

PROJECT MANUAL

FOR

PENINSULA HOUSING AUTHORITY

EKLUND at GALES

Permit Set – Volume II of II

July 10, 2026



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FIRE PROTECTION BASIS OF DESIGN NARRATIVE

PART 1 - GENERAL

1.01 INTRODUCTION

A. Section includes:

1. The purpose of this section is to define the design approach upon which the contractor is to base a budget/estimate for bid purposes and establish the design criteria, and design submittals, which will be required in the preparation and execution of the design.
2. All work under this section shall comply with the requirements of general conditions, supplemental conditions, special conditions, and division 1 – general requirements, and shall include all mechanical sections specified herein.

1.02 APPLICABLE CODES AND STANDARDS:

A. Design shall comply with rules and regulations of the following:

1. NFPA 13R (2019) – Standard for the Installation of Fire Sprinkler Systems
2. 2021 International Fire Code (IFC)
3. 2021 International Building Code (IBC)
4. All other applicable local jurisdiction amendments

1.03 ORDER-OF-PRECEDENCE PROVISIONS

- A. In the case of inconsistency or ambiguities in design documents (all specifications and drawings), compliance with the strictest design requirement among conflicting criteria is required.
- B. If provided, alternate pricing for compliance with less strict criteria will be evaluated in addition to the mandatory baseline strictest criteria.
- C. Provide notice upon discovering potential design conflicts prior to bid where possible.

1.04 PROJECT DELIVERY

- A. This project is to be delivered design build. The design build contractors will be the engineers of record and create and stamp fully coordinated design documents for the

project. Project shall be designed and stamped by a NICET certified designer who has attained level III or higher.

- B. The Sprinkler Contractor will provide pricing that covers the complete scope of work required to deliver a fully functional and code compliant project.
- C. Request for proposal (RFP): If there is a conflict between design documents and the RFP, the contractor will identify the discrepancy and request a clarification prior to RFP response.
- D. Bidders are encouraged to provide voluntary alternates beyond the specific scope outlined in this narrative and the accompanying drawings.
- E. Bidders are encouraged to contact the design team (through the channels identified by the issuer of the RFP) with clarification requests during the proposal process.
- F. The architectural floor plans provided are not final. Pricing shall allow for equipment relocations due to minor interior layout modifications.
- G. The bid proposals will identify scope gaps the contractor perceives and provide breakout pricing to cover these gaps.
- H. The sprinkler contractor shall submit final CAD as-built drawings to the General Contractor for submittal to owner within two weeks of project completion or unless alternative timing is agreed to.
- I. Operations and Maintenance manuals: Provide hard copy and electronic copies of O&Ms for ALL systems within TWO weeks of substantial completion.
- J. Sprinkler contractor to provide owner training on all systems within the building.
- K. Definitions:
 - 1. Complete system: the contract documents do not attempt to address all materials, devices, equipment, and work that shall be required for completion of the mechanical systems. All materials, devices, equipment, and work not addressed in the contract.
 - 2. The sprinkler contractor is responsible for providing the finished sprinkler work, tested, and ready for normal operation.
 - 3. Sprinkler contractor shall properly store all materials and equipment in order to protect materials from physical damage or damage due to the elements or corrosion.
 - 4. The sprinkler contractor shall make every effort to provide materials from a single manufacturer for any given material type, unless otherwise noted.

5. Materials shall be provided, installed, and/or used in conformance with the manufacturer's recommendations. If manufacturer's recommendations are not in conformance with the intent of the contract documents, obtain clarification from the architect and engineer prior to proceeding.
6. Coordination: check drawings of other trades to verify spaces in which work shall be installed. Establish exact locations of piping and ducts in such a manner as to conform to structure, avoid obstructions, and keep openings and passageways clear. Lines that must pitch or that must have a constant elevation, shall have the right-of-way over lines not so restricted. Maintain maximum headroom. If space conditions appear inadequate, notify the architect before proceeding with the work. Make reasonable modifications in the work without extra cost as needed to prevent conflict with work of other trades and for proper execution of the work.
7. Drawings and narratives shall be considered as a single entity, identified as the contract documents. Consider work indicated in one as required by both.

L. Codes, Permits, Inspections, and Fees:

1. The sprinkler contractor shall obtain all permits and inspections and pay all fees required by state and local authorities, except as noted.
2. All work and materials shall be in accordance with requirements of all applicable local and state codes, statutes, standards and other regulations. Date of regulations shall be as adopted by local authorities at the time of permit intake, unless indicated otherwise.
3. The codes shall be construed as establishing a minimum or base level of requirements.
4. Where the contract documents call for material or construction of a better quality or higher capacity than required by the codes, statutes, standards, and other regulations, the provisions of the contract documents shall take precedence over the requirements of the codes and standards.
5. Material and equipment within the scope of the UL testing laboratory service shall be listed by the underwriters laboratories for the purpose for which they are used and shall bear their listing mark. FM shall be allowed if acceptable to the authorities having jurisdiction.
6. Sprinkler contractor shall call for all inspections by the local code authorities when they become due and shall not cover any work until approved by these authorities.

M. Construction Coordination Drawings

1. It shall be the contractor's responsibility to work out and coordinate all conflicts and to provide all transitions and offsets required to facilitate installation of work. Provide construction coordination drawings for congested areas requiring close coordination with other trades and the general construction.
 - a. Grooved joint couplings and fitting shall be referred to on drawings and product submittals, and be identified by the manufacturer's listed model or series designation.
 - b. Sprinklers shall be referred to on drawings and product submittals, and be specifically identified by the manufacturer's listed model or series designation.
2. The construction coordination drawings shall be submitted to the architect/owner/engineer for review prior to commencement of any related work. The construction coordination drawings shall be updated as needed during the execution of the work.
3. The construction coordination drawings shall show all related trades, structure, and ceiling, walls, and partitions. Provide cross sections of all congested areas.
4. The final as-built drawings shall be submitted at the completion of the project for record purposes in hard copy, pdf, as well as electronic files.

N. Design, Submittals, Trade Coordination

1. The contractor shall coordinate their shop drawings with other trades prior to shop drawing approval and construction.
2. No cutting or drilling of joists or beams will occur without structural engineer approval.
3. Architectural drawings shall be checked for ceiling heights, walls, and cabinets that are intended to conceal work of this section. Where conflicts occur, the architect shall be notified prior to rough-in or installation of the work. Location of exposed work such as diffusers, grilles, and piping outlets shall take precedence over concealed work.
4. Complete equipment, and materials submittals shall be provided in electronic format. PDF bookmarks are required. Submittals shall be complete with all components included and customized to this project's requirements. Where cut sheets include more than one model or option, the sheets shall be marked to indicate the specific model/ options proposed for this project. Include warranty provisions for all equipment. All submittals require owner team approval prior to purchase.

5. Working construction shop drawings: complete equipment and materials submittals shall be provided in electronic format submitted per the time schedule issued by the owner/GC. Submittals shall be complete with all components included, installation manuals, and customized to this project's requirements. All submittals require owner and design team approval prior to purchase.
6. Contractor agrees that shop drawings submittals processed by the architect are not change orders, that the purpose of shop drawing submittals by the contractor is to demonstrate to the architect that the contractor understands the design concept and demonstrate its understanding by indicating which equipment and material it intends to furnish and install and by detailing the fabrication and installation methods it intends to use.
7. Contractor further agrees that if deviations, discrepancies, or conflicts between shop drawings and specifications are discovered either prior to or after shop drawing submittals are processed by the architect, the design drawings and specifications shall control and shall be followed.
8. Shop drawings shall be reviewed by the equipment manufacturers before submitting to architect to determine whether the products are being correctly used.
9. Construction administration: the selected contractor will perform construction administration, including RFI responses, attendance at periodic meetings, formal review and approval of shop drawings and submittals, coordination with other trades, preparation of final punchlist.
10. Warranty period to extend for one year from date the project is occupied by the owner, not from the date of completion of the work. Warranty not applicable to defective items due to faulty work of subsequent trades.
11. As-builts: contractor shall maintain up to date as-built drawings showing all construction installation with any/all design changes. Drawings shall be maintained in the project office for inspection by the architect/owner at any time. Provide owner with reproducible and electronic (AutoCAD and pdf files) as-built drawings within 4 weeks of project substantial completion. Drawings shall include final as-installed locations of all piping, valves, and sprinkler heads.
12. All work contracted for must be accepted by all applicable inspectors including site superintendent, GC quality control personnel, AHJ's, owner's representative (IMEG) or their assignees.
13. Provide manufacturers product, installation and warranty information for all products supplied with signed contract documents per an agreed upon schedule at the time of contract award. This is of particular importance for GC to forward

appropriate information to subcontractors to facilitate coordinated installation of his products.

14. During the construction phase of the project the contractor shall maintain a master punch list for items showing all problems discovered during field inspection, owner inspections, startup testing, functional testing and balancing. This list shall track each item to completion and require engineer signoff after completion is verified. Owner inspection items must be signed off by the owner's representative after completion is verified.

PART 2 - PRODUCTS

2.01 FIRE SPRINKLER SYSTEMS:

- A. Sprinkler system components shall be UL listed or factory mutual approved for all such components that have a listing in the respective agency.
- B. A new 4" water supply service and meter in vault shall be supplied for the fire sprinkler system.
- C. The sizing of the feed main sprinkler piping inside of the building shall be hydraulically calculated based on the static pressure, residual pressure, and flow available. Anticipated size is 4" or smaller.
- D. The sprinkler system shall be calculated with a minimum 10% or 10 psi safety factor (whichever is higher) as required by the local Authority Having Jurisdiction.
- E. Provide a double check type backflow preventer approved by the local authority having jurisdiction. Backflow preventer to be located in the water entry room on level 1 (see architectural plans for location).
- F. All sprinkler piping upstream of the backflow preventer assembly shall be potable pipe acceptable to the authority having jurisdiction.
- G. Current water pressure is not available for this site. A hydrant test for a nearby site dated 2013 indicates to expect 60 psi static pressure with 772 gpm at a residual pressure of 20 psi. Bidding contractor shall verify available water pressure available at the project site.
- H. Based on the expected site water pressure, a fire pump is not anticipated for this project.
- I. Provide 2-way fire department connection on exterior of the building with swing check valve and ball drip. Coordinate location of FDC with architect and local authorities having jurisdiction

- J. Provide electric alarm bell on the exterior of the building in a constantly attended location. Coordinate the bell location with the architect and local authorities having jurisdiction. Coordinate power (line voltage or low voltage) with electrical or controls contractor as necessary. Refer to Division 27/28 narratives for additional Fire Alarm details.
- K. Design a wet-pipe fire sprinkler system for all residential, public spaces, and all other heated areas of the building. Wet pipe fire sprinkler system shall be designed for light hazard occupancy in residential and public areas. System shall be designed for ordinary hazard in mechanical, electrical, and storage rooms in accordance with NFPA 13.
- L. Project is only two stories and does not meet the height limits to require standpipes.
- M. Provide tamper switches at all shut-off valves and coordinate wiring with fire alarm contractor.
- N. Provide a paddle type water flow switch at the sprinkler riser assembly and coordinate wiring with fire alarm contractor. Water flow switch shall be located upstream of the main drain and inspector test valves (or combined test and drain valve) as required by code and manufacturer installation requirements.
- O. Floor controls are not required for wet systems on this project. Provide alternate pricing to include floor controls consisting of shut-off valves with integral tamper switches, paddle-type water flow devices, and test and drain valves served from the main riser assembly on level 1.
- P. All wet system drains shall be routed back to a hub drain in the fire sprinkler riser room or to a safe location outside of the building by the fire sprinkler contractor if allowed by the AHJ. Drain sizing and termination shall meet the requirements of NFPA 13 and the local AHJ. If drains are routed to the exterior of the building, coordinate routing and termination with architect.
 - 1. If additional drain termination points are required outside of the fire pump room, sprinkler contractor shall be responsible for identifying and coordinating locations with plumbing design.
- Q. Pipe routing to be coordinated by fire sprinkler contractor. Provide heat trace and insulation as required for wet sprinkler main running through unheated areas. Coordinate power requirements with electrical contractor.
- R. Provide sprinkler coverage of all elevator shafts, pits, and machine rooms in accordance with NFPA 13 and local AHJ requirements.

- S. Sprinkler body shall be die-cast, with a wrench boss integrally cast into the sprinkler body to reduce the risk of damage during installation. Wrenches shall be provided by the sprinkler manufacturer that directly engage the wrench boss.
- T. Sprinkler heads in residential finished ceilings shall be white semi-recessed pendent or sidewall type heads. Provide glass bulb standard temperature quick response heads throughout.
- U. Sprinkler heads in non-residential finished ceilings shall be chrome plated semi-recessed pendent or sidewall type heads. Provide glass bulb standard temperature quick response heads throughout.
- V. Sprinkler heads in occupied spaces without finished ceilings shall be brass upright, pendent, or sidewall type heads as appropriate. Provide head guards where required by code or where there is a risk of mechanical damage to the sprinklers. Provide glass bulb standard temperature quick response heads throughout.
- W. Sprinkler heads in mechanical rooms and other back of house spaces shall be brass upright, pendent, or sidewall type heads as appropriate. Provide head guards where required by code or where there is a risk of mechanical damage to the sprinklers. Provide glass bulb standard temperature quick response heads throughout.
- X. Provide a durable metallic box in the riser room with an acceptable stock of spare sprinkler heads and installation wrenches as required by code. The box shall contain at least one (1) of each type of sprinkler installed within the building.
- Y. All exterior overhangs deeper than 4'-0" shall be sprinkled per NFPA 13. Provide dry-barrel type freezeless sprinklers or separate dry system to protect these areas as necessary.
- Z. Exposed piping 2 1/2" and larger shall be schedule 10 or schedule 40 black steel, joints shall be welded or roll-grooved. NFPA 13 compliant thin wall pipe (Allied brand Dyna-Flow or approved equal) is an acceptable alternate.
 - 1. Mechanical Grooved Couplings shall be cast iron and comply with ASTM F1476 – Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications. Gaskets shall be pressure-responsive synthetic rubber with grade to suit the intended service.
- AA. Exposed piping 2" and smaller shall be schedule 40 black steel. Joints shall be threaded or roll grooved. NFPA 13 compliant light weight threadable pipe (Allied brand Dyna-Thread or approved equal) is an acceptable alternate.

- BB. UL listed CPVC piping may be utilized on residential floors where it is concealed and installed in accordance with applicable code and manufacturer listings.
- CC. Mechanical branch tees are not appropriate for new construction and are not allowed on this project. Contractor shall use groove-o-let and thread-o-let welded outlets or standard reducing tees.
- DD. Provide all hangers/ supports and seismic restraints in accordance with NFPA 13R and all local AHJ requirements. Contractor is responsible for providing seismic restraint calculations as required per code to the AHJ as part of their submittal package.
- EE. Piping shall be run concealed in all areas with finished ceilings and locations must be coordinated with architect and interiors drawings.
- FF. Design build sprinkler contractor to coordinate pipe routing and head locations with the architect, interiors architect, design team, and construction team with special attention to interior reflected ceiling and acoustical plans. Shop drawings shall be submitted with the above information for review and coordination prior to construction.
- GG. In areas open to structure, sprinkler piping shall be routed tight to structure. Piping shall not be run in front of windows or beneath skylights where applicable. Contractor to pay special attention to routing in lobby areas.
- HH. Provide pipe escutcheons at all public areas where sprinkler pipe penetrates walls.
 - 1. Escutcheons and guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
 - II. The fire sprinkler contractor shall fire stop all locations where the sprinkler piping penetrates a fire rated wall. Fill all voids with mineral wool and caulk with Intumescent fire caulking.
- JJ. Provide heat trace and insulation of wet sprinkler main running through unheated areas of the building at minimum 5 watts/ foot. Heat trace is to be listed for use with fire protection equipment. Coordinate with electrical contractor for wiring of heat trace.

PART 3 - EXECUTION

3.01 PREPARATION AND INSTALLATION

- A. Install all materials in accordance with code and manufacturer requirements and best industry practices.

- B. Receive and store all materials on site in such a way as to protect uninstalled items from damage. Additional care shall be taken to ensure that CPVC pipe and fittings are protected from exposure to direct sunlight.
- C. Contractor shall have an ongoing employee training and quality control program that includes periodic documented training updates from manufacturer's representatives for all aspects of installation for contractor's field personnel. This shall be paired with a field QC program including periodic inspection of work installed in the field
- D. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer and shall be verified as suitable for the intended service.
- E. A factory-trained field representative (direct employee) of the CPVC manufacturer shall provide on-site training (either on the job site or contractor's office) for contractor's field personnel in the proper handling and installation of CPVC piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed. Contractor shall remove and replace and improperly installed products. A distributor's representative is not considered qualified to conduct the training.
- F. Do not install any sprinklers that have been dropped, damaged, or show a visible loss of fluid. Never install any sprinkler with a cracked bulb.

3.02 TEST AND INSPECTION

- A. System shall be tested and inspected. Sprinkler contractor is responsible for all required startup and testing. Coordinate with local authority having jurisdiction and all other authorities having jurisdiction for inspection and acceptance.
- B. Provide copies of all sprinkler system test certificates, including all signatures, to owner for building records.

END OF SECTION

SECTION 220500 - BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 22 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
- B. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.

D. Scope of Work:

- 1. Plumbing Work shall include, but is not necessarily limited to:
 - a. Furnish and install all items listed in the Plumbing Material List.
 - b. Furnish and install a new domestic water service to the building.
 - c. Furnish and install water meter and domestic water backflow preventer as required by Code.
 - d. Furnish and install a complete domestic water piping system including cold, hot, and hot water circulating piping within the building. Insulate all piping as specified.
 - e. Furnish and install heat pump water heaters.
 - f. Furnish and install complete] sanitary sewer and vent system.
 - g. Furnish and install indirect waste piping from appliances, backflow preventers, and similar.
 - h. Install and make final connections to fixtures and equipment provided by others, for example from the kitchen equipment contractor or laboratory casework provider.
 - i. Furnish and install condensate drain piping from plumbing related equipment such as ice machines.
 - j. Furnish and install condensate drain piping from cooling related equipment such as air handlers and cooling coil drain pans.

- k. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 220550.
- l. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
- m. Complete all applicable tests, certifications, forms, and matrices.

1.3 OWNER FURNISHED PRODUCTS

- A. The Owner will supply the following items for installation and/or connection by this Contractor:
 - 1. N/A
- B. The following items shall be relocated, installed and/or connected by this Contractor:
 - 1. N/A
- C. The Owner will supply manufacturer's installation data for Owner-purchased equipment for this project.
- D. This Contractor shall make all plumbing system connections shown on the drawings or as required for fully functional units.
- E. This Contractor is responsible for all damage to Owner furnished equipment caused during installation.

1.4 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.
- B. Schedule overtime for the following work:
 - 1. TBD
- C. Itemize all work and list associated hours and pay scale for each item.

1.5 ALTERNATES

- A. N/A

1.6 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

- A. Definitions:
 - 1. "Mechanical Contractors" refers to the following:

- a. Plumbing Contractor.
 - b. Heating Contractor.
 - c. Air Conditioning and Ventilating Contractor.
 - d. Temperature Control Contractor.
 - e. Fire Protection Contractor.
 - f. Testing, Adjusting, and Balancing Contractor.
2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.
6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical busduct.
 - d. Sheet metal.
 - e. Electrical cable trays, including access space.
 - f. Sprinkler piping and other piping.
 - g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Boiler Feed Pumps.
 - b. Condensate Return Stations.
 - c. Makeup Air Units.
 - d. Package Air Handling Units.
 - e. Packaged Rooftop Units.
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.
4. Temperature Control Contractor's Responsibility:

- a. Wiring of all devices needed to make the Temperature Control System functional.
 - b. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor.
 - c. Coordinating equipment locations (such as relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28.
6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.7 COORDINATION DRAWINGS

- A. Provide coordination drawings showing the complete, coordinated installation on mechanical, electrical, plumbing, fire protection, and other systems within available building spaces.
- B. Definitions:
1. Coordination Drawings: Coordination drawings are defined as composite drawings or models that incorporate work of multiple trades and demonstrate coordinated routing, elevations, and clearances.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.

- c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. Provide one complete, composite coordination drawing package for each building area, system, or phase demonstrating fully coordinated conditions.
3. The composite coordination drawing package may be created from multiple trade-specific electronic files; however, the final deliverable shall clearly represent a single coordinated installation.
4. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
 - a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
5. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

C. Participation:

1. The Contractor shall be responsible for coordinating all trades and preparing coordination drawings.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process. The Coordinating Contractor for this project shall be the Mechanical Contractor.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspeople/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

D. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.

- a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

E. General:

1. Provide coordination drawing files to the Architect/Engineer for review for identified conflicts. The Architect/Engineer will not act as the project coordinator and is not responsible for coordination of the work. The Architect/Engineer will review only clearly identified conflicts submitted by the Contractor and will not perform clash detection or coordination. The Architect/Engineer will not compile or reconcile multiple trade files and will rely on the Contractor's composite coordination drawing package.
2. The Contractor remains solely responsible for coordination regardless of any review or comment provided by the Architect/Engineer.
3. A plotted set of coordination drawings shall be available at the project site.
4. Coordination drawings are not shop drawings and are not subject to approval. Receipt or review of coordination drawings does not constitute approval of routing, layout, means, methods, sequencing, or constructability.
5. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
6. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
7. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
8. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
9. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
10. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

- a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
11. Complete the coordination drawing process and obtain documented sign-off from all participating trades confirming that coordination drawings have been reviewed and coordinated prior to installation. Sign-off shall consist of signatures on the composite coordination log identifying participating trades and acceptance of the coordinated layout.
 12. Do not begin installation of work in an area until coordination drawings for that direction prior to installation. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination. Conflicts identified after installation due to incomplete coordination shall be corrected at no additional cost to the Owner.
 13. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.8 WEB-BASED PROJECT SOFTWARE

- A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.
- B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.
- C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.
- D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.9 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.
 1. Submittals List:

Referenced Specification	Submittal Item
Section	
22 05 00	Owner Training Agenda
22 05 03	Fire Seal Systems
22 05 13	Motors
22 05 15	Variable Frequency Drives
22 05 16	Expansion Compensation
22 05 29	Hangers and Supports
22 05 29	Prefabricated Curbs
22 05 48	Vibration Isolation Equipment
22 05 50	Seismic Restraint Systems
22 05 53	Plumbing Identification
22 07 16	Plumbing Equipment Insulation
22 07 19	Plumbing Pipe Insulation
22 09 00	Instrumentation
22 10 00	Plumbing Piping Systems and Valves
22 10 23	Natural Gas and Propane Piping Systems
22 10 30	Plumbing Specialties
22 11 23	Domestic Water Pumps
22 12 00	Plumbing Tanks
22 13 29	Sanitary Sewage Pumps
22 14 29	Sump Pumps
22 15 19	Compressed Air Systems
22 30 00	Plumbing Equipment
22 33 39	Solar Water Heating Systems
22 40 00	Plumbing Fixtures
22 60 00	Medical Gas Systems

B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses

- f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
- 3. Composition:
 - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
- 4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
- 5. Contractor's Approval Stamp:
 - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.
 - 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).

- d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.
 - e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions, or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
- a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 22 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 22 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.10 CHANGE ORDERS

1.11 EQUIPMENT SUPPLIERS' INSPECTION

- A. The following equipment shall not be placed in operation until a competent installation and service representative of the manufacturer has inspected the installation and certified that the equipment is properly installed, adjusted and lubricated; that preliminary operating instructions have been given; and that the equipment is ready for operation:
 1. Fire Seal Systems
 2. Seismic Restraints and Equipment Bracing
 3. Vibration Isolation
- B. Contractor shall arrange for and obtain supplier's on-site inspection(s) at proper time(s) to assure each phase of equipment installation and/or connection is in accordance with the manufacturer's instructions.
- C. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.12 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:

1. Motor windings and ventilation openings.
 2. Bearings.
 3. Equipment pipe and accessories connection openings. (e.g. boiler connections, coil connections, etc.)
 4. Starter and control cabinets.
 5. Heat transfer coils.
 6. Pump Seals.
 7. Combustion burner and blower equipment (e.g. combustion air intake, combustion vent/flue, etc.)
- C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to Owner that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.
- D. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- E. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, he/she shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.
- 1.13 NETWORK / INTERNET CONNECTED EQUIPMENT
- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.
- 1.14 WARRANTY
- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.

- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.15 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.16 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the first manufacturer is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractor's part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

1.17 PROJECT COMMISSIONING

- A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00 and 22 08 00 and provide all services as described in the Commissioning Plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locators can be found at the following website (<https://call811.com/>) or by calling 811.
2. The Contractor shall do all excavating, filling, backfilling and compacting associated with the work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. Where excavations are made in error below foundations, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer, shall be placed in such excess excavations. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment, or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workers.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. Where satisfactory bearing soil for foundations is not found at the indicated levels, the Architect/Engineer or their representative shall be notified immediately, and no further work shall be done until further instructions are given by the Architect/Engineer or their representative.

