle Stone Products



Seat Walls

Rubble stone veneer mixture of Dove Gray and 50% Sterling Silver available from Luck Stone. Minimum 3" thick precast concrete cap – color Buff available from Hoyle Stone Products



Benches

Victor Stanley

SteelSites RB-28 – color Tavern Square Green

<http://www.victorstanley.com/product/rb-28/>



Tables and Chairs

Country Casual Siena Collection



Bike Racks

Victor Stanley

BRHS – 101 Cycle Centry Collection color Tavern Square Green

<http://www.victorstanley.com/product/brhs-101/R>



Trash Receptacles

Victor Stanley Ironsites Collection Color Tavern Square Green

S-42<http://www.victorstanley.com/product/s-42-2/>



Recycling Containers

New standard being developed to match interior recycling materials. More detail to follow

Light Poles

Spring City Electrical Manufacturing Company

The Washington #16 Post with the Washington Armory Square LED Luminaire. Color dark green
5000 Kelvin



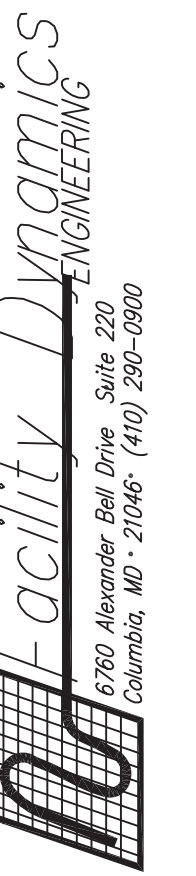
STANDARD CONTROL DRAWINGS AND LOGIC DIAGRAMS

AMERICAN UNIVERSITY
WASHINGTON, DC

LIST OF DRAWINGS

C-001	CONTROLS SYMBOLS & ABBREVIATIONS		
C-100	DUAL DUCT VAV BOX	C-105	FAN COIL UNIT
C-101	PARALLEL FAN POWERED VAV BOX W/ REHEAT	C-106	CHILLED BEAM SYSTEM
C-102	SERIES FAN POWERED VAV BOX W/ REHEAT	C-107	LABORATORY CLASSROOM
C-103	VAV BOX W/ COOLING ONLY	C-108	COMPUTER ROOM AIR CONDITIONER
C-104	VAV BOX W/ REHEAT	C-109	RADIANT PANEL SYSTEM
C-200	VAV DUAL DUCT AHU	C-207	MZ AHU w/ ECONOMIZER, HW/CHW COILS, & CO2 DEMAND
C-201	VAV AHU w/ ECONOMIZER, HW/CHW COILS, RF FLOW TRACKING	C-208	VAV AHU w/ WITH ENERGY RECOVERY WHEEL
C-202	VAV AHU w/ ECONOMIZER, HW/CHW/DX COILS, & CO2 DEMAND	C-209	VAV 100% OUTSIDE AIR AHU
C-203	CV AHU w/ ECONOMIZER, HW/CHW/DX COILS, & CO2 DEMAND	C-210	ROOF TOP UNIT
C-204	CV AHU w/ ECONOMIZER, HW/CHW COILS, & CO2 DEMAND	C-211	KITCHEN MAKE-UP AIR UNIT
C-205	CV AHU w/ ECONOMIZER, DTW/DX COILS, & CO2 DEMAND	C-212	LARGE SINGLE ZONE VAV AHU
C-206	CV AHU w/ ECONOMIZER, DTW COIL, & CO2 DEMAND	C-213	DEDICATED OUTDOOR AIR HANDLER
C-300	QUAD CHW LOOP		
C-301	MULTI-BUILDING, MULTI CHILLER PLANT RESIDENTIAL HALL CHW LOOP		
C-302	CHW PLANT w/ PRIMARY PUMP AND VARIABLE FLOW SECONDARY PUMP		
C-303	BUILDING CHW LOOP CONTROL		
C-400	MISCELLANEOUS CONTROLS		
C-401	STANDARD EXHAUST FAN CONTROLS		

NOTE: MOST DRAWINGS INCLUDE TWO SHEETS; (A) SCHEMATIC, SEQUENCE, ELECTRIC LADDER DIAGRAM; (B) LOGIC, POINTS LIST



AMERICAN UNIVERSITY
STANDARD CONTROL DRAWINGS

Eng	HJN
Drawn	HJN
Chkd	---
Appd	---
Issued	6/11/2018
Job No.	18093
Scale	N/A
Proj Code	

FOR REVIEW
ONLY

TITLE SHEET

01 OF XX
SHEET NUMBER

T-001

DWG NUMBER

Master Commissioning Plan Project Customization Guideline

American University
Washington, DC

March 20, 2012



Questions & Solutions[®] Engineering, Inc.
1079 Falls Curve
Chaska, Minnesota 55318
QSEng.com



Master Commissioning Plan Project Customization Guideline

**American University
Washington, DC**

March 20, 2012

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1. Introduction

Purpose

This document provides instructions on how to customize the American University Master Commissioning Plan into a project-specific Commissioning Plan. As designed, the Master Commissioning Plan is intended to cover the maximum level of commissioning anticipated to ever been desired for an American University project. As such, the project customization process should essentially be a matter of deletions and not additions.

There are two primary types of capital projects at American University:

- Major Capital Projects planned and managed by the Office of the University Architect (OUA)
- Capital Renewal and Deferred Maintenance (CRDM) projects planned and managed by the Facilities Office.

The level of commissioning will typically, but not necessarily always, vary significantly between these two project types. The Master Commissioning Plan should be the starting point for all project types with the **Project Manager** and the **Facilities Management Commissioning Authority** considering all of the following elements and making the appropriate edits to the Master Commissioning Plan.

In Section 5 of this Guideline, however, Questions & Solutions Engineering will suggest a “typical” CRDM Commissioning Process Flowchart. This is based on our experience with respect to best value commissioning in most remodeling, renovation, and deferred maintenance projects. This can be used as a quick reference for how to customize most CRDM projects. However, CRDM projects with major new mechanical and electrical systems and/or equipment may warrant a more comprehensive commissioning program.

When to Customize the Commissioning Plan?

Each Project Commissioning Plan should be customized following Board approval of the Project and prior to selection of the Design Team and the Commissioning Manager (if outsourced). The Project Commissioning Plan should be included in the procurement process for the Design Team, the Commissioning Manager, and the Construction Manager, if one is used. It is beneficial for all project consultants and contractors to understand the intentions for commissioning and their expected role within the commissioning process.



2. Initial Considerations

Is Commissioning Necessary?

Based on project size, scope, and LEED certification goals, American University must determine if commissioning is necessary at all. The following are key questions to consider when making this decision:

1. Is the project pursuing LEED certification at any level? If so, commissioning is a prerequisite. Please refer to Section 4 for Commissioning Process Flowcharts showing the minimum requirements for LEED certification (Fundamental Commissioning) and the minimum requirements for LEED Enhanced Commissioning (worth 2 point towards the project's LEED score).
2. Does the project include complex, inter-related, and computer-based systems?
3. Does the project include critical systems cannot afford a "break-in" period while potential operational problems are worked out after occupancy?
4. Is it a project/facility type that has been prone to operational problems in the past?
5. Does the project success rely on performance of existing mechanical, electrical, or life safety systems that will be reused and/or modified in some way?
6. Is there reason to be concerned about the design and construction support capabilities of the project team?
7. Are there special investments being made in energy conservation equipment and/or operating strategies or renewable energy systems? If not commissioned, these systems may never realize full their energy savings potential.

Who will Serve as Commissioning Manager?

Although responsibility for commissioning will fall on the Facilities Management Commissioning Authority (FMCA), the FMCA is not in a position to be actively involved in facilitating, tracking, and documenting the commissioning process for all projects. That is the Commissioning Manager's (CxM) role.

The Commissioning Manager can be selected from American University facilities personnel or be outsourced to qualified and experienced commissioning professionals who agree to adhere to the Project Commissioning Plan customized by American University. This is a resource management decision only American University can make on a case-by-case basis.

If the project is to be LEED certified but not pursue the Enhanced Commissioning credit (2 points), the in-house or outsourced Commissioning Manager will need to meet the following minimum criteria:

1. The CxM shall have documented commissioning authority experience in at least two building projects.



2. The individual serving as the CxM shall be independent of the project's design and construction management, though they may be employees of the firms providing those services. The CxM may be a qualified employee or consultant of American University.
3. The CxM shall report results, findings, and recommendations directly to American University.
4. For projects smaller than 50,000 square feet, the CxM may be a qualified person on the design or construction teams who has the required experience.

If the project is to be LEED certified and pursue the Enhanced Commissioning credit (2 points), the in-house or outsourced Commissioning Manager will need to meet the following minimum criteria.

1. The CxM shall have documented commissioning authority experience in at least two building projects.
2. The individual serving as the CxM:
 - a. Must be independent of the work of design and construction.
 - b. Must not be an employee of the design firm, though he or she may be contracted through them.
 - c. Must not be an employee of, or contracted through, a contractor or construction manager holding construction contracts.
 - d. May be a qualified employee or consultant of American University.
3. The CxM shall report results, findings, and recommendations directly to American University.



The following are key questions to consider when making the decisions about which systems to commission:

1. Is the project pursuing LEED certification at any level? The above bulleted list is then the minimum systems to be commissioned.
2. With which systems have problems consistently occurred on past projects?
3. What are the risks of system malfunction after occupancy/beneficial use?
4. What are the political implications of poor system performance?
5. How easily would deficiencies be found without commissioning?
6. How many parties are involved in design and construction of a particular system?

Define the Applicable Commissioning Activities

Decide which of the Commissioning Activities list in Master Commissioning Plan Section 4: Commissioning Process Matrix will apply to the customized Project Commissioning Plan.

1. Delete inapplicable rows from the **Section 4: Commissioning Process Matrix**.
2. Delete corresponding inapplicable activities boxes from the **Section 5: Commissioning Process Flowchart**.
3. Delete corresponding narrative descriptions from **Section 6: Commissioning Activities Narratives**.

Updated and/or Additional Commissioning Documentation Templates & Examples

Update all American University-approved commissioning document templates (e.g., Commissioning Action List, Document Review Template, Training Plan Example, Training Agenda Example, Example Prefunctional Checklists, Example Functional Performance Test Procedures, etc.) in **Section 7: Commissioning Documentation**. Commissioning documentation and project deliverables will be consistent from project-to-project if American University dictates the format of the documents and deliverables from the onset.

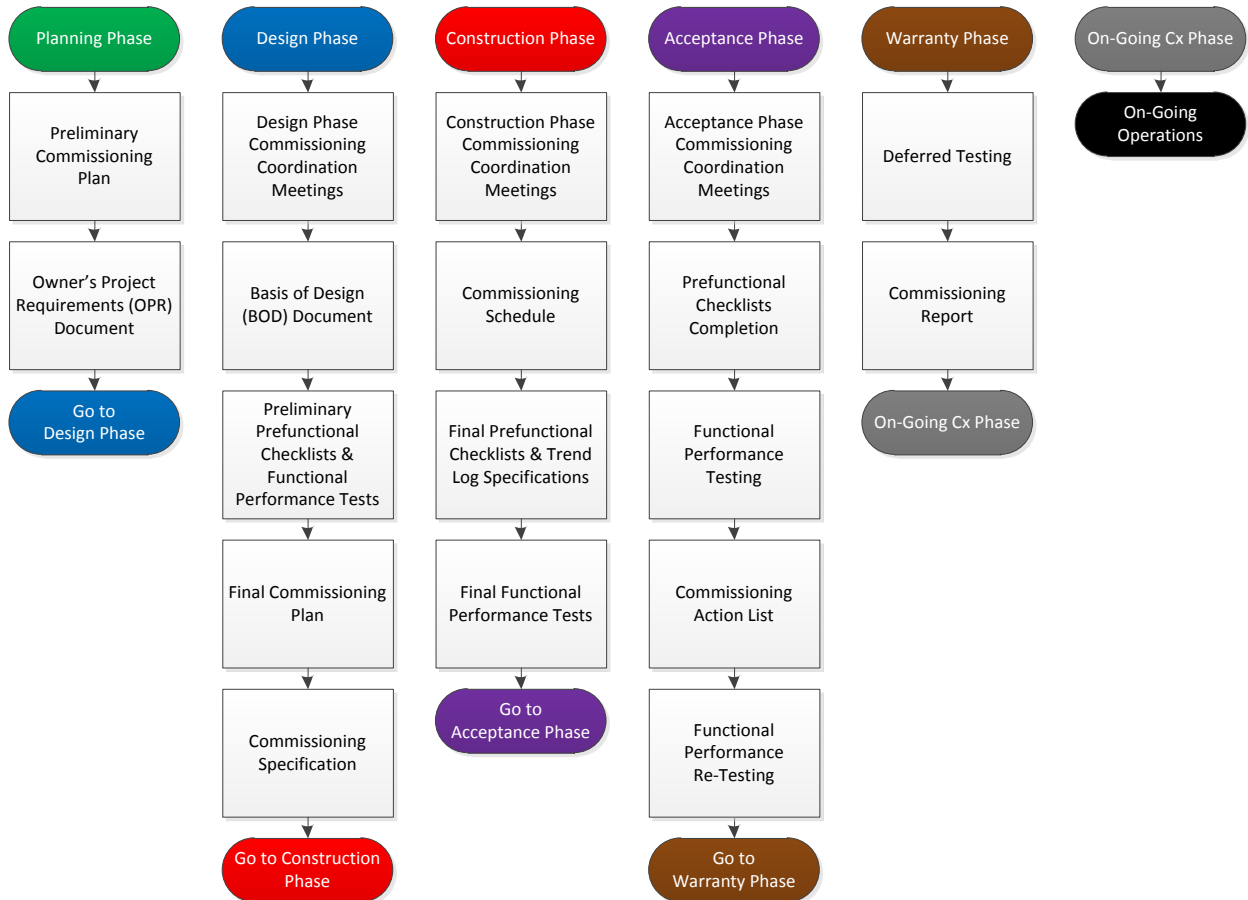
It is expected that the more commissioning projects American University has under its belt, the more customized and evolved the documentation will be in the master- and project specific- commissioning plans. As such, the documents included in Section 7 may change and actually be added-to (i.e., perhaps an Owner's Project Requirements example or a Basis of Design example will be included).

Providing these examples documents is key to demonstrating the level of rigor American University requires of the Commissioning Manager, Design Team, and Construction Team. These Commissioning Team members will be responsible for customizing the examples to match the unique systems and requirements of each project.



4. Commissioning Requirements for LEED Certification

Fundamental Commissioning: Energy & Atmosphere Prerequisite 1





3. Develop a Project-Specific Commissioning Plan

The following steps outline the process of updating the Master Commissioning Plan document and tailoring its contents for a specific project.

Update Introduction

Update **Section 1: Introduction** to outline the project scope of work (e.g., project description, square footage, LEED certification goals, if applicable, etc.) and the key commissioning elements being applied to the project.

Establish the Commissioning Team

Populate the American University Commissioning Team member information into the **Section 2: Commissioning Team Members** table (i.e., AU Project Manager, AU Construction Manager, AU Facilities Management Commissioning Authority, and AU Other Departments representatives). It is expected that the Design Team, Construction Team, and Commissioning Manager representatives to the Commissioning Team will be added later in project evolution by the Commissioning Manager.

Define the Systems to be Commissioned

If the project is pursuing LEED certification, at a minimum the LEED-prescribed systems will need to be included:

- HVAC systems
- Lighting & daylighting controls
- Domestic hot water systems
- Renewable energy systems (wind, solar, etc.)

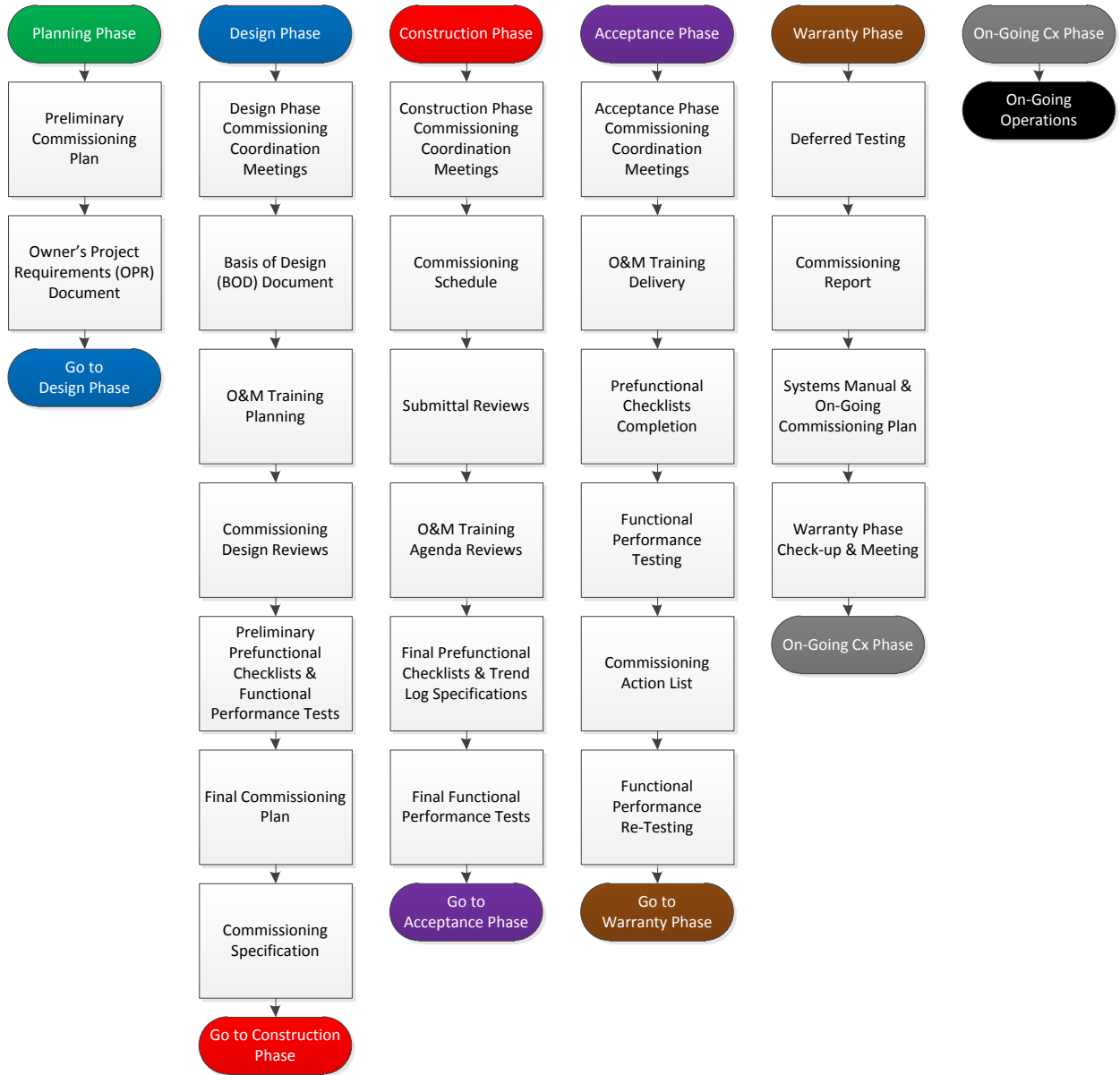
Based on American University's priorities and budget, additional systems can be included in the list of Systems to be Commissioned. This process should simply involve going through the Master Commissioning Plan **Section 3: Systems to be Commissioned** list and deleting systems which are either not included in the project scope or not critical enough to warrant the commissioning process.

The Sampling column of the Systems to be Commissioned table should also be populated with a percentage (100%, 50%, 25%, 10%, etc.) expectation for functional testing of multiple "similar" systems such as air terminal units, baseboard radiation, unit heaters, exhaust fans, etc. This percentage applies only to functional performance testing, whereas all other aspects of the commissioning process (e.g., design review, submittal review, prefunctional checklists, etc.) are intended to apply to 100% of the systems/equipment in the project.

Note that during the pre-design phase, American University will only be able to list "general" systems as listed in the Master Commissioning Plan. However, as the project matures during the Design Phase, the Commissioning Manager will need to update and refine the list including more specific information regarding systems types and quantities.



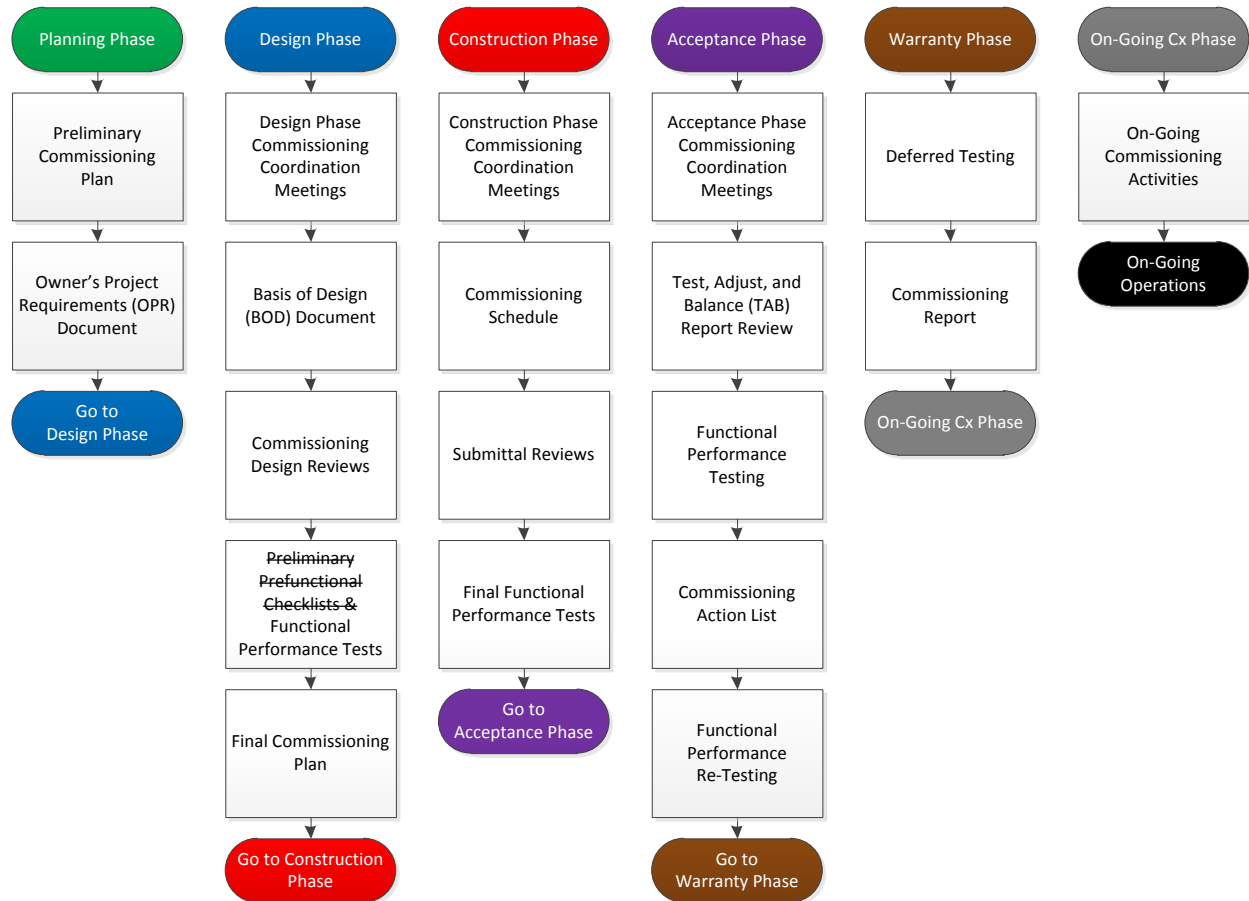
Enhanced Commissioning: Energy & Atmosphere Credit 3 (2 points)





5. Suggested Commissioning Scope for CRDM Projects

The following are QSE's recommendations for commissioning activities for CRDM project for which mechanical and electrical systems are a major component of the work.





6. Update the Master Commissioning Plan

American University will improve their commissioning process based on lessons learned during each project. Those best practices should be incorporated in the Master Commissioning Plan in subsequent “revisions” as they become apparent. Experience-based enhancements are likely to include, but not be limited to:

1. O&M manual requirements, delivery, and review
2. O&M training requirements, delivery, and review
3. As-built documentation requirements, delivery and review
4. Warranty management requirements
5. System manual requirements, delivery, and review
6. On-going commissioning plan requirements and construction phase preparation



EQUIPMENT NUMBERING SCHEME

- First Identifier** – Identifier for the building that the equipment is associated with. This will be consistent with the established computerized maintenance management (AiM) building identifier codes existing in the AiM system.
- Second Identifier** – Floor location of the equipment if the building is multi-level, having more than a basement and a first floor.
- Third Identifier** – Type of equipment that is being identified. Abbreviated equipment type code consistent with existing AiM established codes.
- Fourth identifier** – This will indicate the incremental number of the item according to the location. The incrementing should begin with the lowest physical level of the building.

Examples of Asset Codes for AiM:

If there are 3 VAV units on the first floor and 3 on the third floor and 2 Fan coil units on the first floor and 5 on the third floor in Anderson Hall the AiM asset numbering codes will be:

AH-01-VAV001	VAV BOX
AH-01-VAV002	VAV BOX
AH-01-VAV003	VAV BOX
AH-03-VAV004	VAV BOX
AH-03-VAV005	VAV BOX
AH-03-VAV006	VAV BOX
AH-01-FCU001	FAN COIL UNIT
AH-01-FCU002	FAN COIL UNIT
AH-03-FCU003	FAN COIL UNIT
AH-03-FCU004	FAN COIL UNIT
AH-03-FCU005	FAN COIL UNIT
AH-03-FCU006	FAN COIL UNIT
AH-03-FCU007	FAN COIL UNIT



Refer to the document Schematic Equipment and Building Codes for existing identifiers. Consult with the Facilities Management Planned Maintenance Manager prior to assigning equipment identifiers the contract documents. List AiM number on building documents including equipment schedule. Equipment shall be labeled consistently across all disciplines.

Resolution of equipment not associated with buildings.

There are some items identified as equipment that are not associated with any building. These are equipment items for the Grounds Maintenance Operation (mowers, tillers, clippers, etc.). Other items are unique to the housekeeping operation (vacuums). Equipment that is affixed to the facility or requires special connections shall be identified in the project documents by the corresponding AiM equipment asset identification.



FM EQUIPMENT ASSET ID SCHEMA

The information below is provided to ensure consistency in facility naming on construction and renovation projects. Facilities Management (FM) has assigned location designations to campus buildings and site locations. These designations are used in the AiM computerized maintenance management system as well as the building automation system. Refer any questions about naming to Planning and Project Management or the Project Manager. The FM Planned Maintenance Manager is available to review new equipment naming during the design development stage of the project. Also called the asset ID, this unique number should be used in a consistent manner across all disciplines.

Asset Group	Description	Asset Type	Acronym
AC SYSTEM	ACSYS - MULTI COMPONENT - AIR CONDITIONING SYSTEM [ACSYS]	SERIALIZED	ACSYS
ACTUATOR VALVE	ACTUATOR VALVE [AVLV]	SERIALIZED	AVLV
AERATOR	AERATOR [ARTR]	SERIALIZED	ARTR
AIR COMPRESSOR	AIR COMPRESSOR [AIRCP]	SERIALIZED	AIRCP
AIR CONDITIONER GROUP	AIR CONDITIONER GROUP [ACNGP]	SERIALIZED	ACNGP
AIR CONDITIONING UNIT	AIR CONDITIONING UNIT [ACNU]	SERIALIZED	ACNU
AIR DOOR	AIR DOOR /AIR CURTAIN [AD]	SERIALIZED	AD
AIR DRYER	AIR DRYER [AIRDY]	SERIALIZED	AIRDY
AIR FILTER	AIR FILTER [AFLTR]	SERIALIZED	AFLTR
AIR HANDLER	AIR HANDLER [AHU]	SERIALIZED	AHU
AIR HANDLER MOTOR	AIR HANDLER MOTOR [MTR]	SERIALIZED	MTR
AIR SEPARATOR	AIR SEPARATOR [ARSPTR]	SERIALIZED	ARSPTR
AIR TERMINAL UNIT	AIR TERMINAL UNIT [FPB]	SERIALIZED	FPB
ALARM PANEL-SECURITY	ALARM PANEL-SECURITY [ALPNL]	SERIALIZED	ALPNL
AUTOMATIC DOOR CLOSER	AUTOMATIC DOOR CLOSER [ADC]	SERIALIZED	ADC
AUTOMATIC TRANSFER SWITCH	AUTOMATIC TRANSFER SWITCH [ATS]	SERIALIZED	ATS
BACKFLOW PREVENTER	BACKFLOW PREVENTER [BFP]	SERIALIZED	BFP
BATHROOM	BATHROOM [BTH]	SERIALIZED	BTH
BATTERY	BATTERY/BATTERY RACK [BATT]	SERIALIZED	BATT
BATTERY CHARGER	AUTOMATIC BATTERY CHARGER [CHGR]	SERIALIZED	CHGR
BLDG CONTROL PANEL GROUP	BUILDING CONTROL PANEL GROUP [BLDCPGP]	SERIALIZED	BLDCPGP



BLEACHERS-MOVEABLE	BLEACHERS [BLCH]	SERIALIZED	BLCH
BLOWER	BLOWER [BLOWR]	SERIALIZED	BLOWR
BOILER GROUP	BOILER GROUP [BOILRGRP]	SERIALIZED	BOILRGRP
BOILERS	BOILERS [BOILR]	SERIALIZED	BOILR
BOLLARD	BOLLARD [BLLRD]	SERIALIZED	BLLRD
BUILDING CONTROL PANEL	BUILDING CONTROL PANEL [BLDCP]	SERIALIZED	BLDCP
CARBON MONOXIDE DETECTOR	CARBON MONOXIDE DETECTOR [COD]	SERIALIZED	COD
CARD READER	CARD READER [CRDR]	SERIALIZED	CRDR
CCTV-CAMERA	CCTV-CAMERA [CCTV]	SERIALIZED	CCTV
CCTV-MONITOR	CCTV-MONITOR [CCTM]	SERIALIZED	CCTM
CHAIN SAW	CHAIN SAW [CHANSW]	SERIALIZED	CHANSW
CHILLED BEAM	CHILLED BEAM [CHBM]	SERIALIZED	CHBM
CHILLER	CHILLER [CHILL]	SERIALIZED	CHILL
CHILLER GROUP	CHILLER GROUP [CHILLGRP]	SERIALIZED	CHILLGRP
CIRCULATION FAN	CIRCULATION FAN [CFAN]	SERIALIZED	CFAN
CLOCK	CLOCK [CLOCK]	SERIALIZED	CLOCK
COMMERCIAL BAINE MARIE	BAINE MARIE [BAIN]	SERIALIZED	BAIN
COMMERCIAL BEV DISP	COMMERCIAL BEVERAGE DISPENSER [BEV]	SERIALIZED	BEV
COMMERCIAL CHOPPER	COMMERCIAL CHOPPER [CHPR]	SERIALIZED	CHPR
COMMERCIAL COFFEE URN	COMMERCIAL COFFEE URN [URN]	SERIALIZED	URN
COMMERCIAL COLD LINE	COMMERCIAL COLD LINE [CLIN]	SERIALIZED	CLIN
COMMERCIAL COLD WELL	COLD WELL [CWL]	SERIALIZED	CWL
COMMERCIAL CONVEYOR	COMMERCIAL CONVEYOR [CNVR]	SERIALIZED	CNVR
COMMERCIAL DISH MACHINE	COMMERCIAL DISH MACHINE [DSHM]	SERIALIZED	DSHM
COMMERCIAL DISHWASHER	COMMERCIAL DISHWASHER [DW]	SERIALIZED	DW
COMMERCIAL DISPOSAL	COMMERCIAL DISPOSAL [DISP]	SERIALIZED	DISP
COMMERCIAL FREEZER	COMMERCIAL FREEZER [FRZR]	SERIALIZED	FRZR
COMMERCIAL FRYER	COMMERCIAL FRYER [FRYR]	SERIALIZED	FRYR
COMMERCIAL GARBAGE DISPOS	COMMERCIAL GARBAGE DISPOSER [DISP]	SERIALIZED	DISP
COMMERCIAL GRILL	COMMERCIAL GRILL [GRLL]	SERIALIZED	GRLL



COMMERCIAL GRINDER	COMMERCIAL MEAT GRINDER [GRNDR]	SERIALIZED	GRNDR
COMMERCIAL HOT LINE	COMMERCIAL HOT LINE [HLIN]	SERIALIZED	HLIN
COMMERCIAL HOT WELL	COMMERCIAL HOT WELL [HWL]	SERIALIZED	HWL
COMMERCIAL HOT/COLD LINE	COMMERCIAL HOT/COLD LINE [HCLIN]	SERIALIZED	HCLIN
COMMERCIAL ICE CREAM DISP	COMMERCIAL ICE CREAM DISPENSER [ICED]	SERIALIZED	ICED
COMMERCIAL ICE MACHINE	COMMERCIAL ICE MACHINE [ICEM]	SERIALIZED	ICEM
COMMERCIAL JUICE DISP	COMMERCIAL JUICE DISPENSER [JDIS]	SERIALIZED	JDIS
COMMERCIAL KETTLE	COMMERCIAL KETTLE [KTL]	SERIALIZED	KTL
COMMERCIAL MICROWAVE	COMMERCIAL MICROWAVE [MCRW]	SERIALIZED	MCRW
COMMERCIAL MIXER	COMMERCIAL MIXER [MXR]	SERIALIZED	MXR
COMMERCIAL OVEN	COMMERCIAL OVEN [OVEN]	SERIALIZED	OVEN
COMMERCIAL POTWASHER	COMMERCIAL POTWASHER [POTW]	SERIALIZED	POTW
COMMERCIAL PRESSER	DOUGH PRESSER [PRSR]	SERIALIZED	PRSR
COMMERCIAL PROOFER	COMMERCIAL PROOFER [PROF]	SERIALIZED	PROF
COMMERCIAL RANGE	COMMERCIAL RANGE - GAS/ELECTRIC [RNG]	SERIALIZED	RNG
COMMERCIAL REFRIG PREP ST	COMMERCIAL REFRIGERATED PREP STATION [REFP]	SERIALIZED	REFP
COMMERCIAL REFRIGERATOR	COMMERCIAL REFRIGERATOR [REF]	SERIALIZED	REF
COMMERCIAL SKILLET	COMMERCIAL SKILLET [SKLT]	SERIALIZED	SKLT
COMMERCIAL SLICER	COMMERCIAL SLICER [SLCR]	SERIALIZED	SLCR
COMMERCIAL SOUP WELL	COMMERCIAL SOUP WELL [SPWL]	SERIALIZED	SPWL
COMMERCIAL STEAM WELL	COMMERCIAL STEAM WELL [STWL]	SERIALIZED	STWL
COMMERCIAL STEAMER	COMMERCIAL STEAMER [STMR]	SERIALIZED	STMR
COMMERCIAL TOASTER	COMMERCIAL TOASTER [TSTR]	SERIALIZED	TSTR
COMMERCIAL VAC PKNG MACH	COMMERCIAL VACUUM PACKING MACHINE [VACMCH]	SERIALIZED	VACMCH
COMMERCIAL WALK-IN FRZR	COMMERCIAL WALK-IN FREEZER [FRZR]	SERIALIZED	FRZR
COMMERCIAL WALK-IN REFRIG	COMMERCIAL WALK-IN REFRIGERATOR [REF]	SERIALIZED	REF



COMMERCIAL WARMER	COMMERCIAL WARMER [WRMR]	SERIALIZED	WRMR
CONDENSER MOTOR	CONDENSER MOTOR [CONDM]	SERIALIZED	CONDM
CONDENSER UNIT	CONDENSER UNIT [COND]	SERIALIZED	COND
CONSTANT AIR VOLUME BOX	CONSTANT AIR VOLUME BOX [CAV]	SERIALIZED	CAV
CONTACT	CONTACT [DORCN]	SERIALIZED	DORCN
CONTAINER	CONTAINER [CONT]	SERIALIZED	CONT
CONTROL	CONTROL [CTRL]	SERIALIZED	CTRL
CONVERTER	CONVERTER [CONV]	SERIALIZED	CONV
COOKTOP/RANGE	COOKTOP/RANGE [RNG]	SERIALIZED	RNG
COOLING COIL	COOLING COIL [CCOIL]	SERIALIZED	CCOIL
COOLING TOWER	COOLING TOWER [CLGTR]	SERIALIZED	CLGTR
DEHUMIDIFIER	DEHUMIDIFIER [DHUM]	SERIALIZED	DHUM
DETECTOR	DETECTOR [DET]	SERIALIZED	DET
DETECTOR SYSTEM	DETECTOR SYSTEM [DETSYS]	SYSTEM	DETSYS
DIMMER SWITCH	DIMMER SWITCH [DIMR]	SERIALIZED	DIMR
DISHWASHER	DISHWASHER [DISH]	SERIALIZED	DISH
DOAS	DEDICATED OUTSIDE AIR SYSTEM [DOAS]	SERIALIZED	DOAS
DOMESTIC HOT WATER HEATER	DOMESTIC HOT WATER HEATER [WH]	SERIALIZED	WH
DOOR	DOOR [DOOR]	PROPERTY COMPONENT	DOOR
DOOR GROUP	DOOR GROUP [DOORGP]	SERIALIZED	DOORGP
DOOR HARDWARE	DOOR HARDWARE [DHDW]	SERIALIZED	DHDW
DRILL	DRILL [DRILL]	SERIALIZED	DRILL
DRY COOLER	DRY COOLER CONDENSING UNIT [DCLR]	SERIALIZED	DCLR
DRY PIPE SPRINKLER SUPPLY	DRY PIPE SPRINKLER SUPPLY [SPKLR]	SERIALIZED	SPKLR
DRYER	DRYER (APPLIANCE) [DRYR]	SERIALIZED	DRYR
DUCT SYSTEM	DUCT SYSTEM [DCT]	PROPERTY COMPONENT	DCT
DX UNITS	DX UNITS [DX]	SERIALIZED	DX
ECONOMIZER	ECONOMIZER [ECN]	SERIALIZED	ECN
EDGER	EDGER [EDGER]	SERIALIZED	EDGER
ELECTRIC CAR	ELECTRIC CAR [E]	SERIALIZED	E
ELECTRIC DUCT HEATER	ELECTRIC DUCT HEATER [EDHTR]	SERIALIZED	EDHTR
ELECTRIC MOTOR	ELECTRIC MOTOR [MTR]	SERIALIZED	MTR
ELECTRIC SERVICE SWITCH	ELECTRIC SERVICE SWITCH [DSCS]	SERIALIZED	DSCS
ELECTRIC STRIKE	ELECTRIC STRIKE [ELST]	SERIALIZED	ELST



ELECTRICAL PANEL	ELECTRICAL PANEL [ELCPN]	SERIALIZED	ELCPN
ELEVATOR	ELEVATOR [ELEV]	SERIALIZED	ELEV
ELEVATOR GROUP	ELEVATOR GROUP [ELEVGP]	SYSTEM	ELEVGP
ELEVATOR GROUP	ELEVATOR GROUP [ELEVGP]	SERIALIZED	ELEVGP
EMERGENCY BLUE LIGHT	EMERGENCY BLUE LIGHT [EBL]	SERIALIZED	EBL
EMERGENCY GENERATOR	EMERGENCY GENERATOR [GENR]	SERIALIZED	GENR
EMERGENCY SHOWER STATION	EMERGENCY SHOWER STATION [ESH]	SERIALIZED	ESH
EMS	ENERGY MANAGEMENT SYSTEM [EMS]	SERIALIZED	EMS
ENERGY WHEEL	ENERGY RECOVERY WHEEL [ERU]	SERIALIZED	ERU
EVAPORATOR	EVAPORATOR [EVAP]	SERIALIZED	EVAP
EXHAUST FAN	EXHAUST FAN [EXFAN]	SERIALIZED	EXFAN
EXHAUST HOOD	EXHAUST HOOD [EXHD]	SERIALIZED	EXHD
EXHST HODD CONTROL PANEL	EXHAUST HOOD CONTROL PANEL [EXCP]	SERIALIZED	EXCP
EXPANSION TANK	EXPANSION TANK [TANK]	SERIALIZED	TANK
EXTERIOR/SAFETY DOORS	EXTERIOR/SAFETY DOORS [SFTYDOOR]	SERIALIZED	SFTYDOOR
EXTRACTOR	EXTRACTOR [EXTRACTOR]	SERIALIZED	EXTRACTOR
EYE WASH	EYE WASH [EYEW]	SERIALIZED	EYEW
EYE WASH KIT	EMERGENCY EYE WASH KIT [EYEK]	SERIALIZED	EYEK
FAN	FAN [FAN]	SERIALIZED	FAN
FAN BOX	FAN POWERED BOX [FB]	SERIALIZED	FB
FAN COIL UNIT	FAN COIL UNIT [FCU]	SERIALIZED	FCU
FAN COIL UNIT GROUP	FAN COIL UNIT GROUP [FCUGP]	SERIALIZED	FCUGP
FAN GROUP	FAN GROUP [FANGP]	SERIALIZED	FANGP
FAN MOTOR	FAN MOTOR [MTR]	SERIALIZED	MTR
FILTER	FILTER [FLTR]	SERIALIZED	FLTR
FILTER SYSTEM	WATER FILTER SYSTEM [FLTR]	SERIALIZED	FLTR
FIRE ALARM PANEL	FIRE ALARM PANEL [FAP]	SERIALIZED	FAP
FIRE ALARM STROBE	FIRE ALARM STROBE [FAST]	SERIALIZED	FAST
FIRE ALARM SYSTEM	FIRE ALARM SYSTEM [FAS]	SERIALIZED	FAS
FIRE DAMPER	FIRE DAMPER [FD]	SERIALIZED	FD
FIRE DOOR	FIRE DOOR [FDOOR]	SERIALIZED	FDOOR
FIRE EXTINGUISHER	FIRE EXTINGUISHER [FIRX]	SERIALIZED	FIRX
FIRE HYDRANT	FIRE HYDRANT [FHYD]	SERIALIZED	FHYD
FIRE PUMP	FIRE PUMP [FPUMP]	SERIALIZED	FPUMP
FIRE-ANNUNCIATOR PANEL	FIRE-ANNUNCIATOR PANEL [FAP]	SERIALIZED	FAP



FIRE-NOTIFICATION DEVICE	FIRE-NOTIFICATION DEVICE [FND]	SERIALIZED	FND
FIRST AID KIT	FIRST AID KIT [FAK]	SERIALIZED	FAK
FREEZER	FREEZER [FRZR]	SERIALIZED	FRZR
FUEL TANK-BOILER	FUEL TANK-BOILER [TANK]	SERIALIZED	TANK
FUEL TANK-EMER. GENERATOR	FUEL TANK-EMER. GENERATOR [TANK]	SERIALIZED	TANK
FURNACE	FURNACE [FRNC]	SERIALIZED	FRNC
GAS WATER HEATER	GAS WATER HEATER [WH]	SERIALIZED	WH
GREASE TRAP	GREASE TRAP [GTRP]	SERIALIZED	GTRP
GROUNDS EQUIPMENT	GROUNDS EQUIPMENT [GM-EQUIP]	SERIALIZED	GM-EQUIP
HEAT EXCHANGER	HEAT EXCHANGER [HEX]	SERIALIZED	HEX
HEAT PUMP	HEAT PUMP [HP]	SERIALIZED	HP
HEAT PUMP GROUP	HEAT PUMP GROUP [HPGP]	SERIALIZED	HPGP
HEAT PUMP SYSTEM	HEAT PUMP SYSTEM - FOR MULTIPLE PIECES OF EQUIP [HPSYS]	SERIALIZED	HPSYS
HEAT TRACER	HEAT TRACER [HTRCR]	SERIALIZED	HTRCR
HEATED CABINET	HEATED CABINET [HCAB]	SERIALIZED	HCAB
HEATER	HEATER [HTR]	SERIALIZED	HTR
HIGH VOLTAGE SYSTEM	HIGH VOLTAGE SYSTEM [HVS]	SERIALIZED	HVS
HOOD FIRE SUPPRESSOR SYS.	HOOD FIRE SUPPRESSOR SYS. [HDSP]	SERIALIZED	HDSP
HOT WATER CABINET HEATER	HOT WATER CABINET HEATER [CHU]	SERIALIZED	CHU
HUMIDIFIER	HUMIDIFIER [HUMD]	SERIALIZED	HUMD
HVAC ROOM CONTROL	HVAC ROOM CONTROL [HVACC]	SERIALIZED	HVACC
HYDRAULIC SYSTEM	HYDRAULIC SYSTEM [HYDR]	SERIALIZED	HYDR
IRRIGATION CLOCK	IRRIGATION CLOCK [IRRCLK]	SERIALIZED	IRRCLK
KEYPAD-ALARM	KEYPAD-ALARM [KYPD]	SERIALIZED	KYPD
LADDER-FIXED	LADDER-FIXED [LDDR]	SERIALIZED	LDDR
LEAF VACUUM	LEAF VACUUM [VAC]	SERIALIZED	VAC
LIGHT POLE	LIGHT POLE [LTPL]	SERIALIZED	LTPL
LIGHTING	LIGHTING [LITE]	SERIALIZED	LITE
LOCKER ROOM	LOCKER ROOM [LKR]	PROPERTY COMPONENT	LKR
MAGNETIC LOCK	MAGNETIC LOCK [MAGL]	SERIALIZED	MAGL
MAN LIFT	MAN LIFT [ML]	SERIALIZED	ML
MANHOLE	MANHOLE [MH]	SERIALIZED	MH
METERING DEVICE	METERING DEVICE [MTR]	SERIALIZED	MTR
MOTION DETECTOR	MOTION DETECTOR [MOTD]	SERIALIZED	MOTD
MOTOR CONTROL CENTER	MOTOR CONTROL CENTER [MCC]	SERIALIZED	MCC



MOTORIZED ATHLETIC EQUIP.	MOTORIZED ATHLETIC EQUIP. [MATHLE]	SERIALIZED	MATHLE
MOWER	MOWER [MOWER]	SERIALIZED	MOWER
ORGAN	ORGAN [ORGAN]	SERIALIZED	ORGAN
OVEN	OVEN (APPLIANCE) [OVEN]	SERIALIZED	OVEN
OVERHEAD DOOR	OVERHEAD/ROLLUP DOOR [DOOR]	PROPERTY COMPONENT	DOOR
OZONE GENERATOR	OZONE GENERATOR [OZGEN]	SERIALIZED	OZGEN
PANIC BUTTON	PANIC BUTTON [PANBT]	SERIALIZED	PANBT
PARTITION	PARTITION [PART]	SERIALIZED	PART
PARTITION GROUP	PARTITION GROUP [PRTGRP]	SERIALIZED	PRTGRP
PLUMBING-ACCESSORIES	PLUMBING-ACCESSORIES [PBAC]	SERIALIZED	PBAC
PLUMBING-LAVATORIES	PLUMBING-LAVATORIES [PLAV]	SERIALIZED	PLAV
PLUMBING-SERVICE SINK	PLUMBING-SERVICE SINK [PSSINK]	SERIALIZED	PSSINK
PLUMBING-SHOWER/TUB	PLUMBING-SHOWER/TUB [PSTUB]	SERIALIZED	PSTUB
PLUMBING-SINKS	PLUMBING-SINKS [PSINK]	SERIALIZED	PSINK
PLUMBING-TOILETS	PLUMBING-TOILETS [PTLTS]	SERIALIZED	PTLTS
PLUMBING-URINALS	PLUMBING-URINALS [PURNL]	SERIALIZED	PURNL
POOL	SWIMMING POOL [POOL]	PROPERTY COMPONENT	POOL
POOL ACCESSORIES	POOL ACCESSORIES [POLACC]	SERIALIZED	POLACC
POOL HEATER/DEHUMIDIFER	POOL HEATER/DEHUMIDIFER [DHUM]	SERIALIZED	DHUM
POOL WATER TREATMENT	POOL WATER TREATMENT [WTRTR]	SERIALIZED	WTRTR
POOL-CHEMICAL FEEDER	POOL-CHEMICAL FEEDER [PCFDR]	SERIALIZED	PCFDR
POOL-FILTERS	POOL-FILTERS [FLTR]	SERIALIZED	FLTR
POOL-HEATERS	POOL-HEATERS [PHTR]	SERIALIZED	PHTR
POOL-PUMP	POOL-PUMP [PUMP]	SERIALIZED	PUMP
PRESSURE REDUCER VALVE	PRESSURE REDUCER VALVE [PRV]	SERIALIZED	PRV
PRESSURE WASHER	PRESSURE WASHER [PRWSHR]	SERIALIZED	PRWSHR
PROBE	PROBE [PRB]	SERIALIZED	PRB
PUMP	PUMP [PUMP]	SERIALIZED	PUMP
PUMP GROUP	PUMP GROUP [PUMPGP]	SERIALIZED	PUMPGP
PUMP MOTOR	PUMP MOTOR [MTR]	SERIALIZED	MTR
RADIATOR	RADIATOR [RADR]	SERIALIZED	RADR
RADIATOR, STEAM	RADIATOR, STEAM [RADR]	SERIALIZED	RADR
REFRIGERATOR	REFRIGERATOR [REF]	SERIALIZED	REF



REFRIGERATOR/FREEZER	REFRIGERATOR / FREEZER COMBINATION [REFFRZ]	SERIALIZED	REFFRZ
REHEAT COIL	REHEAT (DEHUMIDIFICATION) COIL [DHC]	SERIALIZED	DHC
ROLLER	ROLLER [ROLER]	SERIALIZED	ROLER
ROOF	ROOF [ROOF]	SERIALIZED	ROOF
ROOF	ROOF [ROOF]	PROPERTY COMPONENT	ROOF
ROOF TOP UNIT	ROOF TOP UNIT (HVAC) [RTU]	SERIALIZED	RTU
SALT SPREADER	SALT & SAND SPREADER [SPRDR]	SERIALIZED	SPRDR
SCRUBBER	SCRUBBER [SCRUBER]	SERIALIZED	SCRUBER
SEATING	THEATER SEATING [STNG]	SERIALIZED	STNG
SENSOR	SENSOR [SNSR]	SERIALIZED	SNSR
SEPARATOR	SEPARATOR [SEP]	SERIALIZED	SEP
SHELTER	SHELTER [SHLTR]	PROPERTY COMPONENT	SHLTR
SHREDDER	SHREDDER [SHRDR]	SERIALIZED	SHRDR
SHUTTER, ROLL-UP	SHUTTER, ROLL-UP [SHTRR]	SERIALIZED	SHTRR
SITE DRAIN	SITE DRAIN [TRDN]	SERIALIZED	TRDN
SMOKE DAMPER	SMOKE DAMPER [SD]	SERIALIZED	SD
SMOKE STACK	SMOKE STACK [STACK]	SERIALIZED	STACK
SOLAR HOT WATER SYSTEM	SOLAR HOT WATER SYSTEM [SLRW]	SYSTEM	SLRW
SPRAY TANK	SPRAY TANK [STANK]	SERIALIZED	STANK
SPRINKLER HEAD	SPRINKLER HEAD [SPKRHD]	SERIALIZED	SPKRHD
SPRINKLER SYSTEM	SPRINKLER SYSTEM (WET OR DRY) [SPKLR]	SERIALIZED	SPKLR
STEAM CONDENSATE PUMP SET	STEAM CONDENSATE PUMP SET [STCND]	SERIALIZED	STCND
STEAM STATION	STEAM STATION [STSTA]	SERIALIZED	STSTA
STEAM TRAP	STEAM TRAP [STTRP]	SERIALIZED	STTRP
STORM WATER COMPONENT	STORM WATER COMPONENT [SWC]	PROPERTY COMPONENT	SWC
STRAINER	STRAINER [STRNR]	SERIALIZED	STRNR
STREET SWEEPER	STREET SWEEPER [SWP]	SERIALIZED	SWP
SUPPLY FAN	SUPPLY FAN [SFAN]	SERIALIZED	SFAN
SURGE PROTECTION DEVICE	SURGE PROTECTION DEVICE [SPD]	SERIALIZED	SPD
TANK	TANK [TANK]	SERIALIZED	TANK
THATCHER	THATCHER [THATHR]	SERIALIZED	THATHR
TILLER	TILLER [TILLER]	SERIALIZED	TILLER
TRACTOR	TRACTOR [TRC]	SERIALIZED	TRC



TRAILER	TRAILER [TRLR]	SERIALIZED	TRLR
TRANSFER SWITCH	TRANSFER SWITCH [ATS]	SERIALIZED	ATS
TRANSFORMER	TRANSFORMER [TRNF]	SERIALIZED	TRNF
TRIMMER	TRIMMER [TRMER]	SERIALIZED	TRMER
TURF COLLECTOR	TURF COLLECTOR [TC]	SERIALIZED	TC
TURF-TRUCKSTER	TURF-TRUCKSTER [KUB]	SERIALIZED	KUB
UPHOLSTERY TOOLS	UPHOLSTERY TOOLS [UPTOOLS]	SERIALIZED	UPTOOLS
UPS	UNINTERRUPTIBLE POWER SUPPLY [UPS]	SERIALIZED	UPS
VACUUM	VACUUM [VAC]	SERIALIZED	VAC
VALVE	VALVE [VLV]	SERIALIZED	VLV
VARI AIR VOLUME BOX	VARI AIR VOLUME BOX [VAV]	SERIALIZED	VAV
VARIABLE FREQUENCY DRIVE	VARIABLE FREQUENCY DRIVE [VFD]	SERIALIZED	VFD
VAV BOX GROUP	VARIABLE AIR VOLUME BOX GROUP [VAVGP]	SERIALIZED	VAVGP
VEHICLE - CAR	CAR [V]	SERIALIZED	V
VEHICLE-BUS	BUS [V]	SERIALIZED	V
VEHICLE-TRUCK	TRUCK [V]	SERIALIZED	V
VEHICLE-VAN	VAN - PASSENGER/WORK [V]	SERIALIZED	V
VENTILATOR	VENTILATOR [VENT]	SERIALIZED	VENT
WASHER	CLOTHES WASHER (APPLIANCE) [WSHR]	SERIALIZED	WSHR
WATER FOUNTAIN	WATER FOUNTAIN [WF]	SERIALIZED	WF
WATER LINE	WATER LINE [WL]	SERIALIZED	WL
WATER TREATMENT OPEN LOOP	WATER TREATMENT OPEN LOOP [WTROL]	SERIALIZED	WTROL
WATER TREATMENT STEAM	WATER TREATMENT STEAM [WTRST]	SERIALIZED	WTRST
WATER TREATMENT SYSTEM	WATER TREATMENT SYSTEM [WTSYS]	SERIALIZED	WTSYS
WATER TRTMNT CLOSED LOOP	WATER TREATMENT CLOSED LOOP [WTRCL]	SERIALIZED	WTRCL
WINDOW	WINDOW [WINDW]	SERIALIZED	WINDW



FM FACILITY DESIGNATIONS

The information below is provided to ensure consistency in facility naming on construction and renovation projects. Facilities Management (FM) has assigned location designations to campus buildings and site locations. These designations are used in the AiM computerized maintenance management system as well as the building automation system. Refer any questions about naming to Planning and Project Management or the Project Manager. The FM Planned Maintenance Manager is available to review new equipment naming during the design development stage of the project. Also called the asset ID, this unique number should be used in a consistent manner across all disciplines.

Property	Description	Region	Facility
3301 NEW MEXICO	3301 NEW MEXICO AVENUE	AU	NM
4124 WARREN	4124 WARREN STREET	AU	WARREN
4401 CONN	4401 CONNECTICUT AVENUE	AU	CONN
4545 42ND ST	4545 42ND STREET	AU	TC
45TH STREET	45TH STREET FIELD	G-SFLD	ZONE E
4620 WISCONSIN	4620 WISCONSIN AVE	AU	WI
4621 ROCKWOOD	4621 ROCKWOOD PARKWAY HOUSE	AU	RW
4625 ROCKWOOD	4625 ROCKWOOD PARKWAY HOUSE	AU	RW
4629 ROCKWOOD	4629 ROCKWOOD PARKWAY HOUSE	AU	RW
4633 ROCKWOOD	4633 ROCKWOOD PARKWAY HOUSE	AU	RW
4810 ROCKWOOD	4810 ROCKWOOD PARKWAY - PRESIDENT'S RENTAL HOME	AU	RW
A	FLETCHER GATE SHADE BED	G-SFLW	ZONE D
ADMIN	ADMINISTRATIVE USE	AU	MC
AH	ANDERSON HALL	AU	MC
AMPTH	WOODS-BROWN AMPHITHEATER	AU	MC
ASB	ASBURY BUILDING	AU	MC
B	FLETCHER GATE ISLAND BED	G-SFLW	ZONE D
BCC	MEDIA PRODUCTION CENTER	AU	MC
BE	BEEGHLY BUILDING	AU	MC
BL	BENDER LIBRARY	AU	MC
BP	BUTLER PAVILION AND ARCADE	AU	MC



BT	BATTELLE-TOMPKINS	AU	MC
BW	BRANDYWINE BUILDING	AU	BW
C	HAMILTON BED UNDER CREPE MYRTLE	G-SFLW	ZONE A
CA	CASELL HALL	AU	MC
CDC	CHILD DEVELOPMENT CENTER	AU	MC
CH	CAPITAL HALL	AU	WCL
CK	CLARK HALL	AU	MC
CN	CENTENNIAL HALL	AU	MC
CNG	CONGRESSIONAL HALL - EAST CAMPUS	AU	EC
CNST	CONSTITUTION HALL - EAST CAMPUS	AU	EC
CS	COSTUME SHOP	AU	MC
D	HAMILTON BED EAST OF WALK	G-SFLW	ZONE A
DH	DUNBLANE HOUSE	AU	WCL
DMTIB	DON MYERS TECHNOLOGY AND INNOVATION BUILDING	AU	EC
EC		AU	EC
EQ	EAST QUAD BUILDING	AU	MC
F	HAMILTON BED WITH BENCH	G-SFLW	ZONE A
FDRL	FEDERAL HALL - EAST CAMPUS	AU	EC
FLT	FLEET-VEHICLES/EQUIPMENT	AU	MC
G	HAMILTON BED AT ENTRANCE	G-SFLW	ZONE A
GB	GREENBERG THEATER	AU	WI
GBD	4825 GLENBROOK	AU	MC
GR	GRAY HALL	AU	MC
GRNDS-IRRIG	GROUNDS-IRRIGATION	AU	GRNDS
GRNDS-MOWING	GROUNDS MOWING	AU	GRNDS
GRNDS-ZONE A	GROUNDS ZONE A	AU	GRNDS
GRNDS-ZONE B	GROUNDS ZONE B	AU	GRNDS
GRNDS-ZONE C	GROUNDS ZONE C	AU	GRNDS
GRNDS-ZONE D	GROUNDS ZONE D	AU	GRNDS
GRNDS-ZONE E	GROUNDS ZONE E	AU	GRNDS
GRNDS-ZONE F	GROUNDS ZONE F	AU	GRNDS
H	HAMILTON BED WITH ROSES	G-SFLW	ZONE A
HA	HAMILTON BUILDING	AU	MC
HARDSCAPE	HARDSCAPE	AU	MC
HF	HOCKEY FIELD	AU	MC
HH	HUGHES HALL	AU	MC



HU	HURST HALL	AU	MC
I	HAMILTON BED WITH DAY LILIES	G-SFLW	ZONE A
ISB	SCHOOL OF INTERNATIONAL SERVICE	AU	MC
J	ASBURY ISLAND BED	G-SFLW	ZONE E
JACOBS FIELD	JACOBS FIELD	AU	MC
K	MCKINLEY SLOPE BED	G-SFLW	ZONE D
KA	KATZEN ART CENTER	AU	MC
KB	KOGOD SCHOOL OF BUSINESS	AU	MC
KH	KERWIN HALL	AU	MC
KR	KREEGER HALL	AU	MC
KS	KAY SPIRITUAL LIFE CENTER	AU	MC
L	LIBRARY CLOCK BED	G-SFLW	ZONE D
LAQD	LETTS-ANDERSON QUAD	AU	MC
LFS	JACK CHILD HALL/DEPT OF LANGUAGE AND FOREIGN STUDIES	AU	MC
LH	LEONARD HALL	AU	MC
LTH	LETTS HALL	AU	MC
M	MGC FLAGPOLE BED	G-SFLW	ZONE D
MCB	MCCABE HALL	AU	MC
MGC	MARY GRAYDON CENTER	AU	MC
MH	MCDOWELL HALL	AU	MC
MK	MCKINLEY BUILDING	AU	MC
MS	TENLEY MAINTENANCE SHOP	AU	WCL
N	QUAD CIRCLE BED	G-SFLW	ZONE D
NH	NEBRASKA HALL	AU	MC
NHAVE	NEBRASKA AVE PARKING LOT	AU	MC
NMA	3201 NEW MEXICO AVENUE	AU	NM
O	BATTELLE FLAGPOLE BED	G-SFLW	ZONE C
OS	OSBORN BUILDING	AU	MC
P	BATTELLE FLAGPOLE SOUTH BED	G-SFLW	ZONE C
PB	PRESIDENTS BUILDING	AU	MC
PG	EAST CAMPUS PARKING GARAGE	AU	EC
PR	PRESIDENTS HOUSE	AU	MC
PS	PUBLIC SAFETY BLDG	AU	MC



Q	BATTELLE FLAGPOLE NORTH BED	G-SFLW	ZONE C
QUAD	FRIEDHEIM QUADRANGLE	AU	MC
R	EAGLE BED	G-SFLW	ZONE B
RB	ROCKWOOD BLDG	AU	MC
REEVES FIELD	REEVES FIELD	AU	MC
RH	ROPER HALL	AU	MC
S	AMPHITHEATER	G-SFLW	ZONE B
SC	SPORTS CENTER/BENDER ARENA	AU	MC
SCA	SPORTS CENTER ANNEX	AU	MC
SCLOT	SPORTS CENTER GARAGE	AU	MC
SOC	SOCCER FIELD	AU	MC
SV	SPRING VALLEY BUILDING	AU	MC
SW	STORAGE WAREHOUSE WISCONSIN AVE	AU	BW
T	MASS. AVE GATE WEST BED	G-SFLW	ZONE B
TB	TRANSMITTER BUILDING	AU	MC
TENLEY FIELD	TENLEY FIELD	G-SFLD	ZONE F
TENNIS	TENNIS COURTS	AU	MC
U	MASS. AVE GATE EAST BED	G-SFLW	ZONE B
UTILITIES	UTILITIES	AU	MC
V	NEB. HALL AT ENTRANCE	G-SFLW	ZONE C
VM	VEHICLE MAINTENANCE SHOP	AU	MC
W	NEB. HALL AT WALL BED	G-SFLW	ZONE C
WA	WATKINS BUILDING	AU	MC
WB	WARREN BUILDING	AU	WCL
WCB		AU	MC
WCL	WASHINGTON COLLEGE OF LAW	WCL	WCL
WCLPG	WCL PARKING GARAGE	AU	WCL
WIS	4200 WISCONSIN AVENUE	AU	WI
WS	WESLEY SEMINARY	WS	WS
Y	TENLEY-DUNBLANE BED	G-SFLW	ZONE F
YH	YUMA HALL	AU	WCL
Z	BRANDYWINE AT ENTRANCE BED	G-SFLW	ZONE F



FM PIPING COLOR CODE

For Labels and PVC Jacket Covers (Based upon Proto jacketing)

Primary Chilled Water – Green

Secondary Chilled Water – Lt. Blue

Heating Water of Dual Tem- Salmon

Domestic Hot Water – Red

Chiller Condenser Water – Gray

Steam Lines – Brown

Steam Condensate – Orange

Fuel Oil – Red

Boiler Feedwater – Blue

Storm and Condensate Drain Lines – Black

Safety Valve Exhaust/Inlet – Brown

Natural Gas - Yellow



Facilities Management Service and Support Function Needs

In addition to mechanical and electrical equipment rooms, Facilities Management requires the following minimum amount of space in each building for long-term operational use. Space guidelines for key functions are listed in the chart below. For interconnected buildings or complexes, consult with Facilities Management to reconfirm space requirements.

Function	Space Required	Service or Support Provided
Satellite stock room	200 square feet	Material staging for items stocked by Material Supply, requirements: <ul style="list-style-type: none"> • Wireless or data for counter release • Separate chargeable items from attic stock
Zone and shop use	200 square feet	Secure space for tools, seasonal and spare items, specific staging, examples: <ul style="list-style-type: none"> • Drain cleaning machine • Ladders • Job site specific materials
Grounds use	100 square feet	Storage for seasonal, spare or replacement items, examples: <ul style="list-style-type: none"> • Ice melt, snow shovels • Landscaping tools • Items staged for removal or disposal
Housekeeping storage	100 square feet	Storage for day-to-day operations, adjacent to ramp for ease of elevator access, examples: <ul style="list-style-type: none"> • Supplies • Floor care equipment
FM attic stock storage	200 square feet	Turnover items, unique to specific building: examples: <ul style="list-style-type: none"> • Specialty carpeting and tile • Matching hardware and spares
Support services use	100 square feet	Staging of items for building events, examples: <ul style="list-style-type: none"> • Tables, chairs, podium or containers



Housekeeping use	100 square feet	Secure location for employee use, examples: <ul style="list-style-type: none"> • Lockers for regularly assigned staff • Time clock, lunch and break
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Mechanical, maintenance, and service areas should be located in close proximity to vehicle parking or service bay. Incorporating separate, designated entries to service access for maintenance deliveries to the facility is strongly recommended to minimize impact on daily operations of end users.

Additional requirements for specialty areas are described on the following pages.

Specialty Area Requirements

Custodial Closets

General Requirements

- Each floor of a building will have a minimum of one custodial closet per 20,000sf.
- The main floor closet may be combined with a central storage closet
- The closet will be 60-80 sf and rectangular
- Custodial closets will serve that custodial use only and will not contain building systems equipment or roof hatches

Furnish with the following

- 24" x 24" floor mounted mop sink with stainless steel edge caps, vandal proof drain, stainless steel splash plates, and a hose connection with a vacuum breaker
- Two duplex electrical outlets , 20 amp, with ground fault protection(
- 16 linear feet of shelving that is 18" deep, 14" between shelves, with the lowest shelf being 20" above the floor; shelves should be of sturdy construction, capable of holding bulk cleaning supplies with ledge to prevent items from rolling off
- A locking storage cabinet 2'W x 20"D x 6'H
- Ladder and mop/broom hangers mounted on one wall
- Lighting at the 20' candle level. The light fixture(s) shall have safety guards
- A floor drain

Custodial Storage Area

General Requirements

- Each building will have a central storage closet on the main floor, accessible to the main corridor, and as close as practical to access doors and an elevator



- The size of the room will be a minimum of 144 sf.
- The door will be a minimum of 36" wide with a storeroom function lockset
- The door should open outward if allowed by code
- Buildings 50,000 sf and larger should consider an adjacent storage room to accommodate specific storage requirements
- Central storage closets will serve that specific use only and will not contain building systems equipment or roof hatches

Furnish with the following:

- 24" x 36" floor mounted mop sink with stainless steel edge caps, vandal proof drain, stainless steel splash plates, and a hose connection with a vacuum breaker
- Two duplex electrical outlets (GFCI)
- 36 linear feet of shelving that is 18" deep, 14" between shelves, with the lowest shelf being 20" above the floor; shelves should be of sturdy construction, capable of holding bulk cleaning supplies
- A locking storage cabinet 2'W x 20"D x 6'H
- Ladder and mop/broom hangers mounted on one wall.
- Lighting at the 20' candle level. The light fixture(s) will have safety guards
- A floor drain.
- Telecom-data telephone in each, with appropriate backing if required for time clock mounting

Loading Dock Facilities

General Requirements

For new construction and building additions, consultant shall review loading dock facility requirements with Facilities Management. Potential needs to be addressed could include:

- Trash dumpster/compactor equipment
- Recycling containers (paper, cardboard, cans): All buildings will have accommodations for recycling containers and material; hose areas can be alcoves, closets, or rooms suitable for such storage, near a building service entrance or preferably at an exterior covered loading dock.
- Truck dock bays (at grade and/or at loading height), with dock protectors
- Service vehicle parking (two minimum)
- Receiving area
- Holding areas (hazardous materials or chemicals separate from other staging)
- Minimum of two duplex electrical outlets, ground fault protected on separate circuits
- Hose bib, full building pressure, frost proof if required



- Lighting at the 5-foot candle level. 10 foot candle minimum if used as work area or lacking ambient light. all light fixtures will have safety guard.
- Any exposed areas are to have bird netting
- High loading docks to have adjustable dock lift and safety railing

Areas with Assigned or Dedicated Staff (or off campus core)

General Requirements

- Consult with Facilities Management for office or shop program requirements. Typical items required include manager or technician workspaces, tool and consumable storage and specialty items, electronic key box mounting, or storage specific to the facility
- Technician or workers typically require lockers, shower, and separate toilet facilities from building occupant
- Work space or cleanup areas shall not be used for lunch or break
- Remote locations require electronic key boxes, units require power and data
- Wireless connectivity is required for EMS monitoring or assigned staff

Mechanical Room Areas

General Requirements – Main Mechanical Areas

- Lighting at 20-foot candle minimum, 30 foot candles over control areas and panels.
- All light fixtures will have safety guards.
- Motion lighting controls with warning capability recommended. Areas under 200 square feet may use switch timers instead.
- The preferred method of placing equipment is on pads, 4 inch height minimum
- Flooring consistently sloped to drain(s); sealed concrete or epoxy or approved alternate.
- Minimum 36" wide door, extended width or double door if heavy use and/or equipment size requires with heavy duty LCN 4040 door closure, Von Dupris 99 or 33 series panic devices if required.
- Doors should be heavy duty with continuous hinge and have door sweeps for rodent mitigation
- Access control via card entry preferred, or store room function lockset
- Minimum of one 2 x 4 light by main door on emergency circuit
- All penetrations are required to be fire stopped and/or rodent proofed.



- Areas with building automation panels, telecommunications equipment or other specialty controls require proper heating and cooling; freeze protection required if located on exterior wall or contains fresh air intakes
- Provide 20% spare capacity in electrical panels dedicated to mechanical spaces
- Vehicle access preferred, service elevator access acceptable to upper floor or roof top mechanical spaces
- Lift eyes or hooks permanently mounted over any piece of major equipment that requires frequent replacement; major equipment should have capability for future permanently mounted beam mounted lifting apparatus
- Areas over 500 square feet should allocate a 3 x 5 (15 square foot) space for work bench or gang box; locate near receptacle and provide lighting at 40 foot candle minimum
- Mechanical rooms are not for stock or spare part storage, see separate stock area requirements
- Permanent mounting of system overview, key equipment identification and valve charts
- Space for lock-out tag out or other appropriate safety equipment mounting

Furnish with the following:

- Two duplex electrical outlets, 20 amp , separate circuits for O&M purposes, ground fault protected; however increase count to keep cord length to 50 foot maximum; preferred one electrical circuit on emergency power distribution
- Service sink or mop sink for staff cleanup, preferred wall mounted faucet or hose connection with vacuum breaker
- Hose mount rack, adjacent to hose connection, suitable for 100 lb commercial grade hose
- A floor drain, centrally located and not used as a condensate drain
- Eye wash station or emergency shower if chemical use is present
- Fire rated trash /oily rag receptacle, one per area.
- Fire extinguisher, wall mounted, ABC or as required for specific use in space. 10 lb. preferred.
- Safety alert drawing per AU standard
- Wireless internet connection or dedicated separate telecom-data drop for field O&M use
- Ladder and mop/broom hangers mounted on one wall
- A locking storage cabinet 2'W x 20" D x 6" high



- 16 linear feet of shelving, that is 18” deep and 14” between shelves, with the lowest shelf being 20” above the floor. The shelves should be of sturdy construction, capable of holding bulk supplies with ledge to prevent items from rolling off

All Purpose or Stock or Storage Areas

General Requirements

- See space chart for room size requirements
- Lighting at the 25-35 foot-candle level
- Consult with Facilities Management Material Supply for shelving requirements. All shelving will be heavy duty, stainless, commercial quality
- Doors sized to allow pallet or hand truck entry
- All light fixtures to have safety covers and be controlled by motion sensor or timers
- Wireless connectivity or data drop required
- Provide minimum of one 20 amp circuit
- Card access entry (with entry approval only by Material Supply Supervisor)

Electrical Rooms or Closets

General Requirements

- Lighting at the 30 foot candle level over panel boards, 20 foot candle minimum
- Permanent mounting of power distribution line diagram served by panels in space
- All light fixtures to have safety covers
- Card access or separate key, store room function but not same key as mechanical spaces
- Size of all closets must ensure required 3 foot panel clearances
- Ceiling lighting and at least one 20 amp circuit, both on emergency power
- Walls should be finished, painted block or sheetrock preferred
- All penetrations should be fire proofed and rodent proofed
- High voltage or main distribution space configurations should be confirmed with Master Electrician

Fire Pump Rooms

General Requirements

- Lighting at the 15 foot candle level
- Permanent mounting of design criteria and shutoff valve location.



- A floor drain, sized to minimize flooding beyond room
- All light fixtures to have safety cover
- Card access or separate key, store room function but not same key as mechanical spaces
- Ceiling lighting and one 20 amp circuit, both on emergency power
- Flooring should be sealed concrete

Roof Areas

General Requirements

- Tie off locations for routine or anticipated work activities within 5 feet of roof edges.; security railing is the preferred option
- Doorways that open onto the roof within 10 feet of the edge should have a rail
- Separate 20 amp ground fault protected circuit, minimum one per roof or at 100 foot cord distances
- A source of water, frost free hose bib with vacuum breaker and isolation valve in a heated, accessible location
- Minimum of one exterior light near exit or access point on emergency power
- Any exterior penthouse access ladders are to have security cages and anti-slip treads
- Permanent ladders for each required location as portable ladders are not accepted
- Areas on roofs that require frequent access should have appropriate walk pads
- Door thresholds require extra heavy footpath protection; all thresholds should be at least 10 inches over the roof elevation or main roof membrane
- All doors to roofs or penthouses should have a door alarm with access swipe tied to University Safety and Security with appropriate signage
- Wi-fi signal is required



Process for Communicating Activities or Interruptions By Facilities Management

All activities or interruptions need to be communicated to parties affected. Therefore, planning and communication is crucial.

Each department or unit that has an activity to perform will need to coordinate such with those responsible parties affected by the activity. The type and scope of the activity will need to be described so that appropriate scheduling can take place. If the activity is an emergency then this merely becomes an effort to communicate.

There are various types of activities that may or may not create an interruption of service to facility occupants. Additionally, the scope of those affected can vary as well.

Types of activities needing planning are:

- Electrical system repairs and maintenance
- Elevator repairs and inspections
- Heating and air conditioning repairs and maintenance
- Residence hall room maintenance
- Fire suppression systems maintenance and testing
- Water systems repair and maintenance
- Roadway and sidewalk repairs and maintenance

Scopes of activities are

- One room (i.e. a bathroom, residence room, office, etc.)
- One facility
- Multiple facilities
- The entire campus
- A system on campus (i.e. underground utilities, computer or telephone network)
- A particular group of persons (i.e. disabled, students and faculty, etc.)

Once coordination has taken place the confirmed information must be sent via email to the Customer Response Center for dissemination of the activity/interruption.

The Customer Response Center sends the formatted communication from the **Service Interruption Notification Worksheet** and disseminates the information based upon the scope of the activity.

The means of communication take place by the following methods:

- Email
- Webpage – <http://www.american.edu/finance/facilities/serviceinterruptions.cfm>





SPACE NUMBERING GUIDELINES

Hopefully this outline will help attain the important goal of general numbering order-making it easier for a visitor to a building to find a space. It may be helpful to imagine a person appearing at the entrance and asking themselves “So how do I find room...?”

Another important goal of this outline is to make it easy to find space types in a report that is ordered by room number. When a person is examining a space report, their focus is usually a specific space or group of spaces at a time. For example, a planner might be concerned with office space sizes- seeing all office spaces with numbers in the lower spectrum would be helpful to their analysis. On the same hand, a network engineer may be concerned with finding network and server closets to implement upgrades. Using the attached Nomenclature Guidelines, one can ensure ease of use for both the visitor and the planner.

Nomenclature Guidelines

Where ever possible, use the following as a guide for general consistency in numbering and renumbering spaces. Following these guidelines will minimize the occurrence of the task (and cost) of renumbering space in the future, as well as provide a simplified method for determining the likely location of a space on a layout.

When space numbers are changed due to renovation, please be certain to send notification to the Planning and Project Management department. This will help improve the accuracy of systems that report and project university space use. If further guidance is needed, contact the Planning and Project Management department.

Numbering Spaces in a New Building

Using the “Nomenclature Guidelines” provided in the following section to complete the steps below.

Step One

From the most likely entrance to that floor and in a clockwise direction, number spaces not requiring a room number sign. These are usually ancillary spaces like restrooms, service closets and hallways. If these space types can be found on the adjacent floor



level, try to use existing number sequences (see section 6, “Space Numbering for New and Renovated Spaces”).

Step Two

Next, from the entrance again, and in a clockwise direction, number primary spaces requiring a room number sign. These are generally office spaces, conference rooms and assembly areas. Be certain to read section 2a, “Space Numbering for New and Renovated Spaces.”

Final Steps

Double-check for missed spaces and common spaces that may change function. When a space changes its overall function, a new number should be assigned. Here are some examples:

1. When a hallway connects different office areas, separately number the hallways. If a hallway continues from a public area through a door to another area, separately number the hallways. This is because office space is considered “private areas” and the portion of the hallway in the public area public circulation while the other portion of the hallway is office circulation. Doors are almost always an indication of privacy or separation.
2. When a lounge area connects to a hall, assign a separate number for the lounge area.
3. Use one number for both the waiting and reception areas because the receptionist is directly responsible for the waiting area. The only exception to this is clinic waiting areas.

Space Numbering for New and Renovated Spaces

Use these guidelines for new buildings and renovations

1. The syntax for room numbers should be:

{Floor ID} {Number} [Suffix] [Sub Suffix]

- 2.

Wherein,

- a. **{Floor ID}** is a sequence of letters and/or numbers that represent the identity of the floor. See **Figure D** below for a list of common Floor IDs at AU.



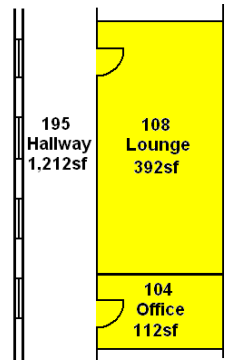
- b. **{Number}** this is a unique space numbering sequence that follows the floor ID, the first beginning with “00,” the highest value being “99.” **See item 9 below** for an exception to this rule.
 - c. **[Suffix]** this is a letter that only follows the room sequence to indicate a subset of space. See **Figure F** below for a sample of its use.
 - d. **[Sub Suffix]** this is a number that follows the suffix letter to indicate a subset of a subset of space. See **Figure G** below for an example.
3. **All spaces should be numbered** including closets, storage, lounges, electrical, mechanical and open spaces whose doors meet the floor. Stairwell and elevator shafts should be numbered as well.

- a. **The sequence for primary spaces** should be flexible to allow for future renovation of single spaces into multiple spaces. For example, the space number of an office numbered 104 that is adjacent to a lounge with separate access to the same corridor should be numbered 108 to allow for future renovation that may separate that lounge into multiple spaces with separate access to the corridor. As a reference, skip one room number for every 13 feet of hallway space between doors, should numbering allow (see Figure A).
- b. **Secondary spaces** should be numbered as follows: **60’s**- Mechanical (plumbing, electrical, telecom, data); **70’s**- Support (rest room, custodial, storage, etc.); **80’s**- Circulation (corridors, study space and lounges, **excluding** multi-function spaces); **90’s** - Stair & Elevator Shafts.

Figure A

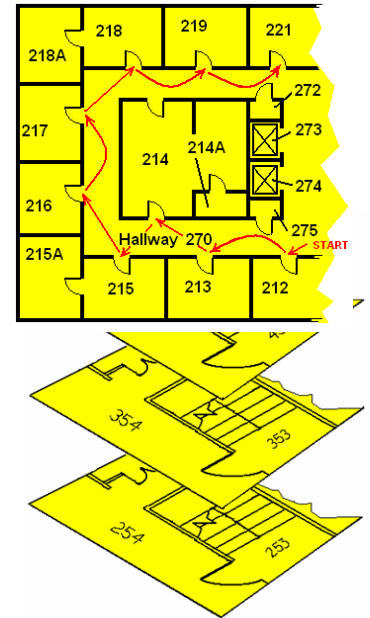
This will help ensure that integers for numbering primary spaces are ample and easier to locate.

- c. Spaces with collapsible or accordion walls should be numbered as if the wall were permanent to accommodate scheduling multiple events in the larger space.
4. The floor that contains the main or most commonly used entrance to the building should be the **first floor**. This will make it easier for a person find the exiting floor in case of an emergency.
5. **For buildings on the “Quad”**, the “quad entrance” should be the “main entrance,” hence the first floor should be at the “quad entrance level.”



6. **Room numbering should begin** from the building entrance, then continue from the left and go in a clockwise direction. Rooms are numbered using the “post office system.” That is, even numbers to the right of the corridor; odd numbers on the other side. In the case where there is a “donut” or multi-donut corridor pattern, with common use areas (with few doors) inside the “donut” and comparatively large number of doors facing the center of the donut, number the adjacent spaces sequentially when there are no doors facing those spaces (see Figure B). Remember to number ancillary spaces first to avoid errors (See 2a above).

Figure B



7. Wherever possible, one should use **common room sequences** for vertically adjacent, stacked spaces. This will simplify numbering on each level, and in some cases, provide for a single floor plan to represent many (see Figure C).

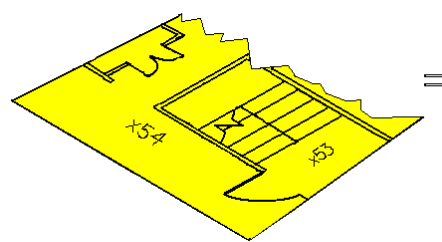


Figure C

8. The main entrance of each floor should be assigned the beginning number of the floor sequence. For example, the first floor entrance would be 100, 200 for the second and 300 for the third floor entrance.
9. A Floor IDs should be utilized to represent each floor, followed by a sequential space number. Use the following list determine Floor ID:

Floor	Description	Note
E	Rooftop Elevator	These letters represent the uppermost levels.
R	Roof	
A	Attic	
PH	Penthouse	
M	Mezzanine	For multiple levels, add a number, i.e., M1, M2...



2	Second Floor	
1	First Floor (Entry)	
G	Ground Floor	
LL	Lower Level	
T	Terrace Level	
ST	Sub Terrace	
B	Basement Level	Never used for residential space- use Terrace or
P	Parking Level	This level is generally located below the 1 st floor; however this may also be at roof level. Successive
P1	Parking Sub	Successive below ground parking level numbers increase as the levels go deeper.
P2	Parking Sub	
P3	Parking Sub	

Figure D

10. The Floor ID should be followed by two digits for the space number. The first one or two digits refer to the floor number; the remaining digits refer to the space number (see Figure E).

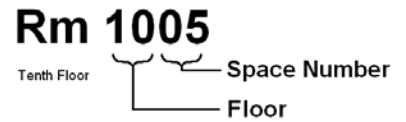
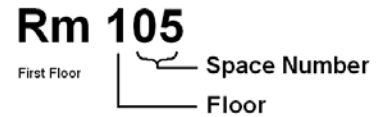
Exceptions:

- a. **If a building has more than 100 spaces on any given floor**, one should consider separating areas into suites and following the related numbering system (see item 10 below). If the suite system is not practical, use the Floor ID followed by four digits for the space number. Once reaching a level that requires the previously mentioned exception, all floors above that level must use four digit space numbers to avoid duplicate room numbers (see Figure E).

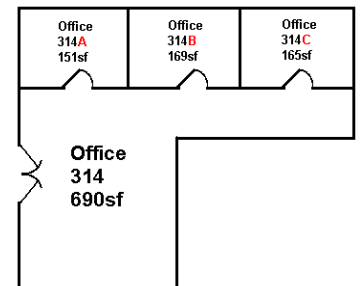
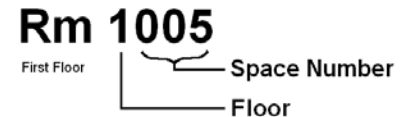
- b. **If the floor uses a one or two letter Floor ID (e.g., “B,” “ST”),** one and two digit space numbers may be used on the same floor, e.g., **Figure E**

B1 can be used instead of B01ST9 can be used instead of ST09

Common Numbering Sequence
(floors with 100 or fewer spaces)



Super Building Exception
(floors with more than 100 spaces)



This exception is possible because duplication of a room number cannot occur with letter-only Floor IDs.

Figure F

11. **Rooms accessed through another room (nested rooms)** should use the “suite system.” Whenever possible, rooms are numbered sequentially in a clockwise pattern from the main suite entrance using the number of the main space, followed by an alphabetical suffix (see Figure F).

12. **Closets and utility rooms** connected directly to a numbered space with a suffix (e.g., A, B, C...) should use the same number and suffix as the larger space, followed by a secondary suffix beginning with the number “1” and continuing to “9.” If numbering is required beyond “9,” continue with the capital letter “A,” continuing through “Z” for remainder of these spaces, e.g., 314C1, 314C2...314C9, 314CA, 314CB (see Figure G).

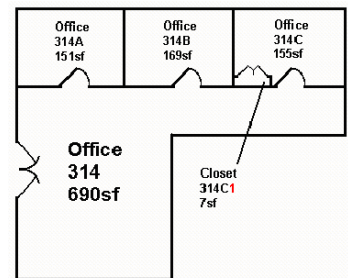


Figure G

One should keep in mind that renumbering vacant and occupied spaces in a logical, orderly fashion is necessitated for the sake of simplicity, to aid emergency personnel in locating spaces in case of emergency and minimize the confusion visitors and service personnel may experience when looking for a space.

While in some instances these guidelines may be difficult to follow, one should always weigh the need to support the three points mentioned above against the need to control costs and the possible inconvenience to persons intended to occupy those spaces.

Numbering Space Boundaries and Retail/Tenant Spaces

Retail and tenant space boundary identifiers are important for planners and decision makers to visualize how space is being used for spaces with temporary or invisible boundaries. These boundary identifiers are included in the drawings for the university’s floor plan book.



1. **Short dash followed by a long dash** are the preferred marking to indicate space boundaries.(Fig. H)

Figure H

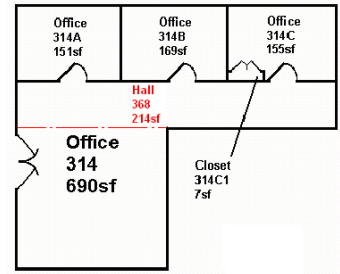
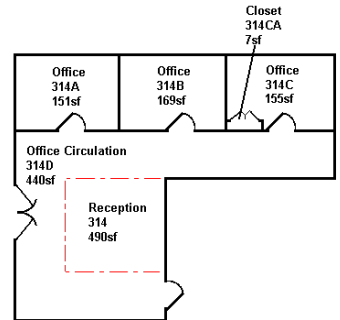
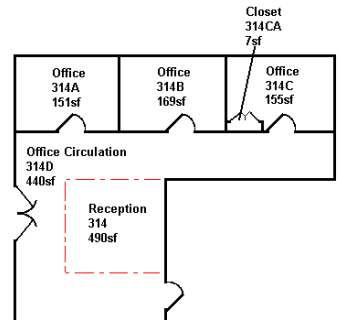


Figure H



2. **Add an office circulation path around or between workspaces** that share a common area between offices. If there is a sitting area near the reception desk, include this area as a 'receptionists' area'.

Figure I



3. **Space information label order:** always use the format: Local Use Description, Space Number and Area Measurement. Follow the area measurement, omitting any spaces, with the letters "sf" to signify square feet. See figures J, K.

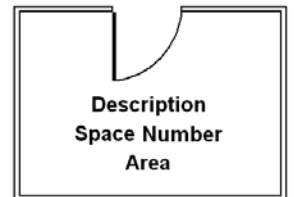


Figure J



4. **Tenant & retail space do not require individual space numbering.** All space in the tenant and retail areas, regardless of function, is coded as merchandise facility, so separate space numbers are unnecessary. However, indicating the purpose of each space may be shown for general information. Additionally, the entire rental space within the outer wall boundaries should be measured, ignoring walls and fixtures and consistent with BOMA standards. Include this value in parenthesis beneath the space value, which is based on PFICM measurement criteria.

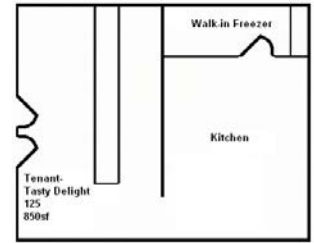


Figure K

Numbering Cubicles or Private Rooms in a Suite

Syntax for private rooms: {Room Number} [Suffix] [Sub Suffix]

Syntax for cubicle spaces: {Room Number} – {Cubicle #} [Suffix] [Sub Suffix]

Note: “{}” indicate required, “[]” indicate optional

Where,

{Room Number} a unique number for the room or suite that contains rooms and/or cubicles. Room Numbers are covered in detail in the core document “Space Numbering Guidelines,” eg., 245, 119, T19

[Suffix] in the case of a private room within a private room or suite, this is a letter that follows the number to indicate a subspace of that room number. In the case of cubicle within a cubicle, it is a letter that follows a hyphenated two-digit number, eg., 119E, T19B, B45-13A

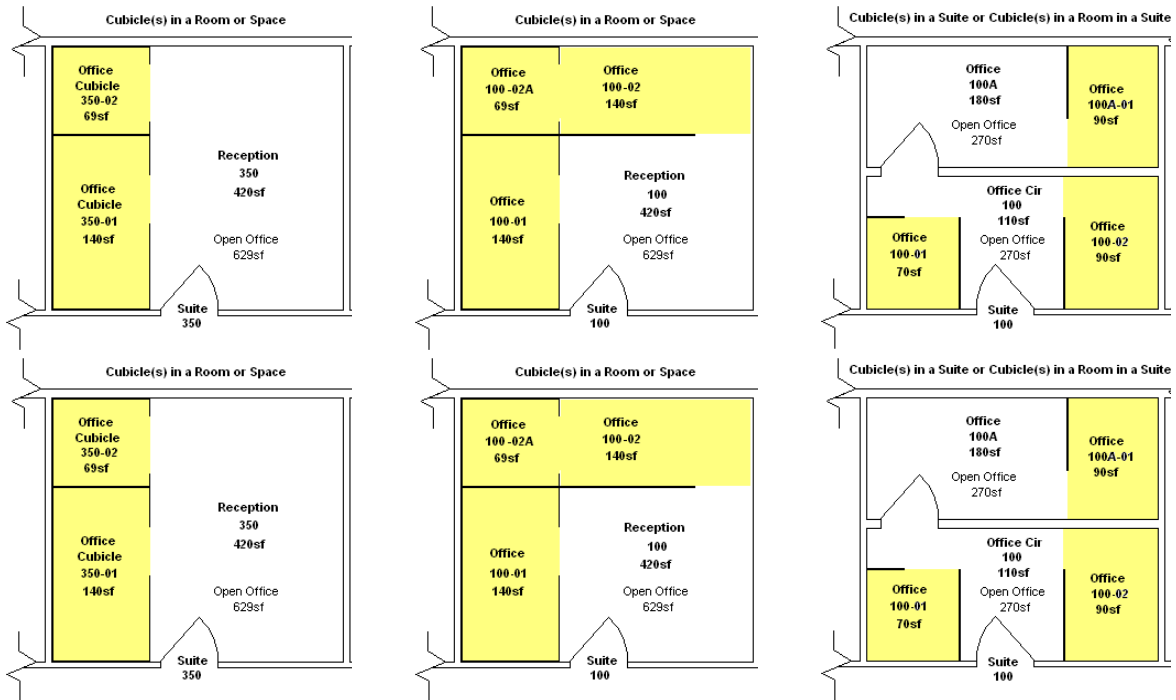
[Sub Suffix] a number that follows the suffix to indicate a subset of a subset of space. This typically occurs for closets or ancillary spaces inside a room within a suite, eg.,: 245A1, 119E1, T19B3

A private room is a space that is enclosed by four walls and typically includes at least one door. Numbering private rooms within a room or suite is covered in detail



in the earlier in the document “Space Numbering Guidelines.” However, this document emphasizes that private rooms in a room or suite **should always be** followed with a letter suffix. In the case where the room is a cubicle (this includes “invisible wall” spaces), the number **should always** be followed by a hyphen and a two-digit number beginning with “-01” The only exception to this convention are the previously-numbered spaces in suite 350 in the 3201 New Mexico building, where there are also more than 24 private rooms.

In addition, whenever possible, one should include the total open office square feet near the suite number, in regular (not bold) lettering in the floor plan. This information can be helpful for managing the design elements within the open office space. Below are examples of implementations of these guidelines in factious buildings.



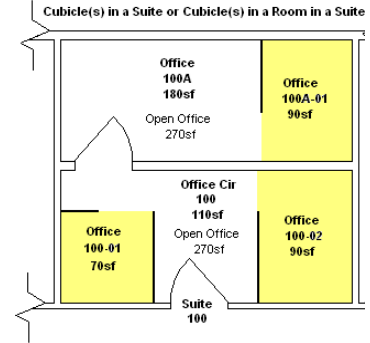
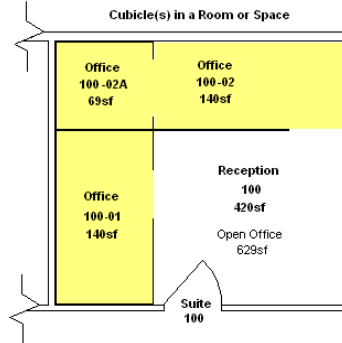
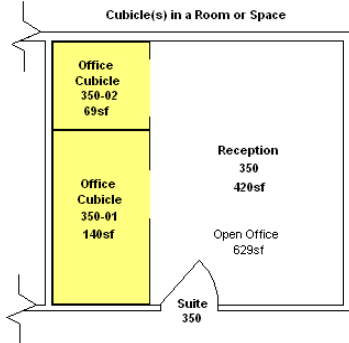
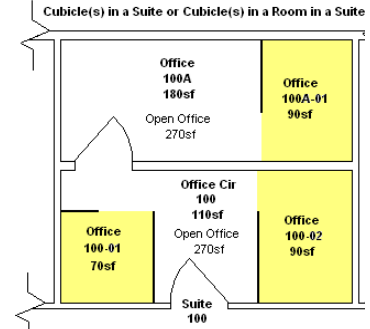
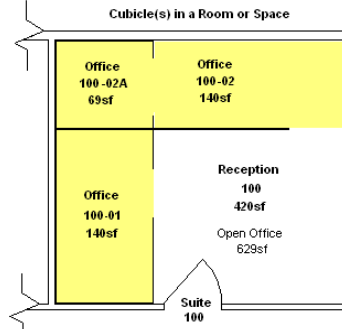
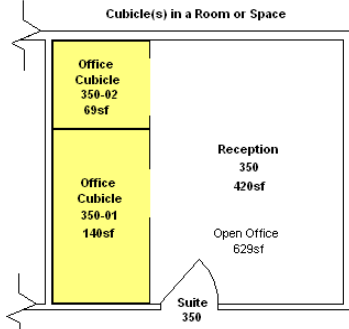
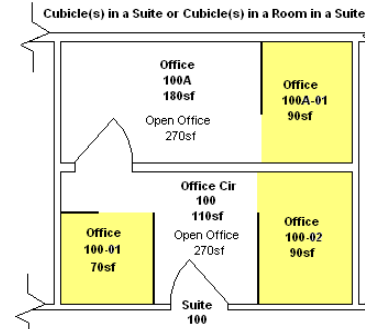
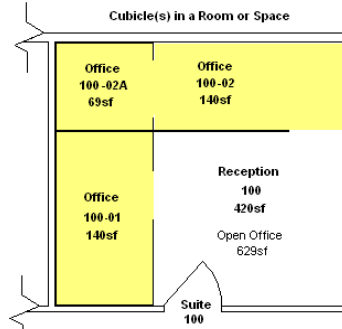
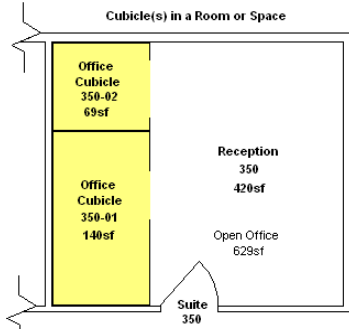
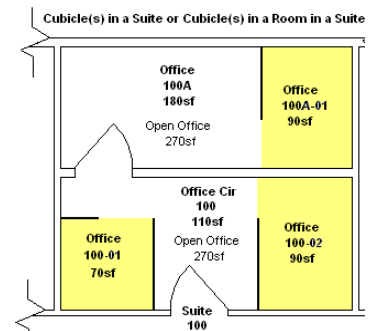
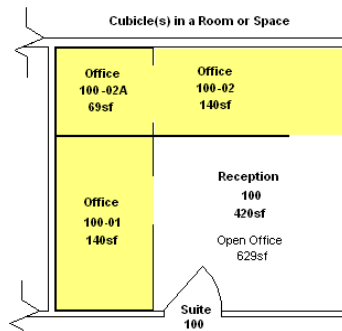
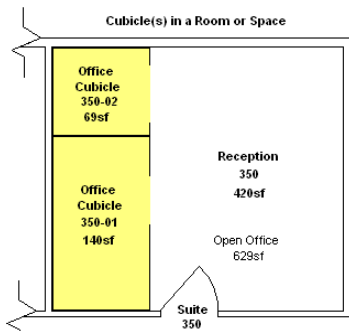


Fig. 1 Cubicles in an open office suite 100

Fig. 2 A cubicle that is a sub space of another

Fig. 3 A private office in suite 100 would be

would be numbered
100-01, 100-02, etc.

cubicle would be
numbered by adding a
sub-suffix letter. In this
example, the subspace
of 100-02 is 100-02A.

numbered 100A, and a
cubicle inside of 100A
would be numbered
100A-01. The suffix "A"
distinguishes the
cubicle within 100A
from the cubicles in the
open office space
external to 100A.

The first private room to the left of the entrance of suite 100 would be numbered **100A**. If there were (or a likelihood of more than 24 private offices in that suite, it would be numbered **100-01**.

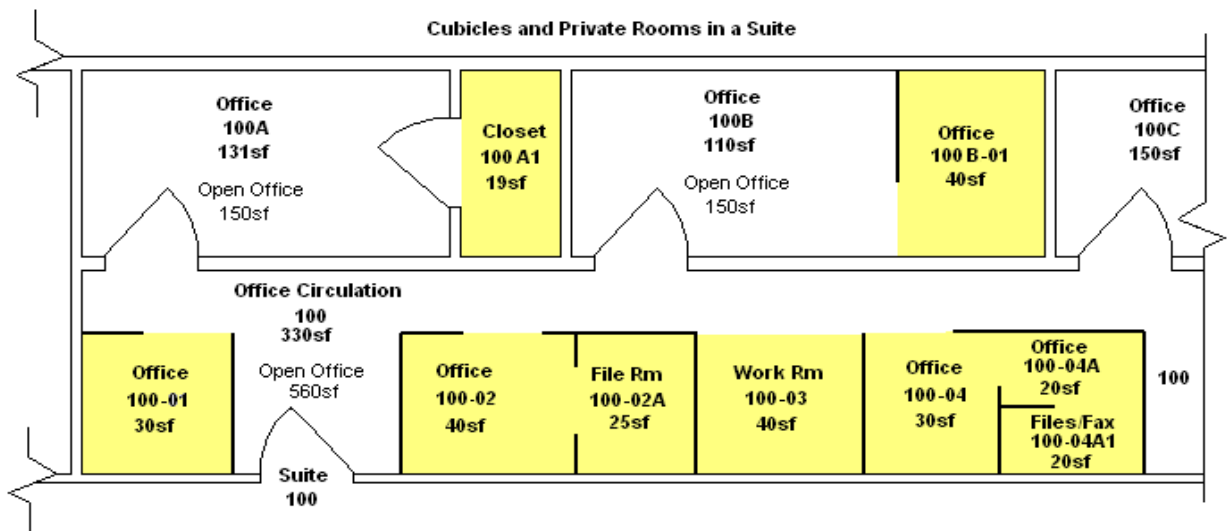


Fig. 4 Here is a configuration that employs all the elements discussed, in proper convention. Notice that the full Office Circulation label is not repeated for long spaces or a space that flows around several adjacent, separately numbered spaces. This helps the observer to understand that those areas are a part of 100. It also helps eliminate repetitious labeling that may become unsynchronized after several floor plan revisions. Also note the suffix letters "I" and "O" should be omitted, as they could easily be confused with the numbers one and zero.



Without a floor plan, one can typically use these conventions to ascertain how a space is situated:

<p>Number Followed by a Letter</p>	<p>100A: <i>a private room inside a room or suite 100</i></p> <p>100A1: <i>a space inside a private room, inside room or suite 100.</i></p> <p>100A-01: <i>a cubicle inside a private room, inside room or suite 100</i></p> <p>100A-01A: <i>a cubicle that is a part of, and can only be accessed through cubicle 100-01</i></p>
<p>Hyphenated Room Number</p>	<p>100-01: a cubicle inside a room or suite 100.</p> <p>100-01A: a cubicle that is a part of another cubicle (and can only be accessed through that cubicle) inside a room or suite 100.</p> <p>100-01A1: a cubicle that is a part of another cubicle (and can only be accessed through that cubicle) that's part of another cubicle inside a room or suite 100.</p>

IMPORTANT NOTE: as these are guidelines for new plans, there may be instances where preexisting room numbers may supersede this convention.

PPM/JDM, Rev /2013

Strategic and Operational Master Plans

Updated January 2019

Master Plan or Study	Department	Contact Information	Area of Responsibility	Name
Arboretum Master Plan	Facilities Management	2Fix@american.edu	Arboretum Manager	Mike Mastroda
Athletic Exterior Site Master Plan 2018 (pending)	Facilities Management	2Fix@american.edu	Energy & Engineering	Mark Feist
Building Automation Master Plan FY18	Facilities Management	2Fix@american.edu	Energy & Engineering	Eddy Peng
Campus Arc Flash Study	Facilities Management	2Fix@american.edu	Energy & Engineering	Barrett Johnson
Campus Geothermal Study FY10	Facilities Management	2Fix@american.edu	Energy & Engineering	David Osborne
Campus Lighting Study 2000	Facilities Management	2Fix@american.edu	Energy & Engineering	Barrett Johnson
Campus Plan 2011	Planning and Project Management	fpd@american.edu	Director, Planning	Vacant
Campus Wide Water Distribution Survey FY10	Facilities Management	2Fix@american.edu	Energy & Engineering	Vacant
Commissioning Master Plan 2012	Facilities Management	2Fix@american.edu	Energy & Engineering	David Osborne
Elevator Master Plan FY18 (pending)	Facilities Management	2Fix@american.edu	Facilities Operations	Stephen Kriesten
Exterior Lighting Master Plan	University Safety and Security Services	police@american.edu	AVP, Risk, Safety and Transportation	Daniel Nichols
Fire Alarm Master Plan 2018	Facilities Management	2Fix@american.edu	Energy & Engineering	Barrett Johnson
Fire Suppression Master Plan FY18 (pending)	Facilities Management	2Fix@american.edu	Energy & Engineering	Barrett Johnson
Generator Master Plan 2006	Facilities Management	2Fix@american.edu	Energy & Engineering	Barrett Johnson
Low Voltage Distribution	Facilities Management	2Fix@american.edu	Energy & Engineering	Barrett Johnson
Medium Voltage Master Plan 2011	Facilities Management	2Fix@american.edu	Energy & Engineering	Barrett Johnson
Roof Survey 2013	Facilities Management	2Fix@american.edu	Capital Renewal Manager	Eder Grandos
Sewer Master Plan Mapping and Assessment 2009	Facilities Management	2Fix@american.edu	Energy & Engineering	Doug Fairley
Sewer Master Plan Report 2009 and 2011	Facilities Management	2Fix@american.edu	Energy & Engineering	Doug Fairley
Smart Grid Study 2009	Facilities Management	2Fix@american.edu	Energy & Engineering	David Osborne
ADA Survey	Planning and Project Management	fpd@american.edu	Director, Planning	Vacant
OIT Master Plan	Office of Information Technology	helpdesk@american.edu	Director, OIT Network Operations	Hassan Marvi
AU Strategic Plan (pending)	Planning and Project Management	fpd@american.edu	Director, Planning	Vacant
Security Master Plan	University Safety and Security Services	police@american.edu	AVP, University Police	Phil Morse
Exterior Lighting Survey	University Safety and Security Services	police@american.edu	AVP, University Police	Phil Morse
Chilled Water	Facilities Management	2Fix@american.edu	Energy & Engineering	Mark Freedman
Domestic Water	Facilities Management	2Fix@american.edu	Energy & Engineering	Mark Freedman

Summary of Changes

August 2018

Document Layout and Content Changes

The document title has been renamed [American University Design Standards](#), further emphasizing the importance of planning and owner project requirements. The emphasis throughout has shifted primarily to design information for pre-construction use with formatting that facilitates review of design and project documents for consistency with the Design Standards. Appropriate references to Strategic and Master Plans was added.

The combined manuscript was broken into individual files comprised of documents, divisions, sections, reference, appendix and references. Individual documents (word, excel, pdf) are added, deleted, or edited with less effort and minor visual rework of the portfolio.

The grouping of documents follow design or construction phases for ease of use. The pdf version at www.american.edu/standards is fully indexed.

- i. [Divisions](#) continue to use the CSI format, following MasterSpec December 2017. Key Division areas are broken into [Sections](#). Changes implemented:
 - a. Division 00 Procurement and Contracting requirements is deleted in its entirety. Text directs the user to contact the Purchasing department directly.
 - b. Division 01 General Requirements includes AU specific project implementation, quality assurance and closeout information. These 17 new Sections result from joint FM and PPM work sessions, identified by CSI title in the Appendix.
 - c. Division 02-33 includes the sub-groups for Facility Construction, Facility Services, Site, and Infrastructure. Changes implemented:
 - i. Divisions include general direction on university design requirements.
 - ii. AU required and acceptable manufactures and products are listed by specific item at the end of the Division.
 - iii. Text or information misplaced was moved into the correct document. Clarifying CSI identifying information has been added where appropriate.
 - iv. The unique Division 25 Integrated Automation requirements for integration with the AU building automation system are individually listed into 12 new Sections following accepted controls nomenclature and sectioning
 - v. Division 31 Earthwork and Division 33 Utilities have been added.
- ii. [Appendixes](#) include the Consultants Guide heavily used by Planning and Project Management as a stand-alone document. The Division 1 documents, intended to be used during the project manual development, are included in the Appendix.
- iii. [References](#) have been expanded to address commonly asked questions during the design and construction process.
- iv. [Archives](#) is a new web page link to the prior version referenced in contract documents at date of contract issue. A version and changes log is included.

Summary of 2018 BAS Changes

- A. Section 25 08 00 - Commissioning of Integrated Automation [UPDATED]
- B. Section 25 11 13 – Integrated Automation Network Servers [NEW – derived from 250000]
- C. Section 25 11 16 - Integrated Automation Network Routers, Bridges, Switches, Hubs, and Modems [NEW – derived from 251200]
- D. Section 25 14 13 - Integrated Automation Remote Control Panels [UPDATED – formerly 251400]
- E. Section 25 15 16 - Integrated Automation Software for Control and Monitoring Networks [UPDATED – formerly 251500]
- F. Section 25 35 00 – Integrated Automation Instrumentation Terminal Devices for HVAC [UPDATED]
- G. Section 25 35 13 – Integrated Automation Actuators and Operators [NEW – derived from 253500]
- H. Section 25 35 16 – Integrated Automation Sensors and Transmitters [NEW – derived from 253500]
- I. Section 25 35 19 – Integrated Automation Control Valves [NEW – derived from 253500]
- J. Section 25 35 23 – Integrated Automation Control Dampers [NEW – derived from 253500]
- K. Section 25 55 00 – Integrated Automation Control of HVAC [UPDATED – formerly 250000]
- L. Section 25 55 00.13 – Integrated Automation Control of HVAC – Object Naming Convention [NEW – derivation and expansion of point naming]
- M. Section 25 95 00 – Integrated Automation Control Sequences for HVAC [UPDATED – formerly 259000]

Summary of Changes

January 2019

Document Layout and Content Changes

1. Based upon feedback from the AU Design Standards Committee the full version format changed slightly into General Requirements and Technical Requirements.
2. General Requirement documents include the Consultants Guideline and Division 01 Requirements for use during planning and programming by the design team. This required minor wording changes on the Division 01 summary document in the combined pdf version.
3. Technical Requirement documents include construction design related requirements and remain organized using the CSI Master Format division nomenclature. This required minor wording changes on the summary page in the combined pdf version.
4. All references to Appendix were removed. This is now General Requirements.
5. The table of contents was updated to reflect format changes above.
6. The missing Division 25 BAS summary document was inserted and hyperlinked in the single combined document.
7. The AU Strategic and Operational Master Plan reference was updated to include the Exterior LED Master Plan.
8. Under the Technical Requirements subdivided documents tab, Divisions with Sections now are available as both a combined document or as individual documents. The content is the same.
9. Due to staffing changes, the Design Standards Committee member list was updated.
10. Several missing documents we placed in the References tab.
11. The missing summary of 2018 changes to the BAS Division 25 documents was added in Version History. A summary of the January 2019 changes (this document) was added and the version log updated.



DESIGN STANDARDS VERSION LOG

Documents List		Approval and Change History					
Reference	Title	Approval	Date	Date	Date	Date	Date
American University Design Standards		Aug-18					
	Letter	Aug-18					
	Standards Committee Members	Aug-18	Jan-19				
	Table of Contents	Aug-19	Jan-19				
	Preface	Aug-18					
	Forward	Aug-18					
AUDS Technical Requirements Cover		Aug-18	Jan-19				
00	Procurement and Contracting	Aug-18					
01	General Conditions	Aug-18	Jan-19				
02	Existing Conditions	Aug-18					
03	Concrete	Aug-18					
04	Masonry	Aug-18					
05	Metals	Aug-18					
06	Composites, Plastics and Wood	Aug-18					
07	Thermal and Moisture Protection	Aug-18					
08	Openings	Aug-18					
09	Finishes	Aug-18					
10	Specialties	Aug-18					
10 14 10	Mechanical Room Safety Alert Drawings	Aug-18					
11	Equipment	Aug-18					
12	Furnishings	Aug-18					
13	Special Construction	Aug-18					
14	Conveying Systems	Aug-18					
15	Mechanical	Aug-18					
16	Electrical	Aug-18					
21	Fire Suppression	Aug-18					
22	Plumbing	Aug-18					
23	Heating, Ventilating and Air Conditioning	Aug-18					
25	Integrated Automation		Jan-19				
25 00 08	Integrated Automation Commissioning	Aug-18					
25 11 13	Integrated Automation Network Services	Aug-18					



DESIGN STANDARDS VERSION LOG

Documents List

Approval and Change History

25 11 16	Network Routers Bridges Switches Hubs and Modems	Aug-18					
25 14 13	Remote Control Panels	Aug-18					
25 15 16	Software For Control and Monitoring Networks	Aug-18					
25 35 00	Instrumentation and Terminal Devices for HVAC	Aug-18					
25 35 12	Actuators and Operators	Aug-18					
25 35 16	Sensors and Transmitters	Aug-18					
25 35 19	Control Valves	Aug-18					
25 55 00	Control of HVAC	Aug-18					
25 55 00.13	Control of _ObjectNamingConvention	Aug-18					
25 95 00	Control Sequences for HVAC	Aug-18					
26	Electrical	Aug-18					
26 32 1.x	Generators	Aug-18					
26 55 22	LED Lighting	Aug-18	pending				
27	Communications	Aug-18					
28	Electronic Safety and Security	Aug-18					
28 46 21.x	Fire Alarm Systems	Aug-18					
31	Earthwork	Aug-18					
32	Exterior Improvements	Aug-18					
33	Utilities	Aug-18					
AUDS General Requirements Cover		Aug-19	Jan-19				
	Consultants Guide	Aug-18					
	Division 01 Requirements	Aug-18					
01 21 00	Allowances	Aug-18					
01 25 00	Substitution Procedures	Aug-18					
01 25 00a	Substitution Attachment	Aug-18					
01 31 00	Project Management and Coordination	Aug-18					
01 32 00	Construction Progress Documentation	Aug-18					
01 32 33	Photographic Documentation	Aug-18					
01 33 00	Submittal Procedures	Aug-18					
01 40 00	Quality Requirements	Aug-18					
01 42 00	References	Aug-18					
01 50 00	Temporary Facilities and Controls	Aug-18					



DESIGN STANDARDS VERSION LOG

Documents List

Approval and Change History

01 60 00	Product Requirements	Aug-18					
01 73 00	Execution	Aug-18					
01 77 00	Closeout Procedures	Aug-18					
01 78 23	Operation and Maintenance Data	Aug-18					
01 78 39	Project Record Documents	Aug-18					
01 91 13	General Commissioning Requirements	Aug-18					
References		Aug-18					
	AU Electrical Labeling Color Scheme	Aug-18					
	AU Site Design Standards	Aug-18					
	Appliance and Electronic Standard (residence halls)		Jan-19				
	BAS Drawings and Control Sequences		Jan-19				
	Cx Customization Guide		Jan-19				
	Equipment Numbering Scheme	Aug-18					
	FM Equipment Asset ID Schemas	Aug-18					
	FM Facilities Designations	Aug-18					
	FM Piping Color Code	Aug-18					
	FM Space Needs	Aug-18					
	Process for Activities or Interruptions	Aug-18					
	Space Numbering Guidelines	Aug-18					
	Strategic and Operational Master Plans	Aug-18	Jan-19				