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SECTION 00 73 19 / 01 35 00

HEALTH AND SAFETY REQUIREMENTS / SPECIAL PROCEDURES

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023 with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 2 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendments to Part 1, 1.08D Asbestos-Containing Materials:

1. To the extent feasible, University will notify Contractor of the location and quantity of asbestos-containing materials (ACMs) known to be present at the work site. / If applicable, University shall provide to Contractor a facility survey report that contains an inventory of confirmed asbestos-containing materials (ACMs) known to be present at the project site.

Amendments to Part 1, 1.08F, 1 Paint and Other Surface Coatings:

- d. Painted Construction and Demolition (C&D) debris from pre-1978 structures shall not be disposed or recycled until a hazardous waste characterization has been performed by EH&S. Contractor shall properly package, label and transfer to EH&S for disposal designated C&D debris found to qualify as hazardous waste. / With the exception of painted plaster or stucco that has been separated from its underlying substrate, construction debris (with surface coatings in good condition) is generally not categorized as hazardous waste. Paint or other surface coating debris generated as a result of scraping, stripping, blasting or manual demolition of painted plaster or stucco is classified as a hazardous waste and Contractor shall properly package, label and transfer for disposal such waste.

Stanford University-Facilities Design Guideline Amendment

SECTION 01 33 00

SUBMISSION REQUIREMENT GUIDELINES

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 3 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment & Addition to Part 1, 1.01A University Plans Review Process:

1. The process by which the Designer's schematic, design development, construction documents and estimates are reviewed and approved is the University Plans Review Process. This occurs at or near the completion of each design phase and is handled by the University's Project Manager by distributing drawings and related documents, specifications to departments for review and comments. These comments, if any, are transmitted to the Project Manager for consideration, response, and discussion with the Project Team prior to incorporation. The time required for this process will vary with the complexity but, ordinarily be expected to take two or three weeks for each stage. The number of sets of plans to be provided by the Designer is covered in the Owner/Architect or Owner/General Contractor Agreement.

Addition to Part 1, 1.01, B, 2a:

Note: at least one copy of the specifications shall be submitted in loose, unbound, unpunched format, for ease of reproduction.

Amendment & Addition to Part 1, 1.01, B, 2b Project Manual:

- b. Project Manual: The Project Dossier is a project document in 8-1/2 inch by 11-inch format that serves as the repository of certain design submissions and other information about the project. The Project Dossier provides the University with a standard format for the organization and presentation of this information required throughout the course of the project. The production of the Project Dossier is the responsibility of the Designer. Sample information that should be included in the Project Manual is as follows:
 - 1) MEPS Basis of Design Narratives with load requirements and distribution plan
 - 2) Soils Report
 - 3) Occupant Loads
 - 4) Designed Floor Loading
 - 5) Special Conditions Applicable to Future Renovation
 - 6) Design Expansion Criteria (if any)
- d. The Project Dossier Guideline (Sample Dossier) is a document that is provided by the University to the Designer at the beginning of the project to guide and assist the Architect in the preparation of the Project Dossier. The Project Dossier Guideline provides detailed descriptions of the contents and format required in the Project Dossier, as well as illustrative examples of each of the sections.

Additions to Part 1:

1.07 AS-BUILT RECORD DRAWINGS

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A. General:

1. The agreement for professional services with the Architect or Engineer requires the submission of record drawings reflecting as-built conditions.
2. The principal purpose of the as-built record drawings is to provide the University with a permanent record of actual construction to facilitate troubleshooting and to provide for the potential of future building alterations. We recognize that change orders and field directives result in actual construction that is somewhat at variance with the executable set of Construction Documents.
3. The Architect or Engineer, in his or her administration of the Construction Contract, is the logical focal point and repository for this as-built information. The Construction Contract requires the Contractor to record all changes to drawings and specifications as they occur, and to deliver these as-built drawings and specifications in both electronic and hard copy format to the Designer upon completion of the work. This information is the Designer's principal source of information in revising drawings and specifications for the record set. In addition, shop drawings, field notes, change orders, correspondence, and the Designer's own set of drawings will provide auxiliary information.
4. At the conclusion of construction, all changes shall be incorporated on the tracings by the Architect or Engineer and noted with a "goose egg" or similar designation showing it as "as-built", "change order number 4", or other appropriate notation. The specifications shall be annotated to show the actual selected products that are incorporated into the project, particularly where a choice of two or more products was permitted.
5. General Contractor shall include as part of the Project Dossier a set of the final structural, mechanical, and electrical calculations that were prepared during the design phase. Submitted material should be clearly marked "as-built" and dated.
6. See Maps and Records <http://maps.stanford.edu/delivering> for information on current CAD standards).

1.08 OPERATING AND MAINTENANCE MANUALS

A. General:

1. This Article contains the general requirements for operating and maintenance manuals to be submitted, reviewed, and approved well in advance of Owner occupancy. The manuals and other supporting material listed herein must contain accurate as-built data, drawings, charts, etc. on each operating system to permit Stanford maintenance personnel to take over maintenance with written instructions sufficient to insure operations and maintenance in accordance with manufacturers' specifications. It is the responsibility of the Architect/Engineer to incorporate the applicable provisions of these Standards into the Project Specifications or other contract documents, and to ensure that the Contractor complies with the Specifications, including the incorporation of these changes in design and specifications during construction into the as-built documents.
2. Description of Systems: In accordance with the sample Project Dossier, the General Contractor shall include in the Project Dossier descriptions of the design intent of the building systems (HVAC, Electrical, and others as applicable) and the principles of their operation in a manner to permit prompt initial understanding of the systems by qualified University maintenance personnel. These descriptions shall include flowcharts, riser diagrams, zone control layouts, and other visual aids showing the components and their relationship to the entire system.

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3. Copies in Electronic format (pdf) shall be part of the submitted package.
- B. Manuals of Systems Components to be specified by Designer: The General Contractor shall specify as applicable to the particular designed system the following information:
1. Manufacturers' printed installation and operating instructions. This shall be the technical specifications and instructions, not "sales" brochures and promotional material. Instructions shall include all modes of operation in sufficient detail to be readily understood by Stanford maintenance personnel.
 2. Complete identification in the manuals of the actual equipment installed as described in the manufacturers' instructions, including dimensional drawings, model, type, size, capacity, performance parameters such as curves, efficiencies, power requirements, operating ranges, etc. NOTE: In cases of multiple installation of identical equipment, only one manual submitted for the identical equipment is necessary, but serial numbers of the several pieces of equipment shall be listed.
 3. Names, addresses, telephone numbers, "person to contact" (if known) of subcontractors, their suppliers, manufacturers' representatives, available service facilities and normal channels of supply.
 4. Detailed parts list showing manufacturers' parts numbers and such other identification as necessary to facilitate procurement of spare or renewal parts and Owner-Manufacturer communications.
 5. Manufacturers' maintenance instructions shall include schedules showing proper time intervals for lubrication, adjustment, and calibration or checking. Contractor shall consolidate manufacturers' schedules with a single master schedule of required maintenance. This requirement is for the Contractor's as well as the Owner's protection to insure proper early maintenance during the warranty period.
- C. Submission of Operating and Maintenance Manuals: Contractor shall submit to Project Manager no later than the seventy-five percent (75%) completion date of the HVAC systems as shown on Payment Requests, four sets of manuals (or if deemed prudent, a draft set of manuals) for review. The University's Project Manager will circulate the document to the appropriate University personnel for their comments and recommendations, and upon receipt shall return them to the Designer, who will then secure the required corrections and transmit three (3) completed sets to the University's Project Manager before a Certificate of Substantial Completion is issued.

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SECTION 01 77 00

CLOSEOUT PROCEDURES

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 3 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment & Addition to Part 1, 1.4:

- A. The General Conditions of the Construction Contract contain instructions and requirements of the Contractor, the Architect and Stanford Hospital and School of Medicine for acceptance of the project. Stanford also has internal procedures for turning over the project to our Engineering & Maintenance Department (E&M). The Architect is responsible for including in the Specifications the obligations of the Contractor for an orderly acceptance and turnover. Included in such obligations are punch lists, "as-built" plans and specifications including CAD drawings (as per Maps & Records specifications), operating and maintenance manuals, and training of Stanford's maintenance personnel. The Project Manager is the point of contact with these departments.
- B. This document is intended to be used during the formulation process to identify costs that may or may not be associated with this procedure, and to identify to the contractor and subs exactly what is expected at turnover by **SOM** E&M Department.
- C. This procedure is to be reviewed again during substantial completion by the Owner, General Contractor, and a representative from the **SOM** E&M Department to ensure that reporting procedures have been followed and this document has been adhered to with all pertinent documentation recorded and submitted.

Part 2

Amendment to Part 2.1, C, 3 Final Warranty Letters:

- a. The date when Commissioning Acceptance and Occupancy Phase has been completed establishes the start of the warranty period.

Part 3

Amendment to Part 3.1, A:

- A. Periodic Walk-Throughs during Construction: At various stages of construction, Maintenance personnel shall, as deemed necessary (and scheduled by E&M), meet PM/GC and appropriate subcontractor foremen at jobsite to observe portions of the project concerning their trades, and to familiarize themselves with construction details before they are closed in. A copy of each monthly Major Project Construction Report will be forwarded to Maps and Records (for the project file and for communication to appropriate LBRE (BGM/SEM) departments to keep them informed of the progress of construction for each project. During periodic walk-throughs, (ideally during the construction phase of the project), the Owners Representative will try to identify any areas that might be difficult to reach, or access after portions of the building are closed in, and other possible maintenance problems. A written Site Observation list for corrections will be forwarded to the Owners Representative. These items are to be incorporated into the Project's punch-list and addressed accordingly by the PM/GC through coordination by the Owners Rep. Items on this list

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will be restricted to Scope and Installation issues only and not be used to increase the scope of work of the contractor.

Amendment to Part 3.1, B:

- B. Acceptance Walk Through: Prior to the Architect's inspection, all appropriate departments (E&M, Building Maintenance, Grounds, Security, IT) shall have the opportunity to review and approve or reject application by the Project Manager / General Contractor for substantial completion. After the Architect's inspection and walk-through for purposes of issuing a Certificate of Substantial Completion, an acceptance walkthrough will be scheduled one week in advance by the Project Manager / General Contractor. The attendees will include but not be limited to: the Architect and Consultants; mechanical, plumbing, and electrical foremen; Project Superintendent, Project Manager, and Owners Representative. Copies of the operating manuals will be provided, and after the walk-through, assuming all parties are satisfied the work was completed as presented, a form letter addressed to Stanford Hospital and School of Medicine, will be presented, turning the building over to SOM. This "Form" shall have a specific date for the assumption of maintenance, with such exceptions as may be noted in the Certificate of Substantial Completion.

Amendment to Part 3.1, C:

- C. To aid SOM in the acceptance period, the Contract Specifications should provide for negotiated amount of training. This time would be utilized for each Foreman of the electrical, mechanical, and plumbing subcontractors to be made available to **SOM** departments for further instruction (if necessary), so that subjects not fully covered in the formal acceptance walk-through may be discussed further.

Amendment to Part 3.1, D:

- D. The date of Commissioning Acceptance and Occupancy Phase establishes the start of the warranty period, with exceptions noted and estimated completion dates for exceptions, which is for one year unless otherwise stated in the Contract Documents. When the Notice of Completion is issued after elimination of the Punch List, SOM will know that the lien period will start when the Notice is formally recorded in the County Recorder's Office. If any punch list items not corrected are noted by the occupant or any SOM Staff during this lien period, the Owners Rep. will promptly inform the Project Manager. However, it is the responsibility of the Owners Rep. to insure timely completion of Punch List corrections.
1. Quarterly meetings are to be scheduled and attended by the PM/GC, Building Manager and Owners Rep. to discuss any on-going warranty issues (if applicable)
 2. The date when Commissioning Acceptance and Occupancy Phase has been completed establishes the start of the warranty period.

Addition to Part 3.1:

- E. Documentation that all equipment to be maintained by **SOM** E&M is to be inventoried and entered into the **SOM** Maintenance Management System.

Amendment to Part 3.2 Deficiencies:

- A. Design Deficiency Problems: In some cases, SOM will discover that the Building Occupant complaint relates neither to maintenance nor warranty deficiencies. The Reporting Trade from **SOM** E&M will then contact the Owners Rep, describe the problem, and recommend any improvements deemed necessary. If the problem is indeed a design deficiency, the Owners Rep will discuss the matter with the Building Occupant, the Architect/Engineer, and **SOM** E&M to determine a solution, if possible. Corrective work then will be performed by contract, negotiated or bid by the Owners Rep.
- B. Equipment Failure under Warranty: All new equipment shall be assumed to be in prime operating condition upon turnover. **SOM** E&M will perform routine maintenance in accordance with the operating manuals, with the first scheduled maintenance measured from the date of turnover. The

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Project must provide BGM with all applicable O&M documents, warranty documents and contractor/vendor contact information at turnover. All equipment failures during the first year of warranty are the responsibility of Project Manager/General Contractor to schedule repair by the responsible sub-contractor.

Addition to Part 3:

3.3 FORMAL NOTICE OF MAINTENANCE ASSUMPTION BY SOM:

- A. As mentioned above, a formal letter turning over maintenance to **SOM E&M** will be delivered either at the acceptance walk-through or within 10 working days.
- B. Additional Documentation on Turnover: In addition to the turnover letter and the operating manuals, the Owners Rep will provide Maps & Records with the following:
 - 1. Copy of Certificate of Substantial Completion and Punch List (showing exceptions if Contractor is to continue maintenance of specific systems).
 - 2. List of Project Managers / General Contractor and sub-contractors, with persons to contact, addresses, and phone numbers, including after-hours contacts.
 - 3. Notice of Completion, when issued
 - 4. Complete commissioning documentation, as required by the contract.
 - 5. Completed Start-up / Check-out documentation, as required by the contract.
 - 6. Copy of the County (or City) Certificate of Occupancy.
 - 7. As-built drawings and CADD are to be made available to SOM no later than 30 days after Turnover.
- C. Modification of Procedures on Small Projects: On small projects (minor remodeling, inhouse design, etc.), the formal procedures outlined above may be too onerous. To streamline procedures, the Project Manager / General Contractor will discuss the turnover with the Owner Rep. They will then arrange for whatever walk-through or inspection is warranted, and sends a copy of the Notice of Completion, or Notice of Acceptance of Work, to SOM, which should serve as the document turning over the project to SOM.

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SECTION 07 60 00

FLASHING AND SHEET METAL

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Addition to Part 1, 1.1:

B. Section 07500 – Built-up Cold Process Roofing

Amendment to Part 1.2, C:

C. Work shall be in accordance with Architectural Sheet Metal Manual, latest edition, as issued by the Sheet Metal and Air Conditioning Contractors' National Association, Inc., (SMACNA)

Part 2

Amendment to Part 2.3 Flashing Membrane, A:

A. Hypalon CSPE sheeting.

Addition to Part 2:

2.4. RELATED MATERIALS

A. Reference Section 07500.

Part 3

Amendment to Part 3.1. GENERAL FLASHING REQUIREMENTS

G. Install secondary stainless steel flashing at equipment curbs to address rust issues.

Amendment to Part 3.5, A:

A. Roofing contractor to install cant strip as specified to scupper opening (scupper supplied by sheet metal contractor installed by roofing contractor).

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SECTION 08 71 00

DOOR HARDWARE

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 3 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.1, A:

A. The purpose of this document is to support School of Medicine standards for door hardware. The **SOM** Lock Shop maintains the following hardware and is currently stocking replacement parts. The products listed in this booklet are to be used without substitution on new construction and modernization projects unless products are listed in this package as an alternate. Changes to this requirement **shall** be **submitted** in writing to the Owner for review and approval. It is the intent of this booklet to provide guidelines for the architect's specification section 08 71 00, for product groups and the hardware schedule. It remains the architect's responsibility to coordinate these products to meet the applicable building codes, life safety codes, and ADA requirements.

Addition to Part 1.3 Hardware Installation:

B. In addition to the above the following will be observed:

1. The SOM Security Lock Shop will be in charge of all re-keying and keys.
2. Construction Locks: All new locks installed by the contractor shall be compatible with Schlage large format interchangeable core key cylinders, keyed to a 0 to 1 bitted key. If a contractor uses their own Schlage large format cylinders during construction on the job site, they shall provide SOM with a control key and operating keys for the cylinders while the construction project is taking place. When SOM installs the keyed cylinders, SOM will return the (construction) cylinders and keys to the contractor. In this case, the locks or housing can be ordered with JT (less cylinders) and installed with contractor's cores. Otherwise, use the RD (keyed 0 or 1 bitted) cylinders.
3. When installing Schlage mortise locks, use lever style 03 or 06 with A or B roses when performing a complete remodel, or match the existing style and rose if only replacing a few doors. Some SOM Buildings use Schlage Escutcheon trim in either L or M style. **Utilize LFIC mortise housing on all new locks with key cylinders.**
4. All key codes, key cylinders, and keys shall be provided by SOM Lockshop. Contact the Lock Shop at (650) 723-6370. Alternate number (650) 721-2146.

SOM REQUIRES 8 WEEKS TO PROCURE THE KEY CYLINDERS AND KEYS. Provide SOM with ample notice prior to the completion date of the project.

5. All locks shall be Schlage mortise lock sets or cylindrical locksets, ND. Panic devices are Von Duprin. Schlage cylinders shall be LFIC compatible.

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Part 2

Amendments & Additions to Part 2.2, B Securing Devices: (These are edits per SOM)

B. Securing Devices

Lock set Schlage Cylindrical Locks:

ND Series X Rhodes or Sparta

1. Lock Set Schlage Interior Doors:

ND 10S Passage Lock

ND 40S Privacy Lock

ND 50RD Office Lock

ND 53RD Entrance Lock

ND 70RD Classroom Lock

ND 80RD Storeroom Lock

2. Lock Set Schlage Exterior Doors: These are Schlage Vandal Guard Style

ND91RD Office Lock

ND92RD Entrance Lock

ND94RD Classroom Lock

ND96RD Storeroom Lock

3. Mortise Locks

L9010 Passage Lock

L9040 Privacy Lock: **Use Part #: Schlage L283-413 (Locked/unlocked trim W cylinder)**

Use Part #: Schlage L283-414 (Occupied/Vacant trim W cylinder)

L9050J Office Lock * **(Use Sch L583-363 Disability t turn)**

L9070J Classroom Lock *

L9080J Storeroom Lock *

L9453J Entrance Lock * **(Use Sch L583-363 Disability t turn)**

Note: Use L94XX deadbolt function on all exterior doors

***Order Schlage LFIC Mortise Housing for these locks with cylinders.**

6. Day use lockers:

5G style digi locks part #NLSK—ADS2-619-010U shall be ordered unprogrammed so existing remote fobs can be used.

Amendments & Additions to Part 2.2, C Misc. Door Hardware:

Description Manufacturer Model / Series

Exit Device Von Duprin CD99NLx990NL"Trim Pull" (at exterior single doors)

CD99NLx990NL"Trim Pull" x CD99DTx990DT "Dummy Trim" .

Do not use CD panic devices on electronic exterior doors.

xSNBxKR4954 Mullion x 154

99L-F-994L (F-rated single doors)

99L-F-994L x 99EO-F x KR9954 Mullion x 154 (F pairs)

SOM Lock Shop to verify KR mullion locations

All KR mullions to be provided with MT54 storage mount

SOM Lock Shop to verify location of MT54 storage mount

All cylinders to be Schlage 6 pin **LFIC Core 1 bitted C or E** keyway.

Auxiliary Locks **American A3900SWO Series (Padlocks Schlage LFIC compatible**

Olympus 100DR or 500DR Series Square Back(Doors)

Olympus 200DW or 600DW Series Square back (Drawers)

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Key System Schlage **All keying and keyways to be provided by SOM Security Lock Shop**

Coordinator Ives COR2 x FB1 x BX Bracket (Storage & Utility rooms)
_ **Use coordinator only where required by fire code**

Flush Bolts Ives FB31P (Automatic) (metal doors) (Storage & Utility rooms)
FB41P (Automatic) (wood doors) (Storage & Utility rooms)
FB51P (Manual) (metal doors) (Storage & Utility rooms)
FB61P (Manual) (wood doors) (Storage rooms)

Closing Device
Closer LCN **4040-XP**

Fire-Rated and Panic Mortise Lock Devices

Push Device Impact 9475-F Models (Single Door)
9447-F Models (Double Door)

Panic Device Von Duprin 260 Finish unless building has 613 hardware specified
Rim Devices 33 – Narrow Glass Doors
99 – Metal/Wood Doors
Mortise 9975
Concealed Vertical Rod 3347 – Narrow Glass Doors
9947 – Metal Doors
9947 WDC – Wood Doors

Note: Use ONLY Schlage I/C Housings for Outside Trim
Rim Devices 20-079 x
Mortise **30-137** x 626

For Doors with High Cart Traffic (Von Duprin Impact Series)
Concealed Vertical Rods 9447
Mortise 9475

Auto Door Operator: Manufacturer; Motion Access is the first choice and LCN is the second. Record Auto closers are prohibited.

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SECTION 09 05 00

COMMON WORK RESULTS FOR FINISHES

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Addition to Part 2.2 FLOORING

C. Flooring manufactured by Amorim WISE is prohibited.

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SECTION 12 46 33

WASTE RECEPTACLES

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Addition to Part 2.1 WASTE MANAGEMENT, B.

2. Use centralized landfill/compost/recycling stations throughout building instead of desk side bins. Include desk side bins in offices only.

Addition to Part 2.1 WASTE MANAGEMENT, M.

4. Storage area in ground floor for Daniels Health to store (Biowaste-Sharps containers).

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SECTION 14 21 00

ELECTRIC TRACTION ELEVATORS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 3 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.02, B,3:

3. During the full maintenance portion of contract, the Elevator Contractor is to submit a monthly report to Stanford University School of Medicine Project Manager.

Addition to Part 1.03, C:

- C. Machine or controller room, properly enclosed and ventilated, shall be provided. The Machine Room door is to be keyed to the SOM / Campus keyway.

Addition to Part 1.03, F:

- F. Sill support angles shall be provided. Grout door sills and entrance frames as necessary.

Addition to Part 1.03, G:

- G. All cutting and patching of surfaces constituting final finish, shall be provided.

Addition to Part 1.03:

- N. A fire extinguisher, ADC rated and tagged, must be permanently mounted in the elevator mechanical room.

Amendment to Part 1.05, C, 1:

1. Operations and Maintenance: After completion of work, three copies of final control wiring diagrams, parts list, description of operating data and other information required for proper maintenance, repairs and adjustment of the equipment installed shall be submitted. At the conclusion of the job, mount a complete set of wiring diagrams including a definition of all nomenclature and symbols on the machine room wall in a suitable frame or laminated in clear plastic. The mounting method must be reviewed by School of Medicine E&M Shop. Submit three copies of all applicable keys for normal operation

Addition to Part 1.06 Warranty:

- B. A list of ALL "special tools" is to be provided to Stanford University, School of Medicine Project Manager.

Amendment to Part 1.07, B:

- B. Provide a monthly report to Stanford University School of Medicine Project Manager showing date and time of semi-monthly service, services done and parts replaced.

Amendments to Part 2.02, A Passenger Elevator:

1. Rated Speed: 350 fpm minimum for travel of 24'-0" or less
350 fpm minimum for travel of 36'-0" or less
350 fpm minimum for travel of 36'-0" or less

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6. Platform Size: 7'-0" wide X 6'-2" deep
7. Inside Clear Size: 6'-8" wide X 5'-5" deep

Addition to Part 2.02, B Operating and Signal Fixtures:

11. Emergency Battery Lowering device.

Amendments to Part 2.02, C Provisions for Handicapped:

2. The uppermost button necessary for operation of the elevator shall be located no higher than forty-eight inches (48") from the floor. Arrange floor buttons in a single column.

Addition to Part 2.02, C Provisions for Handicapped:

5. Flush mounted telephone shall be located below operating buttons, service cabinet above. For warranty and service needs, phones must be obtained from Stanford Communication Services (non-negotiable). Locate between 15" and 48" per accessibility requirements. (1) outside telephone line will be provided by Stanford that reports directly to the SHC Security / Dispatch office.

Addition to Part 2.05, P Operation of Car Under Fire Emergency Conditions:

3. Provide Phase II Fire Recall Switch in Main Car Operating Panel. Switch and jewel to be located at the top row of buttons with engraved instructions adjacent.
4. All key locks shall be manufacturer's standard.

Addition to Part 2.09, A:

- A. Platform: All steel welded or steel frame with stringers and double wood floor, with fire proofing as required, minimum 1" exterior grade plywood. Provide extruded nickel silver threshold full width of entrance column. Finished flooring by Stanford.

Addition to Part 2.09, J Car Interiors:

2. Front return panels and integral entrance columns: 16-gage furniture steel stationary return, #4 stainless steel finish. Swing entire unit on concealed hinges or pivots for access to integral car station wiring and fixtures.
12. Service elevator flooring shall be diamond plate flooring.
13. Wall panels: Provide interior panels of ¾" particle board core. Face and edge panels with patterned stainless steel.

Amendment & Addition to Part 2.09, K:

2. Suitably identify floor buttons, alarm button, door open button and emergency stop button by engraved and painted letters per CA Title 24 the Americans with Disabilities Act (ADA) and ANSI A117.1. Locate operating controls no higher than 48" above the car floor and stop switch and alarm button at 35" above car floor.
3. Provide 1/8" raised vandal resistant floor pushbuttons which illuminate to indicate call registration. Call buttons to be ¾ inch in the smallest dimension (minimum). Buttons to be raised (projected) and shall be of the illuminating type to indicate the registration of a Hall Call. Include designation of the floors served in face of button and on code compliant Braille. Floor designation characters to be a minimum of 2-inch-high, raised 1/32-inch, upper case and accompanied by corresponding Braille indications
9. Provide a lockable service panel with recessed, flush cover plate matching return panel. Cabinet door shall be provided with a flush glazed window of required size to hold elevator operating permit.

Stanford University-Facilities Design Guideline Amendment

Addition to Part 2.09, L:

- L. "...The appropriate arrow will illuminate corresponding to the direction, which the car is set to travel. The audible signal will alert passengers in the car and at the landing to signal illumination, sounding once for UP and twice for DOWN. Two per elevator are required, one each mounted in the entrance columns."

Additions to Part 2.10, A:

- 3. Main lobby landing will have direction of travel buttons, Firemen's Key Switch and Bezel with engraved instructions.
- 4. Typical Floors will have direction of travel buttons with "In Case Of Fire..."instructions engraved upon the (Per Title 8 and 24).
- 5. There will be only one (1) riser at each elevator landing per group of elevators.

Amendments to Part 2.10, E:

- E. All signal fixtures are to be attached with vandal resistant screws and have a #4 stainless steel finish.

Addition to Part 2.10, F:

- 3. Provide instructions for Firemen's key operation on faceplate of service cabinet.

Amendments to Part 2.10, G:

- G. Stanford Elevator number is to be posted at each floor and posted in each elevator. This is to be provided by the SOM E&M Shop.

Amendments to Part 3.01, E:

- E. Final Service and Inspection: Two weeks before expiration of the year's maintenance, the equipment shall be lubricated, fully serviced, adjusted to the standard designated and emergency service operation devices shall be checked. A complete inspection will be made and the elevator units accepted by Stanford University School of Medicine Project Manager, and School of Medicine Engineering & Maintenance Shop, and the Elevator Service Contractor.

Stanford University-Facilities Design Guideline Amendment

SECTION 14 24 00

HYDRAULIC ELEVATORS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated February 2013, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 2 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.01, A,3:

3. During the full maintenance portion of contract, the Elevator Contractor is to submit a monthly report to Stanford University School of Medicine Project Manager.

Addition to Part 1.02, C:

- C. Machine room, properly enclosed and ventilated, shall be provided. The Machine Room door is to be keyed to the SOM / Campus keyway.

Addition to Part 1.02, J:

- J. A sump pit and a protective grating level with the pit floor shall be provided, including a float alarm reporting to SHC security, and drain isolation valve.

Addition to Part 1.02:

- K. The Elevator numbering system is to be provided by the SOM E&M department.
- L. A fire extinguisher, ADC rated and tagged, must be permanently mounted in the elevator mechanical room.
- M. Conduit runs for remote monitoring systems where required

Addition to Part 1.04, A Shop Drawings:

6. All drawings showing structural attachments (rails, clips, fish plates, brackets, machine tie downs, controller tie downs, etc.) shall be stamped by a Certified Engineer and accompanied by a calculation booklet showing how methods of attachment have been achieved.

Amendment to Part 1.04, B Contract Closeout Submittal:

1. Operations and Maintenance: After completion of work, three copies of final control wiring diagrams, parts list, description of operating data and other information required for proper maintenance, repairs and adjustment of the equipment installed shall be submitted. At the conclusion of the job, mount a complete set of wiring diagrams including a definition of all nomenclature and symbols on the machine room wall in a suitable frame or laminated in clear plastic. The mounting method must be reviewed by the School of Medicine E&M Shop. Submit three copies of all applicable keys for normal operation.

Amendment to Part 1.06 B:

- B. Provide a monthly report to Stanford University, School of Medicine Project Manager showing date and time of semi-monthly service, services done and parts replaced.

Stanford University-Facilities Design Guideline Amendment

Addition to Part 1.06:

- C. A fire extinguisher, ADC rated and tagged, must be permanently mounted in the elevator mechanical room.

Addition to Part 2.02, A, 10:

10. Operation: Selective Collective – single car groups
Duplex – two car groups
Group Automatic – three or more car groups

Addition to Part 2.02, C, 2:

2. Flush mounted Telephone shall be located below operating buttons, service cabinet above. For warranty and service needs, phones must be obtained from Stanford Communication Services (not negotiable). (1) outside telephone line will be provided by Stanford that reports directly to the SHC Security / Dispatch office.

Addition to Part 2.05, B:

6. Kone

Addition to Part 2.05, M, 1:

1. In the event normal power fails, provide controls to automatically lower the car nonstop to the lowest landing using DC battery power source installed in machine room. Include solid-state charger and testing means mounted in a common metal container. Provide rechargeable lead acid or nickel cadmium battery, with 10-year life. Contractor to provide dry contact(s) at disconnect for connection of this unit.

Addition to Part 2.06, D:

- D. Pumping Unit: Pumping plant shall be a self-contained cabinet unit with sound-reducing enclosure. NO MINIMUM USE PUMP UNITS.

Additions to Part 2.09, J:

7. Ceiling: Provide manufacturer's standard suspended frame ceiling with flame retardant plastic diffusers. Provide a minimum of two, 2-lamp Stanford standard T-8 fluorescent lighting fixtures with "shatter shield" protection tubes.
13. Service elevator flooring shall be diamond plate flooring.

Addition to Part 2.09, K Section Title:

- K. Car Operating Panel (See School of Medicine Operating Panel Drawings)

Amendment to Part 3.01, E:

- E. Final Service and Inspection: Two weeks before expiration of the year's maintenance, the equipment shall be lubricated, fully serviced, adjusted to the standard designated and emergency service operation devices shall be checked. A complete inspection will be made and the elevator units accepted by Stanford University School of Medicine Project Manager, and School of Medicine Engineering & Maintenance Shop, and the Elevator Service Contractor.

Stanford University-Facilities Design Guideline Amendment

SECTION 14 43 00

VERTICAL PLATFORM LIFTS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 6 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.1, B, 1:

1. During the full maintenance portion of contract, the elevator contractor is to submit a quarterly report to Stanford University School of Medicine Project Manager

Part 3

Amendment to Part 3.1, A:

- A. Bidders shall examine architectural, structural, electrical, and mechanical plans and specifications. Any discrepancies that affect the vertical platform lift work or conditions adverse to the bidders equipment shall be brought to Stanford University School of Medicine Project Manager attention at least 7 calendar days prior to the bid date. If no discrepancies are presented, changes required to plans or specifications become the responsibility of and cost to the contractor.

Amendment to Part 3.5, A:

- A. Instruct: Instruct School of Medicine E&M Shop personnel in proper use of system.

Amendment to Part 3.6, E:

- E. Call-Backs: In the event of failures, provide 24-hour call back service at no additional cost to Stanford.

Stanford University-Facilities Design Guideline Amendment

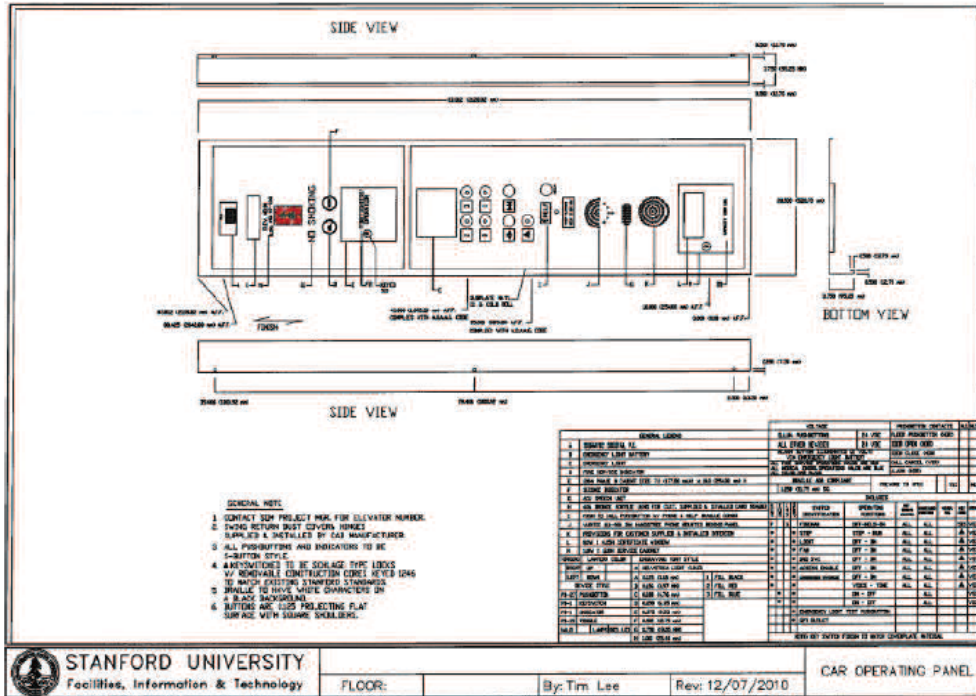
Additions to Guideline:

REV. 06.01.2016

STANFORD UNIVERSITY - SCHOOL OF MEDICINE

No details are shown on
FDG.

Elevator Cab 1 of 5

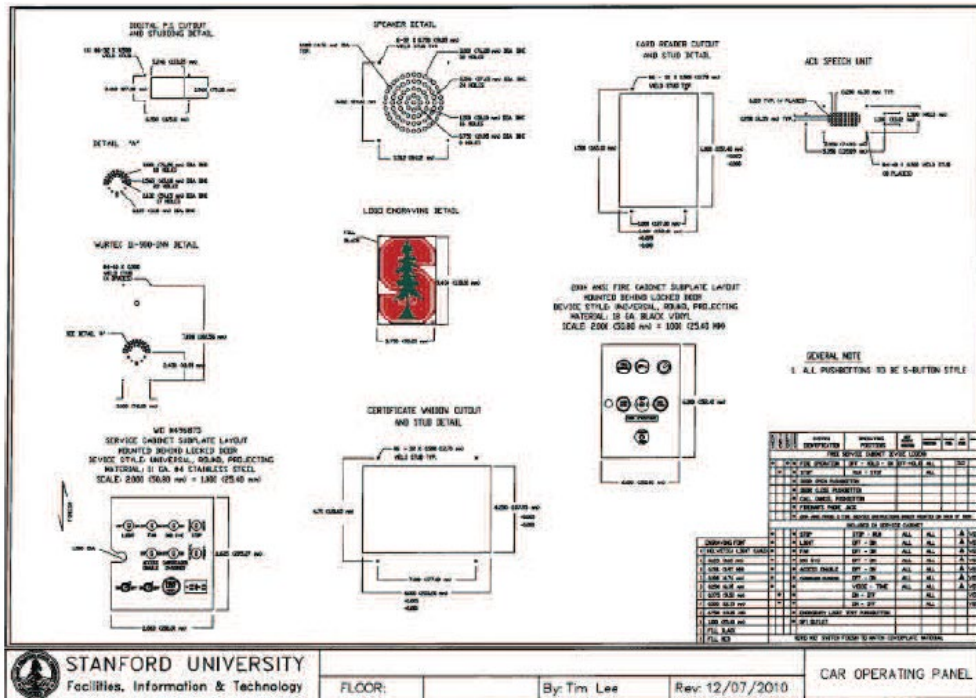


Stanford University-Facilities Design Guideline Amendment

REV. 06.01.2016

STANFORD UNIVERSITY - SCHOOL OF MEDICINE

Elevator Cab 2 of 5

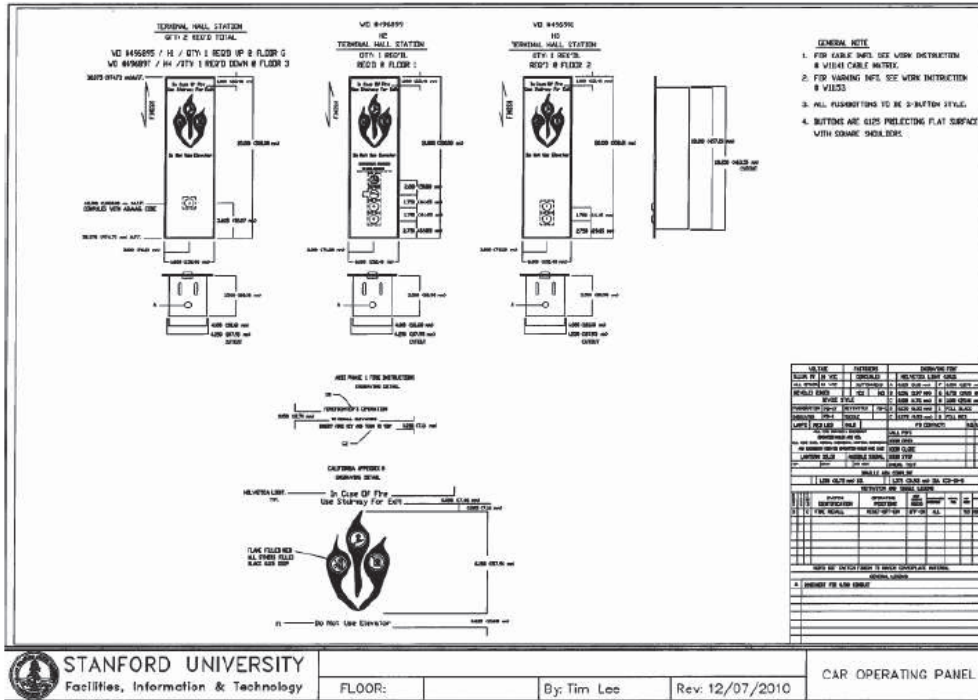


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REV. 06.01.2016

STANFORD UNIVERSITY - SCHOOL OF MEDICINE

Elevator Cab 3 of 5

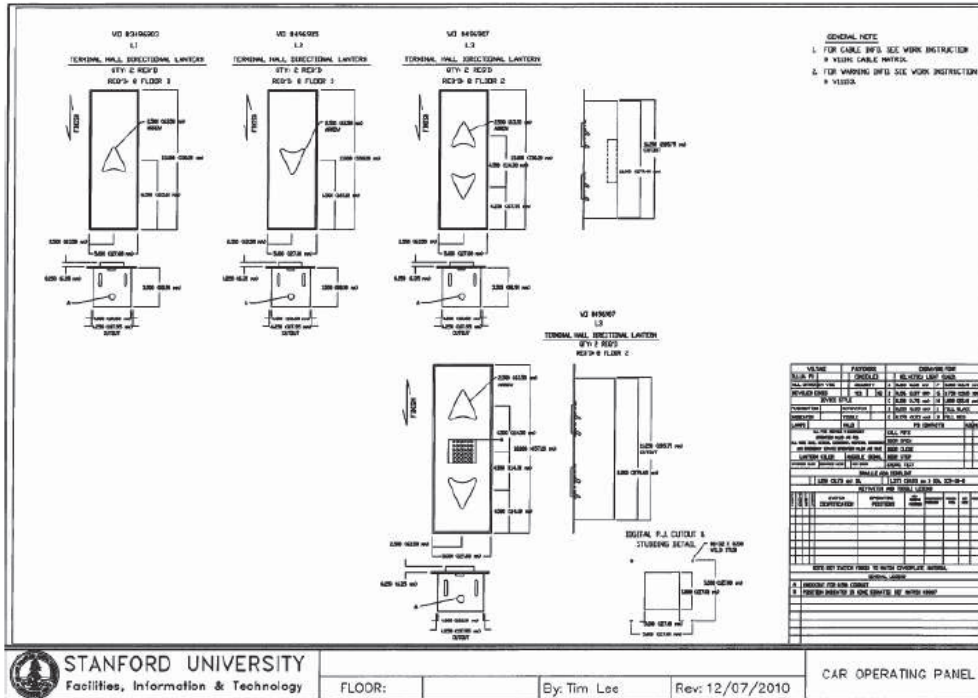


Stanford University-Facilities Design Guideline Amendment

REV. 06.01.2016

STANFORD UNIVERSITY - SCHOOL OF MEDICINE

Elevator Cab 4 of 5



STANFORD UNIVERSITY
Facilities, Information & Technology

FLOOR: _____ By: Tim Lee Rev: 12/07/2010

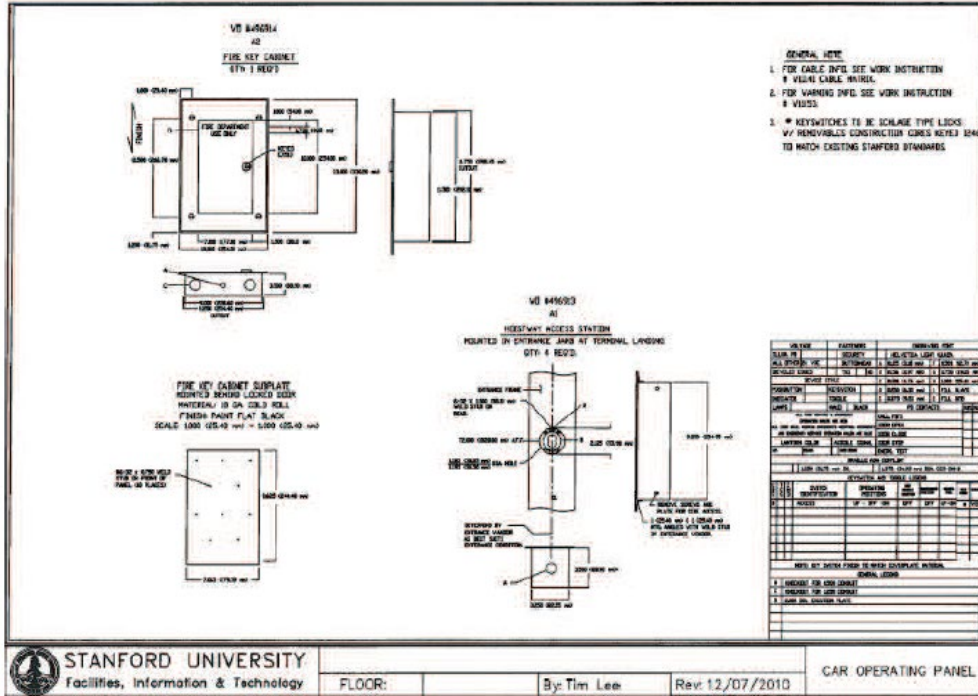
CAR OPERATING PANEL

Stanford University-Facilities Design Guideline Amendment

REV. 06.01.2016

STANFORD UNIVERSITY - SCHOOL OF MEDICINE

Elevator Cab 5 of 5



Stanford University-Facilities Design Guideline Amendment

SECTION 21 13 00

FIRE SUPPRESSION SPRINKLER SYSTEMS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Addition to Part (should be relabeled as 2.01), B Sprinklers:

10. Concealed Pendent Sprinklers Quick & Standard Response, Standard Coverage – Tyco Series RFII – 5.6 K-Factor “Royal Flush II”.

11. Fire Sprinkler calculations are required for all floors and calc plates must be posted on every floor at the riser.

Stanford University-Facilities Design Guideline Amendment

SECTION 21 30 00

FIRE PUMPS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 2 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.1, C:

D. In case of conflict, the Reference Codes and Standards take precedence. Advise the SOM Project Manager of such conflicts prior to taking action.

Amendment to Part 1.3, D:

D. The Medical Center. Reserves the right to reject any contractor who fails to demonstrate the experience required by 1.3B.

Amendment to Part 1.5, A:

A. Shop drawings shall be submitted to the Project Manager for approval prior to the purchase and installation of equipment. The Project Manager will submit the shop drawings to the University Fire Marshal and **SOM** Engineering & Maintenance Fire Alarm Shop for internal review. After receiving review comments from the University Fire Marshal and the E&M Fire Alarm Shop, the contractor shall make appropriate changes to the shop drawings. Thereafter, the Project Manager will submit the shop drawings to the appropriate jurisdictional agency for required permit, review, and approval.

Amendments & Additions to Part 1.5, B:

2. Schedule of performance, showing all major milestones, within 14 calendar days after contract award.
3. Complete catalog data for all components to be installed, within 14 calendar days after contract award.
4. Complete shop drawings of equipment to be installed, including piping, and any calculations, within 28 calendar days of contract award.
5. Testing schedule, 14 calendar days prior to scheduled start of testing.
7. Training syllabus 14 calendar days prior to schedule training.
8. Recommended spare parts list with any special tools required, wiring schematics, installation/operation/maintenance (IO&M) manuals, and as-built drawings, at same time as training syllabus.
10. Maintenance and testing schedule, submitted at the same time as 1.5.B.9

Additions to Part 1:

1.6 SAFETY AND INDEMNITY:

A. Safety: The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours.

1.7 GUARANTEE:

Stanford University-Facilities Design Guideline Amendment

- A. The Contractor shall issue a certificate of guarantee certifying that all materials and workmanship supplied and/or installed by the Contractor shall be free from defects for a period of not less than one year from the date of substantial completion or beneficial occupancy, whichever occurs first.

Part 2

Amendment to Part 2.3, D:

- D. The transfer switch circuitry shall be capable of sensing both normal power source and the emergency power source. The normal power source pickup shall be set at 95% nominal voltage and dropout at 85% nominal voltage. The emergency power source shall be set to pickup at 90% nominal voltage and 95% frequency. All voltage sensing, frequency sensing, and time delays shall be field adjustable to accommodate individual installation requirements. The transfer signal shall be delayed for one second, delaying the transfer so as to override momentary normal power outages.

Part 3

Amendment to Part 3.3, A:

- A. Coordinate Field Acceptance Test with SOM Project Manager, University Fire Marshal, **SOM** Engineering & Maintenance Shop and appropriate jurisdictional agency. Provide 72 hours minimum advance notice to all parties prior to testing.

Amendment to Part 3.3, E:

- E. Contractor shall repair and retest any items found to be defective in any way, to the satisfactory of the SOM Project Manager.

Addition to Part 3.3:

- F. Conduct Field Acceptance Test in the SOM Project Manager, University Fire Marshal, **SOM** Engineering & Maintenance Shop, and the appropriate jurisdictional agency. Test procedures shall be as submitted per section 1.5.A.6 and approved by the University Fire Marshal.

Amendment to Part 3.4, A:

- A. Conduct minimum four (4) hours of training at the time of choosing by the **SOM** Engineering & Maintenance Shop.

Addition to Part 3.5 Cleanup:

- D. Upon completion of the Work under this Section, immediately remove all surplus materials, rubbish and equipment associated with or used in performance of this portion of the Work.

Stanford University-Facilities Design Guideline Amendment

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.1, G:

- G. Energy Efficiency and Water Conservation: Refer to FDG Division 23 & SOM Facilities Guidelines Mechanical

Addition to Part 1.2:

- C. Designer Qualifications: All plumbing design work shall be signed and stamped by a professional mechanical or civil engineer (as applicable) licensed in the state of California. Requests for exceptions to this requirement shall be evaluated by the University Manager of Engineering and Construction Management or SOM Office of Facilities Planning and Management.

Stanford University-Facilities Design Guideline Amendment

SECTION 22 10 00

PLUMBING PIPING

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Addition to 2.1, B, 1 Waste:

- c. Buried below floors, below grade, and within 5 feet of building perimeter: Hub and spigot cast iron piping conforming to ASTM A-74, standard weight soil pipe. All pipe and fittings shall be marked with CISPS trademark or receive prior approval by the engineer of record. Joint for hub and spigot pipe and fittings: ASTM C-565 Compression gaskets. Minimum size for pipe below building floors shall be 3 inch.

Couplings at last connection: Heavy duty type 394 corrugated stainless steel shield couplings having 4 sealing clamps for pipe sizes 1-1/4" to 4", and 6 sealing clamps for pipe sizes 5" to 10", Anaco "Husky SD-4000," clamp-All 125, Tyler WB, MG Couplings, or equal, comply with FM 1680, Class 1

Amendment to 2.1, B, 2 Vents:

2. Lab Waste Vent Piping and Fittings:
 - a. Lab Waste Piping (Below Grade): George Fisher, Enfield, Orion, or equal, conforming to ASTM D-2122, Schedule 80, flame retardant polypropylene, (FRPP) piping and drainage pattern fitting with electric heat coil fusion ends. Lab Waste Vent piping similar except use Schedule 40 piping.
 - b. Lab Waste Piping (Below Slab): Duriron, no known equal, 14.5% silicone content cast iron piping, with mechanical joints for sizes up to 4", and hub and spigot joints for 6" and larger piping. Use mechanical joints at equipment and lab sink rough-ins

Addition to 2.1, B:

7. Corrosion Protection
 - a. 8 mils thickness polyethylene sleeve for underground piping
 - b. Tapecoat "TC", Protecto-Wrap, or equal, 35 mils thick, polymer film with cold-applied tape coating, conforms to AWWA C-209.

Stanford University-Facilities Design Guideline Amendment

SECTION 22 40 00

Plumbing Fixtures

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

PART 3

Amendment to Part 2.5 SINKS (KITCHENS)

D. Accessories:

1. GoJo soap dispensers for all sink areas.

Amendment to Part 2.9 SERVICE SINKS, D. Accessories:

4. GoJo soap dispensers for all sink areas.

Stanford University-Facilities Design Guideline Amendment

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 2 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Additions to Part 1.4, A:

1. Maximum number of office per VAV Box Zone: 3-4
2. Provide RE-HEAT coils on all perimeter (Envelope) Zones and all Zones serving Top Floor and Bottom Floor.

Additions to Part 1.5, B,2:

2. Design Temperatures: Summer 86F dry bulb, **66F** wet bulb
Winter: 34F dry bulb, 30F wet bulb
Lab, Animal and Critical Facility OSA Design Temperature: 95F dry bulb 66F wet bulb

Amendments to Part 1.5, D: (amendments from SOM)

1. Office Indoor Temperatures:
 - a. Summer: 74 +/- 2F
 - b. Winter 70 +/- 2F
 - c. Night setback: 55F
2. Lab Indoor Temperatures:
 - a. Summer: 72 +/- 2F
 - b. Winter 70 +/- 2F
 - c. Night setback: 55F
3. Animal Facility Indoor Temperatures:
 - a. Summer: 72 +/- 2F
 - b. Winter: 70 +/- 2F / 78 +/- 2F
5. Provide maximum **3-4** offices per VAV zone.
6. Provide Reheat Coils on all Perimeter Zones and ALL zones serving bottom floor and top of the building.

Additions to Part 1.5, E, 3. Freeze Protection:

- c. The preheat coil shall be designed to maintain 55F minimum discharge temperature.

Amendment to Part 1.6 General Design Conditions (per SOM Comments)

P. Tele/Data Closets, Main Distribution Frame (MDF), Intermediate Distribution Frame (IDF), Server Rooms:

1. Minimum cooling capacity via house system of 5CFM/SF. In addition, provide 24/7 DX Cooling Split System connected to Emergency Power as a backup.

Q. Larger Server Rooms greater than 100SF

1. Provide cooling from house system sized based on sensible load of 6,000 watts/rack. In addition, provide DX Cooling Split System connected to Emergency Power as a backup. Design for Hot Aisle / Cold Aisle Layout.

Stanford University-Facilities Design Guideline Amendment

- R. Freezer Room Cooling
 - 1. Cooling via house system to provide 5CFM/SF via hot aisle/cold aisle configuration. In addition, provide 24/7 DX Cooling Split System connected to Emergency Power as a backup.

Stanford University-Facilities Design Guideline Amendment

SECTION 23 07 16

HVAC INSULATION

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Additions to Part 2: (amendments from SOM)

2.16 Fiberglass Free Duct Liner:

A. Comparable to Ductmate PolyArmor Polyester Duct Liner.

2.17 Zero Perm Foil Vapor Barrier:

A. Manufactured by TDI Corp and distributed by Insul-Therm International, Inc.

Stanford University-Facilities Design Guideline Amendment

SECTION 23 36 00

Air Terminal Units

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

PART 2

Amendment to Part 2.4 FAN POWERED VARIABLE VOLUME UNITS

E. Four Pipes VAV Drain Pan

3. Provide secondary condensate pan with leak detection at VAV chilled water coils installed within Telecom Room

Stanford University-Facilities Design Guideline Amendment

SECTION 23 37 00

AIR OUTLETS AND INLETS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

PART 2

Amendment to Part 2.3 RECTANGULAR CEILING DIFFUSERS, A.

A. Type: Square, adjustable pattern, stamped, multi-core Square and rectangular, adjustable pattern multi-louvered diffuser to discharge air in 360 degree one way, two-way, three-way or four-way pattern with sector baffles where indicated per design. Lab diffusers shall be Modular Core Type.

Stanford University-Facilities Design Guideline Amendment

SECTION 23 70 00

CENTRAL HVAC EQUIPMENT

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Addition to Part 2.6 Coils:

- F. Steam Heating Coils
1. Clearly label supply and return connections on outside of units.
 2. Provide non-freeze steam distributing type coils. Pitch steam coils in units for proper drainage of steam condensate from coils.
 3. Proof test coils to 300 psig air under water and leak test coils to 200 psig air pressure underwater
 4. Construct headers of cast iron or round copper pipe.
 5. Construct tubes of 5/8 inch O.D. minimum 0.020-inch-thick copper. Construct fins of aluminum.
 6. Inner tubes shall have orifices that ensure even steam distribution across coil face. Direct orifices toward return connections to ensure steam condensate is discharged from coils.
 7. Provide corrosion resistance with Blue Fin, Electro-Fin, Heresite, or equal coating.

Stanford University-Facilities Design Guideline Amendment

SECTION 23 82 19

FAN COIL UNITS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Amendment to Part 2.6 DRAIN PAN

- C. Provide secondary condensate pan with leak detection in Fan Coil Units installed within Telecom Room.

Stanford University-Facilities Design Guideline Amendment

SECTION 23 84 00

HUMIDITY CONTROL EQUIPMENT

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated February 2018, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 2 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Addition to Part 1.8 Quality Assurance:

D. Maintain one copy of each document on site.

Additions to Part 1:

1.10. QUALIFICATIONS:

A. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.11. PRE-INSTALLATION MEETING:

A. Convene minimum one week prior to commencing work of this Section

1.12. DELIVERY, STORAGE, AND HANDLING:

A. Accept units on site in factory packing. Inspect for damage.

Part 3

Amendments to Part 3.1, A:

4. Pipe all units, except for steam grid type, from overflow and manual drain with valve to floor drain.
9. Connect evaporative and evaporative pan and sprayed coil humidifiers to domestic cold-water supply. Provide gate or ball valve and pressure reducing valve (as needed) on water supply line. Provide $\frac{3}{4}$ inch hose bibb accessible from interior.

Stanford University-Facilities Design Guideline Amendment

SECTION 25 00 00

INTEGRATED AUTOMATION

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated February 2018, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 79 pages.

CHANGES TO THE PROJECT GUIDELINES

Addition to Section 25 00 00 Guidelines:

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Stanford University-Facilities Design Guideline Amendment

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PART 5 – REVISION HISTORY

- 12/15/2013 Addition of Table of Contents
 - Addition to Part 2.02 Section C: Operator Workstation
 - Addition of Part 4 Abbreviations, Nomenclatures & Diagrams
 - Addition of Part 5 Revision History
- 06/01/2016 Revised

PART 1 - GENERAL

1.01 Work Included:

- A. General - Building Management System (BMS) Contractor shall provide and install:
 - 1. A fully integrated Building Automation System (BAS), incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems with open communications capabilities as herein specified.
 - 2. Complete temperature control system to be DDC with electric actuation as specified herein.
 - 3. All wiring, conduit, panels, and accessories for a complete operational system.
 - 4. BMS Contractor shall be responsible for all electrical work associated with the BMS.
 - a. Perform all wiring in accordance with all local and national codes.
 - b. Install all line voltage wiring, concealed or exposed, in conduit in accordance with the division 16 specifications, NEC and local building code.
 - c. Provide extension of 120-volt, 20-amp circuits and circuit breakers from Emergency power panels for all BMS equipment power. Provide and install UPS Power supply for all BMS system panels and terminal equipment controllers.
 - d. Surge transient protection shall be incorporated in design of system to protect electrical components in all DDC Controllers and operator's workstations.

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- e. All low voltage electrical control wiring throughout the building whether in exposed areas shall be run in conduit in accordance with the division 16 specifications, local building code and the NEC.
 - f. Provide all miscellaneous field device mounting and interconnecting wiring for all mechanical systems including fuel oil system, emergency generators, chillers, water treatment, AC units, condensing units, expansion tanks, VFD, unit heaters, filtration systems, terminal units, fan coil units, electric heaters, chiller control system.
 - g. All systems requiring interlock wiring shall be hardwired interlocked and shall not rely on the BMS to operate (e.g. emergency generator to fuel oil pump interlock, emergency generator damper interlock, etc.) Interlock wiring shall be run in separate conduits from BMS associated wiring.
5. All wells for water monitoring devices, flow switches and alarms, as required.
 - a. All installation kits for turbine flow meters, allow service and removal under pressure.
 6. Provide open communications system. The system shall be an open architecture with the capabilities to support a multi-vendor environment. To accomplish this effectively, system shall be capable of utilizing standard protocols as follows as well as be able to integrate third-party systems via existing vendor protocols.
 - a. All systems (i.e. UPS System, PDUs and Static Transfer, ATS Switches, Computer Room Air Conditioning, Emergency Generators, Lighting Control System, Security and Access Control, Closed Circuit TV and Fire Alarm System) integrated to Building Automation System that utilize BACnet communication protocol shall provide hardwired, normally closed general alarm signals to Apogee system panel.
 - b. System shall be capable of high-speed Ethernet communication using TCP/IP protocol.
 - c. System shall be capable of BACnet communication according to ANSI/ASHRAE 135-2004.
 - d. The system shall be capable to integrate a wide variety of third-party devices and legacy systems.
 - e. The intent is to either use the Operator Workstation provided under this contract to communicate with control systems provided by other vendors or to allow information about the system provided in this contract to be sent to another workstation. This allows the user to have a single seat from which to perform daily operation.
 7. Provide hardware, software, and wiring to provide communication interfaces with each of the systems listed below.
 - a. UPS System
 - b. PDUs and Static Transfer
 - c. ATS Switches
 - d. Computer Room Air Conditioning (CRAC)
 - e. Emergency Generators
 - f. Lighting Control System
 - g. Security and Access Control
 - h. Closed Circuit TV
 - i. Fire Alarm System
 - j. Hot Water Heat Exchangers
 8. Provide system graphics for each controlled device and/or integrated systems as required by the owner. Origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the BMS.
 9. Primary DDC panels as follows:
 - a. Minimum one (1) BMS system Primary DDC panel per floor installed in the Tele/Data room. The application specific controllers installed for the terminal units on a floor will be connected to the BMS panel on the same floor.
 - b. Minimum one (1) BMS system Primary DDC panel per each major mechanical system:
 - 1) Air Handling Unit and associated Exhaust Fan
 - 2) Hot Water heat Exchangers and associated pumps

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- 3) Chillers and associated pumps
 - 4) Boilers and associated pumps
 - 5) Cooling Towers associated pumps
 - 6) Emergency Generator
 - 7) Fuel Oil System
 - c. It shall be acceptable to combine up to three (3) of the following mechanical equipment into one (1) Primary DDC panel:
 - 1) Exhaust Fans
 - 2) Standalone Supply Fans
 - 3) Package AC Units
 - d. It is acceptable to wire normally-closed general alarm of the following systems into any of the Primary DDC panels:
 - 1) Miscellaneous alarm monitoring (i.e. ATS, leak, temperature, light ...etc.)
 - 2) Miscellaneous equipment (i.e. Unit Heater, Domestic Water Heater, Standalone Dampers ...etc.)
 - e. Motors in motor control centers shall be controlled from the DDC controller associated with HVAC system. It shall not be acceptable to control all motors in a MCC from one DDC controller dedicated to the MCC. The intent of this specification is that the loss of any one DDC controller shall not affect the operation of other HVAC systems, only for the points connected to the DDC controller.
10. Stand-alone Application Specific Controllers (ASCs) for terminal equipment (CAV, FP VAV, and VAV units, and fan coil units). Provide UPS Power supply for all terminal equipment.

B. General product description

1. The installation of the control system shall be performed under the direct supervision of the BMS Contractor with the shop drawings, flow diagrams, bill of materials, component designation, or identification number and sequence of operation all bearing the name of the manufacturer. The BMS Contractor shall certify in writing, that the shop drawings have been prepared according to the equipment manufacturer's guidelines.
2. All materials and equipment used shall be standard components, regularly manufactured for this and/or other systems and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use for at least two years.
3. The system shall be scalable in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, and operator devices.
4. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of any control strategy, reporting, alarming and trending function, or any function at any operator interface device.
5. DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. DDC Controllers shall also be able to send alarm reports to multiple operator workstations without dependence upon a central or intermediate processing device.
6. DDC Controllers shall be able to assign password access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust or control only the points that the operator is authorized for. All other points shall not be displayed at the PC workstation or portable terminal. (E.g. all base building and all tenant points shall be accessible to any base building operators, but only certain base building and tenant points shall be accessible to tenant building operators). Passwords and priority levels for every point shall be fully programmable and adjustable.

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7. Spare Points. All DDC controllers shall be installed with 25% spare points (of each type) and 25% spare memory capacity for connection of floor work.

1.02 Products Furnished but Not Installed Under This Section

- A. Hydronic Piping:
 1. Control Valves
 2. Temperature Sensor Wells and Sockets
 3. Flow Switches
 4. Flow Meters
- B. Refrigerant Piping:
 1. Pressure and Temperature Sensor Wells and Sockets
- C. Duct-work Accessories:
 1. Dampers
 2. Air-flow Stations
 3. Terminal Unit Controls

1.03 Products Installed but Not Furnished Under This Section

- A. Refrigeration Equipment:
 1. Refrigerant Leak Detection System
- B. Rooftop Air Handling Equipment:
 1. Thermostats
 2. Duct Static Pressure Sensors

1.04 Products Integrated to but Not Furnished or Installed Under This Section

- A. Heat Generation Equipment:
 1. Boiler Controls
- B. Refrigeration Equipment:
 1. Chiller Controls
- C. Rooftop Air-Handling Equipment:
 1. Discharge Air Temperature Control
 2. Economizer Control
 3. Volume Control
- D. Unit Ventilators and Fan Coil Units:
 1. Set Point Reset
 2. Day/ Night Indexing
- E. VAV Terminal Units:
 1. Cross-Flow Velocity Sensor
- F. Variable Frequency Drives
- G. Lighting Control
- H. Access/Security
- I. Fire/Life Safety – Alarm, Trouble and Supervisory Signals
- J. Power/Energy Monitoring

1.05 Related Sections

- 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.
- B. The following sections constitute related work:
 1. Section 01 00 00 - General and Special Requirements
 2. Section 01 33 00 - Submittal Requirements
 3. Section 27 05 26 - Commissioning of HVAC
 4. Section 05 45 19 – Commissioning of Integrated Automation
 5. Section 28 13 00 - Security Access
 6. Section 28 20 00 - Security Surveillance
 7. Section 23 31 03 - Detection and Alarm (Fire and Smoke Alarm Systems)
 8. Section 01 60 00 - Materials and Equipment

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9. Section 21 05 00 – Common Work Results for Fire Suppression
10. Section 22 05 00 – Common Work Results for Plumbing
11. Section 23 05 00 – Common Work Results for HVAC
12. Section 23 82 00 - Heat-Generation Equipment
13. Section 23 60 00 - Refrigeration Equipment
14. Section 23 50 00 - Central Heating Equipment
15. Section 23 60 00 - Central Cooling Equipment
16. Section 23 70 00 - Central HVAC Equipment
17. Section 23 80 00 - Decentralized HVAC Equipment
18. Section 23 30 00 - HVAC Air Distribution
19. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC
20. Section 26 05 00 - Common Work Results for Electrical
21. Section 26 30 00- Facility Electrical Power Generating and Storing Equipment
22. Section 26 20 00 - Low-Voltage Electrical Transmission
23. Section 26 50 00 – Lighting

1.06 Approved Control System Contractors and Managers

- A. The following are the approved Control System Contractors and Manufacturers:
 1. New Construction. Siemens Industry, Inc. - Desigo System.
 2. Small renovations. Siemens Industry, Inc. – APOGEE System

1.07 Quality Assurance

- A. The BAS system shall be designed and installed, commissioned and serviced by factory trained personnel. BMS contractor shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. The BMS contractor shall provide full time, on site, experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the BMS. The Bidder shall be regularly engaged in the installation and maintenance of BMS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of BMS systems similar in size and complexity to this project.
- B. The BMS contractor shall maintain a service organization consisting of factory trained service personnel and provide a list of 10 projects, similar in size and scope to this project, completed within the last five years.
- C. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- D. All BAS peer-to-peer network controllers, central system controllers, and local user displays shall be UL Listed under Standard UL 916, category PAZX; Standard ULC C100, category UUKL7; and under Standard UL 864, categories UUKL, UDTZ, and QVAX and be so listed at the time of bid. All floor level controllers shall comply, at a minimum, with UL Standard UL 916 category PAZX; Standard UL 864, categories UDTZ, and QVAX and be so listed at the time of Bid.
- E. The BAS peer-to-peer network controllers and local user display shall also comply with the European Electromagnetic Compatibility (EMC) Framework, and bear the C-Tic Mark to show compliance. The purpose of the regulation is to minimize electromagnetic interference between electronic products, which may diminish the performance of electrical products or disrupt essential communications.
- F. DDC peer-to-peer controllers shall be compliant with the European EMC Directive, Standards EN 50081-2 and EN 50082-2, at the Industrial Levels. Additionally, the equipment shall be compliant with the European LVD Directive and bear the CE mark in order to show compliance to both directives.
- G. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.
- H. All wireless devices shall conform to:

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1. The requirements of Title 47 of the Code of Federal Regulations, FCC Part 15, governing radio frequency intentional radiating devices and be issued a FCC user identification and be so labeled. CE Directive 1999/5/EC (Radio Equipment and Telecommunications Terminal Equipment and the Mutual Recognition of their Conformity)
- I. The manufacturer of the building automation system shall provide documentation supporting compliance with ISO-9002 (Model for Quality Assurance in Production, Installation, and Servicing) and ISO-140001 (The application of well-accepted business management principles to the environment). The intent of this specification requirement is to ensure that the products from the manufacturer are delivered through a Quality System and Framework that will assure consistency in the products delivered for this project.
- J. This system shall have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing field panels to current level of technology, and extend new field panels on a previously installed network. Compatibility shall be defined as the ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers or protocol converters.

1.08 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. Uniform Building Code (UBC)
 - a. Section 608, Shutoff for Smoke Control
 - b. Section 403.3, Smoke Detection Group B, Office Buildings and Group R, Division 1 Occupancies
 - c. Section 710.5, Wiring in Plenums
 - d. Section 713.10, Smoke Dampers
 - e. Section 1106, Refrigeration Machinery Rooms
 - f. Section 1107, Refrigeration Machinery Room Ventilation
 - g. Section 1108, Refrigeration Machinery Room Equipment and Controls
 - h. Section 1120, Detection and Alarm Systems
 3. Uniform Mechanical Code (UMC)
 4. ANSI/ASHRAE Standard 135- 2004, BACnet--A Data Communication Protocol for Building Automation and Control Networks
 5. [Local] Building Code

1.09 System Performance

- A. Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
 1. Graphic Display. A graphic with 20 dynamic points shall display with current data within 10 sec.
 2. Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 3. Multiple Alarm Annunciations.

1.10 Submittals

- A. Product Submittal Requirements. Meet requirements of Section 01330 on Shop Drawings, Product Data, and Samples. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2004 (or newer) compatible files on optical disk (file format: .dwg, .dxf, .vsd, or comparable) or hard copies on 11" x 17" prints of each drawing. When manufacturer's cut sheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be

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accepted as cut sheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work.

- B. Provide submittals within 4 weeks of contract award
- C. Submittal data shall consist of the following:
 - 1. Direct Digital Control System Hardware:
 - a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data, such as product specification sheets, installation and maintenance instructions for items listed below and for relevant items not listed below:
 - 1) Direct Digital Controllers (controller panels)
 - 2) Transducers and transmitters
 - 3) Sensors (including accuracy data)
 - 4) Valves
 - 5) Dampers
 - 6) Relays and Switches
 - 7) Control Panels
 - 8) Power Supplies
 - 9) Operator Interface Equipment
 - 10) Uninterrupted Power Supply (UPS)
 - c. Wiring diagrams and layouts for each control panel. Show all termination numbers.
 - d. Floor plan schematic diagrams indicating control panel and space temperature sensor locations.
 - 2. Central System Hardware and Software:
 - a. Complete bill of material indicating quantity, manufacturer, model number, and relevant technical data of equipment used.
 - b. Manufacturer's description and technical data such as product specifications for items listed below and for relevant items furnished under this contract not listed below:
 - 1) Central Processing Unit (CPU)
 - 2) Monitors
 - 3) Keyboards
 - 4) Power Supply
 - 5) Battery Backup
 - 6) Interface Equipment Between CPU and Control Panels
 - 7) Operating System Software
 - 8) Operator Interface Software
 - 9) Color Graphic Software
 - 10) Third-Party Software
 - c. Schematic diagrams of all control, communication, and power wiring for central system installation. Show interface wiring to control system.
 - d. Provide sample color graphics on 11" x 17" prints for each typical system indicating conceptual layout of pictures and data for each graphic. List of color graphics to be provided showing or explaining which other graphics can be directly accessed.
 - e. Provide a list of BMS point names. BMS point nomenclature shall follow the format shown on Part 4: "Abbreviations & Nomenclature." Of this guideline.
 - 3. Controlled Systems:
 - a. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - c. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic use the same name.

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- d. Instrumentation list for each controlled system. List control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
- e. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system.
- f. Point list for each system controller including both inputs and outputs (I/O), point numbers, controlled device associated with each I/O point, and location of I/O device.
4. Description of process, report formats and checklists to be used in Part 3: "Control System Demonstration and Acceptance."
5. Contractor shall submit documentation in the following phased delivery schedule:
 - a. Valve and damper schedules
 - b. Point Naming Convention – see Part 4: "Abbreviations & Nomenclature." of this guideline.
 - c. Sample Graphics
 - d. System schematics, including:
 - 1) System Riser Diagrams
 - 2) Sequence of Operations
 - 3) Mechanical Control Schematics
 - 4) Electrical Wiring Diagrams
 - 5) Control Panel Layouts
 - 6) Product Specification Sheets
 - e. As-Built drawings
- D. Project Record Documents: Submit three copies of record (as-built) documents upon completion of installation. Submittal shall consist of:
 1. Project Record Drawings. As-built versions of the submittal shop drawings provided as AutoCAD 2004 (or newer) compatible files on optical media and as 11" x 17" prints.
 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Part 3: "Control System Demonstration and Acceptance."
 3. Certification of pressure test required in Part 3: "Control Air Tubing."
 4. Operation and Maintenance (O & M) Manual.
 - a. As-built versions of the submittal product data.
 - b. Names, addresses, and 24-hour telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's Manual with procedures for operating control systems, logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
 - d. Terminal equipment application specific controller installation and startup manuals.
 - e. Programming manual or set of manuals with description of programming language and of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - f. Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - g. Documentation of all programs created using custom programming language, including set points, tuning parameters, and object database.
 - h. Graphic files, programs, and database on magnetic or optical media.
 - i. List of recommended spare parts with part numbers and suppliers.
 - j. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware, including computer equipment and sensors.
 - g. Complete original original-issue copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.

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- h. Licenses, guarantees, and warranty documents for equipment and systems.
 - E. Training Materials. Provide course outline and manuals at least six weeks before training.
- 1.11 Warranty
- A. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Failures on control systems that include all computer equipment, transmission equipment and all sensors and control devices during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
 - B. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
 - C. If Engineer determines that equipment and systems operate satisfactorily at the end of final start-up, testing, and commissioning phase, Engineer will certify in writing that control system operation has been tested and accepted in accordance with the terms of this specification. Date of acceptance shall begin warranty period.
 - D. Provide updates to operator workstation 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 the above-mentioned items. Do not install updates or upgrades without Owner's written authorization.
 - E. Exception:
 - 1. Contractor shall not be required to warrant reused devices, except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.
 - 2. Contractor shall not be required to warrant systems, equipment and devices or software if the damages and/or failures were caused by lack of training, unauthorized use, negligence or deliberate action of other parties, or job site conditions.
- 1.12 Ownership of Proprietary Material
- A. Project specific software and documentation shall become Owner's property. This includes, but not limited to:
 - 1. Graphics
 - 2. Record drawings
 - 3. Database
 - 4. Application programming code
 - B. Documentation
 - 1. General
 - a. Submit two (2) draft copies of owner's manuals for review. After review by authorized representative, the contractor shall incorporate review comments and submit four (4) interim final copies.
 - b. Submit four (4) copies of owner's manuals upon completion of project.
 - c. Submit two (2) electronic copies of complete as-built documentation on CD ROM. All drawings shall be in standard AutoCAD 2004 format, other documentation shall be in standard MS Office format.
 - d. Update manuals with modifications made to system during guarantee period. Provide replacement pages or supplements in quantity stated above for "as built" manuals.
 - e. Assemble owner's manuals into multi-volume sets as necessary and required by the owner.
 - f. Protect each volume with a heavy-duty binder. Volumes to have plastic printed dividers between major sections and have oversized binders to accommodate up to ½ inch thick set of additional information.

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- g. Each binder to be printed with project name and volume title on front cover and binder.
 - h. On the first page of each manual identify with project name, manual title, owner's name, engineer's name, contractor's name, address and service phone number, and person who prepared manual.
- C. Operating manual to serve as training and reference manual for all aspects of day-to-day operation of the system. As a minimum include the following:
- 1. Sequence of operation for automatic and manual operating modes for all building systems. The sequences shall cross reference the system point names.
 - 2. Description of manual override operation of all control points in system.
 - 3. BMS system manufacturers complete operating manuals.
- D. Provide maintenance manual to serve as training and reference manual for all aspects of day-to-day maintenance and major system repairs. As a minimum include the following:
- 1. Complete as-built installation drawings for each building system.
 - 2. Overall system electrical power supply schematic indicating source of electrical power for each system component. Indicate all battery backup provisions.
 - 3. Photographs and/or drawings showing installation details and locations of equipment.
 - 4. Routine preventive maintenance procedures, corrective diagnostics troubleshooting procedures, and calibration procedures.
 - 5. Parts list with manufacturer's catalog numbers and ordering information.
 - 6. Lists of ordinary and special tools, operating materials supplies and test equipment recommended for operation and servicing.
 - 7. Manufacturer's operation, set-up, maintenance and catalog literature for each piece of equipment.
 - 8. Maintenance and repair instructions.
 - 9. Recommended spare parts.
- E. Provide Programming Manual to serve as training and reference manual for all aspects of system programming. As a minimum include the following:
- 1. Complete programming manuals, and reference guides.
 - 2. Details of any custom software packages and compilers supplied with system.
 - 3. Information and access required for independent programming of system.

1.13 Technical Proposal

- A. Technical proposals shall be prepared in accordance with these specifications. Six (6) copies of the proposal shall be submitted with the bid. Proposals that are unbound, loose, and loose in a file folder, stapled, stapled in a manila file folder, etc., will not be acceptable. The technical proposal shall include the following data/information as a minimum. The order of listing here is not intended to indicate, nor should it be construed to indicate, the relative importance of the data/information:
- 1. Information on organizational capability to handle this project (management, personnel, manufacturing, single source responsibility, etc.)
 - 2. Information on training program to demonstrate specification compliance.
 - 3. System Configuration as Proposed:
 - a. Describe system architecture including a schematic layout with location and type (model number) of all control panels.
 - b. Describe system operation, functions and control techniques.
 - c. Modularity.
 - d. Migration strategies to protect owner's investment in BMS system.
 - 4. Technical data to support the information on the hardware and software proposed for this solution including any integrated systems and/or solutions.
 - 5. Detailed description of all operating, command, application and energy management software provided for this project.
 - 6. A signed certificate stating the Contractor "has read the performance and functional requirements, understands them and his technical proposal will comply with all parts of the specification."
 - 7. Line by line specification concordance statement.

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8. Other requirements for inclusion in the technical proposal are located throughout this specification.
- B. Submit technical proposals with pricing in accordance with "Instructions to Bidders".
- C. Failure to submit technical proposal containing the information outlined above will result in rejection of bidder's proposal.

PART 2 – PRODUCTS

2.01 Materials

- A. All products used in this project installation shall be new and currently manufactured and shall have been applied in similar installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner or Owner's representative. Spare parts shall be available for at least five years after completion of this contract.

2.02 Communication

- A. The design of the BMS shall support networking of operator workstations and Building Controllers. The network architecture shall consist of two levels, an Ethernet based primary network for all operator workstations, servers, and primary DDC controllers along with secondary Floor Level Networks (FLN) for terminal equipment application specific controllers.
- B. Access to system data shall not be restricted by the hardware configuration of the building management system. The hardware configuration of the BMS network shall be totally transparent to the user when accessing data or developing control programs.
- C. Operator Workstation:
 1. A workstation, printer and Voice over IP (VOIP) phone shall be installed in the BMS Room. The computer shall be configured through ITS department before connecting to the SOM BMS virtual local area network (VLAN). The BMS computer, printer and desk phone hardware requirements shall include the following:
 - a. Computer:
 - 1) Apple 13" Mac Book Pro or comparable
 - 2) 1.7Ghz dual-core Intel Core with 4MB shared L3 cache
 - 3) 256GB Flash Storage
 - 4) 8GB
 - 5) External Monitor Adapter
 - 6) Ethernet Adapter
 - 7) Mac Book Pro Security Lock Kit
 - 8) Mac Book Pro compatible USB wired keyboard and mouse
 - 9) Mac Book Pro docking station
 - 10) 24" or larger monitor
 - b. Printer:
 - 1) Apple compatible HP Laser Printer or comparable
 - c. Desk Phone:
 - 1) ITS Standard issue VOIP phone or comparable
 1. All color graphic operator workstations shall reside on the Ethernet network and access to client-server configuration via Windows Remote Desktop Protocol (RDP).
 2. The servers will act as the central database for system graphics and databases to provide consistency throughout all system workstations.
 3. The network shall allow concurrent use of multiple BMS software site licenses.
 4. Provide two (2) identical servers and a shared hard disk drive array. The second "back-up" server shall function as a hot standby back-up and automatically and immediately take over as the system server on a failure of the primary server. Each server shall be an enterprise level fault tolerant server with redundant processors. Servers shall be located on different floors to maximize redundancy. Server consoles shall not be used as operator workstations.
- D. Management Level Network Communication (MLN)

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1. All PCs shall simultaneously direct connect to the Ethernet Management Level Network without the use of an interposing device.
 2. Operator Workstation shall be capable of simultaneous direct connection and communication with BACnet/IP and TCP/IP corporate level networks without the use of interposing devices.
 3. The Primary Network shall not impose a maximum constraint on the number of operator workstations.
 4. Any controller residing on the primary network shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.
 5. Any PC on the Primary Network shall have transparent communication with controllers on the building level networks connected via Ethernet.
 6. Any break in Ethernet communication from the server to the controllers on the Primary Network shall result in a notification at the server.
 7. The standard client and server workstations on the Primary Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3.
 8. System software applications will run as a service to allow communication with Primary Network Controllers without the need for user log in. Closing the application or logging off shall not prevent the processing of alarms, network status, panel failures, and trend information.
 9. Access to the system database shall be available from any standard workstation on the Primary Network. Client access to client-server workstation configurations over the Internet network shall be available via Web browser interface.
 10. Thin Client access to client-server workstation configurations via Windows Terminal Services shall provide multiple, independent sessions of the workstations software. Terminal Services clients shall have full functionality, without the need to install the workstation software on the local hard drive.
- E. Primary Network - Panel to Panel Communication:
1. All Building Controllers shall directly reside on the primary Ethernet network such that communications may be executed directly between Building Controllers, directly between server and Building Controllers on a peer-to-peer basis.
 2. Systems that operate via polled response or other types of protocols that rely on a central processor, file server, or similar device to manage panel-to-panel or device-to-device communications shall not be acceptable.
 3. All operator interfaces shall have the ability to access all point status and application report data or execute control functions for any and all other devices. Access to data shall be based upon logical identification of building equipment. No hardware or software limits shall be imposed on the number of devices with global access to the network data.
 4. The primary network shall use TCP/IP over Ethernet. All devices must:
 - a. Auto-sense 10/100 Mbps networks.
 - b. Receive an IP Address from a Dynamic Host Configuration Protocol (DHCP) Server or be configured with a Fixed IP Address.
 - c. Resolve Name to IP Addresses for devices using a Domain Name Service (DNS) Server on the Ethernet network.
 - d. Allow MMI access to an individual Primary Network Controller using industry standard Telnet software to view and edit entire Primary Network.
 5. The primary network shall provide the following minimum performance:
 - a. Provide high-speed data transfer rates for alarm reporting, report generation from multiple controllers and upload/download efficiency between network devices. System performance shall insure that an alarm occurring at any Building Controller is displayed at any PC workstations, all Building controllers, and other alarm printers within 15 seconds.
 - b. Message and alarm buffering to prevent information from being lost.
 - c. Error detection, correction, and re-transmission to guarantee data integrity.
 - d. Synchronization of real-time clocks between Building Controllers, including automatic daylight savings time corrections.

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- e. The primary network shall allow the Building Controllers to access any data from, or send control commands and alarm reports directly to, any other Building Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. Building Controllers shall send alarm reports to multiple operator workstations without dependence upon a central or intermediate processing device. The network shall also allow any Building controller to access, edit, modify, add, delete, back up, restore all system point database and all programs.
 - f. The primary network shall allow the Building Controllers to assign password access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust and control only the points that the operator is authorized for. All other points shall not be displayed at the PC workstation or portable terminal. (E.g. all base building and all tenant points shall be accessible to any base building operators, but only certain base building and tenant points shall be accessible to tenant building operators). Passwords and priorities for every point shall be fully programmable and adjustable.
 - g. Devices containing custom programming must reside on the Primary Network
- F. Secondary Network – Application Specific Controller Communication:
- 1. Communication over the secondary network shall be the manufacturer's standard protocol.
 - 2. This level communication shall support a family of application specific controllers for terminal equipment.
 - 3. The Application Specific Controllers shall communicate bi-directionally with the primary network through Building Controllers for transmission of global data.
 - 4. A maximum of 30 terminal equipment controllers may be configured on individual secondary network trunks to insure adequate global data and alarm response times.
- G. Internet Based Communication:
- 1. Terminal Services Operator Interface
 - a. Client access to client-server workstation configurations over low bandwidth network technologies shall be available optionally via Windows Terminal Services or Web browser interface. Remote client access via Windows Terminal Services shall provide multiple, independent sessions of the workstations software – Terminal Services clients shall have workstation software access, without the need to install the workstation software on the local hard drive]
- H. Remote Notification Paging System:
- 1. Workstations shall be configured to send out messages to numeric pagers, alphanumeric pagers, phones (via text to speech technology), SMS (Simple Messaging Service, text messaging) Devices, and email accounts based on a point's alarm condition. Xxx.
 - 2. There shall be no limit to the number of points that can be configured for remote notification of alarm conditions and no limit on the number of remote devices which can receive messages from the system.
 - 3. On a per point basis, system shall be configurable to send messages to an individual or group and shall be configurable to send different messages to different remote devices based on alarm message priority level.
 - 4. Remote devices may be scheduled as to when they receive messages from the system to account for operators' work schedules.
 - 5. System must be configurable to send messages to an escalation list so that if the first device does not respond, the message is sent on to the next device after a configurable time has elapsed.
 - 6. Message detail shall be configurable on a per user basis.
 - 7. During a "flood" of alarms, remote notification messages shall have the ability to optimize several alarms into an individual remote notification message.
 - 8. Workstation shall have the ability to send manual messages allowing an operator to type in a message to be sent immediately.
 - 9. Workstation shall have a feature to send a heartbeat message to periodically notify users that they have communication with the system.

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- I. Operator Interface Software:
 1. Basic Interface Description
 - a. Operator interface software shall minimize operator training through the use of user-friendly and interactive graphical applications, 30-character English language point identification, on-line help, and industry standard Windows application software. Interface software shall simultaneously communicate with and share data between Ethernet-connected building level networks.
 - b. Provide a graphical user interface that shall minimize the use of keyboard through the use of a mouse or similar pointing device, with a "point and click" approach to menu selection and a "drag and drop" approach to inter-application navigation.
 - c. The navigation shall be user friendly by utilizing "forward & back" capability between screens and embedded hyperlinks to open graphics, documents, drawings, etc.
 - d. Selection of applications within the operator interface software shall be via a graphical toolbar menu – the application toolbar menu shall have the option to be located in a docked position on any of the four sides of the visible desktop space on the workstation display monitor, and the option to automatically hide itself from the visible monitor workspace when not being actively manipulated by the user.
 - e. The graphical toolbar menu shall have the option of adding additional user definable buttons that can launch local or network programs, files, folders on Internet/Intranet addresses external to the BMS software.
 - f. The software shall provide a multi-tasking type environment that allows the user to run several applications simultaneously. BMS software shall run on a Windows XP, 2000, or comparable 32-bit operating system. System database parameters shall be stored within an object-oriented database. Standard Windows applications shall run simultaneously with the BMS software. The mouse or Alt-Tab keys shall be used to quickly select and switch between multiple applications. The operator shall be able to work in Microsoft Word, Excel, and other Windows based software packages, while concurrently annunciating on-line BMS alarms and monitoring information
 - g. The software shall provide, as a minimum, the following functionality:
 - 1) Real-time graphical viewing and control of the BMS environment
 - 2) Reporting
 - 3) Scheduling and override of building operations
 - 4) Collection and analysis of historical data
 - 5) Point database editing, storage and downloading of controller databases.
 - 6) Utility for combining points into logical Point Groups. The Point Groups shall then be manipulated in Graphics, trend graphs and reports in order to streamline the navigation and usability of the system.
 - 7) Alarm reporting, routing, messaging, and acknowledgment
 - 8) "Collapsible tree," dynamic system architecture diagram application:
 - a) Showing the real-time status and definition details of all workstations and devices on a management level network
 - b) Showing the real-time status, definition details and locations of all Building Controllers at the Primary Network.
 - c) Showing the definition details of all application specific controllers
 - 9) Definition and construction of dynamic color graphic displays.
 - 10) Online, context-sensitive help, including an index, glossary of terms, and the capability to search help via keyword or phrase.
 - 11) On-screen access to User Documentation, via online help or PDF format electronic file.
 - 12) Automatic database backup at the operator interface for database changes initiated at Building Controllers.
 - 13) Display dynamic trend data graphical plot.
 - a) Must be able to run multiple plots simultaneously
 - b) Each plot must be capable of supporting 10 pts./plot minimum

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- c) Must be able to command points directly off dynamic trend plot application.
 - d) Must be able to plot both real-time and historical trend data
 - 14) Program editing
 - 15) Report output shall have the option to be sent to an email address or group of email addresses.
 - 16) Transfer trend data to 3rd party spreadsheet software
 - a) Scheduling reports
 - b) Operator Activity Log
 - c) Open communications via OPC Server
 - d) Open communications via BACnet Client & Server
- h. Enhanced Functionality:
 - 1) Provide functionality such that any of the following may be performed simultaneously on-line, and in any combination, via adjustable user-sized windows. Operator shall be able to drag and drop information between the following applications, reducing the number of steps to perform a desired function (e.g., Click on a point on the alarm screen and drag it to the dynamic trend graph application to initiate a dynamic trend on the desired point):
 - a) Dynamic color graphics application
 - b) Alarm management application
 - c) Scheduling application
 - d) Dynamic trend graph data plotter application
 - e) Dynamic system architecture diagram application
 - f) Control Program and Point database editing applications
 - g) Reporting applications
 - 2) Report and alarm printing shall be accomplished via Windows Print Manager, allowing use of network printers.
- i. Security: Operator-specific password access protection shall be provided to allow the administrator/manager to limit users' workstation control, display and data base manipulation capabilities as deemed appropriate for each user, based upon an assigned password. Operator privileges shall "follow" the operator to any workstation logged onto (up to 999 user accounts shall be supported). The administrator or manager shall be able to grant discrete levels of access and privileges, per user, for each point, graphic, report, schedule, and BMS workstation application. And each BMS workstation user account shall use a Windows Operating System user account as a foundation.
- j. The operator interface software shall also include an application to track the actions of each individual operator, such as alarm acknowledgement, point commanding, schedule overriding, database editing, and logon/logoff. The application shall list each of the actions in a tabular format, and shall have sorting capabilities based on parameters such as ascending or descending time of the action, or name of the object on which the action was performed. The application shall also allow querying based on object name, operator, action, or time range.
- k. Dynamic Color Graphics application shall include the following:
 - 1) Must include graphic editing and modifying capabilities
 - 2) A library of standard control application graphics and symbols must be included
 - 3) Must be able to command points directly off graphics application
 - 4) Graphic display shall include the ability to depict real-time point values dynamically with animation, picture/frame control, symbol association, or dynamic informational text-blocks
 - 5) Navigation through various graphic screens shall be optionally achieved through a hierarchical "tree" structure
 - 6) Graphics viewing shall include zoom capabilities

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- 7) Graphics shall be capable of displaying the status of points that have been overridden by a field HAND switch, for points that have been designed to provide a field HAND override capability.
- 8) Advanced linking within the Graphics application shall provide the ability to navigate to outside documents (e.g., .doc, .pdf, .xls, etc.), Internet web addresses, e-mail, external programs, and other workstation applications, directly from the Graphics application window with a mouse-click on a customizable link symbol.
- i. Reports shall be generated on demand or via pre-defined schedule, and directed to CRT displays, printers, file or email address. As a minimum, the system shall allow the user to easily obtain the following types of reports:
 - 1) A general listing of all or selected points in the network
 - 2) List of all points currently in alarm
 - 3) List of all points currently in override status
 - 4) List of all disabled points
 - 5) List of all points currently locked out
 - 6) List of user accounts and access levels
 - 7) List all weekly schedules and events
 - 8) List of holiday programming
 - 9) List of control limits and dead bands
 - 10) Custom reports from 3rd party software
 - 11) System diagnostic reports including, list of Building panels on line and communicating, status of all Building terminal unit device points
 - 12) List of programs
 - 13) List of point definitions
 - 14) List of logical point groups
 - 15) List of alarm strategy definitions
 - 16) List of Building Control panels
 - 17) Point totalization report
 - 18) Point Trend data listings
 - 19) Initial Values report
 - 20) User activity report
- m. Scheduling and override
 - 1) Provide a calendar type format for simplification of time and date scheduling and overrides of building operations. Schedule definitions reside in the PC workstation and in the Building Controller to ensure time equipment scheduling when PC is offline, PC is not required to execute time scheduling. Provide override access through menu selection, graphical mouse action or function key. Provide the following capabilities as a minimum:
 - a) Weekly schedules
 - b) Zone schedules
 - c) Event schedules – an event consists of logical combinations of equipment and/or zones
 - d) Report schedules
 - e) Ability to schedule for a minimum of up to ten (10) years in advance.
 - 2) Additionally, the scheduling application shall:
 - a) Provide filtering capabilities of schedules, based on name, time, frequency, and schedule type (event, zone, report)
 - b) Provide sorting capabilities of schedules, based on name, time and type of schedule (zone, event, report)
 - c) Provide searching capabilities of schedules based on name – with wildcarding options
- n. Collection and Analysis of Historical Data

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- 1) Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Any system point may be trended automatically at time-based intervals (up to four time-based definitions per point) or change of value, both of which shall be user-definable. Trend data shall be collected stored on hard disk for future diagnostics and reporting. Automatic Trend collection may be scheduled at regular intervals through the same scheduling interface as used for scheduling of zones, events, and reports. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.
 - 2) Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual points or predefined groups of selected points. Provide additional functionality to allow predefined groups of up to 250 trended points to be easily transferred on-line to Microsoft Excel. BMS contractor shall provide custom designed spreadsheet reports for use by the owner to track energy usage and cost, equipment run times, equipment efficiency, and/or building environmental conditions. BMS contractor shall provide setup of custom reports including creation of data format templates for monthly or weekly reports.
 - 3) Provide additional functionality that allows the user to view real-time trend data on trend graphical plot displays. A minimum of ten points may be plotted, of either real-time or historical data. The dynamic graphs shall continuously update point values. At any time, the user may redefine sampling times or range scales for any point. In addition, the user may pause the display and take "snapshots" of plot screens to be stored on the workstation disk for future recall and analysis. Exact point values may be viewed and the graphs may be printed. A minimum of ten (10) dynamic graphs shall run simultaneously. Operator shall be able to command points directly on the trend plot by double clicking on the point. Operator shall be able to zoom in on a specific time range within a plot. The dynamic trend plotting application shall support the following types of graphs, with option to graph in 3D: line graph, area graph, curve graph, area-curve graph, step graph, and scatter graph. Each graph may be customized by the user, for graph type, graph text, titles, line styles and weight, colors, and configurable x- and y-axes.
 - 4) Provide additional functionality that allows the user to display trend data for points from a graphic, alarm status screen, or a displayed point log report.
- o. Dynamic Color Graphic Displays
- 1) Capability to create color graphic floor plan displays and system schematics for each piece of mechanical equipment, including, but not limited to, air handling units, chilled water systems, hot water boiler systems, and room level terminal units.
 - 2) The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, point alarm association, or text-based commands. Graphics software shall permit the importing of AutoCAD or scanned pictures for use in the system.
 - 3) Dynamic temperature values, humidity values, flow values and status indication shall be shown in their actual respective locations within the system schematics or graphic floor plan displays, and shall automatically update to represent current conditions without operator intervention and without predefined screen refresh rates.
 - a) Provide the user the ability to display real-time point values by animated motion or custom picture control visual representation. Animation shall depict movement of mechanical equipment, or air or fluid flow. Picture Control shall depict various positions in relation to assigned point values or ranges. A library (set) of animation and picture control symbols shall be included within the operator interface software's graphics application.

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- Animation shall reflect, ON or OFF conditions, and shall also be optionally configurable for up to five rates of animation speed.
- b) Sizable analog bars shall be available for monitor and control of analog values; high and low alarm limit settings shall be displayed on the analog scale. The user shall be able to "click and drag" the pointer to change the setpoint.
 - c) Provide the user the ability to display blocks of point data by defined point groups; alarm conditions shall be displayed by flashing point blocks.
 - d) Equipment state or values can be changed by clicking on the associated point block or graphic symbol and selecting the new state (on/off) or setpoint.
 - e) State text for digital points can be user-defined up to eight characters.
 - f) Provide the user the ability to display trend data from the graphic screen through right click feature selection.
- 4) Colors shall be used to indicate status and change as the status of the equipment changes. The state colors shall be user definable.
 - 5) Advanced linking within the Graphics application shall provide the ability to navigate to outside documents (e.g., .doc, .pdf, .xls, etc.), Internet web addresses, e-mail, external programs, and other workstation applications, directly from the Graphics application window with a mouse-click on a customizable link symbol.
 - 6) The Windows environment of the PC operator workstation shall allow the user to simultaneously view several applications at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
 - 7) Off the shelf graphic software shall be provided to allow the user to add, modify or delete system graphic background displays.
 - 8) A clipart library of HVAC application and automation symbols shall be provided including fans, valves, motors, chillers, AHU systems, standard ductwork diagrams and laboratory symbols. The user shall have the ability to add custom symbols to the clipart library. The clipart library shall include a minimum of 400 application symbols. In addition, a library consisting of a minimum of 700 graphic background templates shall be provided.
 - 9) The Graphics application shall include a set of standard Terminal Equipment controller application-specific background graphic templates. Templates shall provide the automatic display of a selected Terminal Equipment controller's control values and parameters, without the need to create separate and individual graphic files for each controller.
 - 10) The graphic application shall provide a tool be able to change full or partial point names on a graphic.
- p. System Configuration & Definition
- 1) A "Collapsible tree," dynamic system architecture diagram/display application of the site-specific BMS architecture showing status of controllers, PC workstations and networks shall be provided. This application shall include the ability to add and configure workstations, Building Controllers, as well as 3rd-party integrated components. Symbols/Icons representing the system architecture components shall be user configurable and customizable, and a library of customized icons representing 3rd-party integration solutions shall be included. This application shall also include the functionality for real-time display, configuration and diagnostics connections to Building Controllers.
 - 2) Network wide control strategies shall not be restricted to a single Building Controller, but shall be able to include data from any and all other network panels to allow the development of Global control strategies.

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- 3) Provide automatic backup and restore of all Building controller databases on the workstation hard disk. In addition, all database changes shall be performed while the workstation is on-line without disrupting other system operations. Changes shall be automatically recorded and downloaded to the appropriate Building Controller. Changes made at the user-interface of Building Controllers shall be automatically uploaded to the workstation, ensuring system continuity.
 - 4) System configuration, programming, editing, graphics generation shall be performed on-line.
 - 5) Point database configuration shall be available to the user within a dedicated point database editor application included in the operator interface software. The editor shall allow the user to create, view existing, modify, copy, and delete points from the database.
 - 6) The point editor shall have the capability to assign "informational text" to points as necessary to provide critical information about the equipment.
 - 7) The point editor shall also allow the user to configure the alarm management strategy for each point. The editor shall provide the option for editing the point database in an online or offline mode with the Building Controllers.
 - 8) The operator interface software shall also provide the capability to perform bulk modification of point definition attributes to a single or multiple user-selected points. This function shall allow the user to choose the properties to copy from a selected point to another point or set of points. The selectable attributes shall include, but are not limited to, Alarm management definitions and Trend definitions.
 - 9) Control program configuration shall be available to the user within a dedicated control program editor application included in the operator interface software. The editor shall allow for creation, modification and deletion of control programs. The editor shall include a programming assistance feature that interactively guides the user through parameters required to generate a control program. The editor shall also include the ability to automatically compile the program to ensure its compatibility with the Building Controllers. The editor shall provide the option for editing the control programs in an online or offline mode, and also the ability to selectively enable or disable the live program execution within the Building Controllers. Additional compiler checks shall be built into the program editor which assists in the verification of valid GOTO statements. The additional compiler check shall also verify if each point in the program was defined in another panel.
- q. Alarm Management
- 1) Alarm Routing shall allow the user to send alarm notification to selected printers or workstation location(s) based on time of day, alarm severity, or point type.
 - 2) Alarm Notification shall be presented to each workstation in a tabular format application, and shall include the following information for each alarm point: name, value, alarm time & date, alarm status, priority, acknowledgement information, and alarm count. Each alarm point or priority shall have the ability to sound a discrete audible notification.
 - 3) Alarm Display shall have the ability to list & sort the alarms based on alarm status, point name, ascending or descending alarm time.
 - 4) Directly from the Alarm Display, the user shall have the ability to acknowledge, silence the alarm sound, print, or erase each alarm. The interface shall also have the option to inhibit the erasing of active acknowledged alarms, until they have returned to normal status. The user shall also have the ability to command, launch an associated graphic or trended graphical plot, or run a report on a selected alarm point directly on the Alarm Display.

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- 5) Each alarm point shall have a direct link from the Alarm Display to further user-defined point informational data. The user shall have the ability to also associate real-time electronic annotations or notes to each alarm.
 - 6) Alarm messages shall be customizable for each point, or each alarm priority level, to display detailed instructions to the user regarding actions to take in the event of an alarm. Alarm messages shall also have the optional ability to individually enunciate on the workstation display via a separate pop-up window, automatically being generated as the associated alarm condition occurs. The system shall have the ability to modify the priority text based on operator preference.
 - 7) Alarm Display application shall allow workstation operators to send and receive real-time messages to each other, for purposes of coordinating Alarm and BMS system management.
- r. Remote notification of messages
- 1) Operator Interface software shall be configured to send out messages to numeric pagers, alphanumeric pagers, phones (via text to speech technology), SMS (Simple Messaging Service, text messaging) Devices, and email accounts based on a point's alarm condition.
 - 2) There shall be no limit to the number of points that can be configured for remote notification of alarm conditions and no limit on the number of remote devices which can receive messages from the system.
 - 3) On a per point basis, system shall be configurable to send messages to an individual or group and shall be configurable to send different messages to different remote devices based on alarm message priority level.
 - 4) Remote devices may be scheduled as to when they receive messages from the system to account for operators' work schedules.
 - 5) System must be configurable to send messages to an escalation list so that if the first device does not respond, the message is sent on to the next device after a configurable time has elapsed.
 - 6) Message detail shall be configurable on a per user basis.
 - 7) During a "flood" of alarms, remote notification messages shall have the ability to optimize several alarms into an individual remote notification message.
 - 8) Workstation shall have the ability to send manual messages allowing an operator to type in a message to be sent immediately.
 - 9) Workstation shall have a feature to send a heartbeat message to periodically notify users that they have communication with the system.

2.03 Building Controller Software

A. General

1. Furnish the following applications software to form a complete operating system for building and energy management as described in this specification.
2. The software programs specified in this Section shall be provided as an integral part of Building Controllers and shall not be dependent upon any higher-level computer or another controller for execution.
3. All points, panels and programs shall be identified by a 30-character name. All points shall also be identified by a 16-character point descriptor. The same names shall be displayed at both Building Controller and the Operator Interface.
4. All digital points shall have a user defined two-state status indication with 8 characters minimum (e.g. Summer, Enabled, Disabled, Abnormal).
5. Building Controllers shall have the ability to perform energy management routines including but not limited to time of day scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides, start stop time optimization, automatic daylight savings time switch over, night setback control, enthalpy switch over, peak demand limiting, temperature-

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- compensated duty cycling, heating / cooling interlock, supply temperature reset, priority load shedding, and power failure restart.
6. The Building Controllers shall have the ability to perform the following pre-tested control algorithms:
 - a. Two position control
 - b. Proportional control
 - c. Proportional plus integral control
 - d. Proportional, integral, plus derivative control
 - e. Automatic tuning of control loops
 - f. Model-Free Adaptive Control
 7. Each controller shall be provided with an interactive HELP function to assist operators using POTs and remote connected operators.
 8. Building Controllers shall not be susceptible to Microsoft Windows operating systems-based viruses.
- B. System Security
1. User access shall be secured using individual security passwords and user names.
 2. Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.
 3. User Log On / Log Off attempts shall be recorded.
 4. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user-definable.
 5. Use of workstation resident security as the only means of access control is not an acceptable alternative to resident system security in the field panel.
- C. User Defined Control Applications
1. Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
 2. It shall be possible to use any system measured point data or status, any system calculated data, a result from any process, or any user-defined constant in any controller in the system.
 3. Any process shall be able to issue commands to points in any and all other controllers in the system.
 4. Processes shall be able to generate operator messages and advisories to other operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as a printer or pager.
 5. Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.
 6. Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task-oriented information from the user manual.
- D. Alarm Management
1. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each Building Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the Building Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.
 2. Conditional alarming shall allow generation of alarms based upon user defined multiple criteria.
 3. An Alarm "shelving" feature shall be provided to disable alarms during testing. (Pull the Plug, etc.).
 4. Binary Alarms. Each binary object shall be set to alarm based on the operator specified state. Provide the capability to automatically and manually disable alarming.
 5. Analog Alarms. Each analog object shall have both high and low alarm limits. Alarming must be able to be automatically and manually disabled.

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6. All alarm or point change reports shall include the point's user defined language description and the time and date of occurrence.
 7. The user shall be able to define the specific system reaction for each point. 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. Point priority levels shall be combined with user definable destination categories (PC, printer, Building Controller, etc.) to provide full flexibility in defining the handling of system alarms. Each Building Controller shall automatically inhibit the reporting of selected alarms during system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
 8. Alarm reports and messages shall be routed to user-defined list of operator workstations, or other devices based on time and other conditions. An alarm shall be able to start programs, print, be logged in the event log, generate custom messages, and display graphics.
 9. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200-character alarm message to more fully describe the alarm condition or direct operator response.
 - a. Each Building Controller shall be capable of storing a library of at least 50 alarm messages. Each message may be assignable to any number of points in the Controller.
 10. Operator-selected alarms shall be capable of initiating a call to a remote operator device.
- E. Scheduling
1. Provide a comprehensive menu driven program to automatically start and stop designated object or group of objects in the system according to a stored time.
 2. Schedules shall reside in the building controller and shall not rely on external processing or network.
 3. It shall be possible to define a group of objects as a custom event (i.e. meeting, athletic activity, etc.). Events can then be scheduled to operate all necessary equipment automatically.
 4. For points assigned to one common load group, it shall be possible to assign variable time delays between each successive start and/or stop within that group.
 5. The operator shall be able to define the following information:
 - a. Time, day
 - b. Commands such as on, off, auto, etc.
 - c. Time delays between successive commands.
 - d. There shall be provisions for manual overriding of each schedule by an authorized operator.
 6. It shall be possible to schedule calendar-based events up to one year in advance based on the following:
 - a. Weekly Schedule. Provide separate schedules for each day of the week. Each of these schedules should include the capability for start, stop, optimal start, optimal stop, and night economizer. When a group of objects are scheduled together as an Event, provide the capability to adjust the start and stop times for each member.
 - b. Exception Schedules. Provide the ability for the operator to designate any day of the year as an exception schedule. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by the standard schedule for that day of the week.
 - c. Holiday Schedules. Provide the capability for the operator to define up to 99 special or holiday schedules. These schedules may be placed on the scheduling calendar and will be repeated each year. The operator shall be able to define the length of each holiday period.
- F. Peak Demand Limiting (PDL):
1. The Peak Demand Limiting (PDL) program shall limit the consumption of electricity to prevent electrical peak demand charges.
 2. PDL shall continuously track the amount of electricity being consumed, by monitoring one or more electrical kilowatt-hour/demand meters. These meters may measure the electrical consumption (kWh), electrical demand (kW), or both.

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3. PDL shall sample the meter data to continuously forecast the demand likely to be used during successive time intervals.
 4. If the PDL forecasted demand indicates that electricity usage is likely to exceed a user preset maximum allowable level, then PDL shall automatically shed electrical loads.
 5. Ability to initialize and restart the meter area directly from the workstation.
- G. Temperature-compensated duty cycling.
1. The DCCP (Duty Cycle Control Program) shall periodically stop and start loads according to various patterns.
 2. The loads shall be cycled such that there is a net reduction in both the electrical demands and the energy consumed.
- H. Automatic Daylight Savings Time Switchover: The system shall provide automatic time adjustment for switching to/from Daylight Savings Time.
- I. Night setback control. The system shall provide the ability to automatically adjust setpoints for night control.
- J. Enthalpy switchover (economizer). The Building Controller Software (BCS) shall control the position of the air handler relief, return, and outside air dampers. If the outside air-dry bulb temperature falls below changeover set point the BCS will modulate the dampers to provide 100 percent outside air. The user will be able to quickly changeover to an economizer system based on dry bulb temperature and will be able to override the economizer cycle and return to minimum outside air operation at any time.
- K. Loop Control. A Model-Free Adaptive Control algorithm or alternatively a PID (proportional-integral-derivative) closed-loop control algorithm with direct or reverse action and anti-windup shall be supplied. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, set point, and weighting parameters shall be user-selectable.
- L. Sequencing. Provide application software based upon the sequences of operation specified to properly sequence equipment.
- M. Staggered Start
1. This application shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started, along with the time delay between starts, shall be user definable.
 2. Upon the resumption of power, each Building Controller shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operations.
- N. Totalization
1. Run-Time Totalization. Building Controllers shall automatically accumulate and store run-time hours for all digital input and output points. A high runtime alarm shall be assigned, if required, by the operator.
 2. Consumption totalization. Building Controllers shall automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for all analog and digital pulse input type points.
 3. Event totalization. Building Controllers shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly or monthly basis for all points. The event totalization feature shall be able to store the records associated with events before reset.
- O. Data Collection
1. A variety of historical data collection utilities shall be provided to manually or automatically sample, store, and display system data for all points.
 2. Building Controllers shall store point history data for selected analog and digital inputs and outputs:
 - a. 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 Building Controllers point group.

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3. Trend data shall be stored at the Building Controllers and uploaded to the workstation when retrieval is desired. 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 applications.
4. Loop Tuning. Building Controllers shall also provide high resolution sampling capability for verification of DDC control loop performance. Documented evidence of tuned control loop performance shall be provided on a <monthly, seasonal, quarterly, annual> period.
 - a. For Model-Free Adaptive Control loops, evidence of tuned control loop performance shall be provided via graphical plots or trended data logs. Graphical plots shall minimally include depictions of setpoint, process variable (output), and control variable (e.g., temperature). Other parameters that may influence loop control shall also be included in the plot (e.g., fan on/off, mixed-air temp).
 - b. For PID control loops, operator-initiated automatic and manual loop tuning algorithms shall be provided for all operator-selected PID control loops. Evidence of tuned control loop performance shall be provided via graphical plots or trended data logs for all loops.
 - 1) In automatic mode, the controller shall perform a step response test with a minimum one-second resolution, evaluate the trend data, calculate the new PID gains and input these values into the selected LOOP statement.
 - 2) Loop tuning shall be capable of being initiated either locally at the Building Controller, from a network workstation or remotely using dial-in modems. For all loop tuning functions, access shall be limited to authorized personnel through password protection.

2.04 Building Controllers

- A. Building Controllers shall be 32-bit, multi-tasking, multi-user, real-time 48 MHz digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point list.
- B. Each Building Controller shall support a minimum of 3 directly connected Secondary Networks.
- C. Each Building Controller shall have sufficient memory, a minimum of 72 megabyte, to support its own operating system and databases, including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, operator I/O, and dial-up communications.
- D. Building Controller shall have an integral real-time clock.
- E. Each Building Controller shall support firmware upgrades without the need to change hardware.
- F. Each Building Controller shall support:
 1. Monitoring of industry standard analog and digital inputs, without the addition of equipment outside the Building Controller cabinet.
- G. Spare Point Capacity.
 1. Each Building Controller shall have a minimum of 10 percent spare point capacity.
 2. The type of spares shall be in the same proportion as the implemented I/O functions of the panel, but in no case shall there be less than one spare of each implemented I/O type.
 3. Provide all processors, power supplies, and communication controllers so that the implementation of adding a point to the spare point location only requires the addition of the appropriate:
 - a. Expansion modules
 - b. Sensor/actuator
 - c. Field wiring/tubing.
- H. Serial Communication. Building Controllers shall provide at least two EIA-232C serial data communication ports for operation of operator I/O devices such as industry standard printers, operator terminals, and portable laptop operator's terminals. Building Controllers shall allow temporary use of portable devices without interrupting the normal operation of permanently connected printers or terminals.

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- I. Manual Override. The operator shall have the ability to manually override automatic or centrally executed commands at the Building Controller via local, point discrete, integral hand/off/auto operator override switches for all digital control type points and gradual switches for all analog control type points. These override switches shall be operable whether the panel processor is operational or not. Each Building Controller shall monitor and alarm the hand, off and auto positions of integral HOA switches.
- J. I/O Status and Indication. Building Controllers shall provide local LED status indication for each digital input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device. Graduated intensity LEDs or analog indication of value shall also be provided for each analog output. All wiring connections shall be made to field-removable terminals.
- K. Self-Diagnostics. Each Building Controller shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Building Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication for any system.
- L. Power loss. In the event of the loss of power, there shall be an orderly shutdown of all Building Controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 100 hours.
- M. Environment.
 - 1. Controller hardware shall be suitable for the anticipated ambient conditions.
 - 2. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).
 - 3. Controllers used in conditioned space shall be mounted in dust-proof enclosures and shall be rated for operation at 0°C to 49°C (32°F to 120°F).
- N. Immunity to power and noise.
 - 1. Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.
 - a. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).
 - 2. Isolation shall be provided at all primary network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:
 - a. RF-Conducted Immunity (RFCl) per ENV 50141 (IEC 1000-4-6) at 3 V
 - b. Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact
 - c. Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500 V signal, 1 kV power
 - d. Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max)
 - 3. Isolation shall be provided at all Building Controller's AC input terminals to suppress induced voltage transients consistent with:
 - a. IEEE Standard 587 1980
 - b. UL 864 Supply Line Transients
 - c. Voltage Sags, Surge, and Dropout per EN 61000-4-11 (EN 1000-4-11)
- O. Minimum Approved Building Controllers.
 - 1. BMS Contractors shall furnish Building Controllers as listed below. Providing an approved controller does not release the contractor from meeting all performance, software and hardware specifications for Building Controllers and system operations.
 - 2. Siemens Building Technologies Inc. - Apogee Programmable Controller – PX Compact Series (PXC36-PEF.A) – 36 point, Ethernet/IP or RS-485 ALN, Island Bus, P1 FLN with FLN license installed.
 - 3. Johnson Controls Inc., Metasys Extended Architecture- (with NAE-55 and DX-9100s mounted in a common enclosure for each DDC panel).
 - 4. Honeywell, EBI Automation System (with ILOK 1000 and XL5000 in a common enclosure for each DDC panel).

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2.05 Application Specific Controllers (ASC)

A. General

1. Provide for control of each piece of equipment, including, but not limited to the following:
 - a. Variable Air Volume (VAV) boxes
 - b. Constant Air Volume (CAV) boxes
 - c. Reheat Coils (RH)
 - d. Fan Coil Units (FCU)
 - e. Fan Powered Boxes (FPB)
 - f. Unit Conditioners
 - g. Heat Pumps
 - h. Unit Ventilators
 - i. Room Pressurization
 - j. Supplemental AC units
 - k. Digital Energy Monitors
2. Each Building Controller shall be able to communicate with application specific controllers (ASCs) over the Secondary Network to control terminal equipment only.
3. The use of Secondary Network controllers with custom program applications to control AHU's, water systems, etc. is not acceptable.
4. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.
5. Each ASC shall include all point inputs and outputs necessary to perform the specified control sequences. The ASC shall accept input and provide output signals that comply with industry standards. Controllers utilizing proprietary control signals shall not be acceptable. Outputs utilized either for two-state, modulating floating, or proportional control, allowing for additional system flexibility.
6. Discharge Air Temperature Sensors. Each controller performing space temperature control shall be provided with a temperature sensor installed on the supply duct between the terminal box and room supply air diffuser.
7. Space Temperature Sensors. Each controller performing space temperature control shall be provided with a matching room temperature sensor.
 - a. Wired Sensor specifications. The sensor may be either RTD or thermistor type providing the following.
 - 1) Accuracy: + .5 F
 - 2) Operating Range: 35 to 115 F
 - 3) Set Point Adjustment Range: 55 to 95 F
 - 4) Calibration Adjustments: None required
 - 5) Installation: Up to 100 ft. from controller
 - 6) Auxiliary Communications Port: as required
 - 7) Local LCD Temperature Display: as required
 - 8) Set Point Adjustment Dial as required
 - 9) Occupancy Override Switch as required
 - b. Set Point Modes:
 - 1) Independent Heating, Cooling
 - 2) Night Setback-Heating
 - 3) Night Setback-Cooling
 - c. Auxiliary Communication Port. Each room temperature sensor shall include a terminal jack integral to the sensor assembly. The terminal jack shall be used to connect a portable operator's terminal to control and monitor all hardware and software points associated with the controller. RS-232 communications port shall allow the operator to query and modify operating parameters of the local room terminal unit from the portable operator's terminal.
 - d. LCD Display. Interactive, two- line liquid crystal display shall allow the operator to query and modify operating parameters of the local room terminal unit from the room sensor.

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- The display shall indicate the space temperature and associated ASC point when not being used to query or modify operating parameters.
- e. Set Point Adjustment Dial. The set point adjustment dial shall allow for modification of the temperature by the building operators. Set point adjustment may be locked out, overridden, or limited as to time or temperature through software by an authorized operator at any central workstation, Building Controller, room sensor two-line display, or via the portable operator's terminal.
 - f. Override Switch. An override switch shall initiate override of the night setback mode to normal (day) operation when activated by the occupant and enabled by building operators. The override shall be limited to two (2) hours (adjustable.) The override function may be locked out, overridden, or limited through software by an authorized operator at the operator interface, Building Controller, room sensor two-line display or via the portable operator's terminal.
2. Communication. Each controller shall perform its primary control function independent of other Secondary Network communication, or if Secondary Network communication is interrupted. Reversion to a fail-safe mode of operation during Secondary Network interruption is not acceptable.
 3. Control Algorithms. The controller shall receive its real-time data from the Building Controller time clock to insure Secondary Network continuity. Each controller shall include algorithms incorporating proportional, integral and derivative (PID) gains for all applications. All PID gains and biases shall be field-adjustable by the user via room sensor LCD or the portable operator's terminal as specified herein. Controllers that incorporate proportional and integral (PI) control algorithms only shall not be acceptable.
 4. Control Applications. Operating programs shall be field-selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.
 5. Calibration. Each controller shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against drift over time.
 - a. Manual calibration may be accomplished by either commanding the actuator to 0% via the POT or by depressing the room sensor override switch. Calibration of the transducer at the controller location shall not be necessary
 - b. Calibration shall be accomplished by stroking the terminal unit damper actuator to a 0% position so that a 0 CFM air volume reading is sensed. The controller shall automatically accomplish this whenever the system mode switches from occupied to unoccupied or vice versa.
 - c. Calibration shall be accomplished by zeroing out the pressure sensor and holding damper at last known position until calibration is complete. The controller shall automatically accomplish this whenever the system mode switches from occupied to unoccupied or vice versa.
 6. Memory.
 - a. Provide each ASC with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM, or minimum of 72-hour battery backup shall be provided. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration.
 - b. Upon replacement, new ASCs shall recover control function and site-specific defaults automatically and resume normal operation.
 7. Power Supply. Main 120 VAC circuit to ASCs shall be powered from Emergency/UPS power. The ASCs shall be powered from a 24 VAC source and shall function normally under an operating range of 18 to 28 VAC, allowing for power source fluctuations and voltage drops. Power supply for the ASC must be rated at a minimum of 125% of ASC power consumption

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- and shall be of the fused or current limiting type. The BMS contractor shall provide 24 VAC power to the terminal units by utilizing:
- a. The existing line voltage power trunk and installing separate isolation transformers for each controller
 - b. Dedicated line voltage power source and isolation transformers at a central location and installing 24VAC power trunk to supply multiple ASCs in the area.
8. Environment. The controllers shall function normally under ambient conditions of 32 to 122 F (0 to 50 C) and 10% to 95%RH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the circuit board assembly.
 9. Immunity to noise. Operation shall be protected against electrical noise of 5-120 Hz and from keyed radios up to 5 W at 1 m (3 ft.).
 10. Manufacturer Installed Controls.
 - a. BMS manufacturer shall furnish ASC and actuator for factory mounting to equipment manufacturer.
 - b. Cost of factory mounting shall be borne by equipment manufacturer.
 - c. For VAV terminals, equipment manufacturer shall provide and install flow-cross sensor, 24 Vac transformer, controls enclosure, fan relay, SCR and factory install, wire and tube ASC controller and actuator.
 - d. Fan powered VAV terminals shall be equipped with a fan speed controller and relay to change summer and winter speed set point.
- B. Controllers for VAV terminals.
1. All VAV terminal control applications shall be field-selectable such that a single controller may be used in conjunction with any of the above types of terminal units to perform the specified sequences of control. ASC's that require factory application changes are not acceptable. The VAV terminal ASC shall support the following types of pressure independent terminal boxes as a minimum:
 - a. VAV cooling only
 - b. VAV with hot water or electric reheat
 - c. Fan-powered VAV
 - d. Fan-powered VAV with hot water or electric reheat
 2. The controller shall include a differential pressure transducer that shall connect to the terminal unit manufacturer's standard averaging air velocity sensor to measure the average differential pressure in the duct. The controller shall convert this value to actual air flow. Single point air velocity sensing is not acceptable. The differential pressure transducer shall have a measurement range of 0 to 4000 fpm (0 to 20.4 m/s) and measurement accuracy of +5% at 400 to 4000 fpm (2 to 20 m/s), insuring primary air flow conditions shall be controlled and maintained to within +5% of Set point at the specified parameters. The BMS contractor shall provide the velocity sensor if required to meet the specified functionality.
- C. Controllers for CV terminals.
1. Constant volume ASCs shall meet all requirements of paragraphs as previously specified for VAV terminals. The controllers shall have a minimum and maximum flow set point, which shall be selected based on interior ventilation requirements. Under normal conditions, the set point shall be set to minimum set point. When the floor area requires additional ventilation (high CO2 level, manual command, etc.) the set point shall be set to maximum set point.
- D. Controllers for Fan Powered Boxes (FPB) terminals.
1. FPB ASCs shall monitor the primary air and return air flows with separate flow sensors and sum the flows to read total air flow.
 2. The ASC shall have the capability to control the speed of the fan speed through the BMS system.
 3. Each controller performing space heating control shall incorporate an algorithm allowing for modulation of a hot water reheat valve or cycling up to three (3) stages of electric reheat via an SCR to satisfy space heating requirements. Each controller shall also incorporate an algorithm that allows for resetting of the associated air handling unit discharge temperature if required to satisfy space cooling requirements. This algorithm shall function to signal the

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- respective Building Controller to perform the required discharge temperature reset in order to maintain space temperature cooling set point.
- E. Controllers for Supplemental AC Units.
 - 1. Supplemental AC unit ASCs shall meet all requirements of paragraphs as previously specified for VAV terminal ASCs except for velocity/cfm control.
 - F. Digital Energy Monitors:
 - 1. Provide three phase digital Watt-meters with pre-wired current transmitters. (CT) All Watt-meter electronics shall be housed within the CTs. CTs shall include sizes capable of mounting directly on a power bus. Diagnostics visible to the installing electrician (without an operator tool) shall indicate: proper operation, defective wiring or low power-factor, device malfunction, and over-load condition. The meters shall include the following:
 - 2. The device shall be UL Listed, and shall comply with ANSI C12.1 accuracy specification. The minimum CT/meter combined accuracy shall be no greater than 1% of reading over the range of 5% to 100% of rated load. The meter shall not require calibration
 - 3. The Watt-meter shall directly connect to power from 208 through 480 with no potential transformer. In-line fuses for each voltage tap phase shall be included.
 - a. The Watt-meter CTs shall be split-core and at minimum be sized to accommodate loads ranging from 100 to 2400 Amps. The CTs shall be volt-signal type, and shall not require shorting blocks.
 - b. The Watt-meter shall reside directly on the Secondary Network along with other Secondary Network devices. Data transferred shall include:
 - 1) kW & kWh
 - 2) Consumption
 - 3) Demand
 - 4) Power Factor
 - 5) Current
 - 6) Voltage
 - 7) Apparent Power
 - 8) Reactive Power

2.06 Input/output Interface:

- A. Hardwired inputs and outputs may tie into the system through building or application specific controllers.
- B. All input points and output points shall be protected such that shorting of the point to itself, to another point, or to ground will cause no damage to the controller. All input and output points shall be protected from voltage up to 24 V of any duration, such that contact with this voltage will cause no damage to the controller.
- C. Binary inputs shall allow the monitoring of On/Off signals from remote devices. The binary inputs shall provide a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against the effects of contact bounce and noise. Binary inputs shall sense “dry contact” closure without external power (other than that provided by the controller) being applied.
- D. Pulse accumulation input objects. This type of object shall conform to all the requirements of binary input objects and also accept up to 10 pulses per second for pulse accumulation.
- E. Analog inputs shall allow the monitoring of low-voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD). Analog inputs shall be compatible with— and field configurable to— commonly available sensing devices.
- F. Binary outputs shall provide for On/Off operation or a pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers shall have three-position (On/Off/Auto) override switches and status lights. Outputs shall be selectable for either normally open or normally closed operation.
- G. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC, 4 to 20 mA or 0-20 PSI signal as required to provide proper control of the output device. Analog outputs on building or custom application\ controllers shall have status

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lights and a two-position (AUTO/MANUAL) switch and manually adjustable potentiometer for manual override. Analog outputs shall not exhibit a drift of greater than 0.4% of range per year.

- H. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices shall be limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms shall run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
- I. System Object Capacity. The system size shall be expandable to at least twice the number of input/output objects required for this project. Additional controllers (along with associated devices and wiring) shall be all that is necessary to achieve this capacity requirement. The operator interfaces installed for this project shall not require any hardware additions or software revisions in order to expand the system.

2.07 Power Supplies and Line Filtering

- A. Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
- B. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over voltage and over-current protection and shall be able to withstand a 150% current overload for at least three seconds without trip-out or failure.
 - 1. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
 - 2. Line voltage units shall be UL recognized and CSA approved.
- C. Power line filtering.
 - 1. Provide transient voltage and surge suppression for all workstations and controllers either internally or as an external component. Surge protection shall have the following at a minimum:
 - a. Dielectric strength of 1000 volts minimum
 - b. Response time of 10 nanoseconds or less
 - c. Transverse mode noise attenuation of 65 dB or greater
 - d. Common mode noise attenuation of 150 dB or better at 40 Hz to 100 Hz.

2.08 Auxiliary Control Devices

A. General

- 1. Specified in this section are the following hard-wired input/output devices connected to the Building Controller or ASC.
 - a. Automatic Dampers
 - b. Fire/Smoke Dampers
 - c. Electric Damper Actuators
 - d. Pneumatic Damper/valve Actuators
 - e. Motorized Isolation Valves
 - f. Ball Valves
 - g. Automatic Control Valves
 - h. Airflow Measuring Stations
 - i. Binary Temperature Devices
 - j. Temperature Sensors
 - k. Dew Point/Humidity Sensors
 - l. Pressure Sensors
 - m. Water Differential Pressure Sensors
 - n. Differential Pressure Switches
 - o. Analog Water Level Sensors
 - p. Water Leak Detection Systems

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- q. Audio/Visual Alarm Units
 - r. Fuel Oil Meters
 - s. Water BTU Meters
 - t. Vortex Shedding Flow Meters
 - u. Indoor Air Quality (CO₂/VOC) Space Sensors
 - v. Relays
 - w. Override Timers
 - x. Current Transformers
 - y. Voltage Transmitters
 - z. Voltage Transformers
 - aa. Power Monitors
 - bb. Current Switches
 - cc. Pressure Electric Switches
 - dd. Electro-pneumatic Transducers
 - ee. Local Control panels
 - ff. Local User Display
2. Specified in this section are the following devices connected to the BMS using secondary network communication.
- a. Water BTU Meters
 - b. Variable Frequency Drives (VFD)
 - c. Indoor Air Quality (CO₂/VOC) Space Sensors
 - d. Power Monitors

B. Automatic Dampers

1. Dampers shall have 13-gauge galvanized frames of not less than 3" in width and blades of 14-gauge, equivalent thickness, galvanized steel roll formed airfoil type for low pressure drop and low noise generation and shall be adequately braced to form a rigid assembly where required in galvanized duct work. Dampers shall have blades not more 8" wide. Linkage and hardware shall be zinc plated steel and shall be concealed out of airstream within the damper frame. Damper blades and rods shall be installed in horizontal position.
2. In copper, aluminum and stainless-steel duct work, damper material shall match the duct work material.
3. All dampers shall be of the proportioning or opposed blade type, and shall be motor operated. Dampers shall have continuous elastomer or stainless-steel stops to avoid leakage. Bearings shall be corrosion resistant oil tight stainless-steel sleeve type. All dampers shall be provided with continuous 3/16" x 1/2" closed cell neoprene gasket around perimeter of the frame and at interlocking blade edges to form an air tight seal. Blade seals shall be suitable for -76° F to 350° F mechanically locked into blade edge. Adhesive of clip on type are not acceptable. Axles shall be square or hexagonal positively locked into damper blade. Linkage shall be concealed out of airstream within the damper blade.
4. All dampers shall be constructed to provide a maximum leakage of 3-1/2%, with an approach velocity of 1500 fpm when closed against a pressure of 4 inches of water. Submit leakage and flow characteristic data for all dampers.
5. All outside air dampers, with the exception of the emergency generator dampers, shall automatically close in the event of a loss of power. Dampers on emergency generators shall automatically open on a loss of power.
6. All smoke dampers shall be constructed in accordance with UL standard 555S.
7. Dampers shall be Ruskin Model CD60, Imperial Model 800 or approved equal.

C. Fire/Smoke Dampers

1. Dampers shown on drawings designated as "F/SM" shall comply with the following. They shall have a U.L. label. Dampers shall be pneumatically operated combination fire and smoke Ruskin, Imperial or approved equal, provided with factory installed U.L. rated full sleeves. Provide air foil or "V" blade damper blades supported with shafts and stainless-steel bearings to allow daily operation. Provide intermediate supports and bearings for damper blades more than 36" long. They shall conform to UL Standard 555 and 555S as leakage rated dampers in

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- smoke control systems when closed shall be the equivalent of a 1-1/2-hour fire damper. Leakage shall conform to Class 2 with maximum leakage of 10 CFM/Sq. Ft. at 1" W.G. Damper actuators shall be provided with position indicator switches to enable remote status of open or closed positions (only those dampers designated in the electrical trade plans and specifications will be provided with position switches and will be wired for remote status and remote open/closed operation, but all dampers will be provided with position indicators for possible future use). Note that dampers which are controlled from a central fire command station shall be provided with a 212°F heat sensor with normally closed contacts (manual reset) to close and lock damper if open. Additionally, dampers shall be factory equipped with a second normally closed heat sensor correlating to the operator/actuator degradation temperature classification (250°F to 350°F, depending on actuator utilized). The second sensor is wired through a manual override switch on the central fire command station. Dampers which are not controlled from a central fire command station shall have a fusible link which melts on heat causing damper to close and lock in a closed position. The following will be accepted in lieu of the two fire stats described. A resettable bimetallic link which opens on heat permitting damper to close and lock if open. This link may be re-engaged from fire command station at temperature of 150°F or less.
2. Dampers shown on drawings designated "SM" shall comply in all respects to F/S damper description including position indicating switches except they shall not be provided with a heat sensor or fusible link.

D. Electric Damper Actuators

1. Manufacturers
 - a. Belimo
 - b. Siemens
2. Electric Actuators
 - a. Entire actuator shall be UL or CSA approved by a Nationally Recognized Testing Laboratory.
 - b. Enclosure shall meet NEMA 4N weatherproof requirements for outdoor application
 - c. Dampers: The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The clamp shall be steel of a V-belt design with associated V-shaped, toothed cradle attaching to the shaft for maximum strength and eliminating slippage via cold weld attachment. Single bolt or set screw type fasteners are not acceptable. Aluminum clamps are unacceptable.
 - d. Valves: Actuators shall be specifically designed for integral mounting to valves without external couplings.
 - e. Actuator shall have microprocessor-based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible.
 - f. Noise from actuator while it is moving shall be inaudible through a tee bar ceiling.
 - g. Actuators shall provide protection against actuator burnout using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation or use of magnetic clutches are not acceptable.
 - h. Modulating Actuators:
 - 1) General: Actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range. Actuators shall have positive positioning circuit so that controlled device is at same position for a given signal regardless of operating differential pressure. Actuators that internally use a floating actuator with an analog signal converter are not acceptable.
 - 2) Optional for VAV box dampers only: Actuators may be floating type if either:
 - a) Feedback from the actuator is provided as an analog input; or
 - b) For VAV boxes NOT serving areas occupied 24 hours per day, damper position is estimated by timing pulse-open and pulse-closed commands

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- with auto-zeroing whenever zone is in Unoccupied mode and damper is driven full closed.
- i. Where indicated on Drawings or Points List, actuators shall include
 - 1) 2 to 10 VDC position feedback signal
 - 2) Limit (end) position switches
 - j. All 24 VAC/DC actuators shall operate on Class 2 wiring and shall not require more than 10 VA for AC. Actuators operating on 120 VAC power shall not require more than 11 VA.
 - k. All modulating actuators shall have an external, built-in switch to allow the reversing of direction of rotation.
 - l. Actuators shall be provided with a conduit fitting at a minimum three-foot electrical cable and shall be pre-wired to eliminate the necessity of opening the actuator housing to make electrical connections.
 - m. Where fail-open or fail-closed position is required an internal mechanical, spring return mechanism shall be built into the actuator housing. Nonmechanical forms of fail-safe are not acceptable. All spring return actuators shall be capable of both clockwise and counterclockwise spring return operation by simply changing the mounting orientation.
 - n. Actuators shall be capable of being mechanically and electrically paralleled to increase torque where required.
 - o. All non-spring return actuators shall have an external gear release to allow manual position of the damper when the actuator is not powered. Spring return actuators with more than 60 inch-pound torque capacity shall have a manual crank for this purpose.
 - p. Actuators shall be designed for a minimum of 60,000 full cycles at full torque and be UL 873 listed.
 - q. Actuators shall clearly indicate position of damper valve.
3. Electric Actuators for Large Butterfly Valves
- a. Entire actuator shall be UL or CSA approved by a National Recognized Testing Laboratory.
 - b. The valve actuator shall consist of a capacitor-type reversible electric motor, gear train, limit switches and terminal block, all contained in a die cast aluminum enclosure.
 - c. Enclosure shall meet NEMA 4X weatherproof requirements for outdoor applications
 - d. Output shaft shall be electroless nickel plated to prevent corrosion.
 - e. Actuator shall have a motor rated for minimum 75% duty cycle. Duty cycle shall be defined as running time divided by installed time at maximum torque.
 - f. Actuator shall be suitable for operation in ambient temperature ranging from -22° F to +150° F (-30° C to +65° C)
 - g. A pre-wired cable shall bring wiring outside enclosure to avoid necessity of opening cover.
 - h. Gears shall be hardened alloy steel, permanently lubricated. A self-locking gear assembly or a brake shall be supplied.
 - i. Actuator shall be equipped with a hand wheel for manual override to permit operation of the valve in the event of electrical power failure or system malfunction. Hand wheel must be permanently attached to the actuator. When in manual operation electrical power to the actuator will be permanently interrupted.
 - j. The hand wheel will not rotate while the actuator is electrically driven.
 - k. Actuator shall have heater and thermostat to minimize condensation within the actuator housing.
 - l. Provide limit (end) position switches where indicated on schematics.
4. Normal Position: Except as specified otherwise therein, the requirement for spring return actuators and the normal positions of control devices shall be as indicated in table below. For actuators indicated as Spring Return Required in the table, normal position refers to the position with zero control signal and with no power to the actuator. For actuators not indicated as Spring Return Required in the table, non-spring style actuators are acceptable and normal position refers to the position with zero control signal.

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Device	Normal Position	Spring Return Required
Outside air damper	CLOSED	Yes
Return air damper	OPEN	Yes
Exhaust Air Relief Damper	CLOSED	Yes
Domestic hot water generator	CLOSED	Yes
AHU heating coil valves	CLOSED	Yes
AHU cooling coil valves	OPEN	Yes
Equipment isolation valves	OPEN	Yes
Hot water reheat coil valves	CLOSED	Yes
Fan-coil HW and CHW valves	CLOSED/OPEN	Yes
CRAC CHW valves	OPEN	Yes
VAV box dampers	OPEN	Yes

5. Valve Actuator Selection
 - a. Modulating actuators for valves shall have minimum range ability of 50 to 1.
 - b. Water
 - 1) 2-way and two position valves
 - a) Tight closing against 125% of system pump shut-off head
 - b) Modulating duty against 90% of system pump shut-off head.
 - 2) 3-way shall have close-off against twice the full open differential pressure for which they are sized.
 6. Damper Actuator Selection
 - a. Actuators shall be direct coupled. For multiple sections, provide one actuator for each section; linking or jack-shafting damper sections shall not be allowed.
 - b. Provide sufficient torque as velocity, static, or side seals require per damper manufacturer's recommendations and the following:
 - 1) Torque shall be a minimum 5 inch-pounds per square foot for opposed blade dampers and 7 inch-pounds per square foot for parallel blade dampers.
 - 2) The total damper area operated by an actuator shall not exceed 80% of the manufacturer's maximum area rating.
- E. Pneumatic damper/valve actuators
1. Pneumatic actuators shall be piston-rolling diaphragm type or diaphragm type with easily replaceable, beaded, molded neoprene diaphragm.
 2. Actuator housings may be molded or die-cast zinc or aluminum.
 3. Actuator size and spring ranges selected shall be suitable for intended application.
 4. Rate pneumatic actuators for a minimum 140 kPa (20 psig).
 5. Damper actuators shall be selected in accordance with manufacturer's recommendations to provide sufficient close-off force to effectively seal damper and to provide smooth modulating control under design flow and pressure conditions. Furnish a separate actuator for each damper section.
 6. Valve actuators shall provide tight close off at design system pressure and shall provide smooth modulation at design flow and pressure conditions.
 7. On sequencing applications, valve and damper actuators shall be sized for a maximum of 14 kPa (2 psi) shift in nominal spring range. Spring ranges shall be selected to prevent overlap or positive positioners shall be provided.
 8. Positive positioners to have the following performance characteristics:
 - a. Linearity: $\pm 10\%$ of output signal span
 - b. Hysteresis: 3% of the span
 - c. Response: 1/4 psig input change
 - d. Maximum pilot signal pressure: 140 kPa (20 psig)

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- e. Maximum control air supply pressure: 420 kPa (60 psig)
 9. Positive positioners shall be provided on actuators for inlet vane control and on any other actuators where required to provide smooth modulation or proper sequencing.
 10. Positive positioners shall be high-capacity force balance relay type with suitable mounting provisions and position feedback linkage tailored for particular actuator.
 11. Positive positioners shall use full control air pressure at any point in stem travel to initiate stem movement or to maintain stem position. Positioners shall operate on a 20 to 100 kPa (3 to 15 psig) input signal unless otherwise required to satisfy the control sequences of operation.
 12. All actuators shall be designed and manufactured using ISO900 registered procedures, and shall be Listed under Standards UL873 and CSA22.2 No. 24-93
- F. Motorized isolation valves
1. Butterfly Valves.
 - a. Furnish automatic butterfly valves for isolation requirements as shown on the drawings or required herein. All butterfly valves shall have body ratings in accordance with the piping specifications. Valves shall be high performance, fully lugged with carbon steel body ANSI 150/300. Valves shall be rated for bubble tight dead-end closure, with 316 stainless steel disc, stainless steel shaft and reinforced Teflon seat and seals.
 - b. Motorized valves located outdoors or in areas subject to outdoor air conditions provide fail in place, electric operators with water proof enclosure, crankcase heater, and open and closed position limit switches. Valve and all accessories shall be constructed for outdoor use. All electrical devices shall be weather proof and NEMA 4 rated.
 - c. All valves shall be provided with external position indicators and a speed control device to prevent rapid closure.
 - d. All valves shall be provided with manual override hand wheels for operating the valve.
 - e. The valves shall be line size as shown on plans.
 - f. Motorized isolation valves shall be Jamesbury 815/830L, Fisher, DeZurik Model HP II or Bray.
- G. Ball Valves
1. Furnish automatic full port ball valves for isolation requirements on line sizes up to 2' as shown on the drawings or required herein. All ball valves shall have ANSI 250 body rating. Valves shall bronze body and stainless-steel trim.
 2. Valves shall close against a differential pressure equal to the design pump head pressure plus 10%.
 3. The valves shall fail to their safe position upon power loss as specified in the sequence of operation.
 4. All valves shall be provided with manual override.
 5. Provide valve position indicator end switches with the actuator.
 6. The valves shall be line size as shown on plans.
 7. Motorized isolation valves shall be Nepronic, Dezurik or Siemens.
- H. Automatic Control Valves
1. General:
 - a. Control valves shall be two-way or three-way type single seated globe type for two-position or modulating service as shown. Valves shall meet ANSI Class IV leakage rating.
 - b. Body pressure rating and connection type construction shall conform to pipe, fitting and valve schedules. Where pressure and flow combinations exceed ratings for commercial valves and operators, industrial class valves and operators shall be provided.
 - c. Valve operators shall be of pneumatic or electric type.
 - d. The valves shall be quiet in operation and fail-safe in either normally open or normally closed position in the event of power failure.
 - e. Control valve operators shall be sized to close against a differential pressure equal to the design pump head plus 10 percent.

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- f. Furnish differential pressure control valves for all water systems as shown on plans and/or specified in the sequence of operations.
 - g. Provide valves 2" and smaller with screwed end bronze bodies and stainless-steel trim. Provide valves 2-1/2" and larger with flanged ends, cast iron body and stainless-steel trim.
 - h. For modulating service that require large valve size (above 6"), such as cooling tower temperature bypass, chiller head pressure ,etc. where proper control with globe type control valve cannot be achieved or the application is not economical butterfly or v-port ball valves are allowed.
2. Water Valves:
 - a. Control valves shall be of equal percentage flow characteristics for modulating service.
 - b. Sizing Criteria:
 3. Steam Valves:
 - a. Control valves shall be of linear flow characteristics for modulating service.
 - b. Sizing Criteria:
- I. Air Flow Measuring Stations
1. Fan Inlet Type:
 - a. Provide where indicated on the plans, airflow measuring stations of fan inlet type. Airflow traverse probes shall be suitable for mounting in the inlet bell(s) of the indicated fan.
 - b. Probes shall be provided with the appropriate end support brackets for mounting in the inlet bell(s). Where fans are of dual inlet type, two sets of inlet probes must be provided.
 - c. Fan inlet probes shall be provided with the fittings to allow for the connection of control tubing to the probe assemblies.
 - d. Probes shall be capable of operating with an accuracy of 3% of actual volume over the fan operating range.
 - e. The installation of the air flow measuring stations shall be coordinated with sheet metal contractor to ensure actual accuracy and accessibility for maintenance.
 - f. Fan inlet probes shall be Tek-Air T-FP7000.
 2. Duct Mounted Type:
 - a. Provide where indicated on the plans, airflow traverse probes of the insertion type, capable of continuously measuring air volume in the duct served.
 - b. Probes shall utilize multiple total and suction pressure measurement points, located along the length of the probe surface in accordance with ASHRAE recommendations for duct traversing.
 - c. The probes shall provide measurement accuracy within $\pm 2\%$ of actual velocity when used with the appropriate conversion formula.
 - d. Probes shall be of cylindrical cross section and shall indicate no more than a $\pm 3\%$ percent deviation from the centerline velocity at a yaw angles up to 30 degrees.
 - e. Probes shall be constructed of extruded aluminum, unless dictated otherwise by service requirements. Probes over sixteen inches long shall be supported on the insertion end.
 - f. Probe quantities for each location shall be sufficient to meet ASHRAE recommendations.
 - g. The pressure drop created by the traverse probes shall not be greater ten percent of the velocity pressure at the maximum design flow.
 - h. The probes shall not amplify sound levels in the duct. The manufacturer shall provide submittal data indicating the developed differential pressure and pressure loss at the minimum and maximum design air flows for each duct location.
 - i. Traverse probes shall be Tek-Air model T-FP5000.

J. Binary temperature devices

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1. Line-voltage space thermostat:
 - a. Line-voltage thermostats shall be bimetal-actuated, snap acting SPDT contact, enclosed, UL listed for electrical rating. The thermostat cover shall provide exposed set point adjustment knob. The thermostat shall operate within the 55°F to 85°F setpoint range, with 2°F maximum differential.
 2. Low-temperature safety thermostat:
 - a. Low-limit air stream thermostats shall be UL listed, vapor pressure type, with a sensing element of 20 ft. minimum length. Element shall respond to the lowest temperature sensed by any 1 ft. section. The low-limit thermostat shall be automatic reset, SPDT type.
 3. Aquastat:
 - a. Strap-on type thermostats shall be provided for low or high temperature limit service on hot water or steam condensate pipes. The thermostats shall be UL listed, with a liquid-filled bulb type sensing element and capillary tubing. The thermostat shall operate within the 20°F to 120°F, or 100°F to 240°F, setpoint range, with an adjustable 6°F differential.
 - b. The low-limit thermostat shall be automatic reset, snap acting SPDT type with concealed set point adjustment.
- K. Temperature sensors.
1. Provide the following instrumentation as required by the monitoring, control and optimization functions. All temperature sensors shall use platinum RTD elements only, nickel or silicon is not acceptable. All control signals shall be via a 4-20 mA loop.
 2. Room Temperature:
 - a. Temperature monitoring range +40/+90 F (+40/120 F for high temp alarms)
 - b. Output signal 4-20 mA
 - c. Installation adjustments none required
 - d. Calibration adjustments zero & span
 - e. Factory calibration point 70 deg F
 - f. Accuracy at calibration point +0.5 F
 3. Liquid Immersion Temperature
 - a. Temperature monitoring range +20/+120 F or +70/+220 F
 - b. Output signal 4-20 mA
 - c. Installation adjustment none required
 - d. Calibration adjustments zero & span
 - e. Factory calibration point 70 deg F
 - f. Accuracy at calibration point +0.5 F
 4. Duct (Single Point) Temperature
 - a. Temperature monitoring range +20/+120 F
 - b. Output signal 4-20 mA
 - c. Installation adjustments none required
 - d. Calibration adjustments zero & span
 - e. Factory calibration point 70 deg F
 - f. Accuracy at calibration point +0.5 F
 5. Duct (Averaging) Temperature
 - a. Temperature monitoring range +20/+120 F
 - b. Output signal 4 - 20 mA
 - c. Installation adjustments none required
 - d. Calibration adjustments zero & span
 - e. Factory calibration point 70 deg F
 - f. Accuracy at calibration point +0.5 F
 6. Outside Air Temperature
 - a. Temperature monitoring range -50/+122
 - b. Output signal 4-20 mA
 - c. Installation adjustments none required

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- d. Calibration adjustments zero & span
- e. Factory calibration point 70 deg F
- f. Accuracy at calibration point +0.5 F
- L. Dew point/humidity sensors
 - 1. Outside Air Dew Point Temperature
 - a. Dew point monitoring range -40/+115 F DP, 12% to 99% RH
 - b. Output signal 4-20 mA
 - c. Calibration adjustments zero & span
 - d. Factory calibration point 70 F
 - e. Accuracy at calibration point +2.0 Fdp
 - 2. Room/duct Relative Humidity
 - a. Sensor Humidity range 0 to 100%
 - b. Operating temperature 15 F to +170 F
 - c. Accuracy +2% RH
 - d. Sensing element Capacitive sensor
 - e. Output signal 4-20 mA DC
 - f. Installation adjustments zero & span
 - g. Operating temperature 15 F to +170 F
 - h. Voltage requirement 12-36 VDC
- M. Pressure sensors
 - 1. Air Static Pressure Sensor
 - a. Duct Static range -.5 to + 7.5"wg
 - b. Accuracy + .05" w.g.
 - c. Output signal 4 - 20 mA
- N. Water differential pressure sensor
 - 1. Transducer shall have linear output signal. Zero and span shall be field adjustable.
 - 2. Transducer sensing elements shall withstand continuous operating conditions of positive or negative pressure 50% greater than calibrated span without damage.
 - 3. Water pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and block and bleed valves.
 - 4. Water differential pressure transducer shall have stainless steel diaphragm construction, proof pressure of 150 psi minimum. Over range limit (differential pressure) and maximum static pressure shall be 300 psi. Transducer shall be complete with 4 to 20 mA output, required mounting brackets, and three valve manifold.
 - 5. Provide industrial grade differential pressure sensors for all differential pressure bypass valves. Sensor shall be factory calibrated for operating range and rated for system pressure. Provide manufacturers standard 316 stainless steel, 3 valve manifold and pressure gauges for supply and return pressures. Output shall be 4-20 ma. Sensor shall be Rosemount 1151DP, with 316 stainless steel or approved equal.
- O. Differential pressure switches
 - 1. Water Differential Pressure Switch
 - a. Differential pressure type switches (air or water service) shall be UL listed, SPDT snap-acting, pilot duty rated (125 VA minimum), NEMA 1 enclosure, with scale range and differential suitable for intended application or as shown.
 - b. The differential switches shall meet the following requirements:
 - 1) Range 8 to 70 psi
 - 2) Differential 3 psi
 - 3) Maximum differential pressure 200 psi
 - 4) Maximum pressure 325 psi
 - 2. Air Differential Pressure Switch

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- a. Differential pressure switches shall be diaphragm type, with die-cast aluminum housing and adjustable set point. Switch rating shall be a minimum 5 amps at 120 VAC. Switches shall be SPDT and be used for fan status as specified in the point schedule. Switch pressure range shall be suited for application. (E.g. filter 0-2.0", fan status 0-5.0", etc.)
- P. Analog water level sensors
 1. Furnish and install full height, analog level sensors for each location as specified. Sensor shall provide 4-20ma signal in proportion to basin water level. Provide waterproof enclosure and mounting hardware as required. Sensor shall be Drexel Brook or equal.
- Q. Water leak detection system
 1. General:
 - a. Furnish and install a complete water detection system for each area specified. The system shall include electronic alarm and locating modules, sensing cable, graphic maps and all auxiliary equipment. The system shall simultaneously detect the presence of water at any point along the cables length, sound an alarm and pinpoint the distance to the leak. The sensing cable shall be of such construction that no metallic parts shall be exposed to the environment. The system shall provide preconnectorized sensing cable and components. The system shall be UL listed and FM approved.
 - b. The system shall be as manufactured by Raychem Corporation or equal.
 - c. Locating leak detection panel (TTB-FA)
 - d. The alarm and locator module, TTB-FA, shall monitor up to a maximum of 1000 feet of sensing cable. The alarm module shall indicate that water has contacted the sensing cable by sounding an audible alarm, actuating an output relay, sending a proportional 4-20 mA signal to the BMS and displaying the distance from the start of the sensing cable to the start of the first contact with water. The location of the first water contact shall be retained on the display until the cable is dry and the module is updated.
 - e. The alarm module shall be capable of detecting the presence of a 1-inch leak anywhere along the cable with a repeatability of +/- 1%.
 - f. The alarm module shall continuously monitor the sensing cables and interconnecting cables for continuity. Any break in the cable shall generate an audible alarm, activate an output relay and activate a "continuity" LED on the face of the module.
 - g. The alarm module shall have LED's indicating "power" (green), "alarm" (red) and "continuity" (yellow). The module shall be equipped with exposed test, reset and silence buttons. All other functions shall require key access.
 - h. The alarm module shall be powered by Emergency power.
 - i. The module enclosure shall be a minimum of 16-gauge steel, flush mounting type.
 2. Single point leak detector
 - a. The alarm module, TTC, shall monitor up to a maximum of 50 feet of sensing cable. The alarm module shall indicate that water has contacted the sensing cable by sounding an audible alarm and actuating an output relay. The relay shall remain activated until the cable is dry and the module is reset.
 - b. The alarm module shall be capable of detecting the presence of a 1-inch leak anywhere along the cable with a repeatability of +/- 1%.
 - c. The alarm module shall continuously monitor the sensing cables and interconnecting cables for continuity. Any break in the cable shall generate an audible alarm, activate an output relay and activate a "continuity" LED on the face of the module.
 - d. The alarm module shall have LED's indicating "power" (green), "alarm" (red) and "continuity" (yellow).
 - e. The alarm module shall be powered by Emergency power.
 - f. The module shall be mounted in a field equipment cabinet.
 3. Water sensing cable
 - a. The water sensing cable (TT-1000) shall detect the presence of water and pinpoint its location. The cable shall consist of four wires: Two sensor wires, a continuity wire and a return wire. All four wires shall be coated and insulated with a fluoropolymer and wound

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- helically around a fluoropolymer core. The cable shall have a breaking strength, including connectors, of at least 70 pounds, per ASTM D-638. The cable shall have an abrasion resistance of >65 cycles, per UL 719.
- b. The sensing cable shall offer distributed sensing with the ability to detect the location of water at any point along the length of the cable. The cable shall be flexible, and carry less than 24VDC under normal conditions.
 - c. The system shall not alarm when in contact with any metallic equipment such as drip pans, floor tile supports, conduit, etc.
 - d. The cable shall be available in modular, preconnectorized lengths of 5, 10, 15, 25 and 50 feet. Field splicing shall not be acceptable.
 - e. The cable shall be UL 910 rated and plenum rated per NEC 725-2(b).
 - f. Provide two sets of test instrumentation to owner.
4. Jumper cable
- a. Jumper cable shall be used where leak detection cable is not required but continuity is required (in raceways between alarm module and floor surface, etc.). The jumper cable shall be plenum rated and jacketed with fluoropolymer materials, per NEC 725-2(b). The jumper cable shall consist of four different colors (Y, B, R, and G), insulated 18 AWG wires and shall be available in preconnectorized lengths of 5, 10, 15, 25 and 50 feet.
5. Accessories
- a. Provide all end connectors, leader cables, hold down clips, caution tags, spray adhesive (3M 90M) as required.
6. Graphic display map
- a. Provide a graphic display map for each room served. The map shall be a 1/8 in = 1.0 ft. scaled drawing of the area served, indicating actual equipment locations, floor tile and other points of reference. The actual cable routing shall be clearly marked on the map with actual scaled distances every 10 feet.
 - b. A dynamic graphic display, equivalent to the aforementioned map, shall be duplicated on the BMS operator workstation. The area in alarm (within 5 feet) shall blink in red until the alarm is cleared.
7. Performance
- a. A maximum wetted area of 2 inches of cable, at any point along the entire length of cable, shall activate an alarm.
 - b. The system shall be continuously monitored for continuity. The loss of continuity shall cause an alarm within 5 seconds.
 - c. The cable shall be capable of being cleaned with a clean dry cloth, in place.
 - d. The cable shall dry and reset the module immediately upon removal from free water. No shaking, wiping or mechanical action shall be required.
8. Installation
- a. All system components shall be installed in accordance with the manufacturer's recommendations. The manufacturer shall provide necessary installer training and supervision as required.
 - b. The cable shall be installed on clean, dry finished surfaces only (coordinate access and schedule installation as required) after the possibility of physical damage has been eliminated. The cable shall be fastened to the surface it is monitoring every 4 feet with hold down clips and spray mastic adhesive. Hold down clip installation shall be subject to spot checks during commissioning. If any clip fails, all other clips shall be re-attached and retested, at no additional cost.
 - c. The system shall be commissioned prior to acceptance. Submit a test procedure for approval.
9. Warranty
- a. All equipment shall be warranted to the same extent as the BMS system, or per the manufacturer's warranty, whichever is greater.
- R. Water BTU meters

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1. Provide insertion type water flow meters designed to mount through a fully open 1-inch full bore ball valve supplied by flow meter manufacturer. Meter flow range shall be 2-40 feet/second for liquid service. Meter linearity shall be +/-1% for a 10:1 range. Repeatability shall be .10%. All wetted parts shall be constructed of stainless steel, bearings shall be tungsten carbide. Housing and flange shall be carbon steel. Housing pressure rating shall be 350 psig. A D.C. powered transmitter shall be mounted on the flow meter. Flow transmitter output shall be 4-20 mA linear with flow. Transmitter input shall be from magnetic pickup. Transmitter accuracy shall be .25% of span. The water flow meter shall be Onicon F 1220 or equal.
 2. Provide supply and return temperature sensors for "Delta-T" calculation of BTU consumption. Monitor total accumulated BTUs, current BTUs, monthly total BTUs, and yearly total BTUs for each location specified or shown.
 3. Provide isolation valve kit to allow removal and servicing of meter while system is operating.
 4. All devices associated with the BTU meters serving the chilled water and ice storage system shall be suitable for the extreme environmental conditions. The devices shall properly operate with the specified accuracy and shall not be affected by the media, or by the environment that includes but not limited to low temperatures (10 Deg F), temperature fluctuations and condensation. Control panel enclosures and electronics shall meet the aforementioned requirements or located strategically to ensure proper operation.
- S. Vortex shedding flow meters
1. Provide vortex shedding flow meter for steam metering locations. Meter shall be pressure and temperature compensated, rated for service conditions and is manufactured by Endress and Hauser model FTV 1810 or approved equal. Provide remote readout of pressure, flow, MLb/Hr and total MLb.
 2. Coordinate location to provide proper straight run of pipe, pipe size, etc.
 3. Power 24VDC power supply as required from Emergency source.
 4. BMS system shall monitor Mlb/Hr, Mlb total, pressure and temperature values.
- T. Indoor air quality (Co2/vVOC) sensors
1. Provide indoor air quality sensors to monitor Carbon Dioxide (CO2) and Volatile Organic Compound (VOC) levels.
 2. The sensors shall be of microprocessor-based photo acoustic type with heated stannic dioxide semiconductor.
 3. The CO2 sensors shall have no more than 1% drift during the first year of operation and minimal drift thereafter so that no calibration will be required.
 4. The units shall be wall or duct mounted type as indicated on plans and in the sequence of operation.
 5. Wall mounted sensors shall be provided with white plastic cover, without LED indicators.
 6. Duct mounted sensors shall be provided with LED indicators in a dust proof plastic housing with transparent cover.
 7. The VOC sensor shall have automatic self-calibrating capability to ensure accuracy.
 8. The sensor shall meet the following requirements:
 - a. Operating voltage: 24 VAC +/- 20%
 - b. Frequency: 50/60 Hz
 - c. Power consumption: max. 6 VA
 - d. CO2 measuring range: 0 – 2000 ppm
 - e. Tolerance: +/- 100 ppm
 - f. Output: 0 – 10 VAC
 - g. Calibration: none required
 - h. VOC measurement range: 0 – 10 V VOC
 - i. Permissible air velocity in duct: <26.2 Ft/s.
 9. The sensors shall be model:
 - a. Siemens QPA63 Series.
 - b. MSA AirOX
- U. Relays

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1. Control relays shall be UL listed plug-in type with dust cover and LED “energized” indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
 2. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable $\pm 200\%$ (minimum) from set point shown on plans. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
- V. Override timers
1. Override timers shall be spring-wound line voltage, UL Listed, with contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified. Timer shall be suitable for flush mounting on control panel face and located on local control panels or where shown.
 2. Current transmitters.
 3. AC current transmitters shall be the self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A full scale, with internal zero and span adjustment and $\pm 1\%$ full-scale accuracy at 500-ohm maximum burden.
 4. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA Recognized.
 5. Unit shall be split-core type for clamp-on installation on existing wiring.
- D. Current transformers
1. AC current transformers shall be UL/CSA Recognized and completely encased (except for terminals) in approved plastic material.
 2. Transformers shall be available in various current ratios and shall be selected for $\pm 1\%$ accuracy at 5 A full-scale outputs.
 3. Transformers shall be fixed-core or split-core type for installation on new or existing wiring, respectively.
- E. Voltage transmitters
1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4 to 20 mA output with zero and span adjustment.
 2. Ranges shall include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with $\pm 1\%$ full-scale accuracy with 500-ohm maximum burden.
 3. Transmitters shall be UL/CSA Recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1 requirements.
- F. Voltage transformers
1. AC voltage transformers shall be UL/CSA Recognized, 600 VAC rated, complete with built-in fuse protection.
 2. Transformers shall be suitable for ambient temperatures of 4°C to 55°C (40°F to 130°F) and shall provide $\pm 0.5\%$ accuracy at 24 VAC and a 5 VA load.
 3. Windings (except for terminals) shall be completely enclosed with metal or plastic material.
- G. Power monitors
1. Power monitors shall be the three-phase type furnished with three-phase disconnect/shorting switch assembly, UL Listed voltage transformers, and UL Listed split-core current transformers.
 2. They shall provide a selectable rate pulse output for kWh reading and a 4 to 20 mA output for kW reading. They shall operate with 5 A current inputs with a maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.
- H. Current switches
1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. The switches shall be selected to match the current of the application and output requirements of the DDC system.
- I. Pressure-electric (pe) switches
1. Shall be metal or neoprene diaphragm actuated, operating pressure rated 0-175 kPa (0-25 psig), with calibrated scale set point range of 14-125 kPa (2-18 psig) minimum, UL listed.

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2. Provide one or two-stage switch action SPDT, DPST, or DPDT, as required by application. Electrically rated for pilot duty service (125 VA minimum) and/or for motor control.
 3. Shall be open type (panel-mounted) or enclosed type for remote installation. Enclosed type shall be NEMA 1 unless otherwise specified.
 4. Shall have a permanent indicating gauge on each pneumatic signal line to PE switches.
- J. Electro-pneumatic (e/p) transducers
1. Electronic/pneumatic transducer shall provide a proportional 20 to 100 kPa (3 to 15 psig) output signal from either a 4 to 20 mA or 0 to 10 VDC analog controls input.
 2. E/P transducer shall be equipped with the following features:
 3. Separate span and zero adjustments
 4. Manual output adjustments
 5. Pressure gauge assembly. Feedback loop control
 6. Air consumption of 0.05 L/s (0.1 scfm) at mid-range
- K. Local control panels
1. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key-lock latch and removable sub panels. A single key shall be common to all field panels and sub panels.
 2. Interconnections between internal and face mounted devices shall be prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections shall be UL listed for 600-volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for field connection shall be individually identified per control drawings.
 3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.
- L. Local user display
1. Where specified in the sequence of operation or points list, the controllers on the peer to peer building level network shall have a display and keypad for local interface. A keypad shall be provided for interrogating and commanding points in the controller.
 2. The display shall use the same security password and access rights for points in the display as is used in the associated controller.
 3. The LCD display shall be a minimum of a 2-line 40-character display.
 4. The LCD display shall include the full point name, value (numeric, digital or state text), point priority and alarm status on one screen.
 5. The LCD shall dynamically update the value, priority, and alarm status for the point being displayed.
 6. The display shall be mounted either on the door of the enclosure or remote from the controller.
- 2.09 Communication and Control Wiring
- A. General:
1. Provide copper wiring, plenum cable, and raceways as specified in the applicable sections of Division 16 unless otherwise noted herein.
 2. All insulated wire to be copper conductors, UL labeled for 90°C minimum service.
- B. Wire Sizing and Insulation
1. Wiring shall comply with minimum wire size and insulation based on services listed below:
 - a. Service Minimum Gage/Type Insulation Class
 - b. AC 24V Power 12 Ga Solid 600 Volt
 - c. DC 24V Power 10 Ga Solid 600 Volt
 - d. Class 1 14 Ga Stranded 600 Volt
 - e. Class 2 18 Ga Stranded 300 Volt
 - f. Class 3 18 Ga Stranded 300 Volt
 2. Provide plenum-rated cable when open cable is permitted in supply or return air plenum where allowed per execution specifications defined in Paragraph 3.07
- C. Power Wiring:
1. 115V power circuit wiring above 100 feet distance shall use minimum 10 gage.

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2. 24V control power wiring above 200 feet distance shall use minimum 12 gage.
- D. Control Wiring:
 1. Digital input/output wiring shall use Class 2 blue jacketed, twisted pair, and insulated.
 2. Analog inputs shall use Class 2 twisted shielded pair, insulated and blue-jacketed and require a grounded shield.
 3. Actuators with tri-state control shall use 3 conductor with same characteristics
- E. Communication Wiring
 1. Ethernet Cable shall be minimum CAT5
 2. Secondary level network shall be 24 gage orange-jacketed, TSP, low capacitance cable.
- F. Approved Cable Manufacturers:
 1. Wiring from the following manufacturers which meet the above criteria shall be acceptable:
 - a. Anixter
 - b. Belden
- 2.10 Fiber Optic Cable System
 - A. Fiber Optic cable: Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. The sheath shall be UL Listed OFNP in accordance with NEC Article 770. The optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm for us in 10/100 MB fiber optic networks.
 - B. Connectors: All optical fibers shall be field-terminated with ST type connectors. Connectors shall have hot melt and polish or epoxy and polish type connectors. No Mechanical crimp type permitted.
 - C. Outdoor/underground installation of Fiber Optic cable shall be gel coated and rated for outdoor/underground installation.
 - D. Four strands is the minimum required for each run, two for the link and two as spares.
 - E. 1 GB Ethernet networks shall be single mode fiber for lengths over 275m. Single mode Ethernet requires two strands of 9 um cable.
- 2.11 Compressed Air Supply
 - A. General:
 1. Provide a compressed air supply system including duplex type air compressor set, air tanks and pneumatic air distribution system including tubing and pressure reducing stations.
 - B. Air Compressor:
 1. Provide a duplex type air compressor set complete with motors, V-belt drives, OSHA belt guards, pressure switches, ASME safety relief valve, pressure gauge, intake filter silencers, starters, electric alternator, and all other items and accessories.
 2. The two compressors shall be mounted on ASME National Board receiving tank. The entire unit shall be factory piped and wired.
 3. Each compressor shall be single stage, one or two cylinders, air cooled, with drop forged steel crankshaft supported on both ends by means of ball, roller or sleeve main bearings. Lubrication shall be of the constant level splash type, or of the pressure type, to assure adequate supply of oil to all working parts. Compressor shall be provided with oil proof piston rings.
 4. The compressor shall meet the following minimum requirements:
 - a. Working pressure: 70-90 PSI
 - b. System air pressure: 80 PSI
 - c. Maximum oil carryover: 4 ppm
 - d. Maximum run time: 33%
 - e. Maximum Starts per hour: six (6)
 - f. Motor speed: 450 RPM
 - g. Motor voltage: 230 VAC/3 Phase
 5. Compressor shall be sized as necessary to supply all pneumatics associated with the building automation system as well as the main air for all other HVAC equipment and devices as required.
 6. The compressor assembly shall be mounted on vibration isolation pads.
 - C. Motor Starter / Alternator

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1. Each compressor motor shall be provided with a magnetic starter with dedicated local disconnect and three overload relays.
 2. Provide factory-installed duplex starter/automatic alternator package with separate motor feeds, arranged for automatic start of standby compressor.
- D. Air Tank
1. Provide ASME receiver tank, sized according to runtime and start per hour requirements.
 2. The air tank shall be painted with a prime and finish coat of paint in accordance with the manufacturers standard practice.
 3. Air tank shall be provided with a drain opening at the bottom, which shall be piped near the floor drain.
 4. Provide electric solenoid type (normally closed) automatic receiver tank drain valve with built-in timers for operating frequency and duration.
- E. Refrigerated Air Dryer:
1. Provide continuously operating, hermetic compressor refrigerated type air dryer, UL Listed, sized for maximum dew point of -9.5°C (15°F) with 38°C (100°F) saturated inlet air at 550 kPa (80 psig) at maximum rated flow.
 2. Dryer package shall include operating/failure status indication, manual bypass service valve, inlet and outlet pressure gauges, and automatic condensate drain trap with manual override.
- F. Regenerative Desiccant Compressed Air Dryer:
1. Unit shall be wall-mounted, complete with two drying towers containing desiccant beds sized to ensure that air velocity across the desiccant bed is not greater than 0.3 m/s (60 fpm) at 700 kPa (100 psig). Bed shall be sized so that the effects of desiccant aging during the first year are negated. Each tower shall be furnished with fill and drain ports to facilitate desiccant replacement.
 2. Unit shall be complete with On/Off switch, solid-state timer, control valves, and check valves. Purge air shall be exhausted through mufflers to reduce noise levels.
 3. Unit shall have a 3-psi maximum pressure drop and provide dry air with a -40°C (-40°F) dew point.
 4. Unit shall be sized to match required air consumption, 2.5 L/s (5 cfm) minimum. DD. Filter and PRV Station:
 5. Provide aerosol coalescing type auto-drain, submicron air filter assembly with replaceable element, and 98% efficient for solids 0.3 micron and larger, with 99% efficient oil removal at rated capacity. Furnish with manual filter bypass and shutoff valves, upstream and downstream pressure gauges, and one spare filter element.
 6. Provide relieving type pressure-reducing valves suitable for temperature control service sized for rated system capacity, with the following:
 - a. ASME-rated safety relief valve on low-pressure side, factory set at 25 psig maximum
 - b. Control pressure gauge on inlet and outlet
 - c. Valved bypass
 - d. Particle filter
- G. Tubing.
1. Copper. Provide ACR hard-drawn seamless copper tubing.
 2. Polyethylene. Provide type FR plenum rated polyethylene tubing. Tubing shall be rated for a maximum operating pressure of 200 kPa (30 psi) at 80°C (175°F), with an ambient operating temperature range of -13°C (-10°F) to 65°C (150°F). Plastic tubing shall have the burning characteristics of linear low-density polyethylene tubing, shall be self-extinguishing when tested in accordance with ASTM D 635, shall have UL 94 V-2 flammability classification and shall withstand stress cracking when tested in accordance with ASTM D 1693. Plastic tubing bundles shall be provided with Mylar barrier and flame-retardant polyethylene jacket.

PART 3 – EXECUTION

3.01 Examination:

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- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.
- C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor’s work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor’s work with the work of others.

3.02 Protection

- A. The contractor shall protect all work and material from damage by its employees and/or subcontractors and shall be liable for all damage thus caused.
- B. The contractor shall be responsible for its work and equipment until finally inspected, tested, and accepted.

3.03 Coordination

- A. Site
 - 1. The project coordination between trades is the responsibility of the prime contractor who is the one tier higher contractual partner such as mechanical contractor, general contractor, construction manager, owner or owner’s representative as applicable.
 - 2. The controls contractor shall follow prime contractor’s job schedule and coordinate all project related activities through the prime contractor except otherwise agreed or in minor job site issues. Reasonable judgment shall be applied.
 - 3. Where the work will be installed in close proximity to, or will interfere with, work of other trades, the contractor shall assist in working out space conditions to make a satisfactory adjustment.
 - 4. If the contractor deviates from the job schedule and installs work without coordinating with other trades, so as to cause interference with work of other trades, the contractor shall make the necessary changes to correct the condition without extra charge.
 - 5. Coordinate and schedule work with all other work in the same area, or with work that is dependent upon other work, to facilitate mutual progress.
- B. Submittals.
 - 1. Refer to the “Submittals” article in Part 1 of this specification for requirements.
- C. Test and Balance
 - 1. The contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
 - 2. The contractor shall provide training in the use of these tools. This training will be planned for a minimum of 4 hours. [ID: 136]
 - 3. In addition, the contractor shall provide a qualified technician for duration of 8 hours to assist in the test and balance process.
 - 4. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.
- D. Life Safety
 - 1. Duct smoke detectors required for air handler shutdown are supplied under Division 16 of this specification. The contractor shall interlock smoke detectors to air handlers for shutdown as described in Part 3, “Sequences of Operation.”
 - 2. Smoke dampers and actuators required for duct smoke isolation are provided under a Section of Division 15. The contractor shall interlock these dampers to the air handlers as described in Part 3, “Sequences of Operation.”
 - 3. Fire/smoke dampers and actuators required for fire rated walls are provided under another Section of Division 15. Control of these dampers shall be by Division 16.

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4. The Main Fire Alarm Control Panel shall provide Alarm, Trouble and Supervisory signals to the BMS for monitoring and secondary email notification to SOM E&M personnel.
- E. Coordination with controls specified in other sections or divisions.
 1. Other sections and/or divisions of this specification include controls and control devices that are to be part of or interfaced to the control system specified in this section. These controls shall be integrated into the system and coordinated by the contractor as follows:
 - a. All communication media and equipment shall be provided as specified in Part 2, "Communication" of this specification.
 - b. Each supplier of controls product is responsible for the configuration, programming, startup, and testing of that product to meet the sequences of operation described in this section.
 - c. The Contractor shall coordinate and resolve any incompatibility issues that arise between the control products provided under this section and those provided under other sections or divisions of this specification.
 - d. The contractor is responsible for providing all controls described in the contract documents regardless of where within the contract documents these controls are described.
 - e. The contractor is responsible for the interface of control products provided by multiple suppliers regardless of where this interface is described within the contract documents.

3.04 General Workmanship

- A. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
- B. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
- C. Install all equipment in readily accessible locations as defined by Chapter 1, Article 100, Part A of the National Electrical Code (NEC).
- D. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- E. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.

3.05 Field Quality Control

- A. Contractor shall have a 6 Sigma certified quality manager on staff to inspect the project execution and to enforce quality standards.
- B. All work, materials, and equipment shall comply with the rules and regulations of applicable local, state, and federal codes and ordinances as identified in Part 1 of this specification.
- C. Contractor shall continually monitor the field installation for code compliance and quality of workmanship.
- D. Contractor shall have work inspected by local and/or state authorities having jurisdiction over the work.

3.06 Existing Equipment

- A. Unless otherwise directed, the contractor is not responsible for the repairs or replacement of existing energy equipment and systems, valves, dampers, or actuators. Should the contractor find existing equipment that requires maintenance, the engineer is to be notified immediately.

3.07 Wiring

- A. All control and interlock wiring shall comply with national and local electrical codes and Division 16 of this specification. Where the requirements of this section differ from those in Division 16, the requirements of this section shall take precedence.
- B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved conduit according to NEC and Division 16 requirements.
- C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current limit.)

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- D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in conduit may be used provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.
- E. All wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage—shall be installed in conduit.
- F. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- G. Do not install wiring in conduit containing tubing.
- H. Where plenum rated cable is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 3 m (10 ft.) intervals.
- I. Where plenum rated cable is used without conduit, it shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical conduits, piping, or ceiling suspension systems.
- J. All wire-to-device connections shall be made at a terminal block or wire nut. All wire-to-wire connections shall be at a terminal strip or wire nut.
- K. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- L. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers or interposing relays.
- M. All plenum rated wiring shall be installed as continuous lengths, with no splices permitted between termination points
- N. All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or junction boxes.
- O. Maintain fire rating at all penetrations. Install plenum wiring in sleeves where it passes through walls and floors.
- P. Size and type of conduit and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- Q. Include one pull string in each conduit 3/4 in. or larger.
- R. Control and status relays are to be located in designated enclosures only. These enclosures can include packaged equipment control panel enclosures unless they also contain Class 1 starters.
- S. Conceal all conduits, except within mechanical, electrical, or service rooms. Install conduit to maintain a minimum clearance of 15 cm (6 in.) from high-temperature equipment (e.g., steam pipes or flues).
- T. Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes may not be hung on flexible duct strap or tie rods. Conduits may not be run on or attached to ductwork.
- U. Adhere to this specification's Division 16 requirements where conduit crosses building expansion joints.
- V. The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- W. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 1 m (3 ft.) in length and shall be supported at each end. Flexible metal conduit less than 1/2 in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.
- X. Conduit must be adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

3.08 Communication Wiring

- A. The contractor shall adhere to the items listed in the "Wiring" article in Part 3 of the specification.

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- B. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- C. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
- D. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- E. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- F. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.
- G. All runs of communication wiring shall be unspliced length when that length is commercially available.
- H. All communication wiring shall be labeled to indicate origination and destination data.
- I. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.09 Fiber Optic Cable System

- A. Maximum pulling tensions as specified by the cable manufacturer shall not be exceeded during installation. Post-installation residual cable tension shall be within cable manufacturer's specifications.
- B. All cabling and associated components shall be installed in accordance with manufacturers' instructions. Minimum cable and unjacketed fiber bend radii, as specified by cable manufacturer, shall be maintained.
- C. All terminations need to be made into a patch panel, designed for such use. Free air terminations with patch panels are prohibited.

3.10 Installation of Sensors

- A. General:
 - 1. Install sensors in accordance with the manufacturer's recommendations.
 - 2. Mount sensors rigidly and adequately for the environment within which the sensor operates.
 - 3. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing.
 - 4. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
 - 5. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type.
 - 6. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across the full face of the coil.
 - 7. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
 - 8. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
- B. Room Instrument Mounting
 - 1. Room instruments, including but not limited to wall mounted thermostats and sensors located in occupied spaces shall be mounted 53 inches above the finished floor unless otherwise shown.
- C. Instrumentation Installed in Piping Systems
 - 1. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermo wells.
 - 2. Gauges in piping systems subject to pulsation shall have snubbers.
 - 3. Gauges for steam service shall have pigtail fittings with isolation valve.
- D. Duct Smoke Detectors
 - 1. Duct smoke detectors will be provided by the Fire Alarm System Contractor in supply and return air ducts in accordance with Division 16

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2. Contractor shall connect the DDC System to the auxiliary contacts provided on the Smoke Detector as required for system safeties and to provide alarms to the DDC system.
- E. Occupancy Sensors
1. A sufficient quantity of occupancy sensors shall be provided to provide complete coverage of the area (room or space).
 2. Occupancy sensors shall be installed in accordance with NFPA 70 requirements and the manufacturer's instructions.
 3. Occupancy sensors shall not be located within 1.8 m (6 feet) of HVAC outlets or heating ducts.
 4. PIR and dual-technology PIR/ultrasonic sensors shall not be installed where they can "see" beyond any doorway.
 5. Ultrasonic sensors shall not be installed in spaces containing ceiling fans.
 6. Sensors shall detect motion to within 0.6 m (2 feet) of all room entrances and shall not trigger due to motion outside the room.
 7. The off-delay timer shall be set to 15 minutes unless otherwise shown.
 8. All sensor adjustments shall be made prior to beneficial occupancy, but after installation of furniture systems, shelving, partitions, etc.
 9. Each controlled area shall have one hundred percent coverage capable of detecting small hand-motion movements, accommodating all occupancy habits of single or multiple occupants at any location within the controlled room.
- F. Temperature Limit Switch
1. A temperature limit switch (Low Temperature Detector) shall be provided to sense the temperature.
 2. A sufficient number of temperature limit switches shall be installed to provide complete coverage of the duct section.
 3. Manual reset limit switches shall be installed in approved, accessible locations where they can be reset easily.
 4. The temperature limit switch sensing element shall be installed in a serpentine pattern and in accordance with the manufacturer's installation instructions.
 5. Each bend shall be supported with a capillary clip. Provide 3 m of sensing element for each 1 m² (1 ft. of sensing element for each 1 ft²) of coil area.
- G. Averaging Temperature Sensing Elements
1. Sensing elements shall be installed in a serpentine pattern.
 2. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.
- H. Air Flow Measuring Stations (AFMS)
1. Outside Air AFMSs shall be located downstream from the Outside Air filters.
 2. Pitot tube type AFMS shall not be used if the expected velocity measurement is below 3.5 m/s (700 fpm) [or for outside airflow measurements].
- I. Differential air static pressure.
1. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
 2. Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor.
 3. Building Static Pressure: Pipe the low-pressure port of the pressure sensor to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe the high-pressure port to a location behind a thermostat cover.
 4. The piping to the pressure ports on all pressure transducers shall contain a capped test port located adjacent to the transducer.
 5. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork.

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6. Mount transducers in a location accessible for service without use of ladders or special equipment.
 - J. Water Differential pressure sensors
 1. Differential pressure sensors shall be installed with valved taps into the piping to ensure serviceability without draining the system
 2. Sensors shall be mounted with bleed valves
 3. After sensor installation any air shall be eliminated using the bleed valves to ensure reading accuracy
 4. The sensors shall be located to ensure accessibility
 - K. Relative Humidity Sensors
 1. Relative humidity sensors in supply air ducts shall be installed at least 3m (10 feet) downstream of humidity injection elements.
 - L. Flowmeters
 1. The minimum straight unobstructed piping for the flow meter installation shall be at least 10 pipe diameters upstream and at least 5 pipe diameters downstream and/or in accordance with the manufacturer's installation instructions.
 - M. Flow Switch
 1. Use correct paddle for pipe diameter.
 2. Adjust flow switch in accordance with manufacturer's instructions.
- 3.11 Flow Switch Installation
- A. Use correct paddle for pipe diameter.
 - B. Adjust flow switch in accordance with manufacturer's instructions.
- 3.12 Actuators
- A. Mount and link control damper actuators according to manufacturer's instructions.
 1. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5° open position, manually close the damper, and then tighten the linkage.
 2. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 3. Provide all mounting hardware and linkages for actuator installation.
 - B. Electric/Electronic
 1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
 2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.
- 3.13 Warning labels and identification tags
- A. Permanent warning labels shall be affixed to all equipment that can be automatically started by the DDC 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. Permanent warning labels shall be affixed to all motor starters and all 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: "C A U T I O N This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing."
 - C. Equipment and Device labeling:

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1. Labels and tags shall be keyed to the unique identifiers shown on the As-Built drawings.
 2. All Enclosures and DDC Hardware shall be labeled.
 3. All sensors and actuators not in occupied areas shall be tagged.
 4. Airflow measurement arrays shall be tagged to show flow rate range for signal output range, duct size, and pitot tube AFMS flow coefficient.
 5. Duct static pressure taps shall be tagged at the location of the pressure tap.
 6. Tags shall be plastic or metal and shall be mechanically attached directly to each device or attached by a metal chain or wire.
 7. Labels exterior to protective enclosures shall be engraved plastic and mechanically attached to the enclosure or DDC Hardware.
 8. Labels inside protective enclosures may be attached using adhesive, but shall not be hand written.
 9. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
 10. Identify room sensors relating to terminal box or valves with nameplates.
 11. Manufacturers' nameplates and UL or CSA labels are to be visible and legible after equipment is installed.
- D. Identification of Tubing and Wiring
1. All wiring and cabling including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with the DDC address or termination number.
 2. Permanently label or code each point of field terminal strips to show the instrument or item served.
 3. All pneumatic tubing shall be labeled at each end within 5 cm (2 in.) of termination with a descriptive identifier.
- 3.14 Identification of Hardware and Wiring
- A. All wiring and cabling, including that within factory-fabricated panels shall be labeled at each end within 5 cm (2 in.) of termination with the DDC address or termination number.
 - B. All pneumatic tubing shall be labeled at each end within 5 cm (2 in.) of termination with a descriptive identifier.
 - C. Permanently label or code each point of field terminal strips to show the instrument or item served.
 - D. Identify control panels with minimum 1 cm (½ in.) letters on laminated plastic nameplates.
 - E. Identify all other control components with permanent labels. All plug-in components shall be labeled such that removal of the component does not remove the label.
 - F. Identify room sensors relating to terminal box or valves with nameplates.
 - G. Manufacturers' nameplates and UL or CSA labels are to be visible and legible after equipment is installed.
 - H. Identifiers shall match record documents.
- 3.15 Programming
- A. Provide sufficient internal memory for the specified sequences of operation and trend logging. There shall be a minimum of 25% of available memory free within the primary controller for future use.
 - B. Point Naming: System point names shall be modular in design, allowing easy operator interface without the use of a written point index. Point Naming standard shall be agreed upon between owner and BAS contractor. Refer to Submittals section in the General Section.
 - C. Software Programming
 1. Provide programming for the system and adhere to the sequences of operation provided. The contractor also shall provide all other system programming necessary for the operation of the system, but not specified in this document. Imbed into the control program sufficient comment statements to clearly describe each section of the program. The comment statements shall reflect the language used in the sequences of operation and be of different font and color in text editor. Use the appropriate technique based on one of the following programming types:
 - a. Text-based:
 - 1) Must provide actions for all possible situations

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- 2) Must be modular and structured
 - 3) Must be commented
 - 4) Must provide line by line programming and compilation wizard to allow for ease of editing.
 - b. Graphic-based:
 - 1) Must provide actions for all possible situations
 - 2) Must provide programming and compilation wizard to allow for ease of editing.
 - 3) Must be documented
 - D. Operator Interface
 1. Standard graphics—Provide graphics for all mechanical systems and floor plans of the building. This includes each chilled water system, hot water system, chiller, boiler, air handler, and all terminal equipment. Point information on the graphic displays shall dynamically update. Show on each graphic all input and output points for the system. Also show relevant calculated points such as set points.
 2. Show terminal equipment information on a “graphic” summary table. Provide dynamic information for each point shown.
 3. The contractor shall provide all the labor necessary to install, initialize, start up, and troubleshoot all operator interface software and its functions as described in this section. This includes any operating system software, the operator interface database, and any third-party software installation and integration required for successful operation of the operator interface.
 4. Contractor shall provide necessary programming to create all reports referred to in Part 2 Operator Interface Software
- 3.16 Control system checkout and testing
- A. Perform a three-phase commissioning procedure consisting of field I/O calibration and commissioning, system commissioning and integrated system program commissioning. Document all commissioning information on commissioning data sheets that shall be submitted prior to acceptance testing. Commissioning work that requires shutdown of system or deviation from normal function shall be performed when the operation of the system is not required. The commissioning must be coordinated with the owner and construction manager to ensure systems are available when needed. Notify the operating personal in writing of the testing schedule so that authorized personnel from the owner and construction manager are present throughout the commissioning procedure.
 - B. Phase I – Field I/O Calibration and Commissioning
 1. Verify that each control panel has been installed according to plans, specifications and approved shop drawings. Calibrate, test, and have signed off each control sensor and device. Commissioning to include, but not be limited to:
 - a. Sensor accuracy at 10, 50 and 90% of range.
 - b. Sensor range.
 - c. Verify analog limit and binary alarm reporting.
 - d. Point value reporting.
 - e. Binary alarm and switch settings.
 - f. Actuator and positioner spring ranges if pneumatic actuation is utilized.
 - g. Fail safe operation on loss of control signal, pneumatic air, electric power, network communications, etc.
 - C. Phase II – System Commissioning
 1. Each BMS program shall be put on line and commissioned. The contractor shall, in the presence of the owner and construction manager, demonstrate each programmed sequence of operation and compare the results in writing. In addition, each control loop shall be tested to verify proper response and stable control, within specified accuracy. System program test results shall be recorded on commissioning data sheets and submitted for record. Any discrepancies between the specification and the actual performance will be immediately rectified and re-tested.

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- D. Phase III - Integrated System Program Commissioning
1. Tests shall include, but not be limited to:
 - a. Data communication, both normal and failure modes.
 - b. Fully loaded system response time.
 - c. Impact of component failures on system performance and system operation.
 - d. Time/Date changes.
 - e. End of month/ end of year operation.
 - f. Season changeover.
 - g. Global application programs and point sharing.
 - h. System backup and reloading.
 - i. System status displays.
 - j. Diagnostic functions.
 - d. Power failure routines.
 - l. Battery backup.
 - m. Smoke Control, vents, in concert with Fire Alarm System testing.
 - n. Testing of all electrical and HVAC systems with other division of work.
 - o. Year 2000 compliance test.
 2. Sub Systems shall also be tested and commissioned.
 - a. Compressed Air System
 - 1) Test all high-pressure piping (80 PSI) at 100 PSI sustained for 24 hours.
Pressure loss shall not exceed 10 PSI at the end of the 24- hour test period.
 - 2) Test all low-pressure piping (25 PSI and below) at 30 PSI sustained for 24 hours.
Pressure loss shall not exceed 3 PSI at the end of the 24-hour period.
 3. Submit for approval, a detailed acceptance test procedure designed to demonstrate compliance with contractual requirements. This Acceptance test procedure will take place after the commissioning procedure but before final acceptance, to verify that sensors and control devices maintain specified accuracy and the system performance does not degrade over time.
 4. Using the commissioning test data sheets, the contractor shall demonstrate each point. The contractor shall also demonstrate 100 percent of the system functions. The contractor shall demonstrate all points and system functions until all devices and functions meet specification.
 5. The B.M.S. contractor shall supply all instruments for testing. Instruments shall be turned over to the owner after acceptance testing.
 6. All test instruments shall be submitted for approval prior to their use in commissioning.
 - a. Test Instrument Accuracy:
 - 1) Temperature: 1/4F or 1/2% full scale, whichever is less.
 - 2) Pressure: High Pressure (PSI): 1/2 PSI or 1/2% full scale, whichever is less.
 - 3) Low Pressure: 1/2% of full scale (in w.c.)
 - 4) Humidity: 2% RH
 - 5) Electrical: 1/4% full scale
 7. After the above tests are complete and the system is demonstrated to be functioning as specified, a thirty-day performance test period shall begin. If the system performs as specified throughout the test period, requiring only routine maintenance, the system shall be accepted. If the system fails during the test, and cannot be fully corrected within eight hours, the owner may request that performance tests be repeated.
- 3.17 Control system demonstration and acceptance
- A. Demonstration
1. Prior to acceptance, the control system shall undergo a series of performance tests to verify operation and compliance with this specification. These tests shall occur after the Contractor has completed the installation, started up the system, and performed his/her own tests.
 2. The tests described in this section are to be performed in addition to the tests that the contractor performs as a necessary part of the installation, start-up, and debugging process and as specified in the "Control System Checkout and Testing" article in Part 3 of this

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- specification. The engineer will be present to observe and review these tests. The engineer shall be notified at least 10 days in advance of the start of the testing procedures.
3. The demonstration process shall follow that approved in Part 1, "Submittals." The approved checklists and forms shall be completed for all systems as part of the demonstration.
 4. The contractor shall provide at least two persons equipped with two-way communication and shall demonstrate actual field operation of each control and sensing point for all modes of operation including day, night, occupied, unoccupied, fire/smoke alarm, seasonal changeover, and power failure modes. The purpose is to demonstrate the calibration, response, and action of every point and system. Any test equipment required to prove the proper operation shall be provided by and operated by the contractor.
 5. As each control input and output is checked, a log shall be completed showing the date, technician's initials, and any corrective action taken or needed.
 6. Demonstrate compliance with Part 1, "System Performance."
 7. Demonstrate compliance with sequences of operation through all modes of operation.
 8. Demonstrate complete operation of operator interface.
 9. Additionally, the following items shall be demonstrated:
 - a. DDC control loop response. The contractor shall supply trend data output in a graphical form showing the step response of each DDC control loop. The test shall show the loop's response to a change in set point, which represents a change of actuator position of at least 25% of its full range. The sampling rate of the trend shall be from 10 seconds to 3 minutes, depending on the speed of the loop. The trend data shall show for each sample the set point, actuator position, and controlled variable values. Any loop that yields unreasonably under-damped or over-damped control shall require further tuning by the Contractor.
 - b. Demand limiting. The contractor shall supply a trend data output showing the action of the demand-limiting algorithm. The data shall document the action on a minute-by-minute basis over at least a 30-minute period. Included in the trend shall be building kW, demand limiting set point, and the status of sheddable equipment outputs.
 - c. Optimum start/stop. The contractor shall supply a trend data output showing the capability of the algorithm. The change-of value or changeof- state trends shall include the output status of all optimally started and topped equipment, as well as temperature sensor inputs of affected areas.
 - d. Interface to the building fire alarm system.
 - e. Operational logs for each system that indicate all set points, operating points, valve positions, mode, and equipment status shall be submitted to the architect/engineer. These logs shall cover three 48-hour periods and have a sample frequency of not more than 10 minutes. The logs shall be provided in both printed and electronic formats.
 10. Any tests that fail to demonstrate the operation of the system shall be repeated at a later date. The contractor shall be responsible for any necessary repairs or revisions to the hardware or software to successfully complete all tests.

B. Acceptance

1. All tests described in this specification shall have been performed to the satisfaction of both the engineer and owner prior to the acceptance of the control system as meeting the requirements of completion. Any tests that cannot be performed due to circumstances beyond the control of the contractor may be exempt from the completion requirements if stated as such in writing by the engineer. Such tests shall then be performed as part of the warranty.
2. The system shall not be accepted until all forms and checklists completed as part of the demonstration are submitted and approved as required in Part 1, "Submittals."

3.18 Cleaning

- A. The contractor shall clean up all debris resulting from their activities daily. The contractor shall remove all cartons, containers, crates, etc., under his/her control as soon as their contents have been removed. Waste shall be collected and placed in a designated location.

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- B. At the completion of work in any area, the contractor shall clean all work, equipment, etc., keeping it free from dust, dirt, and debris, etc.
- C. At the completion of work, all equipment furnished under this section shall be checked for paint damage, and any factory-finished paint that has been damaged shall be repaired to match the adjacent areas. Any cabinet or enclosure that has been deformed shall be replaced with new material and repainted to match the adjacent areas.

3.19 Training

- A. The Contractor shall provide competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the system installed. Factory employed/certified instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. All training shall be held during normal work hours of 8:00 a.m. to 4:30 p.m. weekdays.
- B. Provide (40) hours of site-specific training for Owner's operating personnel. Training shall include:
 - 1. Day-to-day Operators:
 - a. Proficiently operate the system
 - b. Understand control system architecture and configuration
 - c. Understand DDC system components
 - d. Understand system operation, including DDC system control and optimizing routines (algorithms)
 - e. Operate the workstation and peripherals
 - f. Log on and off the system
 - g. Access graphics, point reports, and logs
 - h. Adjust and change system set points, time schedules, and holiday schedules
 - i. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals
 - j. Understand system drawings and Operation and Maintenance manual
 - k. Understand the job layout and location of control components
 - l. Access data from DDC controllers and ASCs
 - m. Operate portable operator's terminals
 - 2. Advanced Operators:
 - a. Make and change graphics on the workstation
 - b. Create, delete, and modify alarms, including annunciation and routing of these
 - c. Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals
 - d. Create, delete, and modify reports
 - e. Add, remove, and modify system's physical points
 - f. Create, modify, and delete programming
 - g. Add panels when required
 - h. Add operator interface stations
 - i. Create, delete, and modify system displays, both graphical and others
 - j. Perform DDC system field checkout procedures
 - k. Perform DDC controller unit operation and maintenance procedures
 - l. Perform workstation and peripheral operation and maintenance procedures
 - m. Perform DDC system diagnostic procedures
 - n. Configure hardware including PC boards, switches, communication, and I/O points
 - o. Maintain, calibrate, troubleshoot, diagnose, and repair hardware
 - p. Adjust, calibrate, and replace system components
 - 3. System Managers/Administrators:
 - a. Maintain software and prepare backups
 - b. Interface with job-specific, third-party operator software
 - c. Add new users and understand password security procedure
- C. Since the Owner may require personnel to have more comprehensive understanding of the hardware and software, additional training must be available from the Contractor. If such training is

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- required by the Owner, it will be contracted at a later date. Provide description in the Technical Proposal of available local and factory customer training.
- D. Provide course outline and materials in accordance with the “Submittals” article in Part 1 of this specification. The instructor(s) shall provide one copy of training material per student.
 - E. The instructor(s) shall be factory-trained instructors experienced in presenting this material.

PART 4 – ABBREVIATIONS, NOMENCLATURES & DIAGRAMS

4.1 Building Equipment Abbreviations

- A. The equipment abbreviations listed below shall be used on BMS point nomenclature. Deviation from these abbreviations may be made at the discretion of the Facilities Project Manager with Prior approval from the Director of Facilities Operations.

ACU	Air Conditioning Unit
AHU	Air Handling Unit
ATS	Automatic Transfer Switch
BLR	Boiler
BSC/BSH	Bio-Safety Cabinet/Bio-Safety Hood
CHLR	Chiller
CHWS	Chilled Water System
CO2	CO2 Sensor/Transmitter
ACOMP	Air Compressor
CRYO	Cryo Storage Unit
CT	Cooling Tower
CAV	Constant Air Volume Terminal Box
DRUM	Chemical Waste Container
EF	Exhaust Fan
EAV	Exhaust Air Volume Terminal Box
EVCP	Evacuation Control Panel
FACP	Fire Alarm Control Panel
FH	Fume Hood
FRZ	Freezer
GEN	Generator
H2	Hydrogen Sensor/Transmitter
HRS	Heat Recovery System
HWS	Hot Water System
HXS	Heat Exchanger System
INC	Incubator
KEG	Chemical Supply Container
LEL	Low Explosion Limit
LYO	Lyophilize Unit
N2	Nitrogen Sensor/Transmitter
O2	Oxygen Sensor/Transmitter
PHM	PH Meter
PMP	Pump
RDWS	RO/DI Water System
REF	Refrigerator
RF	Return Fan
RTU	Rooftop Unit
SF	Supply Fan
SOLS	Solvent Supply
SOLW	Solvent Waste
STC	Stability Chamber
UPS	Uninterruptable Power Supply

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VBE	Ventilated Balance Enclosure
VCUM	Vacuum System
VFD	Variable Frequency Drive
VAV	Variable Air Volume System

4.2 Database Input/Output/Virtual Point Abbreviations

- A. In addition to the equipment abbreviations, the system points (controlled and monitored) abbreviations listed below shall be used to complete the BMS point nomenclature. Deviation from these abbreviations may be made at the discretion of the Facilities Project Manager with Prior approval from the Director of Facilities Operations.

AIRV	Air Volume
BSPT	Building Static Pressure Transmitter
BYPVLV	Bypass Valve
CCVLV	Cooling Coil Valve
COMD	Command
COOL	Cool Mode
DATT	Discharge Air Temperature Transmitter
DAY	Day Mode
DMND	Demand
DMPR	Damper
DOM	Domestic
DPT	Differential Pressure Transmitter
EADSPT	Exhaust Air Duct Static Pressure Transmitter
EATT	Exhaust Air Temperature Transmitter
ENA	Enable/Disable
FBAK	Feedback
FILT	Filter
FNL	Final
FT	Flow Transmitter
HCVLV	Heating Coil Valve
HEAT	Heat Mode
HI	High
HRTT	Heat Recover Temperature Transmitter
IND	Industrial
L	Level
LAG	Lag
LEAD	Lead
LO	Low
LOAD	Load
MATT	Mixed Air Temperature Transmitter
MED	Medium
NGT	Night Mode
OATT	Outside Air Temperature Transmitter
ODP	Operator Display Panel
POS	Position
PRE	Before
PRF	Proof
PT	Pressure Transmitter
RATT	Return Air Temperature Transmitter
RMTT	Room Temperature Transmitter

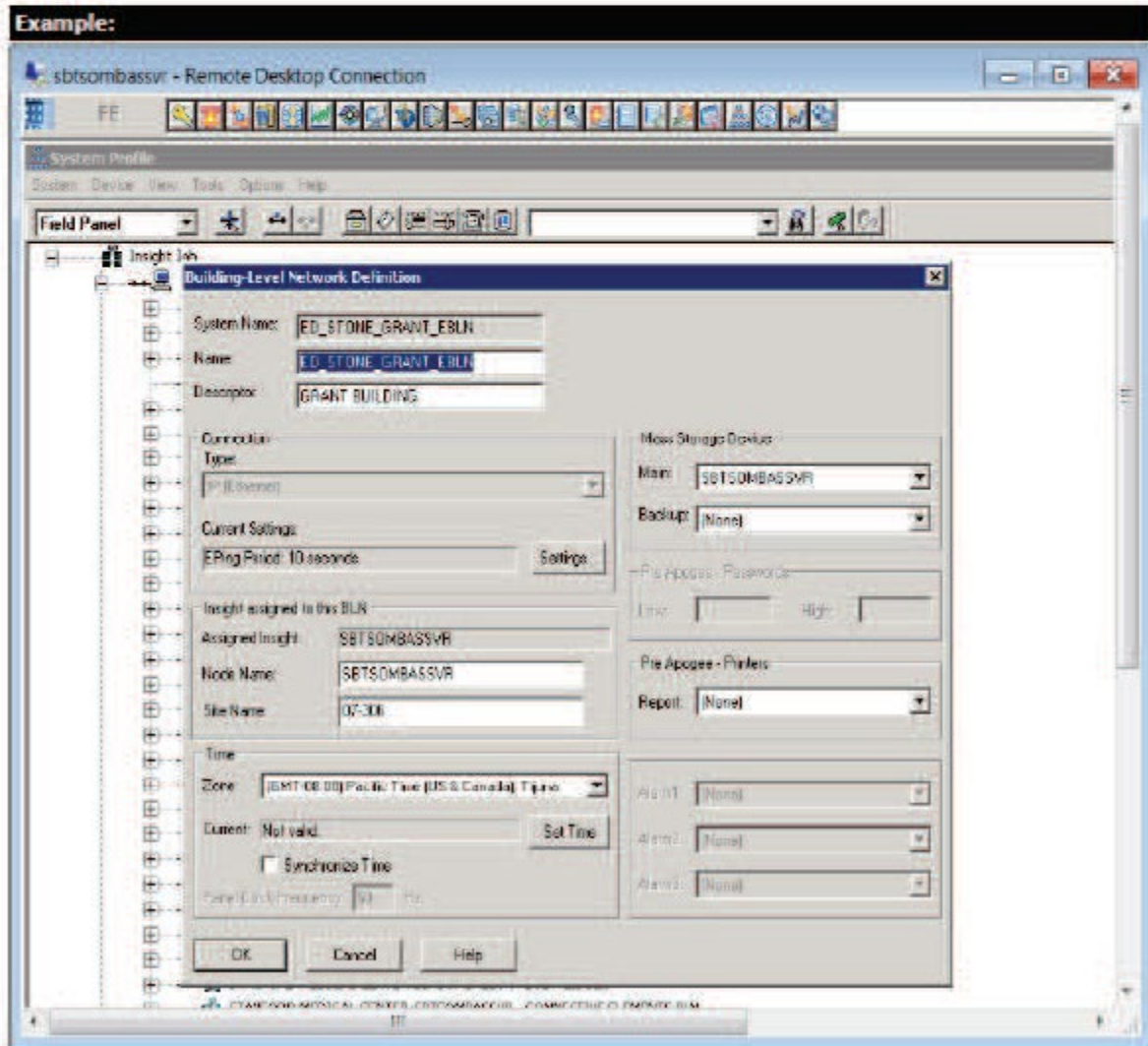
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RWFT	Return Water Flow Transmitter
RWTT	Return Water Temperature Transmitter
SADSPT	Supply Air Duct Static Pressure Transmitter
SATT	Supply Air Temperature Transmitter
SPD	Speed
SSTP	Start/Stop
STAGE	Cooling/Heating Stages
STAT	Status
STPT	Setpoint
SWFT	Supply Water Flow Transmitter
SWTT	Supply Water Temperature Transmitter
TT	Temperature Transmitter
THRSx	Time Delay in Hours, "x" – quantity THRS point
TMINsx	Time Delay in Minutes, "x" – quantity TMIN point
TSECx	Time Delay in Seconds, "x" – quantity TSEC point
VLV	Valve

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4.3 Database Network Nomenclature
A. Building Level Network (BLN)

System Name:	Stanford defined
Name:	Same as System Name
Descriptor:	Building Name or Address
Connection:	IP (Ethernet)
Current Settings:	Default (Eping Period: 10 seconds)
Assigned Insight:	SBTSOMBASSVR
Node Name:	SBTSOMBASSVR
Site Name:	Stanford Zone-Building Asset ID
Time Zone:	(GMT-08:00) Pacific Time (US & Canada); Tijuana
Synchronize Time:	Checked
Mass Storage Device (Main):	SBTSOMBASSVR
Mass Storage Device (Backup):	None
PreApogee Printer Report:	None



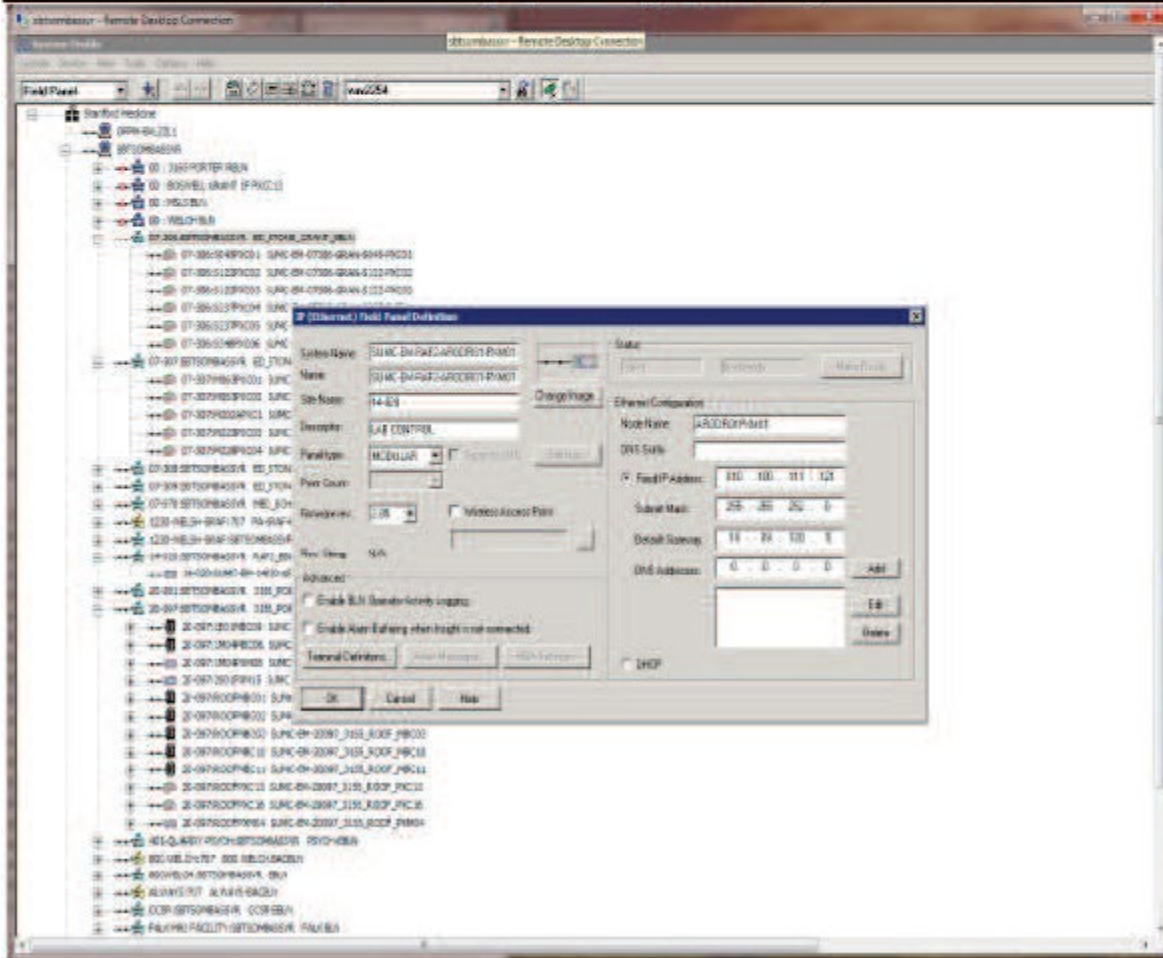
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4.4 Database Controller Nomenclature

A. Primary DDC Controllers (i.e. AHU, EF, CT, CHWS, HWS)

Format:	
IRT Tag + Building Physical Address + Panel Location + CMI + CT + CC	
IRT Tag:	Stanford IRT Required Prefix
Building Address:	On-Campus First 4-letter or Acronym (i.e. LKSC, BECK for Beckman / Off-Campus Physical Building Address (i.e. 3155 Porter will be "3155") - Adjustable
Panel/System Location:	Physical Control Panel Location (i.e. "ROOF", "YARD", Corridor "AROCIR01") - Adjustable
Controller Type:	Controller Type (i.e. M-Modular, C-Compact)
Control Panel Count:	Control Panel Count (1-999 per floor) - Adjustable

Example:						
1	2	3	4	5	6	7
S	U	M	C	-	E	M
-	3	1	5	5	-	1
M	1	-	P	X	C	0
1						
IRT Tag	Building Physical Address	Hyphens	Panel Location - Room #	Hyphens	Controller Type	Control Panel Count



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B. Secondary Floor Level Network (FLN) Controllers (i.e. CAV, VAV, EAV)

Format:	
Building Physical Address • Room T-stat Location • System Number • Box Type • Box ID	
Building Address:	On-Campus First 4-letter or Acronym (i.e. LKSC, BECK for Beckman / Off-Campus Physical Building Address (i.e 3155 Porter will be "3155") - Adjustable
Room T-stat Location:	Room number of the T-stat location - Adjustable
System ID:	i.e. for AHU01 this field shall be "01", EF003 this field shall be "03"
Box Type:	i.e. VAV (VV), CAV(CV), EAV(EV)
Box ID:	Terminal Box ID from Mechanical Drawing CAV/VAV/EV Terminal Box Schedule - Adjustable

Example:																												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
3	1	5	5	.	M	1	0	2	2	X	.	0	1	V	V	V	A	V	0	1	-	1	0	2	2			
Building Physical Address	Period	Room T-stat Location				Period	AHU or EF Number	VAV/CAV/EAV Type	Terminal Box ID																			

Example above represents the variable air volume terminal box id vav01-1022 that serves and room thermostat in room M1022X of building 3155 Porter Drive. AHU01 serves this terminal box.

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4.5 Database Point Nomenclature

A. Main Equipment (i.e. AHU, EF, CT, CHWS, HWS)

Format:	
Building Physical Address + System Location + System ID + Field I/O Abbreviation	
Building Address:	On-Campus First 4-letter or Acronym (i.e. LKSC, BECK for Beckman / Off-Campus Physical Building Address (i.e 3155 Porter will be"3155") - Adjustable
Panel/System Location:	Physical Control Panel Location (i.e. "ROOF", "YARD", Mezzanine "MEZZ") - Adjustable
System Acronym:	See acronym list
Field Device Abbreviation:	i.e. Supply Water Temp (SWT), Supply Air Temp (SAT)

Example:	
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	
3 1 5 5 . Y A R D X X . C H W S . S W T T	
Building Physical Address	Field Device Input/Output/Virtual Point Abbreviation

Example above represents the supply water temperature transmitter for the chilled water system located in the yard "XX" of building 3155 Porter Drive.

B. Miscellaneous Equipment Alarms (i.e. freezers, integrated devices)

Format:	
Building Physical Address + Equipment Location + -80FRZ + Equipment Serial No. + Notification	
Building Address	Physical Building Address or Building Name's first 4 characters or Acronym (Adjustable)
Equipment Location	Room number - Adjustable
Equipment Type	i.e. "-80FRZ", "-20FRZ", "CRYO"
Equipment SN#	Last 5-characters of equipment's serial number
Notification (option)	i.e. 1A,1B,1C - first level alarm recipients; 2A,2B,2C - 2nd level alarm recipient and so forth.

Example:	
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29	
3 1 5 5 . M 4 1 0 2 X . - 8 0 F Z R 1 2 3 4 H . X X	
Building Physical Address	Equipment Location
Equipment Type	Last 5-characters of equipment's Serial No. (SN) and Optional Notification System Point

Example above represents the -80c freezer with serial number xxxxxxxx1234H located in room "M4102X" of building 3155 Porter Drive.

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4.6 Ethernet Network Connection Request Form

Stanford University
 School Medicine - Office of Facilities Planning & Management
NETWORK CONNECTION REQUEST FORM

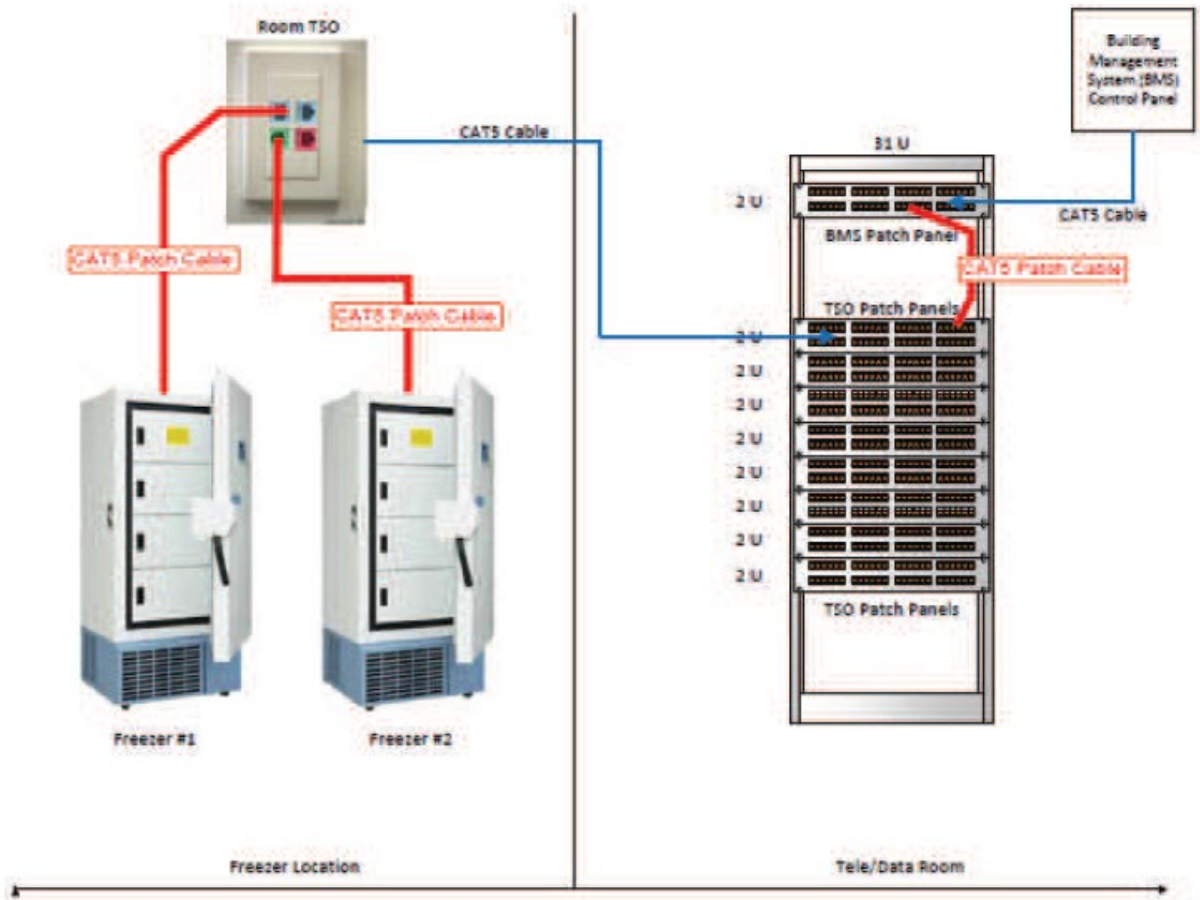
Building	Room No	TSO ID (ITS Provided)	Device Name (OFPM provided)	Equipment Served (i.e. AHU, HWS, CHWS)	MAC Address	IPAddress (IRT provided)
055	MEZZ			AHU02	00 C0 E4 03 92 D1	

REQUESTOR'S CONTACT INFO

Name: _____
 Mobile No: _____
 Email: _____

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4.7 Laboratory Equipment Alarm Monitoring Layout



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4.8 Freezer Monitoring and Power Supply Configuration Photo #1



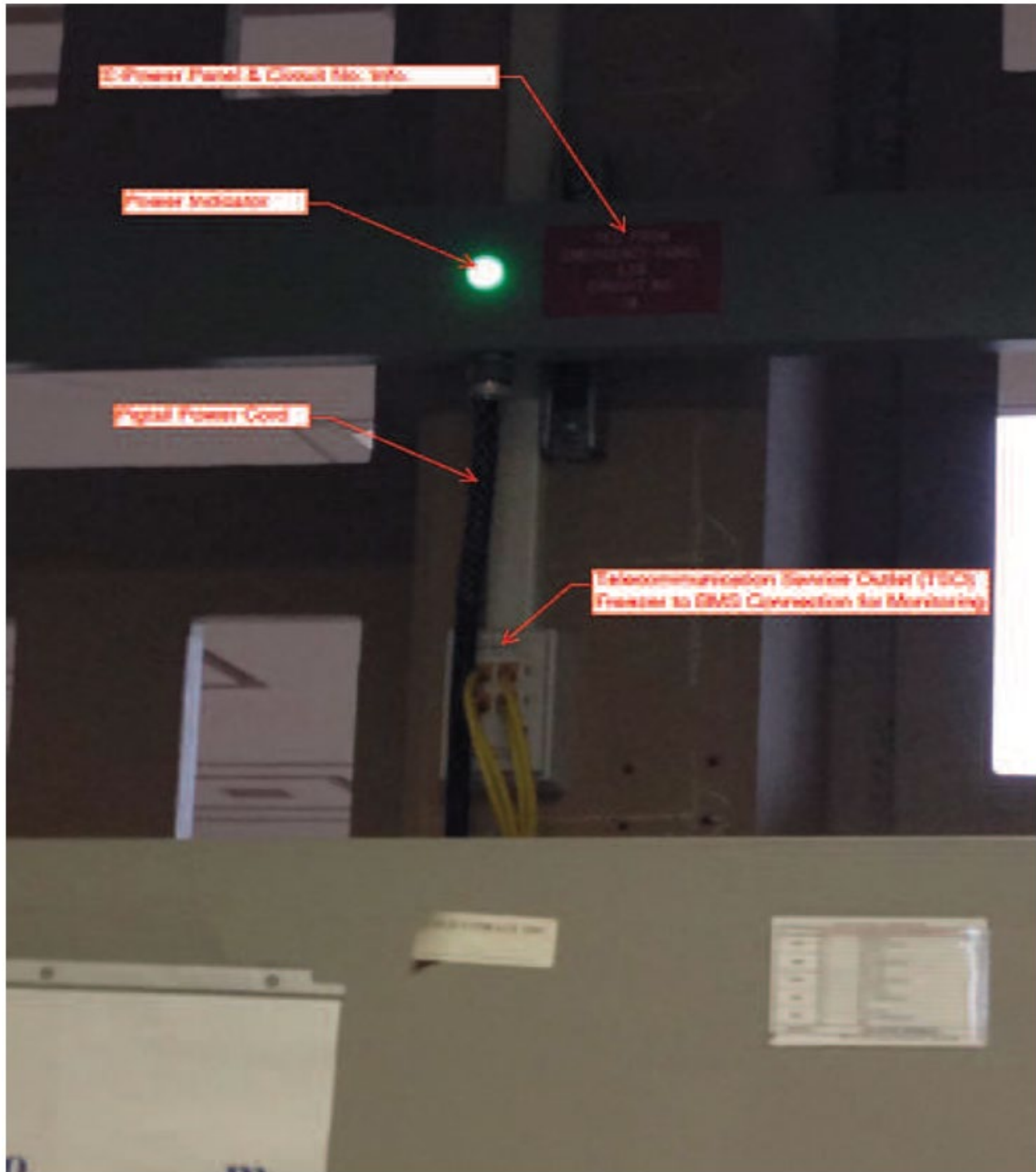
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4.9 Freezer Monitoring and Power Supply Configuration Photo #2



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4.10 Freezer Monitoring and Power Supply Configuration Photo #3



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4.11 Freezer Power Supply Indicating Lights Specification Sheet #1

***** ACCESS TO THE BAYONNET LED SHALL BE FROM THE FRONT HOUSING OF THE DEVICE *****



Schneider Electric USA
1415 South Roselle Road
Palatine, IL 60067
Customer Care Center: 1-888-776-2733
Web: www.schneider-electric.us

ITEM # 9001KM38LG, 30MM LIGHT MODULE

Representative Photo Only. Actual Product May Differ.



Specifications	
UL File	E78403 CCM NKCR
CSA File	LR24590 Class 3211-03
CE Marked	Yes
RoHS compliant	Yes
NEMA / IP Rating	IP20
Light Module Supply Voltage	120VAC/DC
Light Module Type	LED (Green)
Terminal Type	Screw Clamp
Note	Color of LED lamp may be different that photograph shown.

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4.12 Freezer Power Supply Indicating Lights Specification Sheet #1

2.25 *** GREEN LIGHT, PLASTIC FOR PRESS-TEST OR LLUMINATED BUTTONS ***

Schneider Electric 9001G31

Products > Optoelectronics & Lighting > Indicators, Panel Mount > Lenses & Caps > 9001G31
View More: [Schneider Electric Indicators, Panel Mount >>](#)



View larger image

*Image may be a representation.
See specs for product details.*



30MM PLASTIC LENS FOR PILOT LIGHT GREEN

Mfr. Part#: 9001G31
Allied Stock#: 70343021

RoHS Compliant Part

Quantity

Add to Cart



Resources

[View More from Schneider Electric >>](#)

Non-Expendable Non-Returnable (NENR) part. Please see [Terms of NENR](#).

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4.13 Vivarium Room Control and Monitoring Hardware Configuration

SOM VSC RAF1 Room Temp/Humidity/Light Control & Monitoring Configuration

**Mechanical Timer Switch Override
(Outside the Room)**

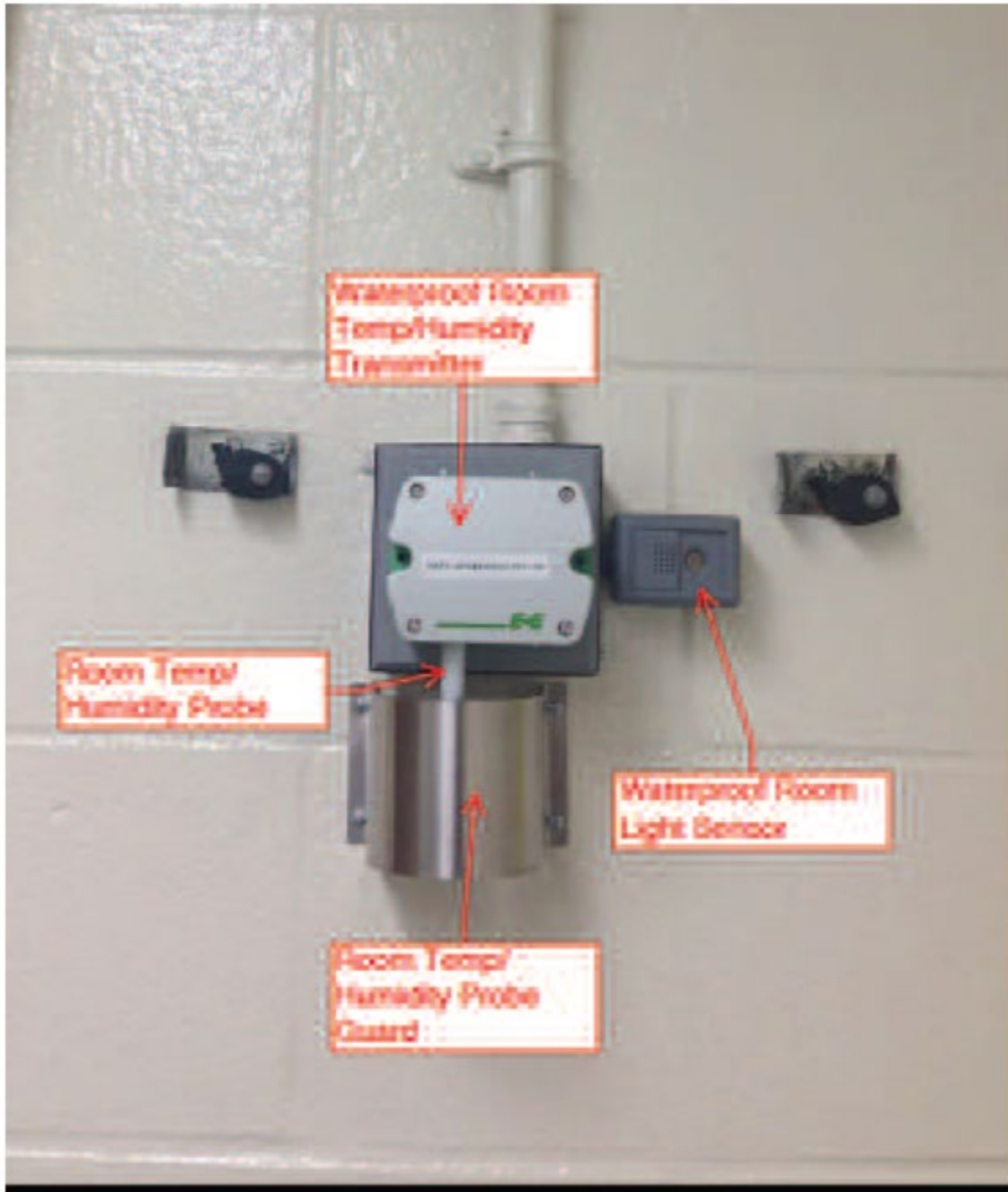


**Room Temp/Humidity/Light Transmitter &
Probe Guard (Inside the Room)**



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4.14 Vivarium **INSIDE** the Room Temp/Humidity/Light for Monitoring



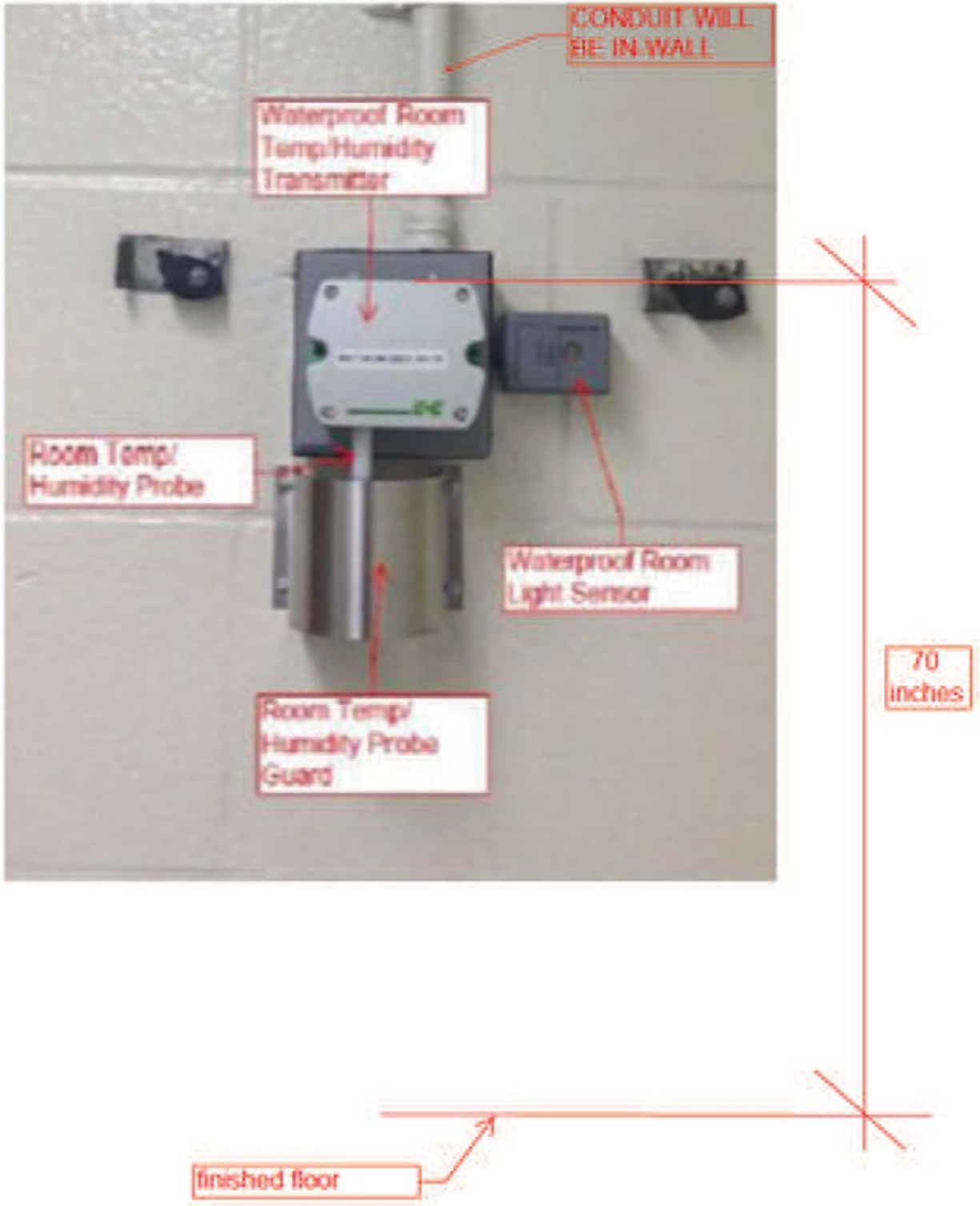
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4.15 Vivarium **OUTSIDE** the Room Mechanical Timer for Light Control



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4.16 Vivarium Room Temp/Humidity/Light Sensor Height Installation



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4.17 Building Automation & Controls Program Format - Page 1 of 3

```
00010 C #####
00020 C *** GENERAL PROGRAM INFORMATION - TEMPLATE ***
00030 C #####
00040 C
00050 C =====
00060 C STANFORD UNIVERSITY - SCHOOL OF MEDICINE
00070 C =====
00080 C
00090 C BUILDING NAME: MSOB BUILDING
00100 C PANEL NAME: SUMC-EM-MSOB-X1M4-PXC03
00110 C PROGRAM NAME: MSOB.X1M4.PXC03.FC.CTRL
00120 C
00130 C PROGRAM DESCRIPTION:
00140 C NIGHTS & WEEKEND SETBACKS OF FAN COIL OPERATION.
00150 C
00160 C
00170 C
00180 C
00190 C VERSIONDATE ENG/SPEC COMMENTS
00200 C 0 03-31-2015 FRED ECHALUSE INITIAL PROGRAMMING
00210 C 1 MM-DD-YYYY XXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXX
00220 C 2 MM-DD-YYYY
00230 C 3 MM-DD-YYYY
00240 C 4 MM-DD-YYYY
00250 C 5 MM-DD-YYYY
00260 C
00270 C NOTES:
00280 C 1.) AVOID USING THE FOLLOWING PPLC STATEMENTS
00290 C - DEFINE
00300 C - ADPTS
00310 C - ADPTM
00320 C
00330 C
00340 C #####
01000 C *** PROGRAM LINE, DATA STORAGE, TIMERS DESCRIPTION ***
01010 C #####
01020 C
01030 C LINE CODE 00010: GENERAL PROGRAM INFORMATION
01040 C LINE CODE 01000: PROGRAM LINE DESCRIPTION
01050 C LINE CODE 02000: START OF PROGRAM - INITIALIZATION
01060 C LINE CODE 03000:
01070 C LINE CODE 04000: SYSTEM STARTUP/ENABLE
01080 C LINE CODE 05000:
01090 C LINE CODE 06000: DAMPER CONTROL SEQUENCE
01100 C LINE CODE 07000:
01110 C LINE CODE 08000: SUPPLY DUCT STATIC/VFD CONTROL SEQUENCE
01120 C LINE CODE 09000:
01130 C LINE CODE 10000: EXHAUST DUCT STATIC/ VFD CONTROL SEQUENCE
01140 C LINE CODE 11000:
01150 C LINE CODE 12000: SUPPLY AIR TEMPERATURE CONTROL SEQUENCE
01160 C LINE CODE 13000:
01170 C LINE CODE 14000: ADDITIONAL CONTROL SEQUENCES
01180 C LINE CODE 15000:
01190 C LINE CODE 16000:
01200 C LINE CODE 17000:
01210 C LINE CODE 18000:
01220 C LINE CODE 19000:
01230 C LINE CODE 20000: GENERAL ALARM MONITORING
01240 C LINE CODE 21000:
01250 C LINE CODE 22000:
01260 C LINE CODE 23000:
```

Stanford University-Facilities Design Guideline Amendment

4.18 Building Automation & Controls Program Format - Page 2 of 3

```
01270 C LINE CODE 24000:
01280 C LINE CODE 25000:
01290 C LINE CODE 26000:
01300 C LINE CODE 27000:
01310 C LINE CODE 28000:
01320 C LINE CODE 29000:
01330 C LINE CODE 30000: SYSTEM GENERAL ALARM DEFINITIONS
01340 C LINE CODE 31000: SYSTEM SHUTDWN/DISABLE
01350 C LINE CODE 32000: END OF PROGRAM
01360 C LINE CODE 32767: MAXIMUM LINE CODE
01370 C
01380 C $LOC1:
01390 C $LOC2:
01400 C $LOC3:
01410 C $LOC4:
01420 C $LOC5:
01430 C $LOC6:
01440 C $LOC7:
01450 C $LOC8:
01460 C $LOC9:
01470 C $LOC10:
01480 C $LOC11:
01490 C $LOC12:
01500 C $LOC13:
01510 C $LOC14:
01520 C $LOC15:
01530 C
01540 C SECND1:
01550 C SECND2:
01560 C SECND3:
01570 C SECND4:
01580 C SECND5:
01590 C SECND6:
01600 C SECND7:
01610 C SECNDS:
01620 C
02000 C *****
02010 C ### START OF PROGRAM ###
02020 C *****
02030 C
02040 C =====
02050 C ON POWER RETURN
02060 C =====
02070 C ONPWRI(2090)
02080 C GOTO 4000
02090 C SET (0, SECNDS, SECND1, SECND2, SECND3, SECND4, SECND5, SECND6, SECND7)
02100 C SET (0, $LOC1, $LOC2, $LOC3, $LOC4, $LOC5, $LOC6, $LOC7, $LOC8)
02110 C
02120 C
02130 C
04000 C *****
04010 C ### SYSTEM STARTUP/ENABLE ###
04020 C *****
04030 C
04040 C
04050 C
04060 C
04070 C
06000 C *****
06010 C ### DAMPER CONTROL SEQUENCE ###
06020 C *****
```

Stanford University-Facilities Design Guideline Amendment

4.18 Building Automation & Controls Program Format - Page 3 of 3

```
06030 C
06040 C
06050 C
06060 C
06070 C
08000 C #####
08010 C ### SUPPLY DUCT STATIC / VFD CONTROL SEQUENCE ###
08020 C #####
08030 C
08040 C
08050 C
08060 C
08070 C
10000 C #####
10010 C ### EXHAUST DUCT STATIC / VFD CONTROL SEQUENCE ###
10020 C #####
10030 C
10040 C
10050 C
10060 C
10070 C
12000 C #####
12010 C ### SUPPLY AIR TEMPERATURE CONTROL SEQUENCE ###
12020 C #####
12030 C
12040 C
12050 C
12060 C
12070 C
14000 C #####
14010 C ### ADDITIONAL CONTROL SEQUENCE ###
14020 C #####
14030 C
14040 C
14050 C
14060 C
14070 C
20000 C #####
20010 C ### GENERAL ALARM MONITORING ###
20020 C #####
20030 C
20040 C
20050 C
20060 C
20070 C
30999 GOTO 32767
31000 C #####
31010 C ### SYSTEM SHUTDOWN/DISABLE ###
31020 C #####
31030 C
31040 C
31050 C
31060 C
31070 C
32000 C #####
32010 C ##### END OF PROGRAM #####
32020 C #####
32767 GOTO 10
```

Stanford University-Facilities Design Guideline Amendment

PART 5 – REVISION HISTORY

Date: Description:

12/15/2013 Addition of the following sections:

- Table of Contents
- Part 2.02 Section C: Operator Workstation
- Part 4: BMS Abbreviations, Nomenclature & Diagrams
- Part 5: Revision History

06/01/2016 Updates of the following sections:

- Section 4.6 added a column for Equipment served.

Addition of the following sections:

- 4.8: Freezer Monitoring and Power Supply Configuration Photo #1
- 4.9: Freezer Monitoring and Power Supply Configuration Photo #2
- 4.10: Freezer Monitoring and Power Supply Configuration Photo #3
- 4.11: Freezer Power Supply Indicating Lights Specification Sheet #1
- 4.12: Freezer Power Supply Indicating Lights Specification Sheet #2
- 4.13: Vivarium Room Control and Monitoring Hardware Configuration
- 4.14: Vivarium INSIDE Room Temp/Humidity/Light for Monitoring
- 4.15: Vivarium OUTSIDE Room Mechanical Timer for Light Control
- 4.16: Vivarium Room Temp/Humidity/Light Sensor Height Installation
- 4.17: Building Automation & Controls Program Format - Page 1 of 3
- 4.18: Building Automation & Controls Program Format - Page 2 of 3
- 4.19: Building Automation & Controls Program Format - Page 3 of 3

END OF SECTION

Stanford University-Facilities Design Guideline Amendment

SECTION 25 35 16

SENSORS AND TRANSMITTERS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1 GENERAL 1.1 SUMMARY, A,

- 9. Oxygen Depletion Sensors

Amendment to Part 2, PRODUCTS,

2.15 Oxygen Depletion Sensors

- A. SoM approved O2 Sensor is Toxgard II. Ox-600 is an approved equal alternative.

Amendment to Part 3, EXECUTION,

3.17 O2 Sensors

- A. Provide O2 sensors to accomplish control sequence.
- B. Coordinate final location.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 05 19 02

WIRING DEVICES

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Amendment to Part 2- PRODUCTS, 2.3 Receptacles

F. Outlets served from an Emergency power system shall be RED. Outlets served from Normal power system shall be WHITE.

Part 3

Amendment to Part 3- EXECUTION, 3.3 INSTALLATION

L. Outlets served from an Emergency power system shall be RED. Outlets served from Normal power system shall be WHITE.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendments to Part 1.7 SYSTEM DESCRIPTION:

M. Maximum conductor fill: Per NEC table 9F.

Part 2

Amendment to Part 2.9, E:

E. Wall Plates for Furnished Areas: As specified in wiring devices specification section. / Provide gasketed cover.

Addition to Part 2.10, E, 1:

1. Cover: Nonskid cover with neoprene gasket and stainless-steel cover screws.

Part 3

Amendment to Part 3.3, F:

F. Do not support raceway to ceiling support wires or other piping systems, except for fixture whips or manufactured wiring systems as allowed by NEC 300.

Addition to Part 3.3, U:

U. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

Addition to Part 3.8 EXISTING WORK:

F. Clean and Repair existing raceway and boxes, which remain or are to be reinstalled.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 05 33.16

FLOOR BOXES FOR ELECTRICAL SYSTEMS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Amendment to Part 2.6, B:

B. Housing: Stainless Steel.

Part 3

Amendment to Part 3.2, F:

F. Coordinate installation of all access floor boxes with access floor system provide under Section or existing access floor system.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 05 36

CABLE TRAYS FOR ELECTRONIC SAFETY AND SECURITY

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Addition to Part 2:

2.9 WARNING SIGNS (WHERE APPLICABLE)

A. Engraved Nameplates: ½ inch black letters on yellow laminated plastic nameplate, engraved with the following wording:

WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR CABLES AND TUBING!

Part 3

Addition to Part 3.1, F:

4. Provide bare copper equipment-grounding conductor through entire length of tray; bond to each component, as design requires for size.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 05 39

UNDERFLOOR RACEWAYS FOR ELECTRICAL SYSTEMS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated February 2009, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Additions to Part 1.9 EXTRA MATERIALS:

3. Supply 5 after set inserts for each 200 feet of distribution raceway.
4. Supply 2 service fittings for each 100 feet of distribution raceway
5. Supply 20 outlet blanking covers

Part 2

Amendment to Part 2.4, A (Pedestal Convenience Receptacle):

A Housing: Satin Aluminum

Addition to Part 2.5 FLUSH CONVENIENCE RECEPTACLE:

C. Receptacles: NEMA WD 6, type 5-15R, single receptacle.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 12 19.01

PADMOUNTED TRANSFORMER-OIL FILLED

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.1 DESCRIPTION:

Pad mount Transformers and Insulating Oil with underground primary and secondary connections for use in distributed system. Pad Mount Transformers and Insulating Oil.

Amendment to Part 2.1 GENERAL DESCRIPTION:

Pad mount Compartmental Type, Self-cooled, Three Phase Distribution Transformer as manufactured by Alstom (Balteau Transformers).

Amendment to Part 2.2 A:

A. Self-Cooled rating: 75, 112.5, 225, 300, 500, 1000 KVA, 3-phase, 60 Hz.

Addition to Part 2.2 C:

C. Primary Voltage (60kV, 95kV) BIL [4,160] [12,470] Delta.

Addition to Part 2.3, A, 1:

1. Configure the primary for loop feed and provide six (6) externally clamped 200 Amp bushing wells and inserts and parking stands. The face of the parking stand shall extend from the tank wall a minimum of 1.75-inch.

Amendment to Part 2.3, A Loop Feed, 3:

3. Provide primary protection by current limiting fuses in Non-load break drywells. Interlock fuse holders so that transformer switch must be in the off position before fuses can be removed. Fuses shall be Cooper Power System or equal.

Amendment to Part 2.3, B Radial Feed, 3:

3. Provide primary protection by current limiting fuses in Non-load break drywells. Interlock fuse holders so that transformer switch must be in the off position before fuses can be removed. Fuses shall be Combined Technologies X-Limiter or equal.

Amendment to Part 2.5, H:

H. Paint and Finish: Finish the transformer according to ANSI standard (C57.12.28/29) for surface preparation, primer, and paint durability. Exterior color: Munsel No. 7GY3.29/1.5 "pad mount green." OR Kelly Moore 1245-407 acrylic low sheen "carbon" or equal

Addition to Part 2.5:

I. Copper Windings shall be copper for transformer rated 1500kVA or higher.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 24 16

PANELBOARDS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 2 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.6 A:

- A. Provide [two] of each panelboard key. All panelboards shall be keyed alike to the Owner's current keying system.

Addition to Part 2.3, A:

- A. Product Description: NEMA PB 1 panelboard, circuit breaker type, fusible switch type, panelboards. Cutler-Hammer type Pow-R-Line 4, or equal.

Addition to Part 2.3, D:

- D. Minimum integrated short circuit rating: 65,000 amperes rms symmetrical for 208-volt panelboards, 65,000 amperes rms symmetrical for 480-volt panelboards or as indicated. Provide fully rated panelboards; series ratings to achieve specified AIC are not acceptable.

Amendment to Part 2.3, F:

- F. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

Amendment & Addition to Part 2.3, G:

- G. Molded Case Circuit Breakers with Current Limiters: NEMA AB 1, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.

Amendment & Addition to Part 2.3, H:

- H. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.

Amendments & Additions to Part 2.3, I:

4. Overload Relay: NEMA ICS 2; bimetal, melting alloy
6. Cover Mounted Pilot Devices: NEMA ICS 5, standard, (heavy), duty, oil tight type, as required for installation
11. Control Power Transformers: 120 volt, 350VA minimum, in each motor starter, as scheduled. Provide fused secondary, and bond unfused leg of secondary to enclosure ground.
12. Pushbuttons: Unguarded type.

Addition to Part 2.3, K:

2. Cabinet Front: Door-in-door type, screws, hinge and latch, hinged door with flush lock, metal directory frame, finished in manufacturer's standard gray enamel.

Stanford University-Facilities Design Guideline Amendment

Addition to Part 2.4, C:

- C. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240-volt panelboards; 14,000 amperes rms symmetrical for 480-volt panelboards, or as indicated. Provide fully rated panelboards; series ratings to achieve specified AIC are not acceptable.

Amendment to Part 2.4, D:

- D. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

Amendment to Part 2.4, E:

- E. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.

Additions to Part 2.4, BRANCH CIRCUIT PANELBOARDS:

- H. Cabinet Front: Door-in-door type, screws, hinge and latch, hinged door with flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- I. Breakers for power in a building shall be located on the floor in which they serve.
- J. Each Lab Bench to be fed by Minimum 1 Dedicated Circuit plus an extra 50% Spares Circuit. (Example: Lab with 10 Benches to have Min. 15 Circuits for Benches / 1.5 Circuits per Bench.)

Additions to Part 2.6, LOAD CENTERS:

- D. Enclosure: General Purpose, or Rainproof.
- E. Box: Flush, or Surface type. Without door, with door and pull ring and latch, lock on door. Finish in manufacturer's standard gray enamel.

Part 3

Additions to Part 3.1:

- C. Provide new circuit breakers of the same type and manufacturer in existing circuit breakers. Remanufactured and rebuilt circuit breakers are not permitted unless they are provided by the original panel manufacturer and approved for use in the specific panel.

Amendment & Addition to Part 3.2, G:

- G. Provide spare conduits out of each recessed panelboard to an accessible location. Minimum spare conduits: provide minimum of five empty 1 inch. Identify each as SPARE.

Addition to Part 3.2, H:

- H. Ground and bond panelboard enclosure. Connect equipment ground bars of panels as required by NEC Article 517.
- J. Provide yellow floor marking that designates the required clearances at the electrical panel.
 1. Bold graphical symbol and message convey the reason to keep area clear.
 2. Constructed of thick adhesive vinyl, subsurface printed, with clear laminate to protect the words and image.
 3. Non-slip, pebble-textured surface provides added durability to withstand heavy pedestrian traffic.
 4. Strong permanent, self-adhesive underside has peel-off back liner.
 5. The following image exemplifies the yellow floor marking.

Stanford University-Facilities Design Guideline Amendment



- K. Wherever possible, locate the panelboard behind the swing door to prevent occupants from storing items within the required clearance in front of the panelboard.

Addition to Part 3:

3.4 Adjusting

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 24 19

MOTOR CONTROL CENTERS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Additions to Part 2.1 MOTOR CONTROL CENTER:

- O. Pilot Lights: LED, Red, "run"
- P. Hand-Off-Auto Selector Switch:
 - 1. Except on pumps or other equipment that may be damaged by control bypass.
- Q. Provide time delays for "Load-Shed" start-up purposes.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 27 16

ELECTRICAL CABINETS AND ENCLOSURES

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Additions to Part 2:

2.4 CABINETS

- A. Boxes: Galvanized steel with removable end walls.
- B. Box Size: Per design and location.
- C. Backboard: Provide ¾-inch thick plywood backboard or metal panel for mounting terminal blocks. Paint matte white.
- D. Front: Steel, flush or surface type depending on design and location with screw cover front or door with concealed hinge and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.
- E. Knockouts: To be determined by design and location.
- F. Provide metal barriers to form separate compartments wiring of different systems and voltages.
- G. Provide accessory feet for free-standing equipment.

Part 3

Additions to Part 3.1:

- F. Provide yellow floor marking that designates the required clearances at the electrical panel.
 - 1. Bold graphical symbol and message convey the reason to keep area clear.
 - 2. Constructed of thick adhesive vinyl, subsurface printed, with clear laminate to protect the words and image.
 - 3. Non-slip, pebble-textured surface provides added durability to withstand heavy pedestrian traffic.
 - 4. Strong permanent, self-adhesive underside has peel-off back liner.
 - 5. The following image exemplifies the yellow floor marking.



- G. Wherever possible, locate the panelboard behind the swing door to prevent occupants from storing items within the required clearance in front of the electrical boards and enclosures.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 29 23

VARIABLE FREQUENCY MOTOR CONTROLLERS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 7 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.1 System Description:

A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor.

Amendment to Part 1.2, B Codes and Standards:

1. IEEE 519 Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
2. National Electrical Manufacturer's Association (NEMA) / National Electrical Manufacturer's Association (NEMA) ICS 7.1 Safety and Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems
3. FCC Rules and Regulations, Part 15, Subpart J, Class A. RFI Levels
4. Underwriter's Laboratories (UL) UL508C

Additions to Part 1.3, A:

6. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
 - a. The VFD manufacturer shall provide calculations, specific to this installation, showing total harmonic voltage distortion is less than 5%. Input line filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors.

Amendments to Part 1.2, B Qualifications:

4. Acceptable Manufacturers

- a. ABB ACH580 E-Clipse Bypass Drives Series.
- b. Engineer approved within 2 weeks of bid. Approval does not relieve supplier of specification requirements.
- c. VFD's that are manufactured by a third party and "brand labeled" shall not be acceptable.

Amendment to Part 1.5, A Shipment Protection:

1. The method of preparation for shipment shall protect the VFDs including all parts, auxiliary devices and accessories against corrosion, dampness breakage, or vibration injury that might be encountered in transportation and handling. The manner of packaging shall be such as to prevent tampering or pilfering and shall be acceptable to transportation companies.
2. The VFDs shall be maintained in an upright position and protected against damage at all times. The supplier shall follow the manufacturer's instructions for on-site storage and handling.

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Amendment to Part 1.6, A:

- A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll-free phone number.

Part 2:

Amendment to Part 2:

2.1 ADJUSTABLE FREQUENCY DRIVES

- A. The VFD package as specified herein shall be enclosed in a UL Listed Type 12 enclosure, completely assembled and tested by the manufacturer in an ISO-9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.
1. Environmental operating conditions: 0 to 40 degrees C continuous. VFD's that can operate at 40 degrees C intermittently (during a 24-hour period) are not acceptable and must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.
 2. Enclosure shall be rated UL type 12 and shall be UL listed as a plenum rated VFD. VFD's without these ratings are not acceptable.
- C. All VFD's shall have the following standard features:
4. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.
 6. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, operating temperature will be monitored and used to cycle the fans on and off as required.
 9. The overload rating of the drive shall be 110% of its normal duty current ratings for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLS rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
 10. The VFD shall have an integral 5% impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add AC line reactors.
 12. The VFD shall include a coordinated AC transient protection system consisting of 4-120 joule rated MOV's (phase-to-phase and phase-to-ground), a capacitor clamp, and 5% impedance reactors.
 13. The VFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay outputs shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.
 15. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communication bus.
- D. All VFDs to have the following adjustments

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2. Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control. The VFD shall have 250 ma or 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etc. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process (ie. Valves, dampers, etc.). All setpoints, process variables, etc. to be accessible from the serial communication network. The setpoints shall be set in Engineering units and not require a percentage of the transducer input.
6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices, typically programmed as follows: There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time clock control, or serial communications) the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop, and the damper shall be commanded to close. The keypad shall display “start enable 1 (or 2) missing”. The safety status shall also be transmitted over the serial communications bus. All digital inputs shall be programmable to initiate upon an application or removal of 24 VDC.
7. Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. Default settings shall be for run, not fault (fail safe), and run permissive. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.
11. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows the highest carrier frequency without derating the VFD or operating at high carrier frequency only at low speeds.
- E. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). The keypad shall utilize the following assistants:
 1. Start-up assistants
 2. Parameter assistants
 3. Maintenance assistant
 4. Troubleshooting assistant
- F. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alphanumeric codes are not acceptable).
 1. Output Frequency
 2. Motor Speed (RPM, %, or Engineering units)
 3. Motor Current
 4. Calculated Motor Torque
 5. Calculated Motor Power (Kw)
 6. DC Bus Voltage
 7. Output Voltage
- G. The VFD shall include a fireman’s override input. Upon receipt of a contact closure from the fireman’s control station, the VFD shall operate at an adjustable preset speed. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands) and force the motor to run at the adjustable, preset speed. “Override Mode” shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation.

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- H.
3. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The DDC system shall also be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.
 5. The VFD shall allow the DDC to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any VFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive’s digital and analog inputs shall be capable of being monitored by the DDC system.
- J All VFD’s through shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad.
- K OPTIONAL FEATURES – Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed by the drive manufacturer as a complete assembly and carry a UL-508 label.
1. A complete factory wired and tested bypass system consisting of an output contactor and bypass contactor. Overload protection and shall be provided in both drive and bypass modes.
 2. Door interlocked, pad lockable circuit breaker that will disconnect all input power from the drive and all internally mounted options.
 3. Fused VFD only disconnect (service switch). Fast acting fuses exclusive to the VFD – fast acting fuses allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection, maintaining bypass capability. Bypass designs, which have no such fuses, or that incorporate fuses common to both the VFD and the bypass will not be accepted. Three contactor bypass schemes are not acceptable.
 4. The drive / bypass shall provide single-phase motor protection in both the VFD and bypass modes.
 19. The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.
 - a. Power-on (Ready)
 - b. Run enable (safeties) open
 - c. Drive mode select damper opening
 - d. Bypass mode selected
 - e. Drive running
 - f. Bypass running
 - g. Drive fault
 - h. Bypass fault
 - i. Bypass H-O-A mode
 - j. Automatic transfer to bypass selected
 - k. Safety open
 - l. Damper opening
 - m. Damper end-switch made
 21. The following relay (Form-C) outputs from the bypass shall be provided:

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- a. System started
 - b. System running
 - c. Bypass override enabled
 - d. Drive fault
 - e. Bypass fault (motor overload or underload (broken belt))
 - f. Bypass H-O-A position.
11. The digital inputs for the system shall accept 24V or 115VAC (selectable). The bypass shall incorporate internally sourced power supply and not require an external control power source.
 22. Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand, Auto, or Bypass modes (not functional in Fireman’s Override 2). The remote start/stop contact shall operate in VFD and bypass modes.
 - 25, 26 Dedicated digital input that will transfer motor from VFD mode to bypass mode upon dry contact closure for fireman’s override. Two modes of operation are required.
 - a. One mode forces the motor to bypass operation and overrides both the VFD and bypass H-O-A switches and forces the motor to operate across the line (test mode). The system will only respond to the digital inputs and motor protections.
 - b. The second fireman’s override mode remains as above, but will also defeat the overload and single-phase protection for bypass and ignore all keypad and digital inputs to the system (run until destruction).
 23. The VFD shall include a “run permissive circuit” that will provide a normally open contact whenever a run command is provided (local or remote start command in VFD or bypass mode). The VFD system (VFD or bypass) shall not operate the motor until it receives a dry contact closure from a damper or valve end-switch. When the VFD system safety interlock (fire detector, freeze stat, high static pressure switch, etc) opens, the motor shall coast to a stop and the run permissive contact shall open, closing the damper or valve.
 27. Class 20 or 30 (selectable) electronic motor overload protection shall be included.
 15. There shall be an internal switch to select manual or automatic bypass.
 10. There shall be an adjustable current sensing circuit for the bypass to provide loss of load indication (broken belt) when in the bypass mode.

Part 3:

Amendment to Part 3:

PART 3 – EXECUTION

3.2 INSTALLATION

- G. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive, in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.
- H. Power wiring shall be completed by the electrical contractor. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.3 FIELD QUALITY CONTROL

A. Startup and Field Tests

4. Factory certified start-up shall be provided for each drive by Intec Solutions Inc., a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 FIELD QUALITY CONTROL

B. Parts and Service Requirements

3. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A 24/365 technical support line shall be available on a tollfree line.

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3.4 WARRANTY

- A. Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll-free phone number.

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SECTION 26 32 13.13
DIESEL ENGINE GENERATOR

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 4 pages.

CHANGES TO THE PROJECT GUIDELINES

PART 1 - GENERAL

Addition to Part 1, 1.1:

3. Sound Attenuated Enclosure with vertical cooling air discharge

Amendment to Part 1, 1.2 Subsection Title:

- 1.2 References / Codes and Standards

Amendment to Part 1, 1.2:

8. Santa Clara County Environmental Resources Agency / Installation Guidelines: Construction Guidelines Aboveground Fuel Storage Tanks for specific requirements / Emergency and Standby Power Systems. (Unified Documents #UN-018, <http://www.unidocs.org/>. This applies in the County and in the City of Palo Alto.) (Santa Clara county exception requires separation of 10-ft. between buildings and generator fuel tanks).

Amendment to Part 1, 1.6 Factory Tests:

- A. Engine generator set shall be completely factory tested under rated full load and rated power factor for performance and proper functioning of control and interfacing circuits. Test shall be a minimum of 2 hours or time required reaching operating temperature. Testing at unity power factor only (resistance only banks) is not acceptable. The generator set shall receive the manufacturer's standard factory load testing.
- E. After installation equipment shall be subjected to a six-hour load test at unity power factor to show that it is free of defects and will start and transfer load automatically. Use a load bank for full load test and use actual connected loads to verify proper operation of system.
- F. Provide a field pressure test before fuel is added.
- G. Provide a Final Acceptance Test, coordinated by the Contractor, and performed in the presence of the City Fire Marshal, the University Fire Marshal, City Hazardous Materials Official, and the Project Manager.
- H. START-UP: On completion of the installation, start-up shall be performed by a factory trained dealer service representative who shall demonstrate proper operation and instruct Owner's operating personnel in procedures. Time for instruction shall be designated by Project Manager.
- I. Reference Section 01770 – Closeout and Turnover Procedures.

Addition to Part 1:

- 1.9 CONDITIONS & REQUIREMENTS: Refer to the General Conditions and Supplementary General Conditions

PART 2 - PRODUCTS

Stanford University-Facilities Design Guideline Amendment

Amendment to Part 2, 2.1, E Acceptable Products:

1. Cummins/Onan: c/o Cummins West, Inc., 14775 Wicks Blvd., San Leandro, CA 94577; (510) 351-6101

Addition to Part 2, 2.2 Engine:

- H. The engine shall have a DC battery charging alternator with a transistorized voltage regulator.

Amendments to Part 2, 2.4 Fuel System, B Fuel Tank:

1. "Furnish an integral double contained, UL labeled fuel tank in a sub-base or free-standing tank with sufficient fuel for at least (SOM 14 hours) 24 hours of full load operation..."
 - g. Local high fuel level alarm and separate DPDT dry contacts for remote alarm monitoring to prevent overfilling.
 - i. Acceptance pressure test in the field after the unit is installed and before fuel is added according to County of Santa Clara and City of Palo Alto requirements.

Addition to Part 2, 2.6 Automatic Starting System:

- E. Jacket Heater: Furnish a coolant heater that will maintain engine coolant to at 90 degrees F. in an ambient temperature of 20°F. The heater shall be single phase, 60 Hz, 120 or 208V.

Addition to Part 2, 2.7 Generator, K Generator Control Panel, 7:

- j. Four position function switch marked "auto", manual", and "stop" and "off/reset."

Addition to Part 2, 2.7 Generator:

- M. Remote Annunciator Panel.
 1. Provide a NEMA 1 enclosure with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamp condition shall be clearly apparent under bright room lighting conditions. Provide lamp test and "alarm silence" features. "Alarm silence" shall not prevent the alarm from sounding on subsequent alarms. The generator set control shall indicate the following alarm and shutdown conditions on the display panel
 - a. Not-In-Auto (red flashing)
 - b. Low oil pressure (alarm)
 - c. Low oil pressure (shutdown)
 - d. Low coolant temperature (alarm)
 - e. High coolant temperature (alarm)
 - f. High coolant temperature (shutdown)
 - g. Low coolant level (shutdown)
 - h. Over-crank (shutdown)
 - i. Over-speed (shutdown)
 - j. Low fuel (alarm)
 - k. Ground fault (alarm) when ground fault alarm is specified
 - l. Primary Tank Leak (alarm)
 - m. Spare

Amendments to Part 2, 2.11 Main Line Circuit Breaker:

- B. The trip unit for each pole shall have elements providing inverse time delay during overload conditions and instantaneous magnetic tripping for short circuit protection. with adjustable long time, short time, and instantaneous tripping for phase only, no ground fault.

Amendments to Part 2, 2.13 Load Bank Connection:

- A. Provide a dead front load bank connection panel connected to the load side of the load bank circuit breaker with Cooper/Crouse-Hinds Cam-Lock® E1016 Series, 400-amp female connectors, one per phase to 200A and two per phase for larger, black, marked: AØ, BØ, CØ, and one ground (green). Provide matching insulated caps over the connectors. The load bank connection shall be rated at main breaker amperage.

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Addition to Part 2, 2.14 Engine Generator Set Mounting:

- D. Support the fuel tank above the pad to avoid corrosion and accumulation of debris under the tank.

Amendment to Part 2, 2.16 Emergency Generator:

- A. The emergency Generator to be sized with 35 % Spare Capacity for Future.
- B. Items to be included during initial construction: Supply Fans, Exhaust Fans, BMS Control Panels, -80 Freezers, Telecom Rooms and Telecom Room AC, Cold Room Refrigeration, etc.

PART 3 – EXECUTION

Amendments to Part 3, 3.7 Remote Monitoring by SOM BMS:

Subsection Title: Remote Monitoring by SOM BMS

- A. The four alarm points described above shall be monitored by **SOM BMS**. Provide cable, conduit, and connections for **SOM BMS** except that termination of the Contractor installed cable at the **SOM BMS** panel will be by Stanford. Coordinate connection and testing of the alarms with the Project Manager.
- B. Wiring: connect Alarm Points at generator set for Security with one 18 AWG, eight pair overall shielded cable, Belden 1057A. Cables shall be continuous and without splices between the generator set and the Security panel. Do not ground drain wires at generator set panel. See drawing ES-12.

Amendment to Part 3, 3.8 Fire Extinguisher:

- A. Contact the Project Manager and arrange for the installation of a fire extinguisher in a weatherproof enclosure, furnished and installed by Owner. The extinguisher shall be rated 3A:40-BC and installed within 30-ft. of the generator.

Additions to Part 3:

- 3.11. SITE LIGHTING – Ensure adequate lighting around the generators.
 - A. When the generator is NOT located inside an enclosure
 - 1. Provide fluorescent lights with weather proof cover and weather proof “on/off” switch to be located inside the enclosure
 - B. When the generator is located inside an enclosure
 - 1. Provide two high output fluorescent lights with weather proof cover and weather proof “on-off” switch
- 3.12. HOSE BIBB
 - A. Provide one 3/4” hose bib in close proximity to the generator for wash down purposes
- 3.13. ELECTRICAL OUTLET
 - A. Provide one 120V – 20-amp GFI outlet with weather cover
- 3.14. ASPHALT WALKWAY
 - A. A minimum three-foot asphalt maintenance path around the generator, the switch-board, and in front of the transformer will be required. Gravel or crushed stone is not acceptable
- 3.13. GENERATOR ACCESSIBILITY FOR MAINTENANCE
 - A. Refueling Trucks come with a 50-foot hose. The truck cannot be more that 50 feet from the generator’s fuel tank fill port

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SECTION 26 36 23

AUTOMATIC TRANSFER SWITCH

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Amendment to 2.1, 1:

2.1 MANUFACTURER

A. Acceptable manufacturer for automatic transfer switches are ASCO, No Substitutions.

Addition to Part 2.2:

M. ASCO with bypass/isolation power transfer switch/external permanently attached handle, and open transition type with in-phase monitor.

Stanford University-Facilities Design Guideline Amendment

SECTION 26 51 00

LIGHTING

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 4 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.3, D Controls:

1. Refer to Section 26 09 43
2. Designers shall consider and design for control schemes to limit the unnecessary operation of artificial lighting. These include:
 - a. Properly placed and accessible manual switching
 - b. Occupancy sensors
 - c. Dimming controls
 - d. Photo-electric cells for outside lighting
 - e. Electronic time clocks
 - f. Central programmable microprocessor-based lighting control systems.
3. Where natural day-lighting is present, artificial lighting systems shall be controlled to eliminate unnecessary illumination. Controls shall be capable of dimming or turning off lights completely. Where lights are dimmed in response to natural light, a minimum of two (20 steps of reduction shall be utilized:
 - a. Fifty percent (50%)
 - b. One hundred percent (100%) Lighting circuits shall be arranged to facilitate localized control. In all areas where effective use may be made of natural light, lighting circuits shall be arranged so that units in areas where natural light is concurrently available are controlled together. Areas where natural light is not available concurrently shall be controlled separately.

Addition to Part 1.3, E:

- E. Surface Reflectivity: Reference Section 09 05 00 – Finishes
1. Coordinate with the Architect so that proper surface reflectivity is incorporated in the design.

Addition to Part 1.3, F:

- F. Exterior Building Lighting: Reference Section 26 56 13 Outdoor lighting System Specifications for requirements for lighting fixtures for roads, parking lots and pathways. Designers shall give priority to the most efficient HID and LED sources for lighting larger areas. Consideration shall be given to existing outdoor illumination, so as to avoid unnecessary lighting.
1. Inverters or other special equipment may be required for outdoor egress lighting.

Amendment to Part 1.3, G:

- G. New Energy Efficient Lighting Products: The School of Medicine wishes to encourage the use of the most life cycle cost-effective (including replacement costs), energy-efficient lighting products, lighting products consistent with program needs and Title-24 requirements available. All products shall have established reliability, maintenance and performance records.

Addition to Part 1.3

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- J. Interior lighting shall be designed to provide illumination to support the activities for which the building is intended.
1. No luminaires, circuiting, or switching shall be considered final until accepted by the Owner at the Schematic Design phase, especially:
 - a. Foot-candle requirements by type of space.
 - b. Appropriate light source technology: fluorescent vs incandescent, etc.
 - c. Control Strategies (circuiting, switching, timers, Energy Management Systems)
 - d. Access for lamp and ballast replacement.
 - e. Classroom needs (include DC Instructional Services rep)
 2. Luminaires shall be commercially available, standard models. Custom designed/built luminaires shall not be used when standard models similar in appearance and performance are available.
 3. Incandescent lighting is subject to specific approval by the Owner
 4. Use daylighting, with appropriate controls, where practical and where required by CAC, Title-24.
 5. In general, the lighting levels shall be in accordance with the IES guidelines for specific tasks and locations. In addition, the lighting design shall comply with CAC Title-24, Energy Standards and shall include Title-24 documents.
 6. Lighting equipment shall be selected so as to insure maintainability. The placement of lighting luminaires shall be made to allow for lamp replacement. Where lamp replacement will reasonably require the use of special equipment such as telescoping poles or lowering devices, these shall be specified to be supplied as part of the project. Placement of lighting above stairways and atriums should be avoided unless convenient relamping provisions are included. Placement of luminaires in locations that require scaffolding or manlifts for relamping is not acceptable.
 7. Fluorescent luminaires shall utilize T-5, T-8 or compact fluorescent lamps.
 8. Emergency lighting systems where required in large classrooms and places of assembly shall consist of evenly spaced luminaires, powered from an emergency generator, central inverter or approved unit equipment, that provides Code compliant illumination of the means of egress.
- K. Light fixtures located in hard ceilings must have ballasts which are accessible / maintainable or must be provided with an access panel.
- L. Breakers serving lighting shall be located on the same floor which they are serving.
- M. DLM Wattstopper network lighting Control System.

Additions to Part 1:

1.4 SUMMARY

- A. The purpose of this section is to describe the general requirements for building lighting.

1.5 SUBMITTALS

- A. General: Design drawings, data and calculations at various stages of completion shall be submitted for each phase of the plan review process. The specific submittal requirements for each phase are outlined below.
- B. Schematic Design: Cost-effective day-lighting strategies, task lighting, lighting controls, and the impact of the of lighting systems on HVAC systems shall be an integral part of the building's design. Different day-lighting and artificial lighting design approaches shall be evaluated for their program needs and cost effectiveness.
- C. Design Development: The submittal shall include an economic analyses considering installed costs, energy use, lighting efficiency, maintenance costs, lamp life, foot-candle levels, and the watts-per-square foot connected load. Manufacturer's literature and photometric data for each fixture shall be provided. Fixture schedules shall be included along with estimates of

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- fixture quantities and watts per fixture.
- D. 50% Construction Documents: Manufacturer's literature and specifications for all controls shall be provided. An economic and energy analysis of the control scheme shall be provided along with specific details and the entire system.
 - E. 95% Construction Documents: Complete design with all details on lighting system, economic and energy analysis.

Part 2

Amendment to Part 2.1, B:

- B. Incandescent sources shall be used rarely and only when no energy efficient alternatives exist. (MR16 incandescent lamps have a short life and adversely affect Title-24 compliance).

Amendment & Addition to Part 2.1, C:

- C. Fluorescent: must be a high-performance T8 lamp on the Consortium for Energy Efficiency's (CEE) list of qualifying products (<http://library.cee1.org/content/commercial-lighting-qualifying-products-lists>) 4-foot linear fluorescent lamps must be 32-watt T8 lamps, color temperature 4100K, minimum color rendering index (CRI) of 81, initial lumens of 3100, 24000 hour lamp life at 3-hr start (based on ANSI C82.11 standard), and TCLP compliant (e.g. low mercury content) from Phillips, Osram/Sylvania, GE, or approved equal, shall be considered the standard fluorescent lamp. For standardization, 4-foot lamps shall be used wherever possible. Recessed "can" style fixtures shall use compact fluorescent lamps with built-in high-powered electronic ballasts (no incandescent Edison-type bases shall be allowed).

Addition to Part 2.2, BALLASTS:

- B. Suggested Manufactures: Advance, Magne Tek, Osram/Sylvania.

Amendment to Part 2.3, A:

- A. Interior: Designers are encouraged to use fixtures with a coefficient of utilization (CU) greater than 0.70 for a room cavity ratio (RCR) of one (1.0). Fixtures shall be easy to clean and relamp, and shall have a low dirt accumulation rate. Lenses (where used) shall be one-hundred percent (100%) virgin acrylic or lexan. Parabolic-type reflector fixtures (where used) shall have minimum three-inch (3") cubes.

Amendment and Addition to Part 2.4, B:

- B. Exit Signs: Exit signs shall be self-powered LED type, have 120/277 VAC, 60 Hz field – selectable connections and be provided with 12 V nickel-cadmium batteries and manual test button, and self-diagnostic functions. The electrical system shall be protected from surges, overvoltage and brownout. The exit signs shall be provided with self-diagnostic capabilities that indicate the condition of the battery, battery charger, transformer, self-powered lamps and lamp circuit. The exit signs shall be supplied with universal mounting for top, side and rear mount, interchangeable single or dual faces with green letter with black trim, and tamper proof LED cover. Words on the sign shall be in block letters six inches in height with a stroke of not less than $\frac{3}{4}$ inch. Exit signs shall have the option of providing directional arrows. Exit signs shall read "Exit" from all directions. Housing construction shall be white textured reinforced molded polycarbonate materials resistant to scratches and UV radiation. Acceptable manufacturers are Sure-lite and Dual lite.

Additions to Part 2.4

- D. Battery ballast units are not allowed.
- E. Light Fixtures located in hard ceilings must have ballasts, which are accessible/maintainable or must be provided with an access panel.

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SECTION 28 31 00

FIRE DETECTION AND ALARM

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 10 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendments to Part 1.1 D Related Work:

1. General: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this section.
2. Basic Door and Window Materials and Methods.
3. Door Hardware
4. Fire Protection
5. HVAC Controls & Instrumentation (Building Automation System)
6. Electrical General Provisions
7. Smoke Fire Dampers
8. Building / Section Access Control System
9. Elevators / Conveying Systems

Amendments to Part 1.3 Design References:

- A. All additions and/or modifications to the fire alarm system shall comply with NFPA 72 and following:
1. NFPA 72 (Latest Edition adopted by the State of California)
 2. Title 24, California Building Code, Current Edition
 3. Title 24, California Fire Code, Current Edition
 4. Title 24, California Mechanical Code, Current Edition
 5. Title 24, California Electrical Code, Current Edition
 6. Title 8, California Code of Regulations, Elevator Safety Orders, Current Edition
 7. ASME A17.1 Safety Code for Elevators, Current Edition
 8. Local Authority having Jurisdiction or Office of Statewide Health Planning and Development (OSHDP) as applicable.

Amendment to Part 1.4 Submittals:

- A. Comply with pertinent provisions of the General and Supplementary Special Conditions Sections and the Electrical Section.
- B. Shop Drawing and supplemental data are required. All plan view shop drawings shall be done using AutoCAD version R14 or later. CAD files shall be submitted along with a hard copy of Shop Drawings:
1. Refer to Article 3.3 below, "Record Drawings," for required information
 2. OSHPD projects shall be submitted to OSHPD for Review and Approval by the Project Architect.
 - a. Fire Alarm Shop Drawings shall be included in the Architect's OSHPD Submittal. Deferred Approvals should be avoided.
 - b. School of Medicine Project Manager shall submit OSHPD Permit Package to SUFMO for review and comment concurrently with the Architects OSHPD submittal.

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3. Non-OSHPD projects shall be submitted to the local Authority Having Jurisdiction (AHJ) by Siemens. Architect or General Contractor shall supply the Building Permit Number to Siemens prior to submittal of the Fire Alarm Shop Drawings.
 - a. Siemens shall submit the Fire Alarm Shop Drawings to SUFMO for review and approval prior to submitting to the AHJ.

Additions to Part 1:

1.6 SUMMARY

- A. Provide fire alarm and detection systems where shown on the Drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to:
 1. Control panel; provide new or modified existing control panel as required.
 2. Remote Annunciator.
 3. Initiating Devices
 4. Notification Appliances
 5. Magnetic door holders (unless specified in hardware section)
 6. Connection to related items furnished under other Sections of the Specifications, or under separate contract, such as (when required): Sprinkler flow and tamper switches; Elevator controls; Fan controls, and/or Access Control System(s).
 7. Connection to the existing networked fire alarm command center. (On-Campus Buildings Only).
- B. Interconnect alarm initiating, notification and ancillary devices with the automatic fire alarm system to operate Annunciators, printers, fire controls, notify the security personnel and activate local and general audible / visible alarm signals, in accordance with the guidelines specified herein.

1.7 CONTRACT DRAWINGS

- A. The Drawings are intended to show the areas to be protected and work to be done, to the extent necessary to prescribe the Work and provide a basis for cost estimating.
 1. The Drawings are not intended to relieve the Contractor of responsibility for avoiding conflicts or obstructions or proper installation of equipment.
 2. Routing of conduit and wiring shall be as shown unless otherwise specified.
 3. Secure written approval from the owner prior to deviating from the arrangement and layout shown on the Drawings.

1.8 SYSTEM DESCRIPTION AND OPERATION

- A. General System Requirements
 1. Provide a Siemens addressable system that utilizes intelligent alarm initiating devices throughout, and intelligent monitoring modules for connection to water flow indicators, valve supervisory devices, and other miscellaneous controls as required and as shown on the drawings to produce a complete and operational system.
 - a. All new buildings and total retrofits of existing facilities shall utilize the Model XLS/XLSV Control Panel and associated devices
 - b. All modifications/expansions of existing systems shall utilize the existing Control Panel and associated devices.
 2. System components are to be powered from life safety system panel boards or approved auxiliary DC power supplies.
 3. Provide Class-B System wiring for all low-rise buildings. This shall include all Addressable Loops, Notification Appliance Circuits, Booster Panel Activation Circuits and various 24VDC Power Circuits.
 - a. All new on-Campus FACP's shall be provided with a Style 7 Network via Copper or Fiber Optic cabling as directed by the Owner.
 4. System addressable loop and zone assignments shall be coordinated and approved by the Stanford School of Medicine.

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5. System design shall include provisions for maintaining 100% area smoke detection for Early Warning in all areas. Use of Duct Smoke Detectors shall be minimized and should be limited only to roof mounted air handling units and Fire Smoke Dampers installed in Duct Shafts. Utilize the appropriate method(s) noted in the applicable edition of the California Building & Mechanical Codes. Changes to this requirement must be submitted in writing and approved by the School of Medicine – Office of Facilities Planning & Management.
 6. Roof Level: Provide a minimum of one (1) Audible/Visual Notification Device and one (1) Manual Pull Station at the stairwell door.
 - a. If access is only via a roof hatch, the General Contractor shall provide a pedestal for the above equipment to be placed at the hatch if no other suitable mounting location is available.
 7. Addressable Initiating Loops shall be dedicated to a single floor.
 - a. All Basement/Sub-Basement level loop assignments shall begin with 00x.
Example:
 - i. Basement Level= 001
 - ii. Second Basement Level = 002
 - b. The First Level loop assignments shall begin with 01x.
 - c. The Second Level loop assignments shall begin with 02x.
 - d. Subsequent floors to follow the above pattern.
 - e. Example: Addressable Loop 011 would indicate First Floor, First DLC Card for that floor.
 - f. All current Good Manufacturing Practice (cGMP) facilities shall have dedicated Initiation (addressable) loops. These loops shall not be extended into or serve any non-cGMP compliant spaces.
 8. Area Smoke Detection shall include all rooms, even if they are not served by the buildings HVAC System and the top of all stairwells. EXCEPTION: Vivarium areas where the detectors LED may impact the research being performed. All Fire Alarm System designs in Vivarium areas shall be coordinated with the Manager of Veterinary Services during the initial design stage.
 9. Manual Pull Stations shall be provided at all doors leading to the exterior, whether or not they are an exit. (i.e., Electrical or Mechanical Rooms with exterior access only).
 10. Provide three (3) addressable relay modules adjacent to any single HVAC controller and program them to activate on General Alarm, General Trouble and General Supervisory respectively. Connections to the BMS controller shall be provided by others.
 11. Provide 20% spare capacity for future expansion of Initiation and Notification Circuits. Applies to new installations or retrofits receiving new Notification Device Power Supplies.
 12. On-Campus fire alarm systems shall transmit alarm, trouble and supervisory signals, to the Networking Command Center (NCC) located in the Medical Center's Security Dispatch Office, (Room HH-0258A).
 - a. Transmission shall be via Fiber Optic cabling to the Fire Alarm Fiber Network Hub located in the LKSC Building, Room LK0T2.
 13. Off-Campus Buildings shall transmit Alarm, Trouble and Supervisory Signals to a UL Listed Central Station.
- B. Sequence of Operation
1. Activation of any alarm initiating device shall:
 - a. Activate all fire alarm audible and visual notification devices in affected building until silenced.
 - b. Indicate the zone or addressable device at the local control panel. On-Campus Buildings shall also display events at the Stanford Medical Center Dispatch Office, (Room HH-0258a).
 - c. Release all electromagnetic door hold devices throughout affected building.
 - d. Shut down air handling equipment and release (close) Fire Smoke Dampers throughout the affected building unless otherwise noted.

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- e. The Mechanical Engineer of Record shall provide a detailed Sequence of Operation if other than 100% shutdown is required.
2. Activation of any Area Smoke Detector shall:
 - b. Perform all functions as noted in #1 above;
 - c. Cause any associated roll-down fire door(s) to close.
3. Activation of any Smoke Detector device in elevator lobbies and designated elevator mechanical areas shall:
 - a. Perform all functions as noted in #1 above,
 - b. Cause Recall, Alternate Recall and other associated elevator functions as required by the current State Elevator Code.
 - c. The General Contractor shall coordinate all required elevator interface points with the selected elevator contractor. The required points shall be provided to the Fire Alarm vendor prior to completion of the Fire Alarm Shop Drawings.
4. Activation of any Duct Smoke Detector device shall:
 - a. Perform all functions as noted in #1 above.
 - b. Provide an Addressable Relay Module at each VFD for fan shutdown.
5. Activation of any Thermal Detector device shall:
 - a. Perform all functions as noted in #1 above.
 - b. Thermal Detectors located in the elevator machine rooms or at the top of the elevator shaft, if provided, shall initiate elevator power Shunt Trip with the appropriate time delay.
 - c. Thermal Detectors shall be provided in Break Rooms in lieu of Smoke Detectors.
6. Operation of any Sprinkler Waterflow Switch shall:
 - a. Perform all functions as noted in #1 above.
 - b. Sound the exterior weatherproof sprinkler alarm horn in a steady tone while water is flowing.
 - c. Power to the sprinkler alarm horn shall be either:
 1. 24 VDC power provided and supervised by the Fire Alarm System via a dedicated Notification Appliance Circuit programmed for Waterflow.
 2. 120 VAC power provided from a dedicated circuit breaker. No other equipment shall be connected to this circuit. Additionally, the 120VAC power shall be supervised at the Waterflow switch to ensure power is available to operate the horn when water is flowing. A Dry Contact Relay to monitor the presence of power shall be provided by the Electrical Contractor. The Relay Coil shall be powered by the 120VAC Waterflow Circuit. The Normally Open Dry Contacts shall be monitored by the Fire Alarm System such that a loss of the 120VAC power to the Waterflow Horn shall result in a closure of the contact monitored by the Fire Alarm System.
 - d. The Waterflow Notification Appliance Circuit shall not be included in any bypass functions.
7. Operation of any Sprinkler Supervisory Valve, Tamper Switch, Post Indicator Valve, or Backflow Preventer Valve shall:
 - a. Activate a dedicated Supervisory Signal at the local Fire Alarm Control Panel. On-Campus Buildings shall also display events at the Stanford Medical Center Dispatch Office, (Room HH-0258a). (Use of the Waterflow alarm circuit trouble for valve supervision is not permitted).
8. Activation of Fire Alarm System Trouble shall:
 - a. Activate a dedicated Trouble Signal at the local Fire Alarm Control Panel On-Campus Buildings shall also display events at the Stanford Medical Center Dispatch Office, (Room HH-0258a).
9. System Trouble condition shall occur per the current edition of NFPA 72.

1.9 WARRANTY

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- A. Provide a one-year Parts & Labor Warranty. The warranty period shall commence upon the Authority Having Jurisdiction's Final system test and sign-off of the Fire Alarm Permit. The warranty shall cover all parts, labor, prompt field service, pick-up, and delivery.

Part 2

Amendment to Part 2:

2.1 MATERIALS AND EQUIPMENT FURNISHED

- A. Provide new and present standard manufacturer products that match the existing Siemens MXL or XLS networked systems installed throughout the complex. Other Manufacturers will not be accepted.
 - 1. Re-use of an existing building FACP is acceptable if it is a current product of the manufacturer, in good working order and approved by the Office of Facilities, Planning & Management (OFPM).
- B. Provide products that match the existing system for renovation projects or interior completion work. Standalone fire alarm systems will not be accepted.
- C. Provide products that are acceptable to Stanford University, School of Medicine (OFPM) and that comply with regulations of the State of California and Authority Having Jurisdiction.
- D. Actuating devices for Fire Smoke Dampers shall be powered by 120 VAC. Refer to Section 1.1.C.7 for additional requirements.

2.2 STANDARD FIRE ALARM SYSTEM EQUIPMENT

- A. Existing MXL control unit expansion, if necessary:
 - 1. Provide the basic MXLR Remote Control Unit with 12-amp Power Supply.
 - a. MLE-6 enclosure. Smaller Enclosures may only be used with Owner's Fire Alarm Shop's approval.
 - b. On-Campus Buildings shall also interface with the existing Networked Fire Command Center (NCC).
 - c. Other optional modules and equipment needed for a complete operational system.
 - 2. Existing MXL Systems requiring significant modification or expansion should be converted to an XLS System
 - a. The FACP and all affected circuits shall be converted to XLS Devices.
 - b. Non-affected circuits shall be connected to a new MLC Card mounted within the XLS FACP.
- B. New or Existing XLS Control Units:
 - 1. Provide the basic XLS Control Unit.
 - a. CAB-3 Enclosures. Smaller Enclosures may be used with Owner's Approval.
 - b. On-Campus Buildings shall also interface with the existing Networked Fire Command Center (NCC).
 - c. Other optional modules and equipment needed for a complete operational system.
- C. Manual Stations:
 - 1. Addressable:
 - a. MXL Systems Model MSI-10B
 - b. XLS Systems Model HMS-S
 - 2. Conventional, if required, shall be monitored by a local Addressable Module:
 - a. Model MS-151
 - b. MSM-K-WP for Weatherproof applications
- D. Smoke Detectors, Photoelectric:
 - 1. MXL Systems Model FP-11
 - 2. XLS Systems Model FDO Series or HFP-11. Apply the appropriate detector to the application and environment.
 - 3. Provide Model RLW-11 / RL-HW wall mount remote LED indicators for concealed detectors as appropriate only when device custom message may not be sufficient to locate a concealed detector.
- E. Duct Smoke Detectors:

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1. XLS Systems: Provide Model FDBZ492 photoelectric air duct housings.
 2. If relay output required, provide FDBZ492-HR photoelectric air duct housings.
 3. Provide Model ST-10, ST-25, ST-50 or ST-100 sampling tube as appropriate. The Mechanical Contractor shall provide the required number of each tube size based upon the actual duct widths and the manufacturer's installation guidelines.
 4. MXL Systems: Provide Model AD3-ILP housing with an ILP-1 Photoelectric Smoke Detector for installation on all rooftop or direct sunlight applications.
 5. Provide Model RLW-11 / RL-HW remote alarm indicating lamps for concealed duct detectors as appropriate only when device custom message may not be sufficient to locate a concealed detector.
 6. Duct Detector Differential Pressure Measurements shall be provided by the Mechanical Contractor.
 - a. If there is no Mechanical Contractor involved with the project, this measurement shall be provided by the Installer.
- F. Thermal Detectors:
1. MXL Systems Model FPT-11
 2. XLS Systems Model FDT421
- In high ambient temperature areas, use an appropriate Conventional Thermal Detector monitored with an Addressable Monitoring Module.
- G. Waterflow Switches:
1. Refer to 1.1.C.4.
- H. Addressable Interface Modules:
1. MXL Systems Model TRI Series
 2. XLS Systems Model HTRI Series and model FDCI422
- Models S, D, M & FDCI422 as appropriate for interface to Waterflow switches, supervisory switches, special systems equipment and similar devices with Form C dry contacts. Model R, Addressable Relay Modules, shall be used where Control interface is required.
- I. Audible and Visual Notification Devices:
1. All Notification devices shall be provided with a RED finish.
 2. Wheelock Model CH series Chime/Strobe devices in Vivarium Areas.
 - a. Red Lens Strobes shall be used in all Mice & Rat Holding Rooms.
 - b. Audible Notification shall be reduced in all Vivarium areas. Increased Strobe coverage shall be used. Submit an Alternate Means Application to the AHJ if required.
 - c. All Fire Alarm System designs shall be coordinated with the Manager of Veterinary Services during the initial design process.
 - d. All current Good Manufacturing Process (cGMP) facilities shall have dedicated Notification Appliance Power Supplies and Circuits. These circuits shall not be extended into or serve any non-cGMP compliant spaces.
 3. Wheelock Model HSR/HSRC series Horn/Strobe in all General Public/Clinic Areas.
** Audible devices shall sound in a synchronized three-pulse temporal pattern, commonly referred to as TEMPORAL CODE 3.
 4. Wheelock Model STR/STRC series Strobes.
 5. Equip with the appropriate Red back box for surface mounting applications
 6. Audible/Visual Power Supply Panel: Wheelock Model PS-8 is acceptable for use; provided the input is controlled directly from the fire alarm control panel and all other wiring and installation guidelines are met as described herein.
 - a. Activation of floor Power Supplies shall be via a dedicated NAC Circuit from the FACP.
 7. Activation of fire alarm system notification device circuits or audible/visual extender panel by field driven devices such as TRI-R / HTRI-R or ICP / HCP modules is not acceptable unless approved in writing by the Owner.
- J. Fire Doors and Electronic Door Hold Open Devices:
1. Reference 1.1.C.2 and 3.

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2. Door Holder Power shall be 24 VDC. Provide a minimum of one (1) Altronix Model AL1024ULM per floor for door holder circuits.
 3. Provide a Control Relay for releasing of doors on a by floor basis.
 - K. System software programming:
 1. New System programming shall be provided by the Vendor.
 2. Re-programming of existing systems already managed by the School of Medicine shall be performed by the School of Medicine. Vendor programming of existing system software is not permitted without prior approval by Stanford University, School of Medicine - Facilities Office.
 - L. Provide other materials, not specifically described but required for a complete and proper installation, as approved by Owner.
- 2.3 SPARE PARTS
- A. New Construction project's (when a new FACP is provided): deliver directly to the Office of Facilities, Planning & Management. A signed Letter of Receipt shall be included in the projects close-out documents.

The quantity of Spare Parts shall be provided at the completion of the project:

Part % of Installed Qty Maximum

1. Smoke Detector with Base 10% 10
2. Heat Detector with Base 10% 5
3. Pull Station 10% 5
4. Duct Detector Housing Assy. 5% 1
5. Addressable Module, Dual 10% 5
6. Addressable Module, Relay 10% 5
7. Addressable Module, Single 10% 5
8. Addressable Module, Mini 10% 5
9. Horn/Strobe 10% 10
10. Strobe 10% 10

Part 3

Amendment to Part 3.2, B, 4, a Test #1 (Contractor's Test):

- 1) Shall be performed by the installing contractor and manufacturer's representative if applicable. The test shall include proper operation of the fire alarm control panel and indicating components in accordance with factory recommended procedures. Audible testing of all notification appliances shall be measured and recorded in all affected areas. In rooms less than 200 sq. ft., minimum of one audible reading shall be recorded with all doors and windows closed. Tests shall also include proper operation of visible indicating devices as needed. Checks of each initiating circuit or device address for correct indications at the control unit, and any remote Annunciator.

Amendment to Part 3.2, B, 4, b Test #2 (SUFMO Test):

- 2) The test shall include proper operation of the fire alarm control and notification devices in accordance with factory recommended procedures. Record of all audible/visual testing of notification devices shall be made available to the SUFMO representative(s) during this test. Tests shall include sound level (decibel readings) and verification that the device candela setting matches the approved Drawings. Checks of each initiating circuit or device address for correct indications at the control panel, and any remote Annunciator. Test shall include ground fault and open troubles on each notification/initiating loop per manufacturer's requirements and a print out of all smoke detector sensitivity readings.

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Amendment to Part 3.2, B, 4, c Test #3 (Final Test):

- 3) Test #3 shall include proper operation of the fire alarm control panel and notification devices in accordance with factory recommended procedures, Audible/Visual testing of all notification devices shall be performed on Battery Power for five (5) minutes. A copy of the contractor's audibility tests shall be made available to the AHJ during this test. Test shall include sound level (decibel readings) and light intensity (lumens), as needed. Checks of each initiating circuit or device address for correct indications at the control panel, and any remote Annunciator. A print out of all smoke detector sensitivity readings shall be provided. Duct Detectors shall be tested under full airflow (dynamic) conditions.
- 4) The Manufacturer's representative shall provide an NFPA 72 Certificate of Completion for the AHJ's review and signature.
- 5) On-Campus Building connections to the existing Medical Center Fire Alarm Network shall be made upon completion of the AHJ's final acceptance. The Stanford University School of Medicine Fire Alarm Shop and manufacturer's representative shall ensure the FACP is communicating properly with the Stanford Medical Center Security Dispatch Office, (room HH-0258a).
- 6) In existing occupied buildings, all Audible Notification Device testing shall be performed prior to 8:00AM.

Amendment to Part 3.2, C Record Drawings and Maintenance Manuals:

- C. Record Drawings and Maintenance Manuals
1. Project Record Documents and Record CAD Files: Upon completion of the installation and final acceptance, provide one set of reproducible As-built Record Drawings and one set of CAD files using Auto CAD version R12, or later.
 - a. All final Fire Alarm System As-built Record Drawings shall be produced by Siemens.
 - b. Drawings shall reflect the entire system; consisting of existing components as well as components added as a result of this project. The Record Drawings shall be complete and accurate, revised to show the exact list of equipment as installed and as wired.
 - c. The Master Set of Fire Alarm Drawing Riser and Floor Plans in AutoCAD format shall be provided directly to Campus Maps & Records by Siemens.
 - d. Provide a CD containing all drawings provided to Maps & Records directly to the School of Medicine Facilities Office.
 2. Drawings shall include the following:
 - a. Plot planes and building floor plans, showing location of devices
 - b. Point-to-point wiring diagrams
 - c. Connection details
 - d. Arrangement of control panel modules
 - e. Conduit routing, including conductor type and quantity
 - f. When applicable, provide a site plan showing all conduit runs to exterior devices, i.e., Post Indicator Valves (PIV) and Backflow Preventer Valves.
 3. Operation and Installation Manuals:
 - a. Operation and Installation Manuals are NOT required.
 - b. Equipment Data Sheets are NOT required UNLESS the product is being provided to the facility for the first time.
 - c. Provide one (1) CD containing all applicable product information.

Addition to Part 3.3:

- A The Contractor shall supply the Owner with:
1. A complete and accurate fire alarm system drawing revised to show exact list of equipment as installed and as wired.

Stanford University-Facilities Design Guideline Amendment

2. Signed NFPA 72 Certificate of Completion report certifying that all work has been completed in accordance with SOM Facilities standards and specifications.
3. Warranty Letter. Warranty period shall commence on the date the final acceptance was granted by the AHJ.

Additions to Part 3:

3.4 INSTALLATION

- A. Comply with Section 1.1.C.6
- B. Mount control or other panels with sufficient clearance for observation, service and testing. Comply with NFPA 70, current edition.
- C. Paint fire alarm junction box covers red and clearly identify boxes using a printed label complying with 3.1.K
- D. Install all wiring in conduit.
 1. Flexible conduit is permitted for short connection to devices installed in lay-in ceilings (6 feet max.)
- E. Securely hang and fasten all conduit, boxes and panels to insure positive grounding throughout the system.
- F. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions is permitted in fire alarm conduits.
- G. Avoid unnecessary wire splices.
 1. If splices connections are required in junction boxes, use a permanent soldered connection only.
 2. Wire nut or crimp type connectors are not permitted.
 3. Interconnect field wiring at individual devices whenever possible using manufacturer provided terminal strips.
 4. Interconnect field wiring in terminal cabinets using standard terminal strips.
- H. When installing a smoke detector base:
 1. Follow manufacturer's installation instructions.
 2. Provide a back-box with a depth of 2-1/8" or greater for all applications
 3. When required, provide smoke detector trim ring(s)
- I. Transposing or changing conductor color coding is not permitted
- J. Installing Contractor shall label each circuit at fire alarm control panel or remote power supply panel using standard Brady Labels.
- K. All devices shall be labeled with device address or device count as appropriate. Label shall be sticky back type, self-adhesive with a minimum of 1/4" font size width. Provide RED lettering on a WHITE label background. The label shall be attached to the base of the device. Label identification shall be consistent with As-built Record Drawings.
- L. When connection to existing systems is required, coordinate tie-in with the Owner's Project Manager and fire alarm shop personnel. Organize work so that there will be minimum disruption to the building functions.
 1. Existing systems must remain operable during all Work of the Contract.
 2. Upon request, portions of the system may be put out of service by authorized SOM personnel during each working day, but must be restored to full operation at the end of each working day, unless otherwise scheduled and approved by the Project Manager.
- M. Wiring
 1. Network cabling requires the use of #16 AWG twisted / shielded pair cable, run in separate raceway.
 2. Addressable initiating device circuits; use #16 AWG THHN/THWN insulated, solid conductors.
 3. Notification circuits; Use #12 AWG, THHN/THWN insulated, stranded conductor wire.
 4. Door holder circuits; use #12 AWG, THHN/THWN insulated, stranded conductor wire.

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5. All stranded wire must be terminated with soldered-on spade terminals. Crimp type connectors are not permitted.
- N. Riser size and fill requirements:
1. New fire alarm system risers will be sized adequately to accommodate no less than two initiating circuits and two notification circuits and one door hold circuit per floor, plus 10% expansion capacity for future use. Comply with NFPA 70, current edition.
 2. The required number of conductors will be installed during the initial installation of fire alarm risers and any unneeded wires will be labeled "spare" for future use.
- O. Color Coding for MXL and XLS System installations:
- | CIRCUITS: | COLOR: |
|---|---|
| Alarm Initiating Horns, | Blue (+) Brown (-) |
| 24VDC Audible Circuits
(on a 4-wire system) | Yellow (+) Black (-) |
| 24VDC Visual Circuits
(on a 4-wire system) | White (+) Purple (-) |
| 24VDC Audible/Visual Circuits
(on a 2-wire system) | Yellow (+) Black (-)
or match existing |
| DC Power | Red (+) Black (-) |
| System AC Power | Black / White |
| Water Flow | Orange / Orange |
| Tamper Switch | Yellow / Yellow |

Stanford University-Facilities Design Guideline Amendment

SECTION 32 84 00

IRRIGATION

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 1 page.

CHANGES TO THE PROJECT GUIDELINES

Part 2

Amendment to Part 2.2 MATERIALS, I. Controller(s), Valves, backflow preventer(s), filter(s), sensor(s) and irrigation heads:

2. Install Hydro Point Weather TRACK pro 3 controllers.
3. Use a semiautomatic filter, Amiad Super Scanaway semiautomatic filter PN#030002-000026.

Amendment to Part 2.2 MATERIALS, J. Control wire:

2. Use traditional direct burial irrigation control wires.

Amendment to Part 2.2 MATERIALS, M. Control or Valve Boxes:

5. Install a Gopher barrier (hardware cloth) at the bottom of the valve boxes.

Amendment to Part 3.4 INSTALLATION, G. Control Wiring:

9. Install an extra set of wires for possible future expansion and possible future damage to an existing wire.

Amendment to Part 3.4 INSTALLATION, A. Trenching:

8. Set up a meeting with SOM Landscape vendor to meet with irrigation designer before breaking ground.

Stanford University-Facilities Design Guideline Amendment

SECTION 33 71 49

MEDIUM VOLTAGE POWER CABLE

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 2 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.1 Scope:

1.9 SUMMARY

- A. This section covers single-conductor 5KV and 15KV shielded power cable insulated with an ozone and discharge resistant, flexible, rubber-like dielectric for high voltage applications that shall be suitable for use in wet and dry locations in conduit, underground duct systems, and aerial installations.
- B. Cable shall be rated 90 C for normal operation, 130 C for emergency overload operation, and 250 C for short circuit conditions. Emergency overload operation may occur for periods up to 100 hours per year and with as many as five such 100-hour periods within the lifetime of the cable.
- C. Use 15KV rated cable for all new work on both 4.16KV and 12.74KV systems. 5KV rated cable may be used only where existing 4.16KV ducts are too small to accommodate 15KV rated cable.

Addition to Part 1.2 RELATED WORK:

Section 16510 – Electrical Utility Services.

Amendment to Part 1.4 REFERENCE SPECIFICATIONS:

- 1.4.5 American Society for Testing and Materials (ASTM): ASTM B-8 and ASTM B-231.
- 1.4.2 Association of Edison Illumination Companies (AEIC): AEIC CS6.
- 1.4.1 Insulated Cable Engineers Association (ICEA): ICEA S-68-516.

Amendment to Part 1.5 QUALITY ASSURANCE:

- C. Factory Tests:
 - 1. Cable shall be factory tested at high voltage AC, high voltage DC, and for corona discharge according to ICEA requirements.
 - 2. Certification of satisfactory completion of factory tests for cable shall be submitted to the Project Manager at the time of cable delivery.

Part 2

Amendment to Part 2:

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers
 - 1. Cablee - UNSHIELDED.
 - 2. Okonite Co.
 - 3. Pirelli Cable Co.
 - 4. B.C.C.C.

2.2 MATERIALS

- B. Basic cable construction shall be 1/C Class B copper strand, extruded semi-conducting strand screen, EPR insulation, copper tape or wire shield, and a tough, oil-resistant jacket overall.

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- C. Conductor size shall be as indicated in specification & drawings and shall consist of bare soft copper wire. Stranding shall be Class B, stranded or compact and shall meet the electrical resistance requirements of ICEA S-68-516, Section 2.5.2.
- D. Conductor screen shall consist of an extruded layer of semi-conducting thermosetting compound.
- E. The insulation shall be ethylene-propylene rubber and shall meet the electrical and physical characteristics set forth in ICEA S-68-516. Cross-linked polyethylene is not acceptable. Average insulation thickness shall be 0.115 inches for 5KV rated cable and 0.220 inches for 15KV rated cable.
- F. Insulation screen shall be an extruded semi-conducting compound.
- G. Copper shield shall be tape or wires sized in accordance with applicable standards.
- H. Overall jacket shall be polyvinyl chloride or polyethylene, according to ICEA S-68-516. The following information shall be printed every 24 inches on the jacket:
 - 1. Manufacturer
 - 2. Insulation thickness and type (shielded)
 - 3. Jacket type
 - 4. Conductor type and size (AWG or MCM)
 - 5. Rated voltage
 - 6. Year of Manufacturer

Stanford University-Facilities Design Guideline Amendment

SECTION 33 71 49.23

MEDIUM VOLTAGE CABLE INSTALLATION

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 4 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Guideline Title:

Primary Voltage Power Installation

Amendment to Part 1.1 Scope:

- A. Work included in this Section: Primary Voltage Cable
- B. Primary voltage cable, stress cone kits, termination kits (200 Amp and 600 Amp elbows) and equipment-ground conductor will be furnished by Stanford. The Contractor provides all other materials including all labor for a complete and fully functioning installation.

Amendment to Part 1.3 CLOSEOUT SUBMITTALS:

- C. Changes to the original contract documents shall be marked, recorded and transmitted to the Project Manager.

Amendment to Part 1.4 QUALIFICATIONS:

- A. Qualifications are detailed in Section 3.3, E.

Amendment to Part 1.5 COORDINATION:

- A. Contractor is responsible for safety on the work site
- B. Barricade open manholes and pull boxes at all times. Provide for safe flow of traffic and pedestrians.
- B. Provide for continuous, mechanically supplied, fresh air to manholes and vaults when workers are inside.
- C. All switching of Stanford circuits shall be performed by Stanford personnel. Contractor shall personally verify that circuits are de-energized and locked out prior to starting work. Provide Contractor's locks in addition to Stanford locks.
- D. Scheduled outages that may be required to complete the work will be arranged by the Project Manager/**SOM** Engineering and Maintenance Shop
- F. All workers working in Manholes shall have OSHA Certification 29CFR1910.146 for Confined Space Access.

Additions to Part 1:

1.6 SUBMITTALS

- A. Manufacturer's literature describing Contractor furnished splice kits and other Contractor furnished equipment.
- B. Field high potential test reports.
- C. Submit proposed splicing materials and methods to the Project Manager for approval prior to starting work.

Stanford University-Facilities Design Guideline Amendment

1.7 DELIVERY, STORAGE & HANDLING

- A. Seal ends of cables before shipment to prevent entrance of moisture.

Part 2

Amendments to Part 2.1 CABLE:

- D. Single conductor, stranded copper, sizes as shown on Drawings.
- E. Insulation: Ethylene propylene rubber, 220 mils or as shown on the Drawings.
- F. Conductor shielding: Semi-conducting non-metallic shield over the conductor.
- G. Insulation shielding: Wires imbedded in jacket or copper tape or copper wires.

Additions to Part 2.2 TERMINATIONS:

- D. Bushing inserts accessories and wall bracket splices will be provided to match cables and terminations.

Amendment to Part 2.3 A:

- A. Make splices by hand taping or approved pre-manufactured splicing kits. Splices shall be rated for continuous submersion in water.

Additions to Part 2:

2.5 General

- A. Standards: Conform to applicable standards of AEIC, IPCEA, IEEE and NEMA, latest edition.
- B. Voltage class: 15,000 volts (and occasionally 5,000 volts) 90-degree C normal operating temperature, 130-degree C emergency overload temperature.

2.6 Wire for Ground and Neutral

- A. Provide 600 volt, THWN insulated, copper wire for equipment grounding conductors (circuit neutrals, where required, shall be of the same material).

2.7 Fault Indicators (devices furnished by Stanford)

- A. Clamp-on style fault indicators will be provided as required by the Project Manager.

2.8 Ground Rods and Connections

- A. Ground rods shall be $\frac{3}{4}$ " x 10' copper clad steel, driven to a depth of at least 9". Provide sectional rods to achieve depth in manholes.
- B. Make connections by exothermic welds (Cadweld or equal) or by approved solid copper clamps. Do not use clamps with steel or aluminum parts.
- C. Make grounding connections to existing ground bus by copper lugs and copper or stainless-steel nuts, bolts and lock washers. Do not use lugs containing aluminum.
- D. Splice neutral and ground conductors passing through manholes and vaults by compression type "T" connectors with the leg of the "T" connected to the ground bus. Do not use the ground bus as a splice point.

Part 3

Additions to Part 3.1:

- H. Pull a stiff brush, mandrel and swab through the conduit prior to pulling cable.
- I. Use only plain Manila rope or other non-abrasive material for pulling cable into conduit or duct.
- J. Pull at an even rate not to exceed 50 feet per minute.
- K. Basket grips may be used only for pulling short lengths and cables between switchgear and transformers. Pulling tension shall not exceed 1000 pounds per grip.
- L. Support cable reels on sturdy reel supports located sufficiently near the manhole to permit feeding the cable through the manhole opening without rubbing on the sides or on the ground.
- M. Attach pulling line to power cable with an approved swivel clevis to prevent twisting of cables.

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- N. Keep cable ends sealed prior to splicing or termination to prevent the entrance of moisture.
- O. All sheaves and similar equipment around which cable is pulled shall have a radius not less than 15 times the outside diameter of the cable. The pull angle shall not exceed 90 degrees.
- P. Return unused cable to the Project Manager on the original reels with the cable ends sealed against moisture. Record the length of the cable used on the reel flange.
- Q. Where old cable is replaced, remove the old cable and return it to the Project Manager for salvage. Cut removed primary voltage cable into approximately four-foot lengths and store on forklift pallets at the location directed by the Project Manager. Do not cut usable 600-volt ground and neutral wires.

Amendment to Part 3.2, A:

- A. Provide an insulated, 600-Volt TW, THW, OR THHN copper grounding conductor with all primary cable runs.

Additions to Part 3.2 INSTALLATION OF GROUND CONDUCTORS:

- E. Ground cable shield at splices and terminations with #6 AWG stranded copper wire or approved equal.
- F. Non-current carrying metal parts shall be grounded.
- G. Make ground connections with exothermic welding or approved solid copper connectors and brass nuts and bolts.

Additions to Part 3.3 CABLE SPLICES AND TERMINATIONS:

- E. Cable splices and terminations shall be made by certified cable splicers with a minimum five years' experience in splicing cables of the type being provided under the Contract. Provide qualifications to the Project Manager prior to splicing or termination of cables. Splicing and terminating shall be in strict accordance with manufacturer's recommendations, utilizing factory furnished materials in kit form, or as specifically shown on the Drawings.

Additions to Part 3.3 CABLES IN MANHOLES:

- C. Contractor shall install Stanford furnished cable I.D. tags with double plastic tie wraps in all manholes and pull-boxes. 4kV circuits shall be tagged with red tags with black letters and 12kV circuits shall be tagged with blue tags with black letters. Stanford furnished Cable I.D. tags will show cable numbers with routing information (to and from).

Amendment to Part 3.6, A:

- A. All primary cables shall be given D.C. high potential tests after installation. All tests shall be performed in the presence of the Project Manager's representatives and shall be performed to their complete satisfaction. Testing of cables shall be done after all splices and cable terminations are made, but before connections to equipment are made. Open cable ends shall be wrapped with plastic or provided with similar coronal protection. Test each cable with the shields and other cables grounded. A high potential test set shall be used to read the leakage current in microamperes in the cable at two-minute intervals during the test.

Additions to Part 3.6:

- F. If any primary cable fails, or shows unacceptable cable defects, all cables in that conduit between the nearest pulling points on each side of the failure shall be withdrawn. If, other cables that may have been installed in the same duct are inspected and not over stressed during pulling or visually damaged, they may be reinstalled, but the failed cable shall be replaced with new cable without additional charge

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G. After replacement of the faulty cable, and any other damaged cables, all cables of the circuit in that conduit shall be re-tested. If cable fails again, or if tests, show unacceptable cable defects, all cables shall be replaced without charge and this procedure shall be repeated until tests prove satisfactory

Addition to Part 3:

3.7 FIELD QUALITY CONTROL

- A. Cables, splices, and terminations shall be tested as described in Section 16402: Underground Power Distribution.

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SECTION 40 10 00

GAS AND VAPOR PROCESS PIPING AND DUCTWORK

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 3 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendment to Part 1.1, B:

B. This section should be used in conjunction with the Facilities Design Guide sections on plumbing piping and vacuum and compressed air piping. Specialty piping systems may include:

Amendments to Part 1.4 REFERENCES:

- G. American Society of Plumbing Engineers (ASPE)
- H. American Water Works Associated (AWWA)
- I. Underwriters Laboratory (UL)
- J. National Committee for Clinical Laboratory Standards (NCCLS)

Part 2

Addition to Part 2.13 GAS MANIFOLD SYSTEMS:

E. CO2 Gas Manifold Automatic Switchover – PRS9500 (Praxair Vendor)

Part 3

Amendments to Part 3.8 CLEANING:

- A. General Cleaning Requirements: All pipe, fittings, valves, and system-related materials shall be cleaned before use.
- B. Cleaning Area for Specialty Piping Construction: There shall be separate cleaning and clean storage areas.
- C. Location: Area shall be clean, dry and dust free. It shall be well lighted and with adequate ventilation to eliminate any hazards from cleaning solutions.
- D. Storage: There shall be three storage areas: uncleaned approved material, work in process, and clean, work-ready material.
- E. Division: All work-ready material shall be stored separately and shall not be allowed to be in contact with the floor, ground, or unclean resting sites.
- F. Dating: All work ready material shall be dated and initialed by the cleaning technician.
- G. Supplies: All chemicals and supplies shall be stored in a safe, ventilated area and protected from contamination.
- H. Used Chemicals: All used chemicals shall be stored in closed drums, held for disposal. Fresh chemicals shall be used daily. No recycled chemicals shall be used.
- I. Industrial Water System:
 - 1. After completing domestic water supply systems, these systems shall be disinfected in accordance with requirements of U.S. Public Health Department. Fifty (50) parts per million (PPM) of chlorine with eight (8) hour retention shall be used and flushed to leave a residual no greater than supply source. Written certification of disinfection completion shall be submitted to the Project Manager.
 - 2. Test piping as described above before disinfecting.

Additions to Part 3:

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3.9 POLYPROPYLENE PIPING INSTALLATION, TESTING AND START-UP

A. General:

1. This article establishes requirements for the installation of polypropylene piping for research grade water systems per ASTM D1785, ASTM D2146 or ASTM D2837-85, SDR-11, Thermoplastic Piping Specification.
2. All installation fitters who fabricate and install polypropylene piping systems shall be requalified by making at least three typical pipe joints into a test spool piece that withstands a test pressure that conforms to the manufacturer's design test recommendations. This will include at least one gasketed joint and is intended to meet the Code qualification of nonmetallic pipe joiners. The Contractor shall arrange the qualifying test with the representative present.
3. All materials and workmanship of this system shall be subject to inspection and examination by the Project Manager's representative at any place where fabrication and/or erection are carried on.
4. All research grade piping distribution systems shall be pressure and leak tested by the Contractor and approved by the Project Manager's representative prior to the final analytical test. See also paragraph 3.03.B., Pipe Testing, above.
5. All research grade piping test medium shall be research grade water.
6. Polypropylene piping shall be supported on continuous trough supports, with hanger spacing and rod sizes same as specified for metallic piping. Troughs shall be galvanized steel V or U shape, or semi-circular shape. V or U shape troughs shall have blocking at hangers to prevent rotation. Troughs shall be sized for a maximum deflection of 1/360th of span under actual loads, with "S" equal to 25,000 psi, and "E" equal to 29,000 psi.

B. Pipe Installation Procedures:

1. Polypropylene piping systems shall be installed in strict accordance with pipe manufacturer's recommendations, including preparation of pipe and fittings, selection of latest approved tooling and equipment.
2. All provisions of this specification shall be followed. No substitutions of items or alterations in the procedures are allowed unless authorized in writing by the Project Manager's representative. A thorough visual inspection of the completed pipe system by the Contractor and Project Manager's representative is required.
3. The pipe and fittings shall be carefully unloaded by hand, or using slings made of nonmetallic (e.g., nylon) material. Pipe shall be stored indoors on sleepers. Fittings shall be stored indoors in sealed containers. A qualified fitter shall supervise unloading and visually inspect the piping for evidence of abuse or damage such as cracks or gouges. Damaged pipe shall be rejected and not used.
4. All capped pipe and boxed fittings and prefabricated spools shall be carefully handled to avoid damage.
5. Pipe shall be cut with pipe cutter, beveled and deburred. Joining surfaces of fitting socket and pipe shall be thoroughly cleaned using absorbent clean room cotton cloth wipes and semiconductor grade anhydrous isopropyl alcohol. New clean room cotton wipe shall be used each time.
6. Pipe shall be cut accurately to job measurements and installed per manufacturer's recommendations without springing or forcing, true to line and grade per design specifications.
7. All joints shall be made up in a dry, clean environment according to the manufacturer's instructions.
8. Piping shall be joined by a heat fusion method. Fittings shall be socket type. The pipe end and fitting socket shall be heated to fusion joint temperature per Manufacturer's specifications.
9. The depth of penetration of the pipe into the socket is to be as defined in manufacturer's instructions. The pipe system selected will determine the size of outside bead.

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10. Valves shall be located with stems above horizontal plane of pipe and in accessible locations with adequate clearance around hand wheels or levers for easy operation.
 11. All valved stubs for future connections shall be piped within six (6) pipe diameters on main run.
 12. Special care shall be taken during installation to keep piping system clean. All open ends shall be capped with Teflon tape.
- C. Piping Distribution Cleaning:
1. Cleaning procedure will require the following materials and equipment:
 - a. Alconox detergent and thirty percent (30%) hydrogen peroxide cleaning agents.
 - b. Circulating pump.
 - c. Acid resistant tanks of sufficient size to fill all lines.
 - d. One percent (1%) potassium permanganate testing solution.
 - e. Balsbough resistivity meter.
 2. Procedure:
 - a. Flush piping system with research grade Type III water to remove all foreign substances.
 - b. Connect piping systems to be cleaned to the pump and tank. Fill the tank with research grade Type III water and add Alconox twenty-five (25) grams/gallon.
 - c. Circulate solution through all research grade piping for six (6) hours, bleeding 0.5 gallons from each valve at two (2) hour intervals.
 - d. Drain system and refill with research grade Type III water and test resistivity. Repeat procedure until the return side of each loop conforms to the NCCLS Type III water specifications.
 - e. Add hydrogen peroxide (1 gallon per 5 gallons of system volume) and repeat Procedures 2.c and 2.d above.
 - f. Flush system with fresh research grade Type III water and test all discharge points with potassium permanganate. Continue flushing until test shows negative. (A positive test will show color change from violet to brown.)
 - g. Drain and fill system including filter housings, pumps, and storage tanks with fresh research grade water and proceed to operate entire system.
 - h. Check water quality and continue flushing with fresh research grade water until the return side of each loop conforms to the NCCLS water type of this piping system.
 3. System Start-up:
 - a. Prior to start-up, all subsystems shall be checked to ensure they are ready, including but not limited to the following: proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting controls, all filters installed and properly set relief and safety valves.
 - b. All systems shall be started and operated. The services of factory trained technicians shall be provided for start-up of major equipment and systems, including but not limited to temperature controls and pump sets. All balancing valves, flow and pressure regulators, and any other adjustable equipment shall be adjusted for optimum performance and to suit job conditions.

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SECTION 40 20 00

LABORATORY WASTE AND WASTE SYSTEMS

PARTICULARS

1.01 This amendment forms a part of the Contract Documents and modifies the Stanford University Guideline Documents dated February 2023, with amendments and additions for School of Medicine (SOM) noted below.

1.02 This Amendment consists of 2 pages.

CHANGES TO THE PROJECT GUIDELINES

Part 1

Amendments to Part 1.2 REFERENCES:

- A. American Society of Plumbing Engineers (ASPE)
- B. American Water Works Associated (AWWA)
- C. National Fire Protection Association (NFPA)
- D. Underwriters Laboratory (UL)
- E. National Committee for Clinical Laboratory Standards (NCCLS)

Amendment to Part 1.3, A:

1. In the absence of specific requirements in the design contract the following submission requirements shall be followed. Confirm the submission requirements with School of Medicine Project Manager.

Amendment to Part 1.3, B:

1. Selection of types of specialty piping systems.
3. Location of major specialty piping equipment.
4. Schematic diagrams of major specialty piping systems.

Amendment to Part 1.3, C:

1. Location of all specialty piping equipment.

Amendment to Part 1.3, D:

1. 50 % complete specialty piping plans, sections and details.

Amendments to Part 1.7 DELIVERY, STORAGE AND HANDLING:

- E. Pre-purchased Equipment: The Consultant responsible for the pre-purchase specification of equipment or materials shall consult the Project Manager regarding delivery, inspection and acceptance, storage and handling of the products.
- F. Equipment Furnished by the Contractor: Specific provisions for delivery and storage locations as well as handling, protection, and security measures shall be included in the Contract Documents.

Addition to Part 1:

1.8 GENERAL DESIGN CONSIDERATIONS

- A. General:
 1. Design shall be in accordance with applicable ASHRAE and ASPE handbooks.

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- 2. Maintenance shall be an important design consideration for all systems. Sectional valving is required. Shutdown of parts of systems should not unnecessarily disrupt operation of entire building systems.
 - 3. Energy conservation shall be an important design consideration for all systems.
- B. Coordination: The University expects careful design coordination between plumbing, specialty piping, HVAC, and fire protection disciplines

Part 2

Amendments to Part 2.3, RESEARCH GRADE WATER SYSTEM DESIGN:

- A. The Architect, in association with the School of Medicine Project Manager, shall meet with the laboratory user to determine which type/grade of National Committee for Clinical Laboratory Standards (NCCLS) water is to be used.
- J. Vacuum Pumps, Air Compressors, Redundant Pumps should run on a Lead/Lag Automated Schedule.
- K. Type 1-A purified water produced at source with purity greater than 18 mega-ohm/cm System must deliver Less Than 10 PPB to researchers.
- L. DI Loop shall have By-Pass Piping.
- M. The DI Skid shall have a Secondary Pump.
- N. Include a Total Organic Carbon Analyzer.
- O. RO is preferred over straight DI. (RO removes 98% of city water contaminants).

Amendment to Part 2.4, RESEARCH GRADE WATER PIPING:

- E. Piping Materials shall be Polypropylene Piping with Butt-fused joints. Glued piping is not recommended as it will leach into the system causing higher TOC levels.

Part 3

Addition to Part 3.2, C:

System	Testing Pressure	Testing Media	Duration
Research Water Grade	150 PSIG	DI Water	4 Hours
Industrial Water	150 PSIG	Water	4 Hours