C. Dewatering:

1. Contractor shall furnish, install, operate, and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Use great care in making installations near underground obstruction.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. Utilities Bedding: Lay underground utilities on minimum of 6" sand bedding or CA6 crushed stone. Compact bedding under utilities smooth, with no sharp edges protruding, to protect the utilities from puncture. Shape bedding to provide continuous support for bells, joints, and barrels of utilities and for joints and fittings.
2. Envelope Around Utilities to 6" Above Utilities: Place sand or CA6 crushed stone or flowable fill to a height of 6" over utilities in 6" layers. After connection joints are made, any misalignment can be corrected by tamping backfill around the utilities.
3. Backfill From 6" Above Utilities to Earthen Grade: Place all backfill materials above the utilities in uniform layers not exceeding 6" deep.
4. Backfill From 6" Above Utilities to Below Slabs or Paved Area: Where the sand or CA6 crushed stone fill and backfill will ultimately be under a building, floor or paving, each layer of backfill materials shall be compacted to 95% of the maximum density determined by AASHTO Designation T 99 or ASTM Designation D 698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content determined by AASHTO T 99 or ASTM D 698 test.
5. Backfill Materials:
 - a. Sand, CA6: Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.
 - b. Native Soil: Native soil materials may be used as backfill if approved by the Geotechnical Engineer. Native soils shall be free of rock or gravel larger than 3" in any dimension and shall be free of debris, waste, frozen materials, vegetation, high void content, and other deleterious materials. Each layer shall be placed, then carefully and uniformly tamped, to eliminate lateral or vertical displacement.
 - c. Flowable Fill: Cementitious, self-leveling, self-compacting slurry as defined by the ACI with compressive strength of 50-100psi at 28 days; consisting of a mixture of fine aggregate or filler, water and cementitious materials. Filler material consist of sand, fly ash, spent foundry sand, quarry fines, baghouse dust. Cementitious materials consist of Portland cement, pozzolanic materials, and self-cementing materials. Flowable fill may be placed in a pour instead of 6" layers noted above.
6. Water shall not be permitted to rise in unbackfilled trenches.
7. Dispose of excess excavated earth as directed.

8. Backfill all trenches and excavations immediately after installing utilities or removal of forms, unless other protection is provided.
9. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Fill and backfill materials shall be spread in 6 inch uniform horizontal layers with each layer compacted separately to required density.

F. Surface Restoration:

1. Where trenches are cut through existing graded, planted, or landscaped areas, the areas shall be restored to the original condition. Replace all planting removed or damaged to its original condition. A minimum of 6 inches of topsoil shall be applied where disturbed areas are to be seeded or sodded.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The Contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.
2. Covering exterior walls, interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. Pipe insulation is installed and fully sealed.
 - b. Pipe wall penetrations are sealed.
 - c. Pipe identification and valve tags are installed.
2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.4 OPERATION AND MAINTENANCE MANUALS

A. General:

1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.

B. Electronic Submittal Procedures:

1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div22.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div22.contractor.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
7. All text shall be searchable.
8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.

C. Operation and Maintenance Instructions shall include:

1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.
3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Copy of final approved test and balance reports.
5. Copies of all factory inspections and/or equipment startup reports.

6. Copies of warranties.
7. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
8. Dimensional drawings of equipment.
9. Capacities and utility consumption of equipment.
10. Detailed parts lists with lists of suppliers.
11. Operating procedures for each system.
12. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
13. Repair procedures for major components.
14. List of lubricants in all equipment and recommended frequency of lubrication.
15. Instruction books, cards, and manuals furnished with the equipment.
16. Owner and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

3.5 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.
- D. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- E. The instructions shall include:
 1. Explanation of all system flow diagrams.
 2. Maintenance of equipment.
 3. Start-up procedures for all major equipment.
 4. Explanation of seasonal system changes.
 5. Explanation of Owner's Responsibilities to operate, maintain, and flush domestic water system (i.e., ASHRAE Standard 188).
- F. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can attend if desired.
- G. Minimum hours of instruction for each item shall be:
 1. Domestic Hot Water System - <Insert> hours
 2. All Domestic Water Systems operation, maintenance and flushing of all fixtures and dead legs - <Insert> hours
 3. Domestic Water Pressure Booster System - <Insert> hours.
 4. Water Softener, Filtration and/or Purification System - <Insert> hours

5. Domestic Water Supplemental Treatment System - <Insert> hours
6. Medical Gas System(s) - <Insert> hours.

H. The Contractor shall prepare a detailed, written training agenda and submit it to the Architect/Engineer a minimum of two four weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: how to adjust setpoints, troubleshooting, proper start-up, proper shut-down, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.

I. Operating Instructions:

1. Contractor is responsible for all instructions to the Owner's representatives for the mechanical and control systems.
2. If the Contractor does not have staff that can adequately provide the required instructions the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.6 SYSTEM STARTING AND ADJUSTING

- A. The plumbing systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final adjustments as required.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper motor rotation, electrical power voltage is within equipment limitations, equipment controls maintain pressures and temperatures within acceptable ranges, all filters and protective guards are in-place, acceptable access is provided for maintenance and servicing, and equipment operation does not pose a danger to personnel or property.
- C. Contractor shall adjust the plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for troubleshooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.7 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of plumbing drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.
- C. Mark drawings to indicate revisions to piping size and location, both exterior and interior; including locations of devices, requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located; Change Orders; concealed control system devices.
- D. Before completion of the project, a set of reproducible plumbing drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducibles shall be clear and permanent.
- E. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- F. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- G. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.

3.8 PAINTING

- A. This Contractor shall paint the following items:
 - 1. All piping in mechanical room
 - 2. Piping exposed in kitchen
- B. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available.
- C. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor.
- D. Equipment cabinets, casings, covers, metal jackets, etc., in equipment rooms or concealed spaces, shall be furnished in standard or prime finish, free from scratches, abrasions, chips, etc.

- E. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chips, etc. If color option is specified or is standard to the unit, this Contractor shall, before ordering, verify with the Architect/Engineer the color preference and furnish this color.
- F. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by this Contractor. Equipment furnished with a factory coat of paint and enamel need not be painted, provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.
- G. Paint all outdoor uninsulated steel piping the color selected by Owner or Architect/Engineer.
- H. Paint all outdoor exposed natural gas propane piping the color selected by Owner or Architect/Engineer.
- I. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:
 - 1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
 - 2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.
 - 3. Color of paint shall be as follows:
 - a. All piping in mechanical room:
 - 1) Domestic Cold Water: Blue pipe/white letters
 - 2) Domestic Hot Water: Red pipe/white letters
 - 3) Sanitary Waste: Green pipe/black letters
 - 4) Natural Gas: Yellow pipe/black letters
 - b. Piping exposed in kitchen:
 - 1) All Piping: White

3.9 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed piping, hangers, and accessories.
- D. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.10 SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.
- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.11 IAQ MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

- A. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:
 - 1. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
 - a. Minimizing the amount of dust generated.
 - b. Reducing solvent fumes and VOC emissions.
 - c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
 - d. Protect stored on-site and installed absorptive materials from moisture damage.
 - 2. Request that the Owner designate an IAQ representative.
 - 3. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
 - 4. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
 - 5. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
 - 6. Request copies of and follow all of the Owner's IAQ and infection control policies.
 - 7. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
 - 8. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
 - 9. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings Under Construction".

3.12 UTILITY REBATE

- A. Submit utility rebate forms, where offered at project location, with rebate items completed. Rebate may include lighting, lighting controls, variable speed drives, heat pumps, package terminal A/C, air conditioners, chillers, water heaters, programmable thermostats, and motors.

1. Contractor must submit notification of any value engineering or product substitution that will affect the utility rebate amount prior to approval.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All pumps operating and balanced.
3. All plumbing fixtures installed and caulked.
4. Pipe insulation complete, pipes labeled and valves tagged.
5. Owner and Contractor attendance list for domestic water systems operation, maintenance, and flushing training.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION

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SECTION 220503 - THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Through-Penetration Firestopping.

1.2 REFERENCES

- A. UL 263 - Fire Tests of Building Construction and Materials
- B. UL 723 - Surface Burning Characteristics of Building Materials
- C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
- D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
- E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
- F. Intertek / Warnock Hersey - Directory of Listed Products
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
- I. The Building Officials and Code Administrators National Building Code
- J. 1997 Uniform Building Code
- K. 2012, 2015, 2018, 2021 International Building Code
- L. NFPA 5000 - Building Construction Safety Code
- M. HCAI - Health Care Access and Information (California)

1.3 SUBMITTALS

- A. Submit under provisions of Division 1 Section 220500.
- B. Submit Firestopping Installers Certification for all installers on the project.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
 - 1. Types of penetrating items.

2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.

- D. Maintain a notebook on the job site at all times that contains copies of approved submittals for all through penetration firestopping to be installed. Notebook shall be made available to the Authority Having Jurisdiction at their request and turned over to the Owner at the end of construction as part of the O&M Manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.
- B. Install material prior to expiration of product shelf life.

1.5 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
- B. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- C. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1.6 MEETINGS

- A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager and General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.

1. Review foreseeable methods related to firestopping work.
2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.7 WARRANTY

- A. Provide one year warranty on parts and labor.
- B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers. All firestopping systems installed shall be provided by a single manufacturer.
 1. 3M; Fire Protection Products Division.
 2. Hilti, Inc.
 3. RectorSeal Corporation, Metacaulk.
 4. HoldRite

2.2 THROUGH PENETRATION FIRESTOP SYSTEMS

- A. Provide materials and systems classified by or listed by Intertek / Warnock Hersey to provide firestopping equal to time rating of construction being penetrated.
- B. All firestopping materials shall be free of asbestos, lead, PCB's, and other materials that would require hazardous waste removal.
- C. Firestopping shall be flexible to allow for normal penetrating item movement due to expansion and contraction.
- D. Firestopping systems for plumbing and wet pipe sprinkler piping shall be moisture resistant.
- E. Provide firestopping systems capable of supporting floor loads where systems are exposed to possible floor loading or traffic.
- F. Provide firestopping systems allowing continuous insulation for all insulated pipes.

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*

Penetrating Item	UL System No.
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999
*Alternate method of firestopping is patching opening to match original rated construction.	

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999
*Alternate method of firestopping is patching opening to match original rated construction.	

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999
*Alternate method of firestopping is patching opening to match original rated construction.	

- G. Any opening in walls or floors not covered by the listed series of numbers shall be coordinated with the firestopping manufacturer.
- H. Any openings in floors or walls not described in the UL or listed by Intertek / Warnock Hersey Fire Resistance Directory, or outlined in manufacturer's information shall be sealed in a manner agreed upon by the Firestopping Manufacturer, Owner, and the Authority Having Jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.
- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
- C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.
- D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 INSTALLATION

- A. In existing construction, provide firestopping of openings prior to and after installation of penetrating items. Remove any existing coatings on surfaces prior to firestopping installation. Temporary firestopping shall consist of packing openings with fire resistant mineral wool for the full thickness of substrate, or an alternate method approved by the Authority Having Jurisdiction. All openings shall be temporarily firestopped immediately upon their installation and shall remain so until the permanent UL or listed by Intertek / Warnock Hersey listed firestopping system is installed.
- B. Install penetration seal materials in accordance with printed instructions of the UL or Intertek / Warnock Hersey Fire Resistance Directory and with the manufacturer's printed application instructions.
- C. Install dams as required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Remove combustible damming after appropriate curing.

3.3 CLEANING AND PROTECTING

- A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.4 IDENTIFICATION

- A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:
 - 1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.5 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.
- C. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.
- D. The Contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the Contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The Contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the Contractor's expense.

END OF SECTION

DIVISION 22 05 05
PLUMBING BASIS OF DESIGN SYSTEMS NARRATIVE

PART 1 - GENERAL

1.01 INTRODUCTION

- A. The purpose of this section is to define the design approach upon which the contractor is to base a budget/estimate for bid purposes and establish the design criteria, and design submittals, which will be required in the preparation and execution of the design.
- B. All work under this section shall comply with the requirements of general conditions, supplemental conditions, special conditions, and division 1 – general requirements, and shall include all plumbing sections specified herein.
- C. This section includes a general narrative description of Division 22 systems with specific equipment and component criteria that are to be included in the project. Reference all other specification sections, floor plans, drawing notes, drawing equipment schedules, and drawing matrices for additional equipment and project criteria.
- D. Specific conflicts between drawings, this specification section, and other specification sections, will not be used to define exclusions. Exclusions based on document conflicts will be accepted or rejected in the engineer of record's formal response to bid clarification requests or Request For Information (RFI's).

1.02 APPLICABLE CODES & STANDARD

- A. Wherever an International, National, or Uniform Code is referenced in this Narrative, it means the 2021 Washington State with Port Angeles Amendments version of that code, including any local amendments, is the design standard for this Project. For example, where the UPC is referenced, the 2021 Washington State with Port Angeles Amendments will be used.
- B. Design and installation shall comply with rules and regulations of the following:

APPLICABLE WASHINGTON STATE BUILDING CODES			
ENERGY CODE	2021 WASHINGTON STATE ENERGY CODE (SEC) FOR COMMERCIAL BUILDINGS	WAC 51-11C	EFFECTIVE MARCH 15, 2021
BUILDING CODE	2021 INTERNATIONAL BUILDING CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-50	EFFECTIVE MARCH 15, 2021
ACCESSIBILITY CODE	2021 INTERNATIONAL BUILDING CODE WITH WASHINGTON STATE AMENDMENTS CHAPTER 11 AND ICC A117.1-2009	WAC 51-50	EFFECTIVE MARCH 15, 2021
SEISMIC CODE	ASCE 7-2016 AS REFERENCED BY 2018 INTERNATIONAL BUILDING CODE	WAC 51-50	EFFECTIVE MARCH 15, 2021
FIRE CODE	2021 INTERNATIONAL FIRE CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-54A	EFFECTIVE MARCH 15, 2021
MECHANICAL CODE	2021 INTERNATIONAL MECHANICAL CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-52	EFFECTIVE MARCH 15, 2021
PLUMBING CODE	2021 UNIFORM PLUMBING CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-56	EFFECTIVE MARCH 15, 2021
BOILER CODE	WASHINGTON STATE BOILER CODE	WAC 296-104	
ELECTRICAL CODE	2020 NATIONAL ELECTRICAL CODE WITH 2020 WASHINGTON AMENDMENTS (NFPA 70)	WAC 296-46B	EFFECTIVE NOVEMBER 1, 2020
ELECTRICAL	ELECTRICIANS AND ELECTRICAL INSTALLATIONS	RCW CHAPTER 19.28	
NFPA STANDARDS	NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARDS AS REFERENCED BY THE CODES ABOVE OR AS SPECIFICALLY LISTED BELOW		

1.03 ORDER-OF-PRECEDENCE PROVISIONS

- A. In the case of inconsistency or ambiguities in design documents (all specifications and drawings), compliance with the strictest design requirement among conflicting criteria is required.
- B. If provided, alternate pricing for compliance with less strict criteria will be evaluated in addition to the mandatory baseline strictest criteria.
- C. Provide notice upon discovering potential design conflicts prior to bid where possible.

1.04 PROJECT DELIVERY

- A. This project is to be delivered design build. The design build contractor responsible for all Plumbing systems (referred to herein as the plumbing contractor or PC) will be the engineer of record and create and stamp fully coordinated design documents for the project.
- B. Pricing Set Bid Notes
 1. The intent is to procure MEP pricing packages that cover the full project though the drawings are not at 100% CD level.
 2. Reference current MEP narratives as well as architectural and structural drawings.
 3. The architectural floor plans provided are not final. Pricing shall allow for equipment relocations due to minor interior layout modifications.
 4. The architectural floor plans provided are not final. Pricing shall allow for equipment relocations due to minor interior layout modifications.
 5. Pricing is to include all MEP provisions as needed to completely buildout the project as defined in all referenced documents.

6. During the bid process, provide specific scope clarification requests through the owner's bid clarification request process.
 7. Bids will include a detailed list of scope exclusions.
 8. Provide breakout additive pricing for specific scope as required to address perceived scope gaps in the project documents. Electrical and Plumbing subcontractors are to include all permit fees. Mechanical permit fees are included in owner's building permit fees.
 9. IMEG will participate in the subcontractor selection process by reviewing proposals, interviewing, and strategizing with the team. Primary goals are to thoroughly identify potential gaps and contingency requirements and to build a strong partnership with the subcontractors and GC.
- C. IMEG scope includes delivery of DD drawings and this Division 22 - Plumbing Systems Narrative. Design efforts beyond this milestone are by Plumbing Contractor (PC).
- D. The Design Build Engineer of Record will create Construction Document drawings starting at the end of Design Development phase using Revit and Level 100 per AIA Level of Development (LOD) Document 2014 at a minimum beginning with the design development phase effort. Level 200 and 300 LOD are to be provided where needed for detailed coordination during the CD phase (mechanical rooms, typical constricted ceiling spaces, other space constrained areas). Shared model coordination with architectural, structural, and all trades is required.
1. Utilize the BIM model to print 2D Design development and CD phase drawings
 2. Use the 3D BIM model throughout the design by the entire project team to facilitate collaboration and coordination. The information contained in the model will be used to create Construction Documents.
 3. Give the 3D BIM design model to the Owner as a record model of the original design at the end of the project. Any modifications to the model to accommodate facilities management or other purposes are at the discretion of the Owner and outside the scope of this contract.
- E. Detailing coordination: The MC will produce a 3D model of all systems. The Contractors will coordinate their shop drawings with other trades. The MC will be lead in this effort and will get signed agreements on shop drawings from MEP and other Subcontractors prior to starting work. The MC is responsible for all trade coordination effort as required for shop drawing completion.
- F. Detailing coordination: There will be no change orders for field interference coordination modifications.

- G. The PC is encouraged to provide voluntary alternates beyond the specific scope outlined in this narrative and the accompanying drawings.
- H. The PC will provide bid response that covers the complete scope of work required to deliver a fully functional and code compliant project.
- I. Contractor shall attend design coordination meetings as needed.
- J. The design build bid package will be utilized as a basis of design through the completion of design and construction. As the design proceeds deviations from this package are to be clearly noted for the architect, owner, and peer review team for acceptance prior to design completion.
- K. The PC will provide budget/estimate response that covers the complete scope of work required to deliver a fully functional and code compliant project. Request for proposal (RFP). If there is a conflict between design documents and the RFP, the contractor will identify the discrepancy and request a clarification prior to RFP response.
- L. Design drawings, submittals, and shop drawings will be reviewed for conformance with the bid package as well as conformance with codes and accepted practice. Discrepancies will be noted for team review prior to acceptance.
- M. Complete equipment, and materials submittals shall be provided in electronic format. PDF bookmarks are required. Submittals shall be complete with all components included and customized to this project's requirements. Include warranty provisions for all equipment. All submittals require owner team approval prior to purchase.
- N. Construction Administration: The selected Contractor will perform construction administration, including RFI responses, attendance at periodic meetings, formal review and approval of shop drawings and submittals, coordination with other trades, preparation of final punchlist.
- O. All work contracted for must be accepted by all applicable inspectors including Site Superintendent, GC Quality Control Personnel, AHJ's, Owner's Representative or their assignees.
- P. Warranty period to extend for one year from date the project is occupied by the Owner, not from the date of completion of the work. Warranty not applicable to defective items due to faulty work of subsequent trades.

- Q. The PC shall submit final CAD as-built drawings to the General Contractor for submittal to Owner within two weeks of project completion or unless alternative timing is agreed to. Drawings shall be submitted in PDF and original AutoCAD formats.
- R. O&Ms: Provide hard copy and electronic copies (PDF) of O&Ms for ALL systems within TWO weeks of substantial completion or as noted in contract.
- S. Codes, Permits, Inspections, and Fees:
1. The PC shall obtain all permits and inspections and pay all fees required by State and Local authorities, except as noted.
 2. All work and materials shall be in accordance with requirements of all applicable local and state codes, statutes, standards, and other regulations. Date of regulations shall be as adopted by local authorities at the time of permit intake, unless indicated otherwise.
 3. The codes shall be construed as establishing a minimum or base level of requirements. Contract Documents shall not be construed to permit or direct work not in conformance with codes, statutes, standards, and other regulations. Where provisions of the various regulations conflict with each other, or with the Contract Documents, the more stringent provisions shall be included in contract pricing. Conflict shall be resolved with the Architect and Authorities Having Jurisdiction (AHJ) prior to completing the design.
 4. Where the Contract Documents call for material or construction of a better quality or higher capacity than required by the codes, statutes, standards, and other regulations, the provisions of the Contract Documents shall take precedence over the requirements of the codes and standards.
 5. Material and equipment within the scope of the UL Testing Laboratory Service shall be listed by the Underwriters Laboratories for the purpose for which they are used and shall bear their listing mark. ETL or CSA shall be allowed if acceptable to the Authorities Having Jurisdiction (AHJs).
 6. PC shall call for all inspections by the local code authorities when they become due and shall not cover any work until approved by these authorities.

1.05 MISCELLANEOUS SCOPE ITEMS:

- A. The PC is to review the Energy, Div 21, 23, 26, 27, and 28 narratives for scope impacts .
1. Div 23 fan coils for split systems and VRF systems require condensate piping by PC routed to indirect drain connections.

- B. Property line and interior acoustical calculations will be by the architectural design team's Acoustical Consultant prior to permit submittal. Acoustical Consultant to provide the requisite analysis to assure the team of acceptable acoustical performance of each system.
- C. The structural engineer is responsible for all structural calculations required for the supporting structure for permit intake.
- D. PC shall include structural tie-down calculations for all equipment as required by the 2021 IBC and ASCE 7. This will be a deferred permit submittal.
- E. PC is to provide and install fire stopping of all through and membrane penetrations as required by the IBC and other applicable codes. Floor penetrations to include fire rated sleeves with either a 2" stand off water dam (Holdrite Pro Series Water Dam, Hilti-CFS-CID MD or approved equal), or a sleeving system with a built-in mid body waterproofing seal with a factory-provided W rating (Hilti CFS-680 or approved equal).
- F. All ductwork, piping, plumbing, and equipment are to be seismically restrained as required by the 2021 IBC.
- G. All code required access panels in walls and/or ceilings are provided and installed by the plumbing contractor. PC to coordinate required locations and sizes with the architect and GC.
- H. The contractors will provide and install phenolic tags identifying each specific piece of equipment.
- I. All exposed piping in mechanical rooms will be labeled in compliance with accepted industry standards and building standards.

1.06 COORDINATION

- A. All pipe routing and equipment locations shall be coordinated with full design team including but not limited to architect, interior designer, and acoustical engineer.
- B. No cutting or drilling of joists or beams will occur without Structural Engineer approval.
- C. PC shall coordinate with the architect a minimum 36" clearance or more in front of equipment access panels for servicing as required by applicable code, NEC, and the AHJ.
- D. Cutting, framing, patching, and painting of wall, ceiling and floor openings shall be by others.

- E. Electrical contractor shall furnish and install magnetic motor starters for all equipment $\frac{3}{4}$ hp and greater unless a VFD is provided. Provide service and disconnect per code, and do all power wiring, including connecting to equipment. Holding coil circuit shall be powered by electrical contractor (120/1 unless indicated otherwise). All starters shall be provided with H-O-A switch.
- F. VFD's (where required) are provided by the PC and are installed (mounted) and wired by the electrical contractor. Disconnects will be provided integral with the VFD's. VFD's will not be provided with manual or automatic bypass.

1.07 ENERGY CODE COMPLIANCE PATH

- A. The project is pursuing Energy C406 Prescriptive Compliance Path. See the Energy Compliance Requirements Narrative for further details.
- B. The following C406 credits are being pursued related to plumbing:
 - 1. C406.2.8 – Service Hot Water Distribution Right Sizing. The building shall utilize the Appendix M sizing method from the 2021 Uniform Plumbing Code for sizing of all domestic water piping within the building.
 - 2. C406.3.6 – Service Hot Water Energy Storage. The project shall include additional DHW storage beyond required capacity and include system controls to allow for operation in alignment with the credit requirements.

1.08 2021 WSEC C404.9 DOMESTIC HOT WATER METER CRITERIA

- A. WSEC C404.9 Domestic hot water meter criteria: Each individual dwelling unit in a Group R-2 multi-family residential occupancy with central service shall be provided with a domestic hot water meter to allow for domestic hot water billing based on actual domestic hot water usage. EC to provide power and data as required for repeaters for water meter data acquisition. PC to provide meters and bases.

1.09 SUSTAINABILITY PROTOCOLS

- A. Evergreen Sustainable Development Standard (ESDS) v4.1
 - 1. The project will achieve ESDS v4.1 New Construction certification. MC/PC/EC shall be involved in coordination efforts required to achieve mandatory and pursued optional criteria points.
- B. The project is not pursuing any other green rating system.

PART 2 - PRODUCTS

2.01 PLUMBING SYSTEMS GENERAL

- A. All plumbing products in contact with potable water shall be certified Lead Free and NSF 61/ NSF 372 compliant.
- B. All plumbing in areas that contain plenums are to be plenum compatible. No plastic material will be utilized unless noted otherwise.
- C. Plumbing materials are per the Plumbing Materials Specification Matrix on the plumbing plans.
- D. The PC shall make every reasonable effort to provide materials from a single manufacturer for any given material type unless otherwise noted.
- E. All pressurized piping shall have a maximum rated working pressure to accommodate the maximum pressure anticipated for the pipe.
- F. Where PVC materials are provided, PC shall provide solid wall piping. Cellular (foam) core piping is not allowed unless noted otherwise in the materials matrix.
- G. All plastic piping installed underground shall be installed in accordance with ASTM D 2321 and ASTM F 1668 as well as all manufacturer guidelines.
- H. PVC & CPVC piping is not allowed in plenum spaces unless it is specifically listed for such use. Plastic piping is not acceptable where water discharge temperatures exceed 140°F.
- I. Provide cleanouts on sanitary sewer system as required by code.
- J. Plumbing is to be insulated per 2021 WSEC requirements.
- K. Pipe hanger rod sizes shall not be smaller than those shown in the 2021 UPC, Table 313.6. Suspended piping shall be supported at intervals not to exceed those show in 2021 UPC Table 313.3.
- L. Trap primers shall be installed to serve all floor and hub drains other than those connected to the garage drainage system.
 - 1. All trap primer lines should be uniformly sloped from the trap primer toward the fixture being primed. Provide PPP Precision Priming Adapter as required to ensure positive slope toward the primed fixture.

2. Flow activated trap primers (PPP Prime Pro) shall be utilized throughout; except as noted below.
 3. Electronic (PPP "Mini-Prime") shall be used where fixture flow is not available for trap primer activation of a flow-activated primer. PC shall coordinate power requirement for all electronic trap primers with the electrical contractor.
 4. Tailpiece trap primers may be used from other than coffee kitchen sinks.
 5. Pressure drop trap primers (PPP Prime-Rite PR-500) shall be used only on water lines serving flush valve fixtures. These shall not be used in other locations due to a lack of reliability based on inadequate pressure fluctuations within the domestic water distribution piping.
- M. All plumbing is to be pressure tested in accordance with code and accepted standards.
- N. All isolation valves are to be installed in accessible locations. Plumbing contractor is to provide access panels and coordinate installation by others as required for access to valves.
- O. All fixtures shall be provided and installed to comply with Washington state accessibility codes or per other architectural directions.
- P. All fixtures to be provided and installed to comply at a minimum with Washington state water conservation performance standards and UPC maximum flow rate standards.
- Q. The PC shall route plumbing vents to maintain minimum 20 feet of clearance from outside air intakes.
- R. All water supply and waste and vent piping shall be secured in place with 3/16" neoprene strips wrapped around the pipe at stud penetrations or point of support to prevent direct contact with framing and resultant rattling and vibration.
- S. Piping and fittings at all water outlets shall be rigidly fastened to structure to prevent movement. Long runs of piping shall be installed with provisions for expansion and contraction.
- T. The air gap between party walls is to mitigate sound transference. Pipes placed within this air space are to be isolated from the studs they pass through. Pipes serving any specific unit must be placed within the stud depth of the wall serving that unit only.
- U. Run all water lines in warm areas where possible, avoiding exterior walls and blind corners.

- V. The plumbing subcontractor is responsible to review plans to determine which walls, if any, should be increased in depth from that shown on the plans to accommodate the subcontractor's piping. The plumbing subcontractor shall meet with the superintendent and framer to coordinate this sizing with the requirements of other trades.
- W. The plumbing subcontractor will supply lead boot roof flashings for pipe penetrations prior to roofing as scheduled by the superintendent. Roof flashings mopped in by roofing contractor. For PVC roofing installations, PC to seal the pipe base with PVC Flashing or Prefabricated vent pipe boots per the roofing manufacturer's installation details.
- X. All HVAC condensate is provided by the PC. Review HVAC deliverables for fan coils with condensate.
- Y. Expansion/contraction:
 - 1. Thermal Expansion: P.C. shall provide adequate thermal expansion compensation for all plumbing systems in accordance with UPC Section 312.2. Contractor is to design, provide calculations, and indicate locations of offsets on shop drawings. Design per 2021 UPC, and manufacturer guidelines. Utilize piping offsets where feasible. Bellows type expansion and contraction sleeves to be used where there is insufficient room to allow for offsets.
 - 2. Accommodation for building shrinkage during dry out: All plumbing components are to accommodate the potential of a minimum of 3/8" shrinkage/compression at each floor level. Final criteria to be confirmed by structural. Provide for expansion and contraction of piping to accommodate building settlement/shrinkage during dry-out of wood frame structure:
 - a. Wherever possible, plumbing vertical pipe risers are not to be installed and glued until after the building dry-out shrinkage is complete to the full extent allowed by project schedule.
 - b. Utilize piping offsets where feasible.
 - 1) Where piping offsets are not feasible due to insufficient room for offsets - utilize either of the following:
 - a) One-piece expansion/ contraction sleeves: Fernco model XJ, Flexicraft Slip-on Drainage Expansion Joint model DWVxxxx or similar. Install such that the joint is in a neutral position (no expansion nor contraction) following building dry-out period.

- b) Sleeve-type expansion/ contraction joint: Canplas Expansion joint model 21381#XXX. Install such that the joint is in a neutral position (no expansion nor contraction) following building dry-out period. Contractor is to design, provide calculations, and indicate locations of offsets and expansion joints on shop drawings. Design per 2021 UPC, and manufacturer's guidelines.
- c) PVC waste and vent risers shall be provided with expansion compensation every 30 feet per IAPMO design standards and 2021 UPC. Provide mechanical slip joint or piping offset sized based on pipe lengths in contractor shop drawings. Offsets may serve for both thermal expansion and building shrinkage compensation.

2.02 AMENITIES AREAS:

- A. PC to provide cold water, hot water, waste, vent, and fixtures for areas that are completely built out (include all common areas and all fixtures shown on Architectural drawings).
- B. Assume all public fixtures(where applicable) including lav faucets, urinal flush valves, and water closet flush valves are manually operated or metering type with low flow or dual flush capability.
- C. Domestic Hot Water (DHW) for public fixtures will be served from the central hot water plant (see Drawings).
 - 1. Public Lavatories (where applicable):
 - a. Provide ASSE 1070 mixing valves to ensure that the maximum temperature does not exceed 120°F per 2021 UPC Section 407.3.
 - b. Per 2021 UPC Sections 407.2.1, 407.4, and 407.2.2 respectively - The maximum flow rate shall not exceed 0.5 gpm at 60 psi, metering faucets shall be provided, and meters shall deliver a maximum of 0.25 gallons per metering cycle.
 - c. Per 2021 WSEC section C404.3.1, the maximum length of ½" piping that runs from the heated water source to the fixture shall extend no longer than 2' from the heated water source.
- D. Provide appropriately sized condensate trap and condensate lines as required by code for all HVAC units.

- E. HVAC condensate systems will be installed complete to an approved indirect drain connection by the plumbing contractor. Condensate trap depth will be per manufacturer requirements and sized per plumbing code criteria. Horizontal condensate piping shall be insulated copper or plenum rated CPVC (Charlotte Pipe plenum rated Flowguard Gold CPVC or equivalent). Vertical copper condensate requires insulation. Vertical CPVC condensate does not require insulation. Condensate risers through the residential units including offset floors are provided and installed by the MC. Collection beneath residential units and in amenity & common areas is by the PC. Piping shall be routed to appropriately located open site drains.

2.03 WASTE AND VENT

- A. Per 2021 UPC section 709.0 Plumbing fixtures shall be drained to the public sewer by gravity. It is currently assumed that all fixtures may be routed to the sanitary sewer locations (per Civil Engineer), however final determination will be made by the contractor.
- B. Per 2021 UPC section 708.0 “Horizontal drainage piping shall be run in practical alignment and a uniform slope of not less than $\frac{1}{4}$ ” per foot or 2% toward the point of disposal provided that, where it is impractical due to the depth of the street sewer, to the structural features, or to the arrangement of a building or structure to obtain a slope of $\frac{1}{4}$ ” per foot or 2%, such pipe or piping 4” or larger in diameter shall be permitted to have a slope of not less than $\frac{1}{8}$ ” per foot or 1%, where first approved by the Authority Having Jurisdiction.”
 - 1. All drainage piping shall be run at 2% unless noted otherwise on the plumbing plans.
 - 2. Final approval for any piping to be sloped at 1% shall be the responsibility of the plumbing contractor.
- C. 2021 UPC section 710.1: “Fixtures installed on a floor level that is lower than the next upstream manhole cover of the public or private sewer shall be protected from backflow of sewage by installing an approved type of backwater valve. Fixtures on such floor level that are not below the next upstream manhole cover shall not be required to be protected by a backwater valve. Fixtures on floor levels above such elevation shall not discharge through the backwater valve.” Contractor to provide backwater valve(s) downstream of any fixture draining to the public sewer by gravity and installed on a floor that is lower

than the next upstream manhole. Preliminary evaluation is that a backwater valve shall not be required for this project. Final determination TBD.

- D. 2021 UPC Section 711: "Suds Relief. Drainage connections shall not be made into a drainage piping system within 8' of a vertical to horizontal change of direction of a stack containing suds-producing fixtures"
- E. Cleanouts shall be provided per 2021 UPC section 707.4 which shall include, but not be limited to: building drains and branches, runs longer than 100', all sinks, all urinals, all horizontal fixture branch lines longer than 5', and at all aggregate changes in direction exceeding 135°. Contractor shall coordinate with AHJ to ensure all required cleanouts have been provided. Final cleanout locations are to be indicated on the shop drawings for IMEG review. 2021 UPC 707.4 exception 3, Excepting the building drain and its horizontal branches, a cleanout shall not be required on a pipe or piping that is above the floor level of the lowest floor of the building. Level 1 will be considered the lowest floor.
- F. Materials: Waste piping to be cast iron or solid wall schedule 40 PVC. Vent piping shall be cast iron or schedule 40 PVC or ABS piping. See below for each type of material.
- G. Heavy duty no-hub couplings provide improved protection against leakage and potential for joint movement. Contractor shall provide heavy duty couplings for any below-grade (buried) cast iron installation, vertical sanitary waste risers, and piping installed over shell and core retail spaces. Standard duty couplings may be used in other locations.
- H. PVC and ABS for vent piping may not be utilized in return air plenums.
- I. PVC, where utilized as waste piping in garages, will be Schedule 40 Solid Wall Pipe and PVC DWV Fitting System. PVC Cellular Core product is not allowed except as noted in the materials matrix. PVC Schedule 40 pipe shall be Iron Pipe Size (IPS) conforming to ASTM D 1785 and ASTM D 2665. Injection molded PVC DWV fittings shall conform to ASTM D 2665. Fabricated PVC DWV fittings shall conform to ASTM F 1866. Solvent cement joints shall be made in a two-step process with primer manufactured for thermoplastic piping systems and solvent cement conforming to ASTM D 2564. Systems shall be hydrostatically tested after installation and before burial if below grade. Pipe and fittings shall conform to National Sanitation Foundation Standard 14.
- J. All below grade PVC will be installed in strict adherence to ASTM D 2321 and ASTM F 1668 protocol.

- K. PVC will not be utilized in any location where transport of 140°F water or greater can be expected now or in the future.
- L. Expansion compensation for PVC is required per 2021 UPC Section 312.2 and Table 313.1.
- M. All PVC piping will be supported with an approved hanger at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or grade reversal, but in no case shall the spacing exceed the spacing indicated in 2021 UPC Table 313.3. Pipe will also be supported at all branch ends and at all changes of direction. Support trap arms as close as possible to the trap.
- N. All waste pipes shall be isolated from the structure using 1/8" thick neoprene sleeve or strips. Where the hanger is rigidly connected to the structure, the piping shall be isolated from the hanger itself with neoprene liners or a pre-isolated products such as Holdrite Silencer series hanger system. Openings shall be oversized for the full depth of the opening so that the pipe can be supported on both sides of the opening without contact. Riser clamps used to support vertical piping shall be isolated from the structure by neoprene pads.
- O. Center all vertical waste lines in the interior walls.
- P. Nail plates shall be installed wherever needed and when piping is within 1-1/2 inches of the edge of a framing member and as required by code. Leaks due to drywall nails/screws penetrating pipes due to omission of or incorrectly installed nail plates will be repaired at subcontractors' expense.
- Q. Indoor waste clean outs shall be installed in storage, mechanical, or unfinished space whenever possible. Otherwise locate within wall and cover by an approved metal access cap. PC is responsible for verifying wall thickness prior to installing pipe.
- R. All plumbing shall be plugged and capped during installation and kept free of contamination and debris.
- S. Sewer connections shall be coordinated with the civil engineer per superintendents' direction. The utility contractor is to make all side sewer connections.
- T. Preliminary calculations indicate that (1) 6" sanitary sewer connection will be required if main is routed at 1/4" per foot slope. If shallower slope is required, POC will need to be upsized to 6". Final location and elevations are to be verified and coordinated by PC.

- U. Provide floor drains in the common area laundry rooms and mechanical rooms. Drains to be installed with trap primers. Per 2021 UPC Section 418.5, floors shall be sloped to drains.
- V. Provide hub drains for sprinkler system blow down and trapped low points of sprinkler system as needed. Basis of design is for all primary sprinkler drainage to be routed to the hub drain in the fire sprinkler riser room – See division 21 narrative for additional details. Additional drains to be coordinated by sprinkler contractor for sections that are trapped.
- W. Trap primers shall be installed to serve all floor drains. See Section 2.1 for trap primer installation locations.

2.04 STORM DRAINAGE

- A. Building roof drainage is to be served by an exterior gutter and downspout system. Refer to architectural drawings for details. No interior storm piping is anticipated for this project.

2.05 DOMESTIC WATER METERING

- A. One domestic hot water meter will be provided and installed in each residence by the PC per 2021 Washington State Energy Code Section C404.9. Meter is to be Next Century M201 Series with NSF 372 and NTEP certifications or equivalent. Meter shall be rated for up to 194 Deg F.
- B. Install a standard manufacturer spool piece and couplings for a future domestic cold water meter in each residence. Cold water meters are excluded at this time.
- C. Provide deduct meters as necessary for irrigation uses.
- D. The PC will install a meter spool piece and couplings for each meter prior to final installation of the meter. After pressure testing and initial system startup to eliminate debris, the meters and meter bases will be installed by the PC to replace the spool pieces.
- E. The meters and spool pieces shall be located accessibly within the residential units. Meters and isolation valves shall be installed in the wall behind an access panel. Final location to be coordinated with the architect.
- F. The meters and meter bases are to be provided and installed by PC. Meters are to utilize wireless technology. Installation of wireless routers, central data logger, and phone line to central monitoring is by the EC.

- G. The PC will provide an Automated Meter Reading system (AMR) to collect the data from the meters. Meters and meter reading system shall be procured from a common vendor. EC is to provide receptacles for routers and central data logger.

2.06 DOMESTIC WATER

- A. All valves, piping, and equipment used in the domestic water system will be certified Lead Free and ANSI/NSF 61 & 372 approved per the 2021 UPC.
- B. The domestic water system (hot water, cold water, and recirculation) shall be sized using the Appendix M calculation method from the 2021 Uniform Plumbing Code.
- C. Materials: Hot and cold domestic water may be copper, stainless steel, or PEX for sizes 2" and under. Piping 2-1/2" and larger shall be copper or stainless steel. See below for each type of material.
- D. Individual residential unit DCW and DHW isolation valves shall be located with the water meters and be easily accessible after installation and provided with a pre-printed label "unit water shut off".
- E. UPC-listed AA arresters shall be installed at the dishwasher and washing machine boxes in all relevant locations.
- F. Supply mains and risers through studs or supported from studs within units will utilize 3/16" neoprene strips to isolate the pipe from direct contact with studs.
- G. PEX Plumbing System: Engle method A Crosslink polyethylene suitable and approved for potable water use. Manufacturers: Uponor
- H. PEX Pipe and fittings: The plumbing system used for potable water distribution and consisting solely of Wirsbo AQUAPEX® tubing, ProPEX® and/or APR Fitting Systems, and Uponor EP manifolds and multi-port tees. The complete system installation will fully comply with the Uponor requirements for the associated 25 year warranty.
- I. Any brass fittings used for PEX piping shall be certified lead free and resistant to dezincification. Provide Wirsbo or approved equal.
- J. Plumbing insulation shall comply with 2021 Washington State Energy Code. Insulation shall be per WSEC and UPC code tables.
- K. Insulate all metallic domestic cold water mains with minimum 1/2" glass fiber insulation to prevent condensation.

- L. Provide sectional DCW & DHW isolation valves at risers serving multiple units.
- M. Balance valves used in the system shall be thermostatic type with stainless steel components and a wax thermostatic element providing a temperature accuracy of $\pm 3.0^{\circ}\text{F}$. Provide valve with P/T ports. Valve shall have a fixed temperature setpoint of 120°F . The balance valve locations will be coordinated with access panels by PC as required. Utilize NSF/ANSI 61 certified ThermOmegaTech Circuit Solver or equivalent.
- N. Insulate and heat trace any cold or hot water plumbing exposed to unconditioned spaces (attics, etc.). Heat tracing, controls, and insulation are to be provided by PC. Power to heat trace termination is to be by EC. Hot and cold plumbing located in the garage may be located on the warm side of the insulation in lieu of providing heat tracing.
- O. Provide plenum rated materials for all plumbing systems exposed in areas that contain plenums.
- P. The water lines are to be connected to and coordinated with the service/supply lines at the meter location, trenching is by others. PC to include all piping from the building to the exterior meter box.
- Q. Current water pressure is not available for this site. A hydrant test for a nearby site dated 2013 indicates to expect 60 psi static pressure with 772 gpm at a residual pressure of 20 psi. Based on this information, preliminary calculations indicate that a domestic water booster pump will be required for this project.
- R. Provide appropriately sized duplex domestic booster pump on factory skid with listed VFD's, alternator, and control panel. Provide and install a pressure switch at an approved location which will provide adequate control without short cycling the pumps
- S. Provide an appropriately sized hydro-pneumatic tank for system.
- T. Provide dual 1-1/2", reduced pressure backflow assemblies (piped in parallel configuration) in water service entry room as indicated on plans and install in compliance with applicable local and state codes. Provide hub drain for backflow assembly relief discharge.
- U. Per the 2021 UPC Section 608.2, the maximum pressure allowed at any fixture shall not exceed 80 psi. PC to provide appropriately sized Pressure Reducing Valves (PRV's) as required to ensure that the maximum allowable pressure is not exceeded.

1. PRV stations shall include fully piped low-flow bypasses as required by the manufacturer to ensure that the system operates properly at low-flow conditions. Main valves and bypasses shall be appropriately sized to deliver the minimum pressure to all fixtures within the pressure zone, with no supply pressures exceeding 80 psi.
 2. Provide maintenance shutoff valves at all PRV bypasses.
 3. Where inlet vs. outlet pressures fall within the cavitation zone per manufacturer, PRV's shall be utilized in series in order to meet the required outlet pressure. Refer to plumbing equipment schedule for location of series valves.
 4. All PRV's Pilot Operated Automatic Pressure Reducing Control Valves unless noted otherwise on plans. Provide Watts Model LFM115 or equivalent. Bypass valves shall be LF223 with -HP option as required.
- V. Non freeze hose bibs with isolation valve and removable keys are required at each level in garage, building exterior locations at each street as well as all public courtyards/terraces and at roof level where noted on the drawings. Provide Woodford Model B65 or equivalent.
1. Provide standalone roof hydrants where roof structures do not allow for the installation of wall hydrants. Provide Woodford Model RHY2-MS or equivalent. PC to provide and install drainage piping from the drain port on the roof hydrant to the nearest indirect drain (sink tailpiece or washer drain box).

2.07 DOMESTIC HOT WATER

- A. Domestic hot water is to be supplied from a central building hot water plant located on level 1. The PC will supply the hot water generation plant for the project. Final sizing is by the design build PC.
- B. Central hot water plant will consist of the following:
1. Primary heating will be provided by (1) air to water heat pump piped in parallel with (1) 300-gallon vertical hot water storage tank. Heat Pump Basis of Design = Transom Hatch HWV105.
Location of the plant is at level 1 in the mechanical room. Heat pumps shall be located on the exterior of the building to the north as shown in the plumbing drawings.
 2. The air-to-water heat pump shall be sized to meet all requirements of WSEC C406.2.6.3, including meeting 100 percent of calculated demand at 40°F

3. Secondary heating will be provided by (1) 80 gallon 18 kW electric water heater piped in series with the primary storage tank. Basis of design = AO Smith DRE-120-18.
- C. Provide temperature gages and P/T ports at each heat pump supply pipe, common heat pump supply, common recirculation water, individual mixing valve outlets, and common supply piping to the building. P/T Ports to be NSF/ANSI 61 compliant Watts Series LFTP or accepted equivalent.
- D. Storage tank glass lining to be certified lead free. 18" clearance to be maintained from all sides and above storage tank.
- E. Contractor to include isolation valves, unions, and P/T ports on inlet and outlet of heater. Pipe ASME temperature and pressure relief valve to indirect drain. Install temperature gauge on outlet of each heater as well as on the combined DHW service to the thermostatic mixing valve.
- F. Hot water will be stored at 140°F to address legionella contamination potential and distributed at 120°F (adjustable) through a packaged mixing valve assembly listed for the specific usage. The mixing valve will have all current code ASSE listings. Utilize appropriately sized lead free Leonard NV Proton Megatron Series or approved equivalent. Valve shall include sensors to monitor incoming hot, cold and recirculation temperatures, and incoming hot and cold inlet pressures. Unit shall control delivery water temperature to a minimum of 5°F temperature differential between inlet and setpoint during all flow conditions. Power to the valve is to be supplied by 120V outlet and provided with UL listed cord. Valve system shall shutoff in the event of a hot or cold water inlet supply failure. Control station to include test port on outlet with downstream shutoff valve, inlet isolation and check valves.
- G. Provide P/T port and threaded hose end connection with cap for test and drain down immediately downstream of the thermostatic mixing valve.
- H. Pipe size transitions between distribution piping and thermostatic mixing valve inlets & outlets shall occur within 12" of the valve assembly.
- I. A full recirculation system will be provided with hot water circulator(s) with ECM motor controlled by on-board controller. Balance valves will be provided as needed and installed in an accessible location. Balancing of the system is by the PC. Circulators shall be lead free.

- J. Wait times: Hot water runouts to individual fixtures shall be routed to minimize the hot water delivery time to the end user, and shall comply with the Maximum Allowable Pipe Volume Method per WSEC Section C404.3.2. PEX manifolds shall be located directly adjacent to the recirculated hot water riser. Each riser will extend from the top residence to the lowest residence and be completely recirculated. PEX runouts will be ½" unless noted otherwise. A dedicated PEX runout will be provided for each individual fixture from the manifold.

1. Hot water runouts to public lavs shall not exceed the lengths provided in 2021 WSEC Table C404.3.1. Typical ½" runouts may not exceed 8'.

2.08 PLUMBING FIXTURES AND APPLIANCES

- A. Dishwasher rough in and hook-up is to be provided including UPC-listed AA arrester.
- B. Provide laundry boxes including UPC-listed AA arresters and isolation valves. Laundry boxes will be appropriately rated for the wall in which they are installed. Coordinate accessible location in laundry room.
- C. Plumbing fixtures will be low flow and in no case will be allowed to exceed flow rates indicated in Chapter 4 of the 2021 UPC. Final required fixture flow rates to be determined. Preliminary anticipated flow rates are as follows:
 1. Water Closet: 1.28 GPF or Dual Flush
 2. Showerheads: 1.75 GPM
 3. Lavatories: 0.8 - 1.2 GPM
 4. Kitchen Sinks: 1.75 GPM
- D. All low flow fixtures shall be WaterSense certified. WaterSense-labeled products and services are certified to use at least 20 percent less water, save energy, and perform as well as or better than regular models.
- E. All plumbing fixtures which are to be used in ADA units are to be certified for this application per the Federal Americans with Disabilities Act.
- F. All handshowers in ADA units are to be provided with a non-positive shutoff per the most recent the Federal Americans with Disabilities Act.
- G. Per owner request, provide floor drains at all residential restrooms and below residential kitchen dishwashers. Floor drains shall be provided with trap primers served from sink tailpieces.

- H. Janitor sinks shall have integral check stems to prevent thermal cross over between hot and cold supply inputs (Symmons Symmetrix™ Service Sink Faucet S-2490-CHKS or equivalent)
- I. Plumbing fixtures and trim are to be provided and installed by PC. Final fixture package is yet to be determined.
- J. Check tub/shower rough openings to make sure they are plumb, square, are the proper size to allow for true and proper installation according to manufacturer's recommended installation instructions and provide adequate support and backing prior to installation of product.
- K. Fasten all tub/shower valves etc. securely to backing. Loose valves, gooseneck or tub spouts will be deemed unacceptable and shall be subcontractor's responsibility to repair.
- L. Provide backing at all tub or shower surrounds for installation of future ADA grab bars. When pre-manufactured tub or shower surrounds are used, they shall be provided with integral backing for grab bars whenever available. Refer to architectural drawings for all ADA requirements.
- M. Plumber is responsible for verifying finish floor elevations and setting all floor drains to the appropriate correct elevation. Per 2021 UPC Section 418.5, floors shall be sloped to drains.
- N. Exposed water supply and toilet handles shall be matched in finish to the faucet selection in that room unless specifically agreed to in writing.
- O. Spigot, gooseneck, and valve escutcheon rings shall be caulked to the tubs/showers/countertop/wall as applicable. Sinks and deck mount tubs shall be caulked to the decks using white silicone caulk. Showerhead goosenecks shall be set at 80 inches off the finished floor unless otherwise specified.
- P. Contractors are to provide rough in and final connections to all appliances and fixtures.
- Q. PC shall provide copper stub out at all plumbing fixture water supply rough-ins, with supply attached to adjacent framing.

PART 3 - EXECUTION

3.01 PREPARATION & INSTALLATION

- A. All work contracted for must be accepted by all applicable inspectors including site superintendent, GC quality control personnel, owner's representative (IMEG) or their assigns.
- B. Piping shall be run concealed in all areas with finished ceilings and locations must be coordinated with architect and interiors drawings.
- C. Design build plumbing contractor is to coordinate pipe routing with the architect, interiors architect, design team, and construction team with special attention to interior reflected ceiling and acoustical plans. Shop drawings shall be submitted with the above information for review and coordination prior to construction.
- D. In areas open to structure, piping shall be routed tight to structure. Piping shall not be run in front of windows or beneath skylights. Contractor to pay special attention to routing in lobby areas.
- E. All exposed piping shall be extensively labeled. Clearly label domestic cold water, hot water, hot water recirculation, natural gas piping, irrigation water and other non-potable water piping.
- F. As-builts: provide owner with electronic as-built drawings within two weeks of substantial completion. As-builts will reflect all changes from the construction drawing set and will comply with 2021 Washington State Energy Code project completion requirements. As-builts will also comply with architectural specification sections.
- G. O&Ms: provide hard copy and electronic copies of O&Ms for all systems within two weeks of substantial completion. O&M's will also comply with architectural specification sections.
- H. All plumbing piping shall be routed in a manner to avoid being within electrical rooms. Where piping in electrical room is unavoidable, and conditions require piping to be installed directly above electrical equipment :
 - 1. Per NEC 110.26(F)(1)(a) "Dedicated equipment space equal to the width and depth of the equipment and extending from the floor to a height of 6 feet above the equipment or to the structural ceiling shall be dedicated to electrical installation." No piping shall be installed within this zone.

2. In the area above the zone required by 110.26(F)(1)(a): Provide pipe containment for piping as required by 110.26(F)(1)(b). Provide drain pan with moisture sensor and normally closed ball valve for tray drain.

3.02 TESTING & INSPECTION

- A. Contractor is fully responsible for engaging manufacturer's representatives for startup of domestic water system to intended function, including but not limited to:
 1. Domestic water booster system
 2. Thermostatic mixing valve
 3. Domestic water heating plant
- B. The Plumbing Contractor is responsible for all test, balance, and startup of plumbing systems.
- C. All plumbing systems are to be tested by the PC as required by the AHJ and UPC.
- D. A 3rd party commissioning agent (CxA) will execute Fundamental Commissioning of the plumbing systems in accordance with 2021 Washington State Energy Code section C408 ESDS requirements. These requirements apply to all residential and non-residential systems.
- E. The contractor will be expected to fully participate with the Cx process as part of their base contract. No change orders will be accepted for contractor participation.
- F. The PC will execute all pre functional testing of plumbing systems to identify and resolve deficiencies prior the final testing.
- G. The PC will document deficiencies and provide equipment, materials, and labor necessary to correct deficiencies found during the commissioning process to fulfill contract and warranty requirements.
- H. Owner training will be provided by the installing contractor.
 1. Water heaters and heat pumps
 2. Circulation Pumps and hot water recirculation system.
 3. Domestic hot water mixing valves

END OF SECTION

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SECTION 220513 - MOTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Single Phase and Three Phase Electric Motors.

1.2 REFERENCES

- A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
- E. ANSI/NEMA MG 1 - Motors and Generators.
- F. ANSI/NFPA 70 - National Electrical Code.
- G. Energy Independence and Act of 2007.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weatherproof coverings. For extended outdoor storage, follow manufacturer's recommendations for equipment and motor.

1.4 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data including assembly drawings, bearing data including replacement sizes, and lubrication instructions.

PART 2 - PRODUCTS

2.1 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Refer to the drawings for required electrical characteristics. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230

277	265
480	460

- B. Design motors for continuous operation in 40°C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
- C. Visible Nameplate: Indicating horsepower, voltage, phase, hertz, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, insulation class.
- D. Electrical Connection: Boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- E. Unless otherwise indicated, motors 3/4 HP and smaller shall be single phase, 60 hertz, open drip-proof or totally enclosed fan-cooled type.
- F. Unless otherwise indicated, motors 1 HP and larger shall be three phase, 60 hertz, squirrel cage type, NEMA Design Code B (low current in-rush, normal starting torque), open drip-proof or totally enclosed fan-cooled type.
- G. Each contractor shall set all motors furnished by him.
- H. All motors shall have a minimum service factor of 1.15.
- I. All motors shall have ball or roller bearings with a minimum L-10 fatigue life of 150,000 hours in direct-coupled applications and 50,000 hours for belted applications. Belted rating shall be based on radial loads and pulley sizes called out in NEMA MG1-14.43.
- J. Bearings shall be sealed type for 10 HP and smaller motors. Bearings shall be regreasable type for larger motors.
- K. Aluminum end housings are not permitted on motors 15 HP or larger.
- L. Motor Driven Equipment:
 - 1. No equipment shall be selected or operate above 90% of its motor nameplate rating. Motor size may not be increased to compensate for equipment with efficiency lower than that specified.
 - 2. If a larger motor than specified is required on equipment, the contractor supplying the equipment is responsible for all additional costs due to larger starters, wiring, etc.
- M. Provide all belted motors with a means of moving and securing the motor to tighten belts. Motors over 2 HP shall have screw type tension adjustment. Motors over 40 HP shall have dual screw adjusters. Slide bases shall conform to NEMA standards.

- N. Motors for pumps 1/12 HP or greater and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either balancing or remote control.

2.2 ELECTRONICALLY COMMUTATED MOTORS (ECM)

- A. Electronically Commutated Motors (ECMs) shall be motors in which rotation and speed are controlled by integral electronic motor controllers utilizing electronic commutation.
- B. ECMs shall utilize Permanent Magnet (PM), Synchronous Reluctance (SynRM), or Ferrite-Assisted Synchronous Reluctance (FASR) motor constructions.
- C. ECMs shall be AC-powered motors with internal electronic conversion of AC power to DC for motor control. Motor input power shall be AC, at the scheduled voltage and phase. Field wiring shall be AC. Internal conversion to DC for electronic commutation shall be provided by the motor manufacturer. Motor shall be pre-wired for scheduled voltage and phase.
- D. Motors shall be variable-speed, suitable for continuous operation over the scheduled operating range, and matched by the manufacturer with an integral electronic motor control module.
- E. Electronics shall be factory-mounted and factory-matched to the motor. Control electronics shall include soft-start functionality, electronic current limiting, and motor protection functions as recommended by the motor manufacturer. Electronics shall be protected against moisture and contaminants in accordance with the application and motor enclosure rating.
- F. ECMs shall be suitable for direct-drive applications unless otherwise indicated. Motors shall be permanently lubricated and provided with ball bearings suitable for the connected driven equipment.
- G. Motors shall be permanently lubricated; utilize ball bearings to match with the connected driven equipment.
- H. Operational mode shall be as scheduled and shall be one of the following:
1. Constant Flow
 2. Constant Temperature
 3. Constant Pressure

HP	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
1.0	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2.0	87.5	86.5	85.5	88.5	86.5	85.5
3.0	88.5	89.5	85.5	89.5	89.5	86.5
5.0	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5

HP	Full-Load Efficiencies %					
	Open Drip-Proof			Totally Enclosed Fan Cooled		
	1200 rpm	1800 rpm	3600 rpm	1200 rpm	1800 rpm	3600 rpm
10.0	91.7	91.7	89.5	91.0	91.7	90.2
15.0	91.7	93.0	90.2	91.7	92.4	91.0
20.0	92.4	93.0	91.0	91.7	93.0	91.0
25.0	93.0	93.6	91.7	93.0	93.6	91.7
30.0	93.6	94.1	91.7	93.0	93.6	91.7
40.0	94.1	94.1	92.4	94.1	94.1	92.4
50.0	94.1	94.5	93.0	94.1	94.5	93.0
60.0	94.5	95.0	93.6	94.5	95.0	93.6
75.0	94.5	95.0	93.6	94.5	95.4	93.6
100.0	95.0	95.4	93.6	95.0	95.4	94.1
125.0	95.0	95.4	94.1	95.0	95.4	95.0
150.0	95.4	95.8	94.1	95.8	95.8	95.0
200.0	95.4	95.8	95.0	95.8	96.2	95.4
250.0	95.4	95.8	95.0	95.8	96.2	95.8
300.0	95.4	95.8	95.4	95.8	96.2	95.8
350.0	95.4	95.8	95.4	95.8	96.2	95.8
400.0	95.8	95.8	95.8	95.8	96.2	95.8
450.0	96.2	96.2	95.8	95.8	96.2	95.8
500.0	96.2	96.2	95.8	95.8	96.2	95.8

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.
- B. For flexible coupled drive motors, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Align shafts to manufacturer's requirements or within 0.002 inch per inch diameter of coupling hub.
- C. For belt drive motors, mount sheaves on the appropriate shafts per manufacturer's instructions. Use a straight edge to check alignment of the sheaves. Reposition sheaves as necessary so the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so the belt(s) can be added, and tighten the base so the belt tension is in accordance with the drive manufacturer's recommendations. Frequently check belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

END OF SECTION

SECTION 220516 - PLUMBING EXPANSION COMPENSATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Expansion Joints and Compensators.
- B. Pipe Loops, Offsets, and Swing Joints.

1.2 REFERENCES

- A. Conform to Standards of Expansion Joint Manufacturer's Association.

1.3 SUBMITTALS

- A. Expansion joint shop drawings shall include maximum deflection distance, material of construction, and intended system service type approved by expansion joint manufacturer.

1.4 DESIGN CRITERIA

- A. Unless noted otherwise, base expansion calculations on 50F installation temperature to 120F for domestic hot water, plus 30% safety factor.

PART 2 - PRODUCTS

2.1 BASIC CONSTRUCTION AND REQUIREMENTS

- A. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.
- B. All expansion joints shall be designed or treated for corrosion resistance. Steel components shall be painted for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All damage to coatings shall be field repaired with two coats of zinc rich coating.
- C. All components in contact with potable water shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act and NSF/ANSI-61 Low Lead Requirements for Drinking Water.

2.2 EXPANSION JOINTS

- A. Type EJ-1U:
 - 1. U loop style assembly consisting of two flexible hose connectors, two 90-degree elbows, and a 180-degree return pipe. Unit shall be in the form of a pipe loop. Rated for deflection +/- 4".

2. Connectors shall have corrugated stainless steel or bronze hose bodies with stainless steel or bronze braided casings.
3. Connectors shall be rated for 200 psi working pressure at 250F.
4. Elbows shall be copper or stainless steel.
5. Wetted surfaces of this product shall contain less than 0.25% lead by weight. NSF 61 - Lead Free potable water certified.
6. Sizes 1/2" to 4" shall have sweat, threaded, flanged or press connections as specified in 22 10 00.
 - a. Manufacturers:
 - 1) Metraflex Metraloop Type Copper MLS or MLSUPC
 - 2) Flexicraft Type Copper ML LOOP

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Provide expansion compensation as indicated on the drawings and as described herein.
- C. Accomplish structural work and provide equipment required to control expansion and contraction of piping; including loops, offsets, swing joints, and expansion joints where required.
- D. Rigidly anchor pipe to building structure where necessary. Provide pipe guides so all movement occurs along axis of pipe only.
- E. Each expansion joint shall have either one anchor or two alignment guides on each side of it. Guides shall be located within 4 and 14 pipe diameters of the expansion joint or as recommended by the joint manufacturer.
- F. Preset all expansion joints to allow for expected expansion from installation temperature to operating temperature.
- G. Expansion joints shall not cause any change in position of piping that will result in stresses in connections or misalignment. Equipment and piping shall be maintained in a rigid position during installation. Do not transfer load to the expansion joints.

3.2 EXPANSION COMPENSATION SCHEDULE

- A. Cold Water, Hot Water, Tempered Water - Potable and Non-Potable (Above Ground):
 1. Expansion Joint: EJ-1U

END OF SECTION

SECTION 220529 - PLUMBING SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Equipment Bases and Supports.
- C. Flashing and Sealing of Equipment and Pipe Stacks.
- D. Cutting of Openings.
- E. Escutcheon Plates and Trim.

1.2 REFERENCES

- A. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- B. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
- C. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices
- D. MSS SP-127 - Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application.

1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 SEISMIC RESTRAINTS

- A. Refer to Section 220550 for additional requirements for seismic restraints.

2.2 HANGER RODS

- A. Hanger rods for single rod hangers shall conform to the following:
 - 1. Steel, Cast Iron, Pipe:
 - a. Hanger Rod Diameter:
 - 1) 2" and smaller: 3/8"

- 2) 2-1/2" through 3-5/8": 1/2"
- 3) 4" through 6": 1/2"
- 4) 8": 5/8"
- 5) 10": 3/4"
- 6) 12": 7/8"
- 7) 14" and 16": 1"
- 8) 18" and 24": 1-1/4")

2. Copper and Plastic Pipe:

a. Hanger Rod Diameter:

- 1) 2" and smaller: 3/8"
- 2) 2-1/2") through 3-5/8": 1/2"
- 3) 4") through 6": 1/2"
- 4) 8": 5/8"
- 5) 10": 3/4"
- 6) 12": 7/8"
- 7) 14" and 16": 1"
- 8) 18" and 24": 1-1/4"

- B. Rods for double rod hangers may be reduced one size. Minimum rod diameter is 3/8 inches.
- C. Hanger rods and accessories used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
- D. All hanger rods, nuts, washers, clevises, etc., in damp areas shall have ASTM A123 hot-dip galvanized finish applied after fabrication. This applies to the following areas:

2.3 PIPE AND STRUCTURAL SUPPORTS

A. General:

1. Pipe hangers, clamps, and supports shall conform to Manufacturers Standardization Society MSS SP-58, 69, 89, and 127 (where applicable).
2. On all insulated piping, provide at each support an insert of same thickness and contour as adjoining insulation, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Refer to insulation specifications for materials and additional information.
3. Copper piping located in an exposed area, including indirect waste piping in **kitchens and janitor's closets**, shall use split ring standoff hangers for copper tubing. Support shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp. Use electro-galvanized or more corrosion resistant and threaded rod for floor applications. Use anchors applicable to the wall type with corrosion resistant threaded rod for wall applications.

B. Hangers and Clamps:

1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp within their temperature limits of -65F to +275F.
3. Vertical cold pipe drops and rough-ins to fixtures shall be supported by insulated pipe clamps to prevent thermal bridging and condensation.
4. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
5. Ferrous hot piping 4 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.
6. Unless otherwise indicated, hangers shall be as follows:
 - a. Clevis Type: Bare Metal Pipe, Rigid Plastic Pipe, Insulated Cold Pipe, Insulated Hot Pipe - 3 inches & Smaller
 - 1) Products: Bare Steel Plastic or Insulated Pipe:
 - a) Anvil Fig. 260
 - b) Eaton Fig. 3100
 - c) nVent Model 400
 - 2) Products: Bare Copper Pipe Felt or PVC Coated:
 - a) Eaton Fig. B3104F or B3100CTC
 - b) Anvil Fig. CT65
 - c) nVent Fig. 402
 - b. Adjustable Swivel Ring Type: Bare Metal Pipe - 4 inches and Smaller
 - 1) Products: Bare Copper Pipe:
 - a) nVent 102A0 Series
 - b) Anvil Fig. CT-69
7. Support may be fabricated from U-channel strut or similar shapes. Piping less than 4" in diameter shall be secured to strut with clamps of proper design and capacity as required to maintain spacing and alignment. Strut shall be independently supported from hanger drops or building structure. Size and support shall be per manufacturer's installation requirements for structural support of piping. Clamps shall not interrupt piping insulation.
 - a. Strut used in mechanical spaces or otherwise dry areas shall have ASTM B633 electro-plated zinc finish.
 - b. Strut used in damp areas listed in hanger rods shall have ASTM A123 hot-dip galvanized finish applied after fabrication.

C. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
 - a. Wood Anchors: Tension wood rod hanger for suspending 3/8" threaded rod. Zinc plated carbon steel.
 - 1) Minimum allowable tension loads for Douglass Fir/Southern Pine:
 - a) 3/8" diameter rod; 2-1/2" shank: 600 lb/590 lb.
 - b) Load values are based on full shank penetration into wood member. Minimum edge distance 3/4". Minimum end distance 3-1/4".
 - 2) Limitations:
 - a) Truss: Do not hang from wood trusses without truss manufacturer or Structural Engineer^{TMTM}s approval.
 - b) Sheetrock/Gypsum Ceiling: When drilling through non-wood materials (e.g., sheet rock, gypsum, etc.), increase shank length by depth of non-wood materials.
 - c) Plywood Flooring/Roofing: Do not hang from plywood floor or roofing.
 - d) Spacing: Refer to wood structure spacing of hangers.
 - 3) Products:
 - a) Simpson RWV
 - b) DeWALT
 - c) ITI Sammys GT25

2.4 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Concrete Bases (Housekeeping Pads):
2. Refer to Section 220550 for additional requirements for concrete bases in seismic applications.

B. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

2.5 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Exact locations of all openings for the installation of materials shall be determined by the Contractor and given to the General Contractor for installation or construction as the structure is built.
- B. Coordinate all openings with other Contractors.
- C. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- D. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at Contractor's expense.
- E. Do not cut structural members without written approval of the Architect or Structural Engineer.
- F. Exposed Housing Penetrations: Seal pipes with surface temperature below 150F, penetrating housings with conical stepped, white silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite.

2.6 ROOF PENETRATIONS

- A. Roof Curb Enclosure: Provide weatherproof roof curb and enclosure for pipe penetrations. Refer to drawings for details.
- B. Conical Pipe Boot: Seal pipes with surface temperature below 150F, penetrating single-ply roofs with conical stepped, UV-resistant silicone, EPDM or neoprene pipe flashings and stainless steel clamps equal to Portals Plus Pipe Boots or Pipetite. Color: White, Black shall match roofing membrane.
- C. Break insulation only at the clamp for pipes between 60F and 150F. Seal outdoor insulation edges watertight.

		Element	
Model	Service	Material	Temperature Range
S	Standard (Stainless)	EPDM	-40F to 250F
T	High/Low Temperature (Steam)	Silicone	-67F to 400F
T	Fire Seals (1 hour)	Silicone	-67F to 400F
FS	Fire Seals (3 hours)	Silicone	-67F to 400F
OS	Oil Resistant/Stainless	Nitrile	-40F to 210F

2.7 ESCUTCHEON PLATES AND TRIM

- A. Fit escutcheons to all insulated or uninsulated exposed pipes passing through walls, floors, or ceilings of finished rooms.

- B. Escutcheons shall be heavy gauge, cold rolled steel, copper coated under a chromium plated finish, heavy spring clip, rigid hinge and latch.
- C. Install galvanized steel (unless otherwise indicated) trim strip to cover vacant space and raw construction edges of all rectangular openings in finished rooms. This includes pipe openings.

2.8 PIPE PENETRATIONS

- A. Seal all pipe penetrations. Seal non-rated walls and floor penetrations with grout or caulk. Backing material may be used.
- B. Seal fire rated wall and floor penetrations with fire seal system as specified.

PART 3 - EXECUTION

3.1 PLUMBING SUPPORTS AND ANCHORS

- A. General Installation Requirements:
 - 1. Install all items per manufacturer's instructions.
 - 2. Coordinate the location and method of support of piping systems with all installations under other Divisions and Sections of the Specifications.
 - 3. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
 - 4. Supports shall extend directly to building structure. Do not support piping from duct hangers unless coordinated with Sheet Metal Contractor prior to installation. Do not allow lighting or ceiling supports to be hung from piping supports.
- B. Supports Requirements:
 - 1. Where building structural steel is fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Repair all fireproofing damaged during pipe installation.
 - 2. Set all concrete inserts in place before pouring concrete.
 - 3. Furnish, install and prime all auxiliary structural steel for support of piping systems that are not shown on the Drawings as being by others.
 - 4. Install hangers and supports complete with lock nuts, clamps, rods, bolts, couplings, swivels, inserts and required accessories.
 - 5. Hangers for horizontal piping shall have adequate means of vertical adjustment for alignment.
- C. Pipe Requirements:
 - 1. Support all piping and equipment, including valves, strainers, traps and other specialties and accessories to avoid objectionable or excessive stress, deflection, swaying, sagging or vibration in the piping or building structure during erection, cleaning, testing and normal operation of the systems.

2. Do not, however, restrain piping to cause it to snake or buckle between supports or to prevent proper movement due to expansion and contraction.
 3. Support piping at equipment and valves so they can be disconnected and removed without further supporting the piping.
 4. Piping shall not introduce strains or distortion to connected equipment.
 5. Parallel horizontal pipes may be supported on trapeze hangers made of structural shapes and hanger rods; otherwise, pipes shall be supported with individual hangers.
 6. Trapeze hangers may be used where ducts interfere with normal pipe hanging.
 7. Provide additional supports where pipe changes direction, adjacent to flanged valves and strainers, at equipment connections and heavy fittings.
 8. Provide at least one hanger adjacent to each joint in grooved end steel pipe with mechanical couplings.
- D. Provided the installation complies with all loading requirements of truss and joist manufacturers, the following practices are acceptable:
1. For attachments to joists that are concentrically loaded on the joist, a max of 100 lbs may be attached to the joist within a chord panel.
 2. For attachments to joists that are eccentrically loaded, a max of 25 lbs may be attached to the joist within a chord panel without an additional angle.
 3. Multiple attachments are allowed in each chord panel as long as the sum of the loads do not exceed the max load indicated.
 4. For loads between 100 lbs - 200 lbs, additional L2x2x3/16" (L51xL51x4.8) ASTM A36 structural steel angles are required and joist must be concentrically loaded.
 5. For loading conditions noted above, total sum of loads shall not exceed 200 lbs for an 8 ft segment of joist. For loads greater than 200 lbs and not noted on the drawings, contact engineer prior to installation.
 6. No loads shall be supported from joist bridging.
 7. It is prohibited to cantilever a load using an angle or other structural component that is attached to a truss or joist in such a fashion that a torsional force is applied to that structural member.
 8. If conditions cannot be met, coordinate installation with truss or joist manufacturer and contact Architect/Engineer.
- E. After piping and insulation installation are complete, cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- F. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (limitation not required with concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and architectural items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- G. Do not exceed the manufacturer's recommended maximum load for any hanger or support.
- H. Wood Structure: Spacing of hangers shall not exceed the compressive strength of the insulation inserts, and in no case shall exceed the following:

1. Steel and Fiberglass (Std. Weight or Heavier - Liquid Service):
 - a. Maximum Spacing:
 - 1) 1-1/4" & under: 7'-0"
 - 2) 1-1/2": 9'-0"
 - 3) 2": 10'-0"
 - 4) 2-1/2": 11'-0"
 - 5) 3": 12'-0"
 - 6) 4" through 6": 12'-0"
 - 7) 8": 9'-0"
 - 8) 10": 6'-0"
 - 9) 12": 4'-0"
 2. Hard Drawn Copper & Brass (Liquid Service):
 - a. Maximum Spacing:
 - 1) 3/4" and under: 5'-0"
 - 2) 1": 6'-0"
 - 3) 1-1/4": 7'-0"
 - 4) 1-1/2" 8'-0"
 - 5) 2": 8'-0"
 - 6) 2-1/2": 9'-0"
 - 7) 3": 10'-0"
 - 8) 4": 12'-0"
 - 9) 6": 12'-0"
 3. Plastic Pipe:
 - a. Hangers shall be spaced based on the piping system manufacturer's instructions or, if no system instructions are available, space hangers at 4'-0" maximum centers.
 4. Ultra-Flexible Pipe, Flexible Hose, and Soft Copper Tubing:
 - a. Continuous channel with hangers maximum 8'-0" OC.
- I. Installation of hangers shall conform to MSS SP-58, 69, 89 and the applicable Plumbing Code.

END OF SECTION

SECTION 220548 - PLUMBING VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Vibration Isolation.
- B. Flexible Connectors.

1.2 SUBMITTALS

- A. Vibration isolation submittals may be included with equipment being isolated but must comply with this section.
- B. Base submittals shall include equipment served, construction, coatings, weights, and dimensions.
- C. Isolator submittals shall include:
 - 1. Equipment served
 - 2. Type of Isolator
 - 3. Load in Pounds per Isolator
 - 4. Recommended Maximum Load for Isolator
 - 5. Spring Constants of Isolators (for Spring Isolators)
 - 6. Load vs. Deflection Curves (for Neoprene Isolators)
 - 7. Specified Deflection
 - 8. Deflection to Solid (at least 150% of calculated deflection)
 - 9. Loaded (Operating) Deflection
 - 10. Free Height
 - 11. Loaded Height
 - 12. Kx/Ky (horizontal to vertical stiffness ratio - for spring isolators)
 - 13. Materials and Coatings
 - 14. Spring Diameters
- D. Make separate calculations for each isolator on equipment where the load is not equally distributed.

PART 2 - PRODUCTS

2.1 BASIC CONSTRUCTION AND REQUIREMENTS

- A. Vibration isolators shall have either known undeflected heights or other markings so deflection under load can be verified.

- B. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the deflection curve of all spring isolators shall extend 50% beyond the calculated operating deflection (e.g., 3" for 2" calculated deflection). The point of 50% additional deflection shall not exceed the recommended load rating of the isolator.
- C. The lateral to vertical stiffness ratio (K_x/K_y) of spring isolators shall be between 0.8 and 2.0.
- D. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.
- E. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8" diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All ferrous portions of isolators, other than springs, for exterior use shall be hot dip galvanized after fabrication. Outdoor springs shall be neoprene dipped or hot dip galvanized. All damage to coatings shall be field repaired with two coats of zinc rich coating.
- F. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets shall be 1-1/2" to 2-1/2" above the floor or housekeeping pad, unless shown otherwise on the drawings. Steel bases shall have at least four points of support.
- G. Provide motor slide rails for belt-driven equipment per Section 220513.
- H. All isolators, except M1, shall have provision for leveling.
- I. All components in contact with potable water shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act and NSF/ANSI-61 Low Lead Requirements for Drinking Water.

2.2 MOUNTINGS

- A. Type M1:
 - 1. 0.75" thick waffled neoprene pad with minimum static deflection of 0.07" at calculated load and 0.11" at maximum load. For loads less than 15 pounds, the deflection at calculated load requirement is waived, but the isolator must have a maximum stiffness of the ratio of 45#/0.35".
 - 2. Units need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators.

2.3 HANGERS

- A. Type H1:
 - 1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.
 - 2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.

3. Provide hangers with end connections as required for hanging ductwork or piping.

2.4 FLEXIBLE CONNECTORS (NOISE AND VIBRATION ELIMINATORS)

A. Type FC3:

1. Rated for minimum working pressures of 150 psi at 70F and 100 psi at 800F.
2. Sizes 2" and under shall be braided bronze hose with copper sweat ends or stainless steel braided hose with stainless steel threaded nipples,
3. Sizes 2-1/2" and over shall be stainless steel braided hose with 150 lb. stainless steel flanges.
4. Suitable for 1/2" permanent misalignment.
5. All components shall be lead free per Federal Act S.3874, Reduction of Lead in Drinking Water Act and NSF/ANSI-61 Low Lead Requirements for Drinking Water.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Provide vibration isolation as indicated on the drawings and as described herein.
- C. Clean the surface below all mountings that are not bolted down and apply adhesive cement equal to Mason Type WG between mounting and floor. If movement occurs, bolt mountings down. Isolate bolts from baseplates with neoprene washers and bushings.
- D. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection of the isolator under the weight of the installed equipment - not the maximum rated deflection of the isolator.
- E. Support equipment to be mounted on structural steel frames with isolators under the frames or under brackets welded to the frames. Where frames are not needed, fasten isolators directly to the equipment.
- F. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support points that require multiple hangers, such as pipes supported on a strut rack.

3.2 PIPE ISOLATION

- A. The first three hangers from vibration-isolated equipment shall be type H1.
- B. For base mounted pumps without resilient mountings, the first five hangers shall be Type H1.
- C. Install flexible connectors in all piping connected to vibration producing equipment. This includes all base-mounted pumps, compressors, etc. Absence of flexible connectors on piping diagrams does not imply that they are not required.

- D. Use Type FC3 for all potable water services. FC3 shall be installed parallel with equipment shafts.
- E. Provide sufficient piping flexibility for vibrating equipment, or furnish flexible connectors with appropriate temperature and pressure ratings.
- F. Vibration isolators shall not cause any change in position of piping that will result in stresses in connections or misalignment of shafts or bearings. Equipment and piping shall be maintained in a rigid position during installation. Do not transfer load to the isolators until the installation is complete and under full operational load. Hanger H3 and Mounting M4 may be used instead of other products for this purpose.
- G. Support piping to prevent extension of flexible connectors.

3.3 VIBRATION ISOLATION SCHEDULE

- A. Inline Pumps:
 - 1. Base Type: NA
 - 2. Static Deflection: 0.75"
 - 3. Flexible Connections: NA
- B. Base-Mounted Domestic Water Booster Pumps:
 - 1. Base Type: M1
 - 2. Isolator Type: NA
 - 3. Static Deflection: NA
 - 4. Flexible Connections: FC-3

END OF SECTION

SECTION 220550 - SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Seismic Requirements.

1.2 REFERENCES

- A. International Building Code 2021.
- B. ASCE 7-16, Chapter 13.
- C. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems.
- D. NFPA 13 - Installation of Sprinkler Systems.

1.3 SUBMITTALS

- A. Submit under provisions of Section 220500.
- B. A seismic restraint designer shall be provided whether or not exceptions listed in the applicable building code are met. If seismic restraints are not provided for a system that requires seismic bracing, the seismic designer shall submit a signed and sealed letter to the Architect/Engineer and Authorities Having Jurisdiction stating the exceptions, along with code reference, utilized for each item. Seismic designer shall review system installation for general conformance to the exception requirements stated in the code and document, in writing, the system has been installed in accordance to the exception.

1.4 TESTING AND INSPECTION

- A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the Building Code.
- B. The Contractor shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.
- C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.

- D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

1.6 DESIGN REQUIREMENTS

- A. This project is subject to the seismic bracing requirements of the International Building Code, 2021 edition.
- B. The following criteria are applicable to this project:
 - 1. Risk Category: II
 - 2. Seismic Importance Factor: $IE = 1.0$ Seismic Design Category: D
 - 4. Component Amplification Factors (a_p) and Component Response Modification Factors (R_p) shall be taken from Table 13.5-1 in ASCE 7-16 for the individual equipment or system being restrained.
 - 5. Component Importance Factors (I_p) shall be taken from Section 13.1.3 in ASCE 7-16 for the individual equipment or system being restrained.
 - 6. The total height of the structure and the height of the system to be restrained within the structure shall be determined in coordination with architectural plans and the General Contractor.
- C. Forces shall be calculated with the above requirements and Equations 13.3-1, -2, and -3 of ASCE 7-16, unless exempted by 13.1.4. Equipment shall meet International Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.

1.7 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

1.8 WARRANTY

- A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

PART 2 - PRODUCTS

2.1 SUPPLIERS

A. Following is a partial list of manufacturer/supplier contact information for seismic restraints:

1. B-Line Systems, Inc. (800) 851-7415, www.b-line.com.
2. Unistrut Corporation <http://www.unistrut.us/>
3. Kinetics Noise Control (877) 457-2695, www.kineticsnoise.com.
4. Mason Industries, Inc. www.mason-ind.com.
5. Loos & Co., Inc. (800) 321-5667, www.loosnaples.com.
6. Tolco (909) 737-5599, www.tolco.com
7. ISAT 877.523.6060, www.isatsb.com
8. Vibro-Acoustics (416) 291-7371, <https://virs.vibro-acoustics.com/>

2.2 SEISMIC DESIGN CRITERIA

A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.

B. Definitions:

1. Remain Operational:
 - a. Requirements for "Stay in Place" listed above shall be met.
 - b. The following systems and associated equipment are intended not to fail externally or internally and are intended to continue operation following a seismic event:
 - 1) Plumbing

2.3 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

A. General:

1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record; refer to submittal requirements.
2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer's submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.
3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.
5. All seismic restraint devices shall be designed to accept without failure the forces calculated per the applicable building code.
6. All seismic restraints and combination isolator/restraints shall have verification of their seismic capabilities witnessed by an independent testing agency.

B. Friction from gravity loads shall not be considered resistance to seismic forces.

C. Housekeeping Pads:

1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.

2.4 SEISMIC RESTRAINT AND CONSTRUCTION OF EQUIPMENT

- A. Equipment supplied for the project shall be designed to meet the requirements of lateral forces calculated using the applicable code and method described above.
- B. The following is a partial list of equipment that shall be restrained and that shall be constructed to meet seismic forces described in this section:
 1. Pumps
 2. Tanks

2.5 MATERIALS

- A. Use the following materials for restraints:
 1. Indoor Dry Locations: Steel, zinc plated.
 2. Outdoors and Damp Locations: Galvanized steel.
 3. Corrosive Locations: Stainless steel.

2.6 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

- A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Strength in tension and shear of components used shall be at least two times the maximum seismic forces to which they will be subjected.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.
- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.7 SEISMIC BRACING COMPONENTS

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
 - 1. Materials for Channel: ASTM A 1011, GR 33.
 - 2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.
 - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
 - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
 - 1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
 - 2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- C. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.
- B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.
- C. All rigid floor mounted equipment shall have a resilient media between the equipment mounting hole and the anchor bolt in concrete.
- D. All seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.
- E. Installation of seismic restraints shall not cause any change in position of equipment, piping, or ductwork, resulting in stresses or misalignment.
- F. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
- G. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.

- H. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer's attention prior to specific equipment selection.
- I. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- J. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.
- K. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.
- L. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.
- M. Do not install cables over sharp corners.
- N. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.
- O. Provide reinforced clevis bolts when required.
- P. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.
- Q. Post-Installed anchors shall be provided to meet seismic requirements.
- R. Vertical pipe risers flexibly supported to accommodate thermal motion and/or pipe vibration shall be guided to maintain pipe stability and provide horizontal seismic restraint.
- S. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
- T. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide required motion capability and limit motion of adjacent piping.
- U. Water tanks shall be secured to their saddles by welding or proper concrete attachment, and those saddles shall be properly attached to the structure.
- V. Brace all terminal units with water coils as required by the building code and provide flexible connection to the coil if bracing is required.
- W. Independently brace duct mounted equipment (terminal units, in-line fans, etc.) and the associated suspended ductwork.

- X. Do not brace a system to two different structures such as a wall and a ceiling.
- Y. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- Z. Positively attach all roof mounted equipment to roof curbs. Positively attach all roof curbs to building structure.
- AA. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.
- BB. Coordinate seismic bracing of architecturally exposed ductwork with the Architect/Engineer.

3.2 SEISMIC RESTRAINT EXCLUSIONS

- A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

END OF SECTION

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SECTION 220553 - PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 22.

1.2 REFERENCES

- A. ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. ASTM B-1, B-3, and B-8 for copper conductors.
- C. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 “ 2kV Cables.
- D. NFPA-99: Health Care Facilities.
- E. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

1.3 SUBMITTALS

- A. Include valve chart and schedule listing valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 3M
- B. Craftmark
- C. Seton
- D. W.H. Brady

2.2 MATERIALS

- A. All pipe markers shall conform to ANSI A13.1. Marker lengths and letter sizes shall be at least the following:

OD of Pipe or Insulation	Marker Length	Size of Letters
Up to and including 1-1/4"	8"	1/2"
1-1/2" to 2"	8"	3/4"

2-1/2" to 6"	12"	1-1/4"
8" to 10"	24"	2-1/2"
Over 10"	32"	3-1/2"

Plastic tags may be used for outside diameters under 3/4"

- B. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4" minimum letters on light contrasting background.
- C. Plastic Tags: Minimum 1-1/2" square or round laminated three-layer phenolic with engraved, 1/4" minimum black letters on light contrasting background.
- D. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2" square or 1-1/2" round.
- E. Plastic Pipe Markers: Semi-rigid plastic, preformed to fit around pipe or pipe covering; indicating flow direction and fluid conveyed.
- F. Vinyl Pipe Markers: Colored vinyl with permanent pressure sensitive adhesive backing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Valves:
 - 1. All valves (except shutoff valves at equipment) shall have numbered tags.
 - 2. Provide or replace numbered tags on all existing valves that are connected to new systems or that have been revised.
 - 3. Provide all existing valves used to extend utilities to this project with numbered tags. Review tag numbering sequence with the Owner prior to ordering tags.
 - 4. Secure tags with heavy duty key chain and brass "S" link or with mechanically fastened plastic straps.
 - 5. Attach to handwheel or around valve stem.
 - 6. Number all tags and show the service of the pipe.
 - 7. Provide one 36" x 24" minimum Plexiglas framed piping schematic showing valve locations with respective tag numbers. Mount directory in location chosen by the Architect/Engineer.
- D. Pipe Markers:

1. Adhesive Backed Markers: Use Brady Style 1, 2, or 3 on pipes 3" diameter and larger. Use Brady Style 4, 6, or 8 on pipes under 3" diameter. Similar styles by other listed manufacturers are acceptable. Secure all markers at both ends with a wrap of pressure sensitive tape completely around the pipe.
2. Snap-on Markers: Use Seton "Setmark" on pipes up to 5-7/8" OD. Use Seton "Setmark" with nylon or Velcro ties for pipes 6" OD and over. Similar styles by other listed manufacturers are acceptable.
3. Apply markers and arrows in the following locations where clearly visible:
 - a. At each valve.
 - b. On both sides of walls that pipes penetrate.
 - c. At least every 20 feet along all pipes.
 - d. On each riser and each leg of each "T" joint.
 - e. At least once in every room and each story traversed.

E. Equipment:

1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
2. Provide engraved plastic tags at all hydronic or steam system makeup water meters.
3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.

3.2 SCHEDULE

A. Pipes to be marked shall be labeled with text as follows, regardless of which method or material is used:

1. CONDENSATE DRAIN: White lettering; green background
2. DOMESTIC COLD WATER: White lettering; green background
3. DOMESTIC HOT WATER - 115F: White lettering; green background
4. DOMESTIC HOT WATER - 140F: White lettering; green background
5. DOMESTIC HOT WATER CIRCULATING - 115F: White lettering; green background
6. SANITARY SEWER: Black lettering; yellow background
7. VENT: Black lettering; yellow background
8. STORM SEWER (PRIMARY AND SECONDARY): White lettering; green background
9. NATURAL GAS: Black lettering; yellow background

B. Non-Potable Piping: All piping conveying non-potable water shall be permanently identified by continuous adhesive-backed marker along the entire length of the pipe and branches so the piping is readily distinguishable from piping carrying potable water. Pipe markers shall be located as described above.

1. NON-POTABLE WATER: White lettering; purple background
2. IRRIGATION WATER: White lettering; purple background

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END OF SECTION

SECTION 220593 - PLUMBING TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjusting, and balancing of plumbing systems.

1.2 REFERENCES

- A. AABC - National Standards for Total System Balance, 2002.
- B. ASHRAE - 2003 HVAC Applications Handbook; Chapter 37, Testing, Adjusting and Balancing.
- C. TABB - International Standards for Environmental Systems Balance.

1.3 SUBMITTALS

- A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.

1.4 REPORT FORMS

- A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.
- B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.
- C. Refer to PART 4 for required reports.

1.5 WARRANTY/GUARANTEE

- A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of **24** manhours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.
- B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

1.6 SCHEDULING

- A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.
- B. Project will be constructed in phases. Provide balancing report after each phase is complete.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.
- B. The Balancing Contractor shall incorporate all pertinent documented construction changes (e.g., submittals/shop drawings, change orders, RFIs, ASIs, etc.) and include in the balancing report.
- C. Recorded data shall represent actual measured or observed conditions.
- D. Cut insulation, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.
- E. Permanently mark setting of valves and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- F. Leave systems in proper working order, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.
- G. Installations with systems consisting of multiple components shall be balanced with all system components operating.

3.2 EXAMINATION

- A. Before beginning work, verify that systems are complete and operable. Ensure the following:
 - 1. General Equipment Requirements:
 - a. Equipment is safe to operate and in normal condition.
 - b. Equipment with moving parts is properly lubricated.
 - c. Temperature control systems are complete and operable.

- d. Proper thermal overload protection is in place for electrical equipment.
- e. Direction of rotation of all pumps is correct.
- f. Access doors are closed and end caps are in place.

2. Pipe System Requirements:

- a. Hydronic systems have been cleaned, filled, and vented.
- b. Strainer screens are clean and in place.
- c. Shutoff, throttling and balancing valves are open.

- B. Report any defects or deficiencies to Architect/Engineer.
- C. Promptly report items that are abnormal or prevent proper balancing.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.
- B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

3.4 INSTALLATION TOLERANCES

- A. $\pm 10\%$ of scheduled values:
 - 1. Adjust piping systems to $\pm 10\%$ of design values.

3.5 ADJUSTING

- A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.
- B. Once balancing of systems is complete, at least one valve must be 100% open.
- C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.
- D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.
- E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

3.6 SUBMISSION OF REPORTS

- A. Fill in test results on appropriate forms.

PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

4.1 GENERAL REQUIREMENTS

- A. Title Page:

1. Project name.
2. Project location.
3. Project Architect.
4. Project Engineer (IMEG Corp.).
5. Project General Contractor.
6. TAB Company name, address, phone number.
7. TAB Supervisor's name and certification number.
8. TAB Supervisor's signature and date.
9. Report date.

- B. Report Index

- C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

- D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

4.2 PLUMBING SYSTEMS

- A. Pump Data:

1. Drawing symbol.
2. Service.
3. Manufacturer, size, and model.
4. Impeller size: specified, actual, and final (if trimmed).
5. Flow Rate (gpm): specified and actual.
6. Pump Head: specified, operating and shutoff.

7. Suction Pressure: operating and shutoff.
8. Discharge Pressure: operating and shutoff.

B. Electric Motors:

1. Drawing symbol of equipment served.
2. Manufacturer, model, frame.
3. Nameplate: HP, phase, service factor, RPM, operating amps, efficiency.
4. Measured: Amps for each phase.

C. Balancing Valve:

1. Drawing symbol.
2. Service.
3. Location.
4. Size.
5. Manufacturer and model.
6. Flow rate (gpm): specified and actual.
7. Pressure drop: specified and actual.

END OF SECTION

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SECTION 220716 - PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment Insulation.
- B. Equipment Insulation Finishes.

1.2 REFERENCES

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM B209 - Aluminum and Aluminum Alloy Sheet and Plate
- C. ANSI/ASTM C534 - Elastomeric Foam Insulation
- D. ANSI/ASTM C921 - Properties of Jacketing Materials for Thermal Insulation
- E. ANSI/ASTM D1668 - Glass Fabric for Waterproofing
- F. ASTM E84 - Surface Burning Characteristics of Building Materials.
- G. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.
- H. NFPA 255 - Surface Burning Characteristics of Building Materials.
- I. UL 723 - Surface Burning Characteristics of Building Materials.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Type A: Glass Fiber Blanket; ANSI/ASTM C612; 0.40 maximum 'K' value at 300F; 3.0 lb./cu ft.; suitable to 850F, 25/50 flame spread/smoke developed.
- B. Type C: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534, Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75F, minimum density 3.0 lb/cu ft. (48kg/m3), listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where thicker values are specified.

2.2 INSULATION FINISHES

- A. Type 1: Glass Fabric; ASTM D1668, woven glass fabric with two coats of mastic approved for insulation type. Use vapor barrier mastic on system requiring a vapor barrier.
- B. Type 2: All Service Jacket; ASTM C921; Factory or Field Applied; all-purpose polymer or polypropylene service jacket; Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Seal all joints with manufacturer approved tape and adhesive to maintain vapor barrier. Indoor use only, if used outdoors add type 4 finish.
- C. Type 3: Flexible Elastomeric Thermal Insulation; After adhesive has fully cured, apply two coats of latex enamel paint approved by insulation manufacturer for outdoor use.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all materials per manufacturer's instructions, codes and industry standards.
- B. Maintain ambient temperatures and conditions required by manufacturers of adhesive and insulation.
- C. Do not insulate factory insulated equipment.
- D. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation. Secure to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier mastic.
- F. Do not insulate over nameplates or ASME stamps. Bevel and seal insulation around such, unless omitting insulation would cause condensation problem. When such is the case, appropriate tagging shall be provided to identify the presence of these items.
- G. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning; install specially fabricated removable insulation sections. Covers shall have mechanical fasteners and be reusable.
- H. Install 26 gauge galvanized sheet metal corner protection angles where insulation extends to the floor. Minimum 2" coverage of insulation.
- I. Insulate all equipment surfaces that are not factory insulated and are intended to operate below 60F and/or above 100F. Verify insulation type and thickness with equipment manufacturer and Architect/Engineer.
- J. Insulate all supports on equipment operating below ambient temperature.

3.2 INSULATION

- A. Type A and B:

1. Apply with edges tightly butted and joints staggered.
2. Secure with welded pins and washers, 4" from each edge and 16" on center, or 1/2" x 0.015" galvanized steel bands, 12" on center.

B. Type C:

1. Apply with edges tightly butted and joints staggered. Install multiple layers if required thickness is greater than 1" thick.
2. Secure with manufacturer approved adhesive. Seal all joints with manufacturer approved adhesive.
3. Exterior Installation: Exterior installations shall contain factory applied 17.5 mils laminated UV resistant cladding with ends sealed and adhesive and similar cover; or Contractor shall paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.

3.3 SCHEDULE

- A. Domestic Hot Water Storage Tank (up to 250F): 2" thick Type B; Finish 1 or 2.
- B. Steam-to-Water Heat Exchanger (up to 200F): 2" thick Type B; Finish 1 or 2. Steam-to-Water Heat Exchanger (200F to 299F): 2" thick Type B; Finish 1 or 2.
- C. Steam-to-Water Heat Exchanger (300F to 399F): 2-1/2" thick Type B; Finish 1 or 2.
- D. Steam-to-Water Heat Exchanger (400F to 499F): 3" thick Type A; Finish 1.
- E. Steam-to-Water Heat Exchanger (500F to 599F): 3-1/2" thick Type A; Finish 1.
- F. Domestic Cold Water Storage Tank:
 1. 1-1/2" thick Type B, Finish 1 or 2
 2. 1" Type C, Finish 3.
- G. Water Softener Tank:
 1. 1" thick Type B, Finish 1 or 2
 2. 1" thick Type C, Finish 3.
- H. Plate and Frame Heat Exchanger: 1" thick Type C, Finish 3.

END OF SECTION

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SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Piping Insulation.
- B. Insulation Jackets.

1.2 REFERENCES

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- C. ANSI/ASTM C534 - Elastomeric Foam Insulation.
- D. ASTM C591 - Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation.
- E. ASTM C1126 - Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
- F. ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation.
- G. ASTM C1767 - Standard Specification for Stainless Steel Jacketing for Insulation.
- H. ASTM E84 - Surface Burning Characteristics of Building Materials.
- I. NFPA 255 - Surface Burning Characteristics of Building Materials.
- J. UL 723 - Surface Burning Characteristics of Building Materials.
- K. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.

PART 2 - PRODUCTS

2.1 INSULATION

- A. Type A: Glass fiber; ANSI/ASTM C547; 0.24 maximum 'K' value at 75F; non-combustible, minimum density 3.0 lb/cu. ft (48kg/m³). All-purpose polymer or polypropylene service jacket, listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.

- B. Type B: Flexible elastomeric foam insulation; closed-cell, sponge or expanded rubber (polyethylene type is not permitted); ANSI/ASTM C534 Grade 1 Type I for tubular materials; flexible plastic; 0.25 maximum 'K' value at 75F, minimum density 3.0 lb/cu. ft (48kg/m³), listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code. Maximum 1" thick per layer where multiple layers are specified.

2.2 VAPOR BARRIER JACKETS

- A. All-purpose polymer or polypropylene service jacket vapor barrier with self-sealing adhesive joints. Beach puncture resistance ratio of at least 50 units. Tensile strength: 35 psi minimum. Single, self-seal acrylic adhesive on longitudinal jacket laps and butt strips.
- B. Polyvinylidene Chloride (PVDC or Saran) film and tape: Durable and highly moisture and moisture vapor resistant. Please refer to manufacturer's recommended installation guidelines.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install insulation after piping has been tested. Pipe shall be clean, dry and free of rust before applying insulation.

3.2 INSTALLATION

- A. General Installation Requirements:
 - 1. Install materials per manufacturer's instructions, building codes and industry standards.
 - 2. Continue insulation with vapor barrier through penetrations. This applies to all insulated piping. Maintain fire rating of all penetrations.
- B. Insulated Piping Operating Below 60F:
 - 1. Insulate fittings, valves, unions, flanges, strainers, flexible connections, flexible hoses, and expansion joints. Seal all penetrations of vapor barrier.
 - 2. On piping operating below 60F in locations that are not mechanically cooled (e.g., penthouses, mechanical rooms, tunnels, chases at exterior walls, etc.), Type B insulation shall be used.
 - 3. All balance valves with fluid operating below 60F shall be insulated with a removable plug wrapped with vapor barrier tape to allow reading and adjusting of the valve.
- C. Insulated Piping Operating Between 60F and 140F:
 - 1. Do not insulate flanges and unions, but bevel and seal ends of insulation at such locations. Insulate all fittings, valves and strainers.
- D. Insulated Piping Operating Above 140F:
 - 1. Insulate fittings, valves, flanges, and strainers.
 - 2. All balance valves with fluid operating above 140F shall be insulated and an opening shall be left in the insulation to allow for reading and adjusting the valve.

E. Exposed Piping:

1. Locate and cover seams in least visible locations.
2. Where exposed insulated piping extends above the floor, provide a sheet metal guard around the insulation extending 12" above the floor. Guard shall be 0.016" cylindrical smooth or stucco aluminum and shall fit tightly to the insulation.
3. On exposed piping serving kitchen equipment or plumbing fixtures, the piping shall be insulated unless local code allows it to be uninsulated. In no instance should the uninsulated portion of the piping be more than 4ft in developed length.

3.3 SUPPORT PROTECTION

A. Insulation with pipe size greater than 1-1/2" (38mm) shall be protected from sagging and crushing by one of the following means.

1. High Compressive Strength Insert: On all insulated piping greater than 1-1/2", provide shield with insulation insert of same thickness and contour as adjoining insulation at each support, between the pipe and insulation jacket, to prevent insulation from sagging and crushing. Inserts shall be as follows:
 - a. The insert shall be suitable for planned temperatures, be suitable for use with specific pipe material, and shall be a minimum 180-degree cylindrical segment the same length as metal shields. Inserts shall be:
 - b. Cellular glass (Type C) (for all temperature ranges) with a minimum compressive strength of 90 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.
 - c. Molded hydrous calcium silicate (Type D) (only use for pipes with operating temperatures above 90F, with a minimum compressive strength of 100 psi is acceptable for pipe sizes 14" and below. For pipe sizes larger than 14", provide rolled steel plate in addition to the shield.
 - d. Polyisocyanurate insulation (Type E) (for pipes below 300F with a minimum compressive strength of 24 psi is acceptable for pipe sizes 3" and below, minimum 60 psi for pipe sizes 4" to 10". For pipe sizes larger than 10", provide rolled steel plate in addition to the shield Where insulation is installed on piping located within return air plenums and mechanical rooms, insulation shall be listed and labeled at no more than 25/50 when tested per ASTM E84 or UL 723 as required by code.
 - e. Provide metal shields between hangers or supports and the pipe insulation/insert. Shields shall be galvanized sheet metal, half-round with flared edges. Adhere shields to insulation. On cold piping, seal the shields vapor-tight to the insulation as required to maintain the vapor barrier, or add separate vapor barrier jacket.

1) Shields shall be at least the following lengths and gauges:

Pipe Size	Shield Size
1/2" to 3-1/2"	12" long x 18 gauge
4"	12" long x 16 gauge
5" to 6"	18" long x 16 gauge
8" to 14"	24" long x 14 gauge
16" to 24"	24" long x 12 gauge

- f. Where rolled steel plate is noted above, provide minimum 1/4" (6mm) rolled galvanized steel plates in addition to the shield as reinforcement on large pipes as noted above to reduce point loading on roller, trapeze hanger and strut support locations depending on insulation compressive strength.
 - 2. Premanufactured Insulation Insert/Shield: As an alternative to separate pipe insulation insert and saddle, properly sized manufactured integral rigid insulation insert and shield assemblies may be used.
 - a. Products:
 - 1) Buckaroo CoolDry
 - 2) Cooper/B-Line Fig. B3380 through B3384
 - 3) Pipe Shields A1000, A2000
 - 3. Premanufactured Insulation Couplings:
 - a. Molded thermoplastic slip coupling, -65F to 275F, sizes up to 4-1/8" OD, and receive insulation thickness up to 1". Suitable for use indoors or outdoors with UV stabilizers. Vertical insulation riser clamps shall have a 1,000lb vertical load rating. On cold pipes operating below 60F, cover joint and coupling with vapor barrier mastic to ensure continuous vapor barrier.
 - b. PET thermoplastic foam load bearing core with elastomeric foam ends and lap-seal jacket.
 - c. Horizontal Strut Mounted Insulated Pipe Manufacturers:
 - 1) Klo-Shure or equal
 - 2) Armafix Ecolight
 - d. Vertical:
 - 1) Manufacturers: Klo-Shure Titan or equal
 - 4. Premanufactured shield/saddle for use with Elastomeric Foam (Type B): Molded thermoplastic rigid pipe saddle sized for insulation outside diameter. Length as required by manufacturer.
- B. Rectangular blocks, plugs, or wood material are not acceptable.
- C. Temporary wood blocking may be used by the Piping Contractor for proper height; however, these must be removed and replaced with proper inserts by the Insulation Contractor. Refer to Supports and Anchors specification section for additional information.
- D. Neatly finish insulation at supports, protrusions, and interruptions.
- E. Ferrous hot piping 4 inches and larger, provide steel saddle at rollers as described in Section 220529 "Plumbing Supports and Anchors".

3.4 INSULATION

A. Type A Insulation:

1. All Service Jackets: Seal all longitudinal joints with self-seal laps using a single pressure sensitive adhesive system. Do not staple.
2. Insulation without self-seal lap may be used if installed with Benjamin Foster 85-20 or equivalent Chicago Mastic, 3M or Childers lap adhesive.
3. Apply insulation with laps on top of pipe.
4. Fittings, Valve Bodies and Flanges: For 4" and smaller pipes, insulate with 1 lb. density insulation wrapped under compression to a thickness equal to the adjacent pipe insulation. For pipes over 4", use mitered segments of pipe insulation. Finish with preformed plastic fitting covers. Secure fitting covers with pressure sensitive tape at each end. Overlap tape at least 2" on itself. For pipes operating below 60F, seal fitting covers with vapor retarder mastic in addition to tape.

B. Type B Insulation:

1. Install per manufacturer's instructions or ASTM C1710.
2. Elastomeric Cellular Foam: Where possible, slip insulation over the open end of pipe without slitting. Seal all butt ends, longitudinal seams, and fittings with adhesive. At elbows and tees, use mitered connections. Do not compress or crush insulation at cemented joints. Joints shall be sealed completely and not pucker or wrinkle. Exterior installations shall contain factory applied polymeric, moisture, and UV resistant covering with ends sealed with adhesive and similar cover; or Contractor shall paint the outside of outdoor insulation with two coats of latex enamel paint recommended by the manufacturer.
3. Insulation Installation on Straight Pipes and Tubes:
 - a. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
 - b. Insulation must be installed in compression to allow for expansion and contraction. Insulation shall be pushed onto the pipe, never pulled. Stretching of insulation may result in open seams and joints.
4. Insulation Installation on Valves and Pipe Specialties:
 - a. Install preformed sections of same material as straight segments of pipe insulation when available.
 - b. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 - c. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3.5 SCHEDULE

- #### A. Refer to drawings for insulation schedule.

END OF SECTION

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SECTION 220800 - COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Description
- B. Responsibilities
- C. Related Work
- D. Test Equipment

1.2 DESCRIPTION

- A. The purpose of this section is to specify Division 22 responsibilities in the commissioning process.
- B. The systems to be commissioned are listed in Section 019100.
- C. Commissioning requires the participation of the Division 22 Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019100. Division 22 Contractor shall be familiar with all parts of Section 019100 and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.3 RESPONSIBILITIES

- A. Refer to Section 019100.

1.4 RELATED WORK

- A. Specific commissioning requirements are given in the following sections of these specifications. All the following sections apply to the Work of this section.
 - 1. Section 017823 - Operations and Maintenance
 - 2. Section 017900 - Demonstration and Training
 - 3. Section 019100 - Commissioning
 - 4. Section 210800 - Commissioning of Fire Suppression
 - 5. Section 230800 - Commissioning of HVAC
 - 6. Section 260800 - Commissioning of Electrical
 - 7. Section 270800 - Commissioning of Communications
 - 8. Section 280800 - Commissioning of Electronic Safety and Security

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Contractor shall provide all test equipment necessary to fulfill the testing requirements of this Division. This equipment includes, but is not limited to, the following:
 - 1. Handheld temperature and relative humidity meter.
 - 2. Infrared thermometer gun.
 - 3. Analog differential pressure gauge and associated tubing.
 - 4. Portable computer with access to the building automation system.
- B. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the related specifications. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5F and a resolution of +/- 0.1F.
 - 2. Pressure sensors shall have an accuracy of +/- 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.
 - 3. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.
- C. Refer to Section 019100 for additional Division 22 requirements.

PART 3 - EXECUTION

- A. Refer to Section 019100.

END OF SECTION

SECTION 220900 - INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pressure Gauge.
- B. Pressure Gauge Accessories.
- C. Thermometers.
- D. Test Plugs.

1.2 REFERENCES

- A. ANSI/AWWA C700 - Cold Water Meters - Displacement Type, Bronze Main Case.
- B. ANSI/AWWA C701 - Cold Water Meters - Turbine Type, for Customer Service.
- C. ANSI/AWWA C702 - Cold Water Meters - Compound Type.
- D. ANSI/AWWA C706 - Direct Reading, Remote Registration Systems for Cold Water Meters.
- E. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
- F. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle and Venturi.
- G. ASTM E1 - Specification for ASTM Thermometers.

1.3 SUBMITTALS

- A. Submit shop drawings per Section 220500. Include list that indicates use, operating range, total range and location for manufactured components.

PART 2 - PRODUCTS

2.1 POSITIVE DISPLACEMENT METERS (LIQUID)

- A. AWWA C700, AWWA C701, AWWA C702 positive displacement disc type suitable for fluid with hermetically sealed register remote reading to AWWA C706.
- B. Provide water meters with bronze case with cast iron frost-proof, breakaway bottom cap.
- C. Meters downstream of utility company meters shall be same manufacturer as utility company meter.

- D. Meter shall contain an analog 4-20 mA output, scaled and unscaled pulse outputs for connection to the building automation system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install per manufacturer's instructions.
2. Coil and conceal excess capillary on remote element instruments.
3. Install gauges and thermometers in locations where they are easily read from normal operating level.
4. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

B. Positive Displacement Meters:

1. Install positive displacement meters with shutoff valves on inlet and outlet. Provide full line size valved bypass with globe valve for liquid service meters.

C. Pressure Gauges:

1. Connect pressure gauges to suction and discharge side of all pumps.
2. Provide 1/2" tubing for pressure gauge and gauge accessories.
3. Provide snubber for each pressure gauge.
4. Provide coil syphon for each pressure gauge connected to steam piping.
5. Install gauges with bottom threaded connections at 6 o'clock position.
6. All pressure gauge connections shall be made on the side of the pipe to prevent air or dirt from entering the gauge connection.

D. Thermometers:

1. Install piping system thermometers in sockets with short couplings. Enlarge pipes smaller than 2-1/2" for installation of thermometer sockets.
2. Install thermometer sockets adjacent to control system thermostat, transmitter and sensor sockets.

END OF SECTION

SECTION 221000 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pipe and Pipe Fittings.
- B. Valves.
- C. Check Valves.

1.2 REFERENCES

- A. ANSI/ASME A112.3.1 - Stainless Steel Drainage Systems for Sanitary DWV, Storm, and Vacuum Applications, Above and Below Ground.
- B. ASME A112.6.9 - Siphonic Drain Test; The American Society of Mechanical Engineers.
- C. ANSI/ASME B16.22 - Wrought Copper and Bronze Solder-Joint Pressure Fittings.
- D. ANSI/ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.
- E. ANSI/ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
- F. ANSI/ASME B16.3 - Malleable Iron Threaded Fittings Class 150 NS 300.
- G. ANSI/ASME B16.5 - Pipe Flanges and Flanged Fittings.
- H. ANSI/ASME B16.9 - Factory-Made Wrought Steel Butt Welding Fittings.
- I. ANSI/ASME B31.3 - Chemical Plant and Petroleum Refinery Piping.
- J. ANSI/ASME Sec 9 - Welding and Brazing Qualifications.
- K. ANSI/ASTM B32 - Solder Metal.
- L. ANSI/ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
- M. ANSI/ASTM D2466 - PVC Plastic Pipe Fittings, Schedule 40.
- N. ANSI/AWS D1.1 - Structural Welding Code.
- O. ANSI/AWWA C110 - Ductile Iron and Gray Iron Fittings 3" through 48", for Water and Other Liquids.

- P. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings.
- Q. ANSI/AWWA C151 - Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- R. ANSI/AWWA C153 - Compact Ductile Iron Fittings 3" through 48", for Water and Other Liquids.
- S. ASME - Boiler and Pressure Vessel Code.
- T. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Supply Systems.
- U. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.
- V. ASTM A74 - Hub and Spigot Cast Iron Soil Pipe and Fittings.
- W. ASTM A234 - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
- X. ASTM A312 - Standard for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- Y. ASTM A554 - Standard for Welded Stainless Steel Mechanical Tubing.
- Z. ASTM A674 - Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids.
- AA. ASTM A888 - Hubless Cast Iron Soil Pipe and Fittings.
- BB. ASTM B88 - Seamless Copper Water Tube.
- CC. ASTM B306 - Copper Drainage Tube (DWV).
- DD. ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- EE. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- FF. ASTM C1540 - Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- GG. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- HH. ASTM D1785 - Polyvinylchloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- II. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- JJ. ASTM D2661 - ABS DWV Pipe & Fittings.

- KK. ASTM D2665 - PVC DWV Pipe & Fittings.
- LL. ASTM D2846 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
- MM. ASTM D3034 - Type PSM (Polyvinylchloride) (PVC) Sewer Pipe and Fittings.
- NN. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
- OO. ASTM F437 - Standard Specification for Threaded Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- PP. ASTM F439 - Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- QQ. ASTM F477 - Elastomeric Seals (Gaskets) for Joining Plastic Pipes.
- RR. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- SS. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- TT. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
- UU. ASTM F1412 - Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.
- VV. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing.
- WW. ASTM F2618 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Fittings for Chemical Waste Drainage Systems.
- XX. AWS A5.8 - Brazed Filler Metal.
- YY. AWWA C651 - Disinfecting Water Mains.
- ZZ. CISPI 301 - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.
- AAA. CISPI 310 - Joints for Hubless Cast Iron Sanitary Systems.
- BBB. FM 1680 - Couplings Used in Hubless Cast Iron Systems.
- CCC. NFPA 24 - Private Fire Service Mains and Their Appurtenances.
- DDD. NFPA 54 - National Fuel Gas Code.
- EEE. NFPA 58 - Storage and Handling of Liquefied Petroleum Gases.

FFF. NSF - National Sanitation Foundation

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.

1.4 COORDINATION DRAWINGS

- A. Reference Coordination Drawings article in Section 220500 for required plumbing systems electronic CAD drawings to be provided to Coordinating Contractor for inclusion into composite coordination drawings.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install all products per manufacturer's recommendations.
- B. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- C. Remove scale and dirt, on inside and outside, before assembly.
- D. Remove all scale, rust, dirt, oils, stickers and thoroughly clean exterior of all bare metal exposed piping, hangers, and accessories in preparation to be painted.
- E. Connect to equipment with flanges or unions. Unions or flanges for servicing and disconnect are not required in installations using grooved joint couplings.
- F. Use only piping materials rated for the maximum temperature of the application, e.g., do not use PVC for dishwasher drainage or piping that receives boiler blowdown.
- G. Roof Penetration (Vent) Flashing:
 - 1. Built-up Roofing: Flash vents with 3# seamless sheet lead of sufficient size to extend 15" into roofing felts for built-up roofs.
 - 2. Membrane, Metal or Shingled Roofs: Flash vents with premolded pipe flashing cones for single-ply membrane roofs, metal roofs, or shingled roofs.
- H. Existing building sewers or building drains which are shown on the documents to be reused shall be inspected and recorded by closed circuit television for their condition. Report findings back to the Architect, Engineer, and Owner before proceeding with work so any necessary rework can take place if needed.

3.2 SYSTEM, PIPING AND VALVE SCHEDULE

- A. The schedule below lists acceptable pipe and valve materials for each plumbing system type. Refer to the paragraph of the same name above in Part 2 for material specifications and limits for usage. This schedule is kept brief to simplify the information but shall not be interpreted to contradict limitations in Part 2. For example, if PVC/ABS is listed for sanitary waste and vent above ground in this schedule, that does not mean it is universally allowed for the entire project. Rather the material is still limited by Part 2 and is not allowed in return air plenum spaces.
- B. Sanitary Waste - Pumped (Underground - Outside Building)

3.3 TESTING PIPING

- A. Sanitary Drainage, Sanitary Vent, Storm Drainage, Acid Waste, Acid Vent:
1. Test all piping with water to prove tight.
 2. Test piping before insulation is applied.
 3. Hydrostatically test all soil, waste, and vent piping inside of building with 10 feet head of water for 15 minutes. Inspect before fixtures are connected. If leaks appear, repair them and repeat the test.
 4. Hydrostatically test interior downspouts with 10 feet head of water for 15 minutes with no leaks.
 5. A smoke/air test at the same pressure may be used in lieu of the hydrostatic water test. Exception: Smoke/air test shall not be performed on plastic piping.
 6. Test force mains with water at 105% of the operating pump discharge pressure for 15 minutes.
 7. Test pressures stated above shall be as listed or as required by the Authority Having Jurisdiction, whichever is most stringent.
- B. Hot Water - Potable and Non-Potable, Cold Water - Potable and Non-Potable, Tempered Water - Potable and Non-Potable, Service Water:
1. Test pipes underground or in chases and walls before piping is concealed.
 2. Test all pipes before the insulation is applied. If insulation is applied before the pipe is tested and a leak develops which ruins the insulation, replace damaged insulation.
 3. Test the pipe with 100 psig water pressure or equal inert gas such as nitrogen. Exception: Inert gas test shall not be used to test plastic piping.
 4. Hold test pressure for at least 2 hours.
 5. Test to be witnessed by the Architect/Engineer's representative, if requested by the Architect/Engineer.
- C. Fire Service:
1. Hydrostatically test the entire system for two hours at 200 psig. Maximum leakage shall be:
 - a. Interior Piping: 0 quarts per hour.
 - b. Underground Piping: 2 quarts per 100 joints per hour.

D. Vacuum Piping:

1. Testing pipes in chases, walls, or above non-accessible ceilings before piping is concealed.
2. Test with 100 psig compressed air or nitrogen.
3. During the test, strike all soldered joints sharply with a rubber or rawhide mallet to cause failure of any weak joints. After striking, soap test each joint.
4. Repair and retest all leaking joints.
5. After all joints pass the soap test, the system must maintain test pressure for 24 hours. If system fails the 24-hour, retest ALL joints by resoaping and repair all faulty joints. Repeat this procedure until the test pressure can be maintained for 24 hours.
6. After passing the above test, operate the vacuum pump. With all vacuum valves closed, the pump and piping system shall be able to maintain a vacuum of 25" Hg for at least one hour.
7. All materials, labor and equipment for testing shall be provided by the installing Contractor.
8. Tests to be witnessed by the Architect/Engineer's representative, if requested by the Architect/Engineer.
9. After testing, seal the complete system against entry of foreign material until it is turned over to the Owner.

E. All Other Piping:

1. Test piping at 150% of normal operating pressure.
2. Piping shall hold this pressure for one hour with no drop in pressure.
3. Test piping using water, nitrogen, or air as compatible with the final service of the pipe. Do not use combustible fluids.
4. Drain and clean all piping after testing is complete.

3.4 CLEANING PIPING

A. Air Blow:

1. Blow out pipe and components with clean compressed air. Instrument air, argon, nitrogen and sulfuric acid lines shall be blown out with dry, oil free air or nitrogen gas. "Oil Free" is defined as air compressed in a centrifugal, Teflon ring, carbon ring or water pumped air compressor. Where air supply is judged to be inadequate to continually attain cleaning velocity, alternate pressurization and sudden relief procedure may be used until discharge at all blow out points is clean. Use 80-90 psig pressure unless otherwise indicated.
2. Air blow applies to the following systems:
 - a. Acetylene
 - b. Carbon Dioxide
 - c. Nitrogen (use oil free air or nitrogen gas)
 - d. Argon (use oil free air or nitrogen gas)
 - e. Instrument Air (use oil free air or nitrogen gas)
 - f. Distilled Water (use maximum of 50 psig pressure)
 - g. Chemical Feed
 - h. Air Compressor Intakes
 - i. Sulfuric Acid (use oil free air or nitrogen gas)

B. All Water Piping:

1. Flush all piping using faucets, flush valves, etc. until the flow is clean.
2. After flushing, thoroughly clean all inlet strainers, aerators, and other such devices.
3. If necessary, remove valves to clean out all foreign material.

C. Fire Service:

1. Flush all underground piping with minimum flow equal to the system design flow but not less than the following:
 - a. 390 gpm for 4" pipes.
 - b. 880 gpm for 6" pipes.
 - c. 1560 gpm for 8" pipes.
 - d. 2440 gpm for 10" pipes.
 - e. 3500 gpm for 12" pipes.

3.5 INSTALLATION

A. General Installation Requirements:

1. Provide dielectric connections between dissimilar metals.
2. Route piping in orderly manner and maintain gradient. Install to conserve building space.
3. Group piping whenever practical at common elevations.
4. Install piping to allow for expansion and contraction without stressing pipe, joints, or equipment.
5. Slope water piping and arrange to drain at low points.
6. Install bell and spigot piping with bells upstream.
7. Where pipe supports are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
8. Seal pipes passing through exterior walls with a wall seal per Section 220529. Provide Schedule 40 galvanized sleeve at least 2 pipe sizes larger than the pipe.
9. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.
10. All vertical pipe drops to sinks or other equipment installed below the ceiling shall be routed within a wall cavity, unless specifically noted otherwise to be surface mounted. For renovation projects, this Contractor is responsible for opening and patching existing walls for installation of piping. Wall patching shall match existing condition.

B. Installation Requirements in Electrical Rooms:

1. Do not install piping or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the equipment.

C. Installation Requirements in MRI (Magnetic Resonance Imaging - Healthcare):

1. All piping in MRI rooms shall be non-ferrous regardless of materials described on Part 2.

D. Valves/Fittings and Accessories:

1. Install shutoff valves that permit the isolation of equipment/fixtures in each room without isolating any other room or portion of the building. Individual fixture angle stops do not meet this requirement. Exception: Back-to-back rooms in no more than two adjacent rooms.
2. Provide clearance for installation of insulation and access to valves and fittings.
3. Provide access doors for concealed valves and fittings.
4. Install valve stems upright or horizontal, not inverted.
5. Provide one plug valve wrench for every ten plug valves 2" and smaller, minimum of one. Provide each plug valve 2-1/2" and larger with a wrench with set screw.
6. Install corrugated, stainless steel tubing system according to manufacturer's written instructions. Include striker plates to protect tubing from puncture where tubing is restrained and cannot move.

E. Underground Piping:

1. Install buried water piping outside the building with at least 5 feet of cover. Refer to Section 220500 for Excavation, Fill, Backfill and Compaction requirements
3. Install buried borosilicate glass pipe with the protective polystyrene covering intact. Lay the pipe on bedding and backfill per manufacturer instructions.
4. Underground fire protection service piping shall have at least 6-1/2 feet of cover, or as recommended by NFPA 24.
5. Install thrust blocking and restraints on all underground fire protection service piping per NFPA 24 and as shown on drawings.
6. Install underground, sleeved, corrugated, stainless steel tubing system according to manufacturer's written instructions. Extend vent from sleeve to exterior of building and terminate with screened elbow.
7. Direct buried, uninsulated steel pipe shall have a factory applied external protective coating consisting of two coats with an intermediate layer of 18 mil fibrous glass mat. Coating thickness shall total not less than 3/32". The outer coating shall be further protected by a wrapping of heavy Kraft paper. This external protection shall extend and be exposed for a minimum of 1 foot beyond the buried or concealed portion of the pipe.

a. Manufacturers:

- 1) Pipe Line Service Co., Franklin Park, Illinois
- 2) Lithcote Corp., Melrose Park, Illinois

8. As an option, the Contractor may provide factory applied protective coatings consisting of a polyethylene plastic film bonded to the pipe surface by a hot applied thermo-plastic adhesive.

a. Manufacturers:

- 1) Republic Steel Corp. "X-Tru-Coat"

9. Exercise care in handling, storing and laying pipe to avoid damaging factory applied coatings. If any damage occurs, repair the coating to a condition equal to the original.

10. Field application of protective coatings to joints, fittings and to any damaged factory applied coatings shall be similar to factory applied coatings specified above and shall be done in strict accordance with recommendations of the supplier of pipe coatings.
11. After completion of the fabrication, laying and field coating of the joints and fittings, but prior to backfilling, inspect the entire line in the presence of the Architect/Engineer's representative with an electronic holiday detector. Any defects in the protective coatings shall be repaired in accordance with requirements for original coatings.
12. Coat flange bolts and nuts in pits and below ground at the time of installation with a corrosion protective coating.

F. Sanitary and Storm Piping:

1. Install all sanitary and storm piping inside the building with a slope as shown on the drawings.
2. Install horizontal offset at all connections to roof drains to allow for pipe expansion.
3. Slope sanitary and storm piping outside the building to meet invert elevations shown on drawings and to maintain a minimum velocity of 2 feet per second.
4. Sway Bracing: Where horizontal sanitary and/or storm pipes 4 inches and larger change flow direction greater than 45 degrees, rigid bracing or thrust restraints shall be installed to resist movement of the upstream pipe in the direction of pipe flow. The rigid bracing or thrust restraint shall be connected to structure. A change of flow direction from horizontal into a vertical pipe does not require the upstream pipe to be braced.
5. All sanitary and storm piping shall have at least 42" of cover when leaving the building.
6. Starter fittings with internal baffles are not permitted.

G. Siphonic Storm Piping:

1. Siphonic storm drainage is an engineered piping system. All piping components form part of the hydraulic design calculation that has been engineered to create a siphonic action and make the system function. The Contractor must refer to both the layout drawings and design calculation sheets to identify correct configuration, lengths of pipes, locations of bends, wye branches, and reducers. The Architect/Engineer shall be notified of any changes to the original design. The Contractor shall provide certified drawings from manufacturer if not the basis of design.
2. The piping system shall comprise of swept fittings with 1/4 (90-degree) bend or 1/8 (45-degree) bends and 1/8 (45-degree) wye branches. 90-degree branches (straight or sanitary tees) are not permitted at any time. Where a right-angle branch is required, it shall be made using a 45-degree wye branch connecting to a 45-degree or a combination wye and 1/8 bend.
3. Cleanout/access points are not permitted.
4. The horizontal pipe shall be installed with top of pipe (crown) level; there shall be no pitch. Any changes in diameter shall be created with the transition slope at the invert. The drawings shall notate the top of pipe level.
5. Reducers (increasers) shall be of the eccentric type and oriented to ensure the crown of the two adjoining diameters remains level and the diameter transitioning sloped pipe is at the invert.

3.6 PIPE ERECTION AND LAYING

- A. Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be removed from the job immediately.
- B. All pipe, fittings, valves, equipment and accessories shall have factory applied markings, stampings, or nameplates with sufficient data to determine their conformance with specified requirements.
- C. Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not install any item that is not clean.
- D. Until system is fully operational, all openings in piping and equipment shall be kept closed except when actual work is being performed on that item or system. Closures shall be plugs, caps, blind flanges or other items specifically designed and intended for this purpose.
- E. Run pipes straight and true, parallel to building lines with minimum use of offsets and couplings. Provide only offsets required to provide needed headroom or clearance and to provide needed flexibility in pipe lines.
- F. Make changes in direction of pipes only with fittings or pipe bends. Changes in size only with fittings. Do not use miter fittings, face or flush bushings, or street elbows. All fittings shall be of the long radius type, unless otherwise shown on the drawings or specified.
- G. Provide flanges or unions at all final connections to equipment, traps and valves.
- H. Arrange piping and connections so equipment served may be totally removed without disturbing piping beyond final connections and associated shutoff valves.
- I. Use full and double lengths of pipe wherever possible.
- J. Unless otherwise indicated, install all piping, including shutoff valves and strainers, to coils, pumps and other equipment at line size with reduction in size being made only at control valve or equipment.
- K. Cut all pipe to exact measurement and install without springing or forcing except in the case of expansion loops where cold springing is indicated on the drawings.
- L. Underground pipe shall be laid in dry trenches maintained free of accumulated water. Refer to Section 220500 for Excavation, Fill, Backfill and Compaction requirements.
- M. Unless otherwise indicated, branch take-offs shall be from top of mains or headers at either a 45-degree or 90-degree angle from the horizontal plane for air lines, and from top, bottom or side for liquids.
- N. Do not use geotextile fabric with footing tile if silt content of soil exceeds 40% or if clay content exceeds 50%. The fabric shall be installed around 1" river rock or 2" limestone.

3.7 DRAINING AND VENTING

- A. Unless otherwise indicated on the drawings, all horizontal water lines, including branches, shall pitch 1" in 40 feet to low points for complete drainage, removal of condensate and venting.
- B. Maintain accurate grade where pipes pitch or slope for venting and drainage. No pipes shall have pockets due to changes in elevation.
- C. Provide drain valves at all low points of water piping systems for complete or sectionalized draining.
- D. Use eccentric reducing fittings on horizontal runs when changing size of pipes for proper drainage and venting. Install gravity drain pipes with bottom of pipe and eccentric reducers in a continuous line; all other liquid lines with top of pipe and eccentric reducers in a continuous line.
- E. Provide air vents at high points and wherever else required to eliminate air in all water piping systems.
- F. Install air vents in accessible locations. If necessary to trap and vent air in a remote location, install an 1/8" pipe from the tapping location to an accessible location and terminate with a venting device.
- G. All vent and drain piping shall be of same materials and construction for the service involved.

3.8 PLUMBING VENTS

- A. Vent as shown on the drawings and in accordance with all codes having jurisdiction.
- B. Extend the high side of the soil and waste stacks at least 12" above roof.
- C. Flash pipes at the roof with 3# lead sheet. Extend flashing under roofing 15" in all directions from pipe to be flashed. Extend a lead collar up on the outside of pipe to be flashed and extend 1" beyond the top of the pipe. The 1" excess length of collar shall be turned down into the top of the pipe where it shall fit tight to the inside of the pipe.
- D. Flash pipes at roof with premolded EPDM pipe flashing cones adhered to roof membrane by General Contractor. Secure top of cone with stainless steel clamp and seal watertight.
- E. Increase vent pipes through the roof two pipe sizes with long increasers located at least 12" below the roof.
- F. In no case shall the vent through the roof be less than 4" in diameter.
- G. Vent pipes through the roof shall be located a minimum of 10 feet and 25 feet from any air intake opening on the roof.

3.9 BRANCH CONNECTIONS

- A. For domestic water and vent systems only, make branch connections with standard tee or cross fittings of the type required for the service.
- B. Reducers are generally not shown. Where pipe sizes change at tee, the tee shall be the size of the largest pipe shown connecting to it.
- C. Do not use double wye or double combination wye and eighth bend DWV fittings in horizontal piping.
- D. Branch connections from the headers and mains may be mechanically formed using an extraction device. The branch piping connection shall be brazed connection for the following services only:
 - 1. Domestic water piping above ground.
- E. Further limit use of mechanically formed fittings as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Main must be Type K or L copper tubing.
 - 3. Permanent marking shall indicate insertion depth and orientation.
 - 4. Branch pipe shall conform to the inner curve of the piping main.
 - 5. Main must be 1" or larger.
 - 6. Branch must be 3/4" or larger.
- F. Forged weld-on fittings are limited as follows:
 - 1. Must have at least same pressure rating as the main.
 - 2. Main must be 2-1/2" or larger.
 - 3. Branch line is at least two pipe sizes under main size.

3.10 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Disinfection of the domestic water piping shall be completed within three (3) weeks prior to building occupancy. Contractor is responsible for disinfecting water piping if used by workers during construction; disinfection during construction does not eliminate the requirement for final disinfection prior to occupancy. Flushing of piping shall be completed within two (2) weeks prior to building occupancy.
- B. Provide necessary connections at the start of individual sections of mains for adding chlorine.
- C. Before starting work, verify system is complete, flushed and clean.
- D. Follow the disinfection of potable water procedure outlined in this project's applicable plumbing code. For example: IPC 610.1, UPC 609.10, CPC 609.10, and Illinois 890.1180. Where local codes do not outline a disinfection procedure, follow the International Plumbing Code procedure 610.1.

- E. Bleed water from all outlets to ensure chlorine distribution throughout the entire domestic water system.
- F. Take water samples, no sooner than 24 hours after flushing, from 2% of outlets and from water entry. Obtain, analyze, and test samples in accordance with AWWA C651, Section 5 - Verification.

END OF SECTION

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SECTION 221030 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cleanouts.
- B. Traps.
- C. Trap Seals and Primers.
- D. Floor Drains and Sinks
- E. Hub Drains and Standpipes
- F. Backflow Preventers.
- G. Strainers.
- H. Unions.
- I. Balancing Valves.
- J. Water Hammer Arresters.

1.2 REFERENCES

- A. ANSI A112.21.1 - Floor Drains.
- B. ANSI A112.21.2 - Roof Drains.
- C. ASSE 1010 - Water Hammer Arresters.
- D. ANSI A112.6.3 - Floor and Trench Drains; The American Society of Mechanical Engineers.
- E. ANSI A112.6.4 - Roof, Deck, and Balcony Drains; The American Society of Mechanical Engineers.
- F. ASME A112.6.9 - Siphonic Drain Test; The American Society of Mechanical Engineers.
- G. ANSI 1011 - Hose Connection Vacuum Breakers; American Society of Sanitary Engineering.
- H. ANSI 1012 - Backflow Preventer with Intermediate Atmospheric Vent; American Society of Sanitary Engineering.
- I. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers; American Society of Sanitary Engineering; 1.

- J. ASSE 1019 - Vacuum Breaker Wall Hydrants, Freeze Resistant Automatic Draining Type; American Society of Sanitary Engineering.
- K. ASSE 1047 - Reduced Pressure Detector Assemblies.
- L. ASTM C478 - Precast Reinforced Concrete Manhole Sections.
- M. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.
- N. PDI WH-201 - Water Hammer Arresters.

1.3 SUBMITTALS

- A. Include sizes, rough-in requirements, service sizes, and finishes.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Provide cleanouts as shown and specified on the drawings as well as required by code.
- B. Coordinate floor cleanout cover with surrounding floor finish. Provide either solid, recessed for tile or terrazzo or carpet marker as applicable.
- C. Cleanouts on exposed pipes shall be cast iron with heavy duty cast brass plug with raised head.
- D. Cleanout shall be same size as the pipe up to 6" and 6" for larger pipes.

2.2 TRAPS

- A. Provide all individual connections to the sanitary system with P-traps, except where such drains discharge directly into a properly trapped collection basin or sump. Unless otherwise specified or shown, traps shall be of the same material as specified for waste system.
- B. All traps shall have accessible, removable cleanouts, except where installed on floor drains with removable strainers.
- C. Deep seal pattern traps shall be provided where required by code.
- D. Each trap shall be completely filled with water at the end of construction but before building turnover to the Owner. All floor drains, floor sinks, trench drains, etc. shall be filled with water.

2.3 TRAP SEALS AND PRIMERS

- A. Provide trap seals as specified on the drawings.
- B. Provide trap primers as shown and specified on the drawings.

- C. Where trap primers are shown on drawings, coordinate with corresponding floor drains to ensure they include a side inlet connection for the trap primer line.

2.4 FLOOR DRAINS AND SINKS

- A. Floor drains and sinks shall be in the form of a receptor with grate/strainer set flush with the surrounding floor.
- B. Provide floor drains and sinks as shown and specified on the drawings as well as required by code.

2.5 HUB DRAINS AND STANDPIPES

- A. A hub drain shall be in the form of a hub or pipe without a grate/strainer extending through the floor for receiving indirect waste. A hub drain has a flood level rim above the finished floor.
- B. Provide hub drains as shown and specified on the drawings as well as required by code.

2.6 BACKFLOW PREVENTERS

- A. Provide backflow preventers as shown and specified on the drawings as well as required by code.

2.7 STRAINERS

- A. Unless otherwise indicated, strainers shall be Y-pattern and have stainless steel screens with perforations as follows:
 - 1. Water:
 - a. 2-1/2" - 10": 1/16" perforations
- B. Furnish pipe nipple with shutoff valve to blow down all strainer screens.
- C. Use bronze body strainers in copper piping and iron body strainers in ferrous piping.

2.8 UNIONS

- A. Copper pipe - wrought copper fitting - ground joint.

2.9 AUTO-THERMOSTATIC FIXED BALANCING VALVE

- A. Fixed thermostatic balancing valve for domestic hot water recirculation circuits. Internal thermostatic balancing cartridge automatically modulates flow to ensure constant temperature. Fixed preset temperature at 5F and 10F below system temperature.
- B. Sizes: 1/2", 3/4" and 1" with NPT female connections.
- C. Flow Rating:

1. 1/2": Open Cv1.3; closed Cv0.2
2. 3/4": Open Cv1.8; closed Cv0.2
3. 1": Open Cv3.3; closed Cv0.2

D. Maximum Working Pressure: 200 psi. Maximum Inlet Temperature: 250F.

E. Low-lead brass valve, stainless steel thermostatic cartridge and spring.

F. Acceptable Manufacturers:

1. Circuit Solver CS
2. Hays Mesurflo 2510

2.10 WATER HAMMER ARRESTERS

A. Provide water hammer arresters as shown and specified on the drawings as well as required by code.

B. ANSI A112.26.1; sized and located in accordance with PDI WH-201, precharged for operation between -100F and 300F and maximum 250 psig working pressure.

PART 3 - EXECUTION

3.1 INSTALLATION AND APPLICATION

A. Coordinate construction to receive drains at required invert elevations.

B. Install all items per manufacturer's instructions.

C. Water Hammer Arresters:

1. Install water hammer arresters in accessible locations. Provide access doors as required. Coordinate type with Architect/Engineer/Owner.
2. Water hammer arrestors shall be installed in cold and hot water lines upstream of all plumbing fixtures or equipment, with a quick acting valve or multiple quick acting valves. Quick acting valves shall be defined as solenoid actuated valves, manual flush valves, sensor activated faucets and flush valves, squeeze handle spray faucets, and other similar type valves.
3. Install multiple water hammer arrestors in toilet group branch piping greater than 20 feet in developed length from the cold and hot water mains.

D. Cleanouts:

1. Provide cleanouts where shown on the drawings and as required by code, but in no case farther apart than 50 feet in pipe less than 6") size and 100 feet apart in 6" and larger pipes inside the building.
2. Provide cleanouts at bases of all sanitary and storm risers as shown on the drawings and as required by code.

3. Provide a cleanout at the upstream end of a horizontal waste pipe in a plumbing chase serving multiple plumbing fixtures; for example a bank of water closets or lavatories.
4. Provide cleanouts on the branch line connected to individual plumbing fixtures as required by code; for example just below a sink, lavatory or urinal.
5. Extend underfloor cleanouts up to the floor with long sweep elbows.
6. Install a full size, two-way cleanout within 5 feet of the foundation inside or outside of building.
7. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with graphite and linseed oil. Ensure clearance at cleanouts for rodding of drainage system.
8. Wall cleanouts shall be installed above the flow line of the pipe they serve, but no less than 12" above the finished floor.

E. Floor Drains and Floor Sinks:

1. Drains in upper floors shall have a flashing of EPDM or similar membrane sheet. The sheet shall be at least 36" X 36" square with the drain in the center. Clamp membrane in auxiliary clamping ring of floor drain. Membrane is not required if upper floor construction is single pour, cast-in-place concrete.
2. Use alternate sealing method when installing drains in existing floor slabs.
3. Coordinate sloping requirements with the architectural plans and specifications.
4. Top of floor drain and sink grate/strainer shall not extend above the finished floor elevation. Grate/strainer shall be installed flush with surrounding finished floor. Should the Plumbing Contractor believe this presents a conflict with code, the issue should be evaluated before installation of the floor drain or sink begins. Proceeding with installing a floor drain or sink raised above the finished floor without prior approval will result in the Contractor being required to remove the drain or sink in question and reinstall it at the approved elevation.

F. Hub Drains and Standpipes:

1. The top of a hub drain/standpipe shall extend above the finished floor elevation. Refer to drawings for dimensions above the finished floor.
2. Access shall be provided to drains and standpipes for rodding.

G. Backflow Preventer:

1. Provide an air gap fitting and piping to drain. On 2-1/2" and larger units, install a tail piece from air gap fitting to drain to prevent water from spraying out of drain air gap receptor. Maintain air gap distance required by Code.
2. Units shall be field tested and tagged in accordance with manufacturer's instructions and applicable codes by a certified tester before initial operation.
3. Install unit between 12" and 60" above finish floor in a location that is accessible for annual testing and maintenance.

H. Balancing Valves:

1. Install balancing valves with straight, unobstructed pipe section both upstream and downstream as required, per manufacturer's installation instructions.

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END OF SECTION

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Domestic Water In-Line Circulators.

1.2 SUBMITTALS

- A. Submit certified pump performance curves with pump and system operating point plotted. Include NPSH curve when applicable.
- B. Pumps with motors operating above the RPM the pump curves are based on shall have impellers trimmed to deliver GPM and head scheduled.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Statically and dynamically balance rotating parts.
- B. Construction shall permit complete servicing without breaking piping or motor connections.
- C. Pumps shall operate at 1750 rpm unless specified otherwise.
- D. Pump connections shall be flanged, whenever available.
- E. Domestic hot water pumps shall be suitable for 225F water.
- F. Motors shall comply with Section 220513.
- G. Submitted pump selections must have a diameter impeller that meets or exceeds the scheduled pump. The inlet and discharge pipe sizes shall also meet or exceed the scheduled pump.

2.2 DOMESTIC WATER IN-LINE CIRCULATORS

- A. Provide pumps as specified on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install all products per manufacturer's recommendations.
 - 2. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

B. In-Line Pump:

1. Support in-line pumps individually so there is no strain on the piping. Support pump so no weight is carried on pump casings. Install with a minimum of five diameters of straight pipe on pump suction and discharge.
2. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
3. Pumps shall be factory aligned. If alignment is not satisfactory, as determined by the Architect/Engineer, manufacturer shall provide a factory trained representative to field align the shafts.
4. Alignment shall be inspected and approved by a factory trained representative. If alignment is not satisfactory, representative shall field align this shaft.

C. Pump without VFD or ECM:

1. For pumps not powered by a VFD, trim impeller to meet maximum operating conditions. Coordinate final trimmed diameter with Testing, Adjusting, and Balancing Contractor and Architect/Engineer.

END OF SECTION

SECTION 221200 - TANKS - PLUMBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Domestic Hot Water Storage Tanks.

1.2 SUBMITTALS

- A. For domestic hot water storage tanks, include tank lining instructions.

1.3 REGULATORY REQUIREMENTS

- A. Construct pressurized tanks to ASME Code for unfired pressure vessels.
- B. Comply with applicable government regulations.

PART 2 - PRODUCTS

2.1 DOMESTIC HOT WATER STORAGE TANKS

- A. Tank: Steel, 125 psi working pressure, ASME stamped, with screwed stainless steel connections.
- B. Line interior with corrosion resistant concrete approximately 1/2" thick. Line flanged connections. Clean and prime coat before lining. Lining may be factory or field applied. If factory applied, all cracks shall be repaired after installation.
- C. Provide 11" x 15" access opening and steel support saddles or legs.
- D. Provide tappings for accessories. Include tank drain, water inlet and outlet, 30F to 200F thermometer per Section 233100, and pressure relief valve suitable for maximum working pressure. Refer to drawings for additional tank openings.
- E. Manufacturers:
 - 1. PVI
 - 2. Bradford White
 - 3. Cemline.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support indoor tanks from building structure or construct support stand.

- B. Flush and clean fuel tanks prior to delivery to site and keep sealed during construction.
- C. Provide all flexible connections required due to tank flex during fill operation.

END OF SECTION

SECTION 223000 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Water Heaters.
- B. Pressure Booster System.

1.2 REFERENCES

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASME Section 8D - Pressure Vessels.
- C. ANSI Section 21.10.1 or Section ANSI 21.10.3 - Gas Water Heaters Ratings 75,000 BTU per Hour and Less.
- D. ANSI/NFPA 30 - Flammable and Combustible Liquids Code.
- E. ANSI/NFPA 54 - National Fuel Gas Code.
- F. ANSI/NFPA 70 - National Electrical Code.
- G. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters.
- H. ASSE 1005 - Water Heater Drain Valves, 3/4" Iron Pipe Size.
- I. UL 174 - Household Electric Storage Tank Water Heaters.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 220500.
- B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Include heat exchanger dimensions, size of tappings, and performance data.
- D. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- E. For equipment connected to an electric power source, submit short circuit rating (SCCR) of integrated unit.

- F. Submit manufacturer's installation instructions including control and electrical power/controls wiring diagrams.
- G. Submit manufacturer's certificate that pressure vessels meet or exceed specified requirements.
- H. Submit operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- I. Submit a current water analysis from the actual water source serving the project site existing building for softening equipment verification before sending shop drawings to the Architect/Engineer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.5 REGULATORY REQUIREMENTS

- A. Water heaters shall conform to AGA, ANSI/NFPA 54, ANSI/NFPA 70, ANSI/UL 1453 as applicable.
- B. Conform to ANSI/ASME Section 8 Division 1 for fabrication of steel pressure vessels.
- C. Conform to ANSI/ASME Section 10 for manufacture of fiber-reinforced plastic pressure vessels.

PART 2 - PRODUCTS

2.1 WATER HEATERS

- A. All water heaters shall be as scheduled on the drawings.

2.2 PRESSURE BOOSTER SYSTEMS

- A. Packaged pressure boosting system shall be completely factory assembled, run-tested, and shipped to site as an integral unit assembled on a steel skid including pumps, motors, valves, Type "L" copper or Schedule 10, 300 series stainless steel suction and discharge manifolds, all interconnecting piping, wiring, variable frequency drives with Logic and power controls. Size and capacity shall be as scheduled on the drawings.
- B. Shutoff valves shall be provided on the suction and discharge of each pump. Silent spring-loaded check valves shall be installed on the discharge of each pump.

- C. Pressure gauges shall be provided on the front cover of the control panel indicating system suction and discharge pressure. Pressure gauges shall be 4-1/2 inch diameter, Grade 1A, having 1% total range span accuracy and installed with shutoff valve and pressure snubber at gauge connection to system piping. All skid-mounted components shall be factory finished with enamel paint. Individual pumps, motors, variable frequency drives, and check valves shall be serviceable with the booster system in operation, and all components shall be suitable for the maximum system working pressure.
- D. System shall include two, three, or four vertical, horizontally mounted pumps with ANSI flanged or NPT threaded connections, replaceable casing wear rings, and hydraulically balanced impellers. Pumps shall be cast iron, bronze or stainless steel fitted construction with replaceable shaft sleeves and mechanical seals suitable for 175 psig working pressure.
- E. Each pump shall include a pressure relief valve, set to relieve 15 psi above the high limit pressure switch setting, which shall be piped to a floor drain by the installing contractor.
- F. Provide a hydro-pneumatic tank with carbon steel or fiberglass shell and a replaceable FDA-approved, heavy-duty bladder to separate the air and water. No water shall come in contact with metal tank walls. Features shall include an air fill valve and a bottom system connection suitable for 100% draw-down. Tank shall be constructed in accordance with Section VIII of the ASME code and be N.B. stamped. Refer to the schedule on the drawings for size. The tank shall be located remotely from the booster pump as shown on the floor plans. Coordinate location with Architect/Engineer prior to installation.
- G. Provide each pump with a premium efficient open drip-proof totally enclosed fan-cooled motor labeled for use with variable frequency drives (VFDs) and sized for operation at any point of the pump curve, including pump run-out (non-overloading operation).
- H. Provide and mount on the system skid one two three four VFDs suitable for variable torque applications. Minimum acceptable VFD full load/full speed efficiency shall be 97%, with a fundamental power factor of 0.98. VFDs shall meet the following:
 - 1. Pulse width modulated (PWM).
 - 2. Starts into rotating load.
 - 3. Overcurrent protection.
 - 4. Adjustable carrier switching frequency of up to 8 kHz.
 - 5. Keypad operator device or touchscreen that includes the following:
 - a. 2-line backlit display.
 - b. Power on and alarm/fault indicators
 - c. Hand-Off-Auto switch on VFD front panel cover
 - d. When switched to "Auto" operation, the VFDs shall follow the signal from the control panel logic section.
 - e. When switched to "Hand", the VFD speed is determined by the setting of the manual speed adjustment located on the VFD front panel cover.
 - f. Automatic VFD shutdown for electrical fault
 - g. Automatic restart after electrical power is restored from a loss of power
 - h. Service diagnostics with fault history log.

- I. Provide and mount on the system skid one, two, three, and four VFDs suitable for variable torque applications. VFDs shall meet the requirements of Section 262923.
- J. Provide a high limit pressure switch compatible with the system controls, temperature, and pressure requirements. The pressure switch shall be mounted and wired on the control panel, with sensing line connected to the system discharge manifold. The high limit pressure switch shall shut down the system if the system pressure is more than 30 psi above the normal operating pressure.
- K. Provide a factory-mounted pressure sensor/transmitter in the discharge header that provides a modulating output compatible with the system controls. The pressure sensor/transmitter shall be used to control booster pump VFDs to maintain a constant system pressure. Control logic shall be capable of adjusting the pressure setpoint using a system pressure drop algorithm based on real-time flow data.
- L. Use of a single pressure sensor/transmitter to control system pressure and high limit pressure cutoff is not acceptable. Both the high limit pressure switch and the pressure sensor/transmitter shall be separately wired back to the booster pump control panel.
- M. The lead pump shall run only as necessary to maintain system pressure and will be automatically controlled by means of a pressure sensor/transmitter and control programming to prevent short cycling.
- N. If the lead pump is unable to maintain system pressure at the pressure sensor/transmitter, the lag pump will be called on after a time delay and will operate in parallel with the lead pump in accordance with control programming. When a low or no-flow condition is reached, the controls will shut down the lag pump if running and accelerate the lead pump to charge the system and hydro-pneumatic tank to 20 psi above normal operating pressure, then shut the lead pump down and alternate. Should any pump fail to operate, the next pump in sequence shall start automatically.
- O. Provide, mount and wire on the skid a programmable logic controller in a NEMA 1, 12, 3R, 4X enclosure. The controller shall interface the signals from the sensors to the VFDs and shall provide a stabilized response to speed up or slow down the pump or add additional pumps to meet system requirements. The controller shall provide setpoint control that can be changed by a keypad entry on the control faceplate. The controller shall have an alpha/numeric display, PID functions and both system and controller self-diagnostics. Controller shall be provided with dual function PID loop for startup mode and normal operation. Startup mode shall provide a quick response from shutdown and normal operation is tuned to eliminate hunting. Controller shall have a real-time calendar/clock and memory transfer cartridge.
- P. Provide a UL listed control panel in a NEMA 1, 12, 3R, 4X enclosure, factory mounted and wired on the steel skid. The panel shall be furnished with individual pump disconnects with through-the-door handles, pump run lights, H-O-A selector switches, 120-volt fused control transformer, and necessary relays, timers and a programmable controller with pump start, stop and sequence controls.
- Q. The controller shall be capable of outputting system pressure and a general alarm signal to the building automation system.

- R. Non-mercury low pressure control to stop pump operation if incoming water pressure drops to atmospheric.
- S. Size and capacity shall be as scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all items in accordance with manufacturer's instructions.

3.2 WATER HEATER INSTALLATION

- A. Install water heaters on concrete bases. Coordinate sizes and locations of concrete bases. Refer to Section 220529.
- B. Install water heaters level and plumb, according to drawings, manufacturer's instructions, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend drain piping full size from relief valve and discharge by positive air gap onto closest floor drain. Discharge pipe material shall be same as domestic water piping.
- D. Install gas water heaters according to NFPA 54.

3.3 PRESSURE BOOSTER INSTALLATION

- A. Provide startup by factory authorized start-up technician.
- B. Provide four (4) hours of instruction and orientation to the Owner's maintenance staff by factory trained personnel. System walk-through, including programming of any system controllers, shall be included in the training.
- C. Support piping adjacent to pumps so that no weight is carried by pump casings. Provide supports under elbows on 4" and larger.
- D. Ensure pumps operate at specified fluid temperatures without vapor binding or cavitation, are non-overloading in parallel or individual operation, and operate within 25% of midpoint of published maximum efficiency curve.
- E. Pumps shall be factory aligned. If alignment is not satisfactory, as determined by the Architect/Engineer, manufacturer shall provide a factory trained representative to field align the shafts.
- F. Unless otherwise shown on the drawings, mount all pump skids on 4" high concrete pads and anchor frames to pads with cast-in-place anchors.

- G. All pump skids shall be grouted in. Follow manufacturer's instructions for grouting.
- H. Install on vibration isolators as scheduled on drawings.
- I. Coordinate installation to ensure manufacturer's recommended service clearances are met.

END OF SECTION

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. All plumbing fixtures.

1.2 REFERENCES

- A. ANSI A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- B. ANSI A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
- C. ANSI A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
- D. ANSI A112.19.2M - Vitreous China Plumbing Fixtures.
- E. ANSI A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
- F. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
- G. ANSI A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals.
- H. ANSI Z358.1 - Emergency Eye Wash and Shower Equipment.
- I. AHRI 1010 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.
- J. ASSE 1002 - Water Closet Flush Tank Ball Cocks.
- K. Americans with Disabilities Act (ADA), Title III.
- L. The Energy Policy Act (EPAAct) of 2005.

1.3 SUBMITTALS

- A. Include fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- B. For fixtures and trim requiring electrical connections, submit product data indicating general assembly, components, electrical power/controls wiring diagrams, and service connections.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All fixtures shall be as shown on the drawings and as scheduled in the plumbing material list. Additional requirements below:
- B. All vitreous china fixtures shall be from the same manufacturer where possible.
- C. All lavatory and sink trim shall be from the same manufacturer where possible.
- D. All fixtures shall be lead free. Faucets, traps, stops, and other fixture accessories shall not contain more lead than allowed per the latest State or Federal Act.
- E. P-Traps and Tailpieces:
 - 1. Lavatories:
 - a. Accessible Type: 1-1/4" chrome plated 17-gauge cast brass offset tailpiece and p-trap with cleanout on bottom of trap.
 - b. Non-Accessible Type: Offset not required for tailpiece, otherwise same.
 - 2. Sinks:
 - a. Accessible Type: 1-1/2" chrome plated 17-gauge cast brass offset tailpiece and p-trap with cleanout on bottom of trap.
 - b. Non-Accessible Type: Offset not required for tailpiece, otherwise same.
 - 3. Acceptable Manufacturers:
 - a. McGuire
 - b. Dearborn Brass
 - c. Zurn
 - d. Chicago Faucet
- F. Insulation Covers and Enclosures for Accessible Lavatories and Sinks:
 - 1. Premanufactured rigid enclosure for concealing lavatory P-trap, stop valves, and supply lines,
 - a. Rigid, high impact PVC, paintable, stainless steel fasteners for anchoring and removal.
 - b. Acceptable Manufacturers:
 - 1) Truebro (Lav Shield #2018)
 - 2) Zurn (Z6900-VG)
 - 3) Approved equal
 - 2. Premanufactured rigid enclosure for concealing sink P-trap, stop valves, supply lines, garbage disposal, etc.

- a. Rigid, high impact PVC, white or beige (Color by architect), paintable, 36" or 42" widths, stainless steel fasteners for anchoring and removal.

G. Angle Stops and Supplies:

1. Lavatories, Sinks and Tank Type Water Closets:

- a. Lead-free, 3/8" chrome plated brass, quarter turn ball valve type with loose key stops, solder or compression or threaded connection type.
- b. Lead-free, 3/8" chrome plated soft copper risers or stainless steel braided reinforced PVC hose.
- c. Acceptable Manufacturers:
 - 1) McGuire
 - 2) BrassCraft
 - 3) Zurn
 - 4) Chicago Faucet

H. Wall Hung Fixture Carriers:

1. Material: All Metal, ASME/ANSI A112.6.1M.
2. Lavatory carrier shall be rated to support 250 lbs unless noted otherwise on the drawings.
3. Water closet carrier shall be rated to support 500 lbs unless noted otherwise on the drawings

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.
2. Install each fixture with trap easily removable for servicing and cleaning. Use screwed tailpiece couplings. Connect fixture waste to stack with slip fitting.
3. Provide fixtures with supply lines, stop valves, reducers, escutcheons, and any other items required for a complete and operational plumbing fixture assembly.
4. Install components level and plumb.
5. Caulk joint between finish floor and floor mounted fixtures and between finish walls and wall mounted fixtures with silicone caulk. Caulk the joint, between rim and fixture where a fixture builds into a counter top, with caulking compound. Refer to DIVISION 7 for "Caulking" requirements. Color to match fixture.
6. Where there is a possibility of water following pipe brackets, etc., into a wall; caulk escutcheons, space around brackets, etc., to exclude water. Refer to DIVISION 7 for "Caulking" requirements.
7. Refer to Plumbing Material List architectural drawings for fixture mounting heights.
8. All non-potable outlets shall be clearly marked with a permanently affixed laminated sign with 3/8" high lettering saying "Non-Potable Water Not for Human Consumption." Sign shall have black lettering on a yellow background.

B. Wall-Mounted Fixture Requirements:

1. All wall-mounted fixtures shall have compatible carriers designed for their intended service and suitable for the space available and configuration of fixtures. All carriers shall extend to the floor and be anchored to the slab as intended by the carrier manufacturer.

C. Floor-Mounted Fixture Requirements:

1. Where floor mounted fixtures are installed on a sloped floor, the open void below the fixture shall be grouted, leveled, and caulked to eliminate stress on the fixture and to prevent water migration to the floor below.

D. Exposed or Inside Accessible Cabinets Traps, Valve and Pipe Requirements:

1. All water or waste piping for plumbing fixtures that is exposed or inside cabinets shall be chrome plated.
2. All exposed flush valves for water closets and urinals shall have a chrome plated hanger to anchor the piping to the wall.
3. All exposed water supply piping and fittings in a finished space to a shower valve, hose bibb, or other water outlet shall be chrome plated.

E. ADA Accessible Exposed Sink and Lavatory Trim:

1. All exposed sink and lavatory traps, piping and angle stops installed at accessible sink and lavatory locations shall include offset style drain tailpiece, p-trap installed near and parallel with back wall, and insulation kit specially manufactured for this installation. Armaflex with duct tape is not acceptable.

F. ADA Accessible Water Closet Requirements:

1. Handicapped accessible water closet flush valve or flush tank handles shall be on the left hand or right hand side of the fixture, whichever is nearer to the center of the stall.
2. Coordinate flush valves in handicap accessible locations with grab bars installed by the General Contractor. Make modifications as necessary to flush valve piping to avoid conflict with grab bars. Common solutions include shortened or offset vacuum breaker tailpieces.

G. Bathtubs and Shower Requirements:

1. All acrylic and fiberglass bathtubs and showers shall have a non-shrink grout or manufacturer-approved material installed between the finished floor and floor of the fixture to prevent damage caused by deflection.
2. All rough-in pockets for showers and tubs located in basement floor installations shall be filled in with concrete and sealed tight.

3.2 ADJUSTING AND CLEANING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

- B. At completion, clean plumbing fixtures, equipment, and faucet aerator screens.

3.3 FIXTURE ROUGH-IN SCHEDULE

- A. Rough-in fixture piping connections in accordance with table on plumbing drawings of minimum sizes for particular fixtures.

END OF SECTION

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SECTION 230500 - BASIC HVAC REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 23 Sections. Also refer to Division 01 - General Requirements.
 - B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.
 - C. This Specification and the associated drawings govern the furnishing, installing, testing and placing into satisfactory operation the Mechanical Systems.
 - D. Each Contractor shall provide all new materials indicated on the drawings and/or in these specifications, and all items required to make the portion of the Mechanical Work a finished and working system.
 - E. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
 - F. Scope of Work:
 - a. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
2. Air Conditioning and Ventilating Work shall include, but is not necessarily limited to:
- a. Furnish and install complete supply air ductwork systems including all fittings, insulation, and outlets.
 - b. Furnish and install complete return air ductwork systems including all fittings, insulation, and inlets.
 - c. Furnish and install complete exhaust ductwork systems including all fittings, insulation, inlets, and fans.
 - d. Furnish and install mechanical room ventilation systems including louvers, ductwork, insulation, and fans.
 - e. Furnish and install all temperature control systems.
 - f. Furnish and install all fire dampers.
 - g. Furnish and install seismic restraint and equipment designed for use in seismic conditions described in Section 230550.
 - h. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
3. Temperature Control Work shall include, but is not necessarily limited to:
- a. Furnish and install a complete temperature control system as shown on drawings and schedules.
 - b. Temperature control system shall consist of a full Direct Digital Control (DDC) system including all accessories, sensors, and programming.

- c. Furnish and install firestopping systems for penetrations of fire-rated construction associated with this Contractor's work.
- 4. Testing, Adjusting, and Balancing Work shall include, but is not necessarily limited to:
 - a. Furnish complete testing, adjusting, and balancing as specified in Section 230593, including, but not limited to, air systems, hydronic systems, plumbing systems, and verification of control systems.
- G. This Contractor shall make all mechanical system connections shown on the drawings or as required for fully functional units.

1.2 WORK SEQUENCE

- A. All work that will produce excessive noise or interference with normal building operations, as determined by the Owner, shall be scheduled with the Owner. It may be necessary to schedule such work during unoccupied hours. The Owner reserves the right to determine when restricted construction hours will be required.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL & CONTROL CONTRACTORS

- A. Definitions:
 - 1. "Mechanical Contractors" refers to the following:
 - a. Heating Contractor.
 - b. Air Conditioning and Ventilating Contractor.
 - c. Temperature Control Contractor.
 - d. Testing, Adjusting, and Balancing Contractor.
 - 2. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case the devices are usually single phase and are usually connected to the motor power wiring through a manual motor starter having "Manual-Off-Auto" provisions.
 - 3. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
 - 4. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is used to give a control voltage of 120 volts.
 - 5. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
 - a. This wiring will be from a 120 volt source and may continue as 120 volt, or be reduced in voltage (24 volt) in which case a control transformer shall be furnished as part of the temperature control wiring.

6. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
7. Voltage is generally specified and scheduled as distribution voltage. Motor submittals may be based on utilization voltage if it corresponds to the correct distribution voltage.

Distribution/Nominal Voltage	Utilization Voltage
120	115
208	200
240	230
277	265
480	460

B. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors and the like. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals reviewed. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall provide complete electrical power/controls wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. All electrical work shall conform to the National Electrical Code. All provisions of the Electrical Specifications concerning wiring, protection, etc., apply to wiring provided by the Mechanical Contractor unless noted otherwise.
4. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements
5. All Contractors shall establish utility elevations prior to fabrication and shall coordinate their material and equipment with other trades. When a conflict arises, priority is as follows:
 - a. Light fixtures.
 - b. Gravity flow piping, including steam and condensate.
 - c. Electrical busduct.
 - d. Sheet metal.
 - e. Electrical cable trays, including access space.
 - f. Sprinkler piping and other piping.
 - g. Electrical conduits and wireway.

C. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - a. Energy Recovery Ventilators (ERV)
 - b. Ductwork
 - c. Fan assisted electric heaters
 - d. Grilles, registers and diffusers (GRDs)
2. Assumes all responsibility for the Temperature Control wiring, when the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
3. Shall verify all existing equipment sizes and capacities where units are to be modified, moved or replaced. Contractor shall notify Architect/Engineer of any discrepancies prior to ordering new units or replacement parts, including replacements of equipment motors.

D. Electrical Contractor's Responsibility:

1. Provides all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor on the Mechanical Drawings or Specifications.
2. Installs and wires all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor or Contractor when so noted on the Electrical Drawings.
3. Provides motor control and temperature control wiring, where so noted on the drawings.
4. Coordinate with the Mechanical Contractor for size of motors and/or other electrical devices involved with repair or replacement of existing equipment.
5. Furnishes, installs and connects all relays, etc., for automatic shutdown of certain fans upon actuation of the Fire Alarm System as indicated and specified in Division 28. Furnishes, installs and connect all non-fan assisted heaters and their corresponding thermostats.
6. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guidelines, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Design Team any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Design Team will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers are acceptable.
2. All Contractors and subcontractors shall employ only workers skilled in their trades.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Port Angeles and all Washington State Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all State Codes.
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after letting of the contract, to comply with codes or requirements of Inspectors, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. All rotating shafts and/or equipment shall be completely guarded from all contact. Partial guards and/or guards that do not meet all applicable OSHA standards are not acceptable. Contractor is responsible for providing this guarding if it is not provided with the equipment supplied.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Pay all fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by an authorized body.
6. Pay all charges arising out of required contract document reviews associated with the project and as initiated by the Owner or authorized agency/consultant.

E. Electronic Media/Files:

1. The drawings prepared by IMEG for bidding purposes may not be used directly for ductwork layout drawings or coordination drawings.
2. The use of these CAD documents by the Contractor does not relieve them from their responsibility for coordination of work with other trades and verification of space available for the installation.
3. The information is provided to expedite the project and assist the Contractor with no guarantee by IMEG as to the accuracy or correctness of the information provided. IMEG accepts no responsibility or liability for the Contractor's use of these documents.

1.5 WEB-BASED PROJECT SOFTWARE

- A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.
- B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.
- C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.
- D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.6 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.
- B. General Submittal Procedures: In addition to the provisions of Division 01, the following are required:
 - 1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
 - 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps

3. Composition:
 - a. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; electrical power criteria (e.g., voltage, phase, amps, horsepower, kW, etc.) wiring and control diagrams; Short Circuit Current Rating (SCCR); dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
 - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
 - a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.

1.7 SCHEDULE OF VALUES

- A. The requirements herein are in addition to the provisions of Division 01.
- B. Format:
 1. Use AIA Document Continuation Sheets G703 or another similar form approved by the Owner and Architect/Engineer.
 2. Submit in Excel format.
 3. Support values given with substantiating data.
- C. Preparation:

1. Itemize work required by each specification section and list all providers. All work provided by subcontractors and major suppliers shall be listed on the Schedule of Values. List each subcontractor and supplier by company name.
2. Break down all costs into:
 - a. Material: Delivered cost of product with taxes paid.
 - b. Labor: Labor cost, excluding overhead and profit.
3. Itemize the cost for each of the following:
 - a. Overhead and profit.
 - b. Bonds.
 - c. Insurance.
 - d. General Requirements: Itemize all requirements.
 - e. Site utilities (5' beyond building)
 - f. Seismic design
 - g. Air balancing
 - h. Water balancing
 - i. Commissioning
 - j. Record drawings
 - k. Punchlist and closeout

1.8 CHANGE ORDERS

- A. A detailed material and labor takeoff shall be prepared for each change order, along with labor rates and markup percentages. Change orders shall be broken down by sheet or associated individual line item indicated in the change associated narrative, whichever provides the most detailed breakdown. Change orders with inadequate breakdown will be rejected.
- B. Itemized pricing with unit cost shall be provided from all distributors and associated subcontractors.
- C. Change order work shall not proceed until authorized.
- D. Submit copies of start-up reports to the Architect/Engineer and include copies of Owner's Operation and Maintenance Manuals.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage. Keep materials clean, dry and free from harmful conditions. Immediately remove any materials that become wet or that are suspected of becoming contaminated with mold or other organisms.
- B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:
 1. Motor windings and ventilation openings.

2. Bearings.
 3. Equipment pipe and accessories connections openings. (e.g. boiler connections, coil connections, etc.)
 4. Equipment duct and accessories connections openings. (e.g. AHU/RTU duct connections; terminal air boxes, etc.)
 5. Starter and control cabinets.
 6. Heat transfer coils.
 7. Pump seals.
 8. Combustion burner and blower equipment (e.g. combustion air intake, combustion vent/flue, etc.)
- C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to Owner that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.
- D. Keep all bearings properly lubricated and all belts properly tensioned and aligned.
- E. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Mechanical Contractor does not have prior documented experience in rigging and lifting similar equipment, they shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.10 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this Division of the specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

1.11 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.12 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the scheduled manufacturer is the basis for job design and establishes the quality required.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections, piping and ductwork connections and arrangement, plumbing connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten days prior to the bid opening.
- D. This Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractor's part or on the part of other Contractors whose work is affected.
- E. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder.
- F. All material substitutions requested later than ten (10) days prior to bid opening must be listed as voluntary changes on the bid form.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 ARCHITECT/ENGINEER OBSERVATION OF WORK

- A. The Contractor shall provide fourteen (14) calendar days' notice to the Architect/Engineer prior to:
 - 1. Covering exterior walls, interior partitions and chases.
 - 2. Installing hard or suspended ceilings and soffits.
- B. The Architect/Engineer will have the opportunity to review the installation and provide a written report noting deficiencies requiring correction. The Contractor's schedule shall account for these reviews and show them as line items in the approved schedule.
- C. Above-Ceiling Final Observation
 - 1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. Pipe insulation is installed and fully sealed.
 - b. Pipe and duct wall penetrations are sealed.
 - c. Pipe identification and valve tags are installed.
 - d. Main, branch and flexible ducts are installed.
 - e. Diffusers, registers and grilles are installed and connected to ductwork.
 - f. Terminal air box reheat coil piping or wiring is complete.
 - g. Terminal air box control wiring is complete and all control boxes are closed.
 - 2. In order to prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
 - 3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to 7 days elapsing, the Architect/Engineer may not recommend further payments to the contractor until such time as full access has been provided.

3.3 OPERATION AND MAINTENANCE MANUALS

- A. General:
 - 1. Provide an electronic copy of the O&M manuals as described below for Architect/Engineer's review and approval. The electronic copy shall be corrected as required to address the Architect/Engineer's comments. Once corrected, electronic copies and paper copies shall be distributed as directed by the Architect/Engineer.
 - 2. Approved O&M manuals shall be completed and in the Owner's possession prior to Owner's acceptance and at least 10 days prior to instruction of operating personnel.
- B. Electronic Submittal Procedures:
 - 1. Distribution: Email the O&M manual as attachments to all parties designated by the Architect/Engineer.
 - 2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.

3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
 4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. O&M file name: O&M.div23.contractor.YYYYMMDD
 - b. Transmittal file name: O&Mtransmittal.div23.contractor.YYYYMMDD
 5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.
 6. Provide the Owner with an approved copy of the O&M manual on compact discs (CD), digital video discs (DVD), or flash drives with a permanently affixed label, printed with the title "Operation and Maintenance Instructions", title of the project and subject matter of disc/flash drive when multiple disc/flash drives are required.
 7. All text shall be searchable.
 8. Bookmarks shall be used, dividing information first by specification section, then systems, major equipment and finally individual items. All bookmark titles shall include the nomenclature used in the construction documents and shall be an active link to the first page of the section being referenced.
- C. Paper Copy Submittal Procedures:
1. Once the electronic version of the manuals has been approved by the Architect/Engineer, 3 paper copies of the O&M manual shall be provided to the Owner. The content of the paper copies shall be identical to the corrected electronic copy.
 2. Binder Requirements: The Contractor shall submit O&M manuals in heavy duty, locking three ring binders. Incorporate clear vinyl sheet sleeves on the front cover and spine for slip-in labeling. "Peel and stick" labels are not acceptable. Sheet lifters shall be supplied at the front of each notebook. The three-ring binders shall be 1/2" thicker than initial material to allow for future inserts. If more than one notebook is required, label in consecutive order. For example; 1 of 2, 2 of 2. No other form of binding is acceptable.
 3. Binder Labels: Label the front and spine of each binder with "Operation and Maintenance Instructions", title of project, and subject matter.
 4. Index Tabs: Divide information by specification section, major equipment, or systems using index tabs. All tab titling shall be clearly printed under reinforced plastic tabs. All equipment shall be labeled to match the identification in the construction documents.
- D. Operation and Maintenance Instructions shall include:
1. Title Page: Include title page with project title, Architect, Engineer, Contractor, all subcontractors, and major equipment suppliers, with addresses, telephone numbers, website addresses, email addresses and point of contacts. Website URLs and email addresses shall be active links in the electronic submittal.
 2. Table of Contents: Include a table of contents describing specification section, systems, major equipment, and individual items.

3. Copies of all final approved shop drawings and submittals. Include Architect's/Engineer's shop drawing review comments. Insert the individual shop drawing directly after the Operation and Maintenance information for the item(s) in the review form.
4. Refer to Section 230900 for additional requirements for Temperature Control submittals.
5. Copy of final approved test and balance reports.
6. Copies of all factory inspections and/or equipment startup reports.
7. Copies of warranties.
8. Schematic electrical power/controls wiring diagrams of the equipment that have been updated for field conditions. Field wiring shall have label numbers to match drawings.
9. Dimensional drawings of equipment.
10. Capacities and utility consumption of equipment.
11. Detailed parts lists with lists of suppliers.
12. Operating procedures for each system.
13. Maintenance schedule and procedures. Include a chart listing maintenance requirements and frequency.
14. Repair procedures for major components.
15. List of lubricants in all equipment and recommended frequency of lubrication.
16. Instruction books, cards, and manuals furnished with the equipment.

3.4 INSTRUCTING THE OWNER'S REPRESENTATIVES

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of all systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. The instructions shall include:
 1. Explanation of all air handling systems.
 2. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
 3. Maintenance of equipment.
- D. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can attend if desired.

3.5 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 01 requirements.
- B. Maintain at the job site a separate and complete set of mechanical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

- C. Mark drawings to indicate revisions to piping and ductwork, size and location, both exterior and interior; including locations of coils, dampers, other control devices, filters, and other units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (e.g., traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices.
- D. Refer to Section 230900 for additional requirements for Temperature Control documents.
- E. Before completion of the project, a set of reproducible mechanical drawings will be given to the Contractor for transfer of all as-built conditions from the paper set maintained at the job site. All marks on reproducible shall be clear and permanent.
- F. Mark specifications to show approved substitutions; Change Orders, and actual equipment and materials used.
- G. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- H. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.
- I. After surfaces have been thoroughly cleaned and are free of oil, dirt, and other foreign matter; paint all pipes and equipment with the following:
 - 1. Bare Metal Surfaces - Apply one coat of primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
 - 2. Insulated Surfaces - Paint insulation jackets with two coats of semi-gloss acrylic latex paint.

3.6 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from all equipment.
- B. Clean all drain pans and areas where moisture is present. Immediately report any mold, biological growth, or water damage.
- C. Remove all rust, scale, dirt, oils, stickers and thoroughly clean exterior of all exposed bare metal ductwork, piping, hangers, and accessories.

3.7 Remove all rubbish, debris, etc., accumulated during construction from the premises. SPECIAL REQUIREMENTS

- A. Contractor shall coordinate the installation of all equipment, valves, dampers, operators, etc., with other trades to maintain clear access area for servicing.

- B. All equipment shall be installed in such a way to maximize access to parts needing service or maintenance. Review the final field location, placement, and orientation of equipment with the Owner's designated representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's designated representative will result in removal and reinstallation of the equipment at the Contractor's expense.

3.8 MAINTAINING CLEAN DUCTWORK THROUGHOUT CONSTRUCTION

- A. Throughout the duration of construction, all ductwork shall be capped or sealed with sheet metal caps, polyethylene film, or other airtight protective to keep dust, dirt, and construction debris out of ducts. Similar means shall be used to seal air-side connections of HVAC equipment to include, but not limited to, air handling units, fans, terminal air boxes, fan coil units, cabinet heaters, blower coils, and the like.
- B. When air terminal devices are installed, contractors shall seal all supply, return, and exhaust grilles with polyethylene film or other airtight protective to keep dust, dirt, and construction debris out of ducts.
- C. Should HVAC equipment be started during construction, Contractor shall remove airtight protectives and shall install one-inch thick MERV 8 filter media over all return and exhaust grilles to prevent dust, dirt, and construction debris from entering ductwork. Filter media shall cover the entire grille face and shall be secured such that air cannot bypass filter media.
- D. Should filter media become laden with dust and dirt, Contractor shall replace filter media with new media to prevent damage to air distribution system and equipment.
- E. The following steps shall be taken during testing, adjusting, and balancing of each air system:
 - 1. All construction activities in all spaces served by the air system shall stop.
 - 2. All airtight protectives and temporary filter media shall be removed from all portions of the air system.
 - 3. Testing, adjusting, and balancing work shall not commence until all construction activity is stopped and all airtight protectives and temporary filter media is removed.
 - 4. Once testing, adjusting, and balancing work is complete for the air system, airtight protectives or temporary filter media shall be installed over all ductwork openings and air terminals on the air system prior to resuming construction activities in any spaces served by the air system.
- F. The Owner shall agree the building is sufficiently clean prior to the removal of any filtration media and airtight protectives from air terminal devices.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to requesting a final job observation.

1. Penetrations fire sealed and labeled in accordance with specifications.
2. All air handling units operating and balanced.
3. All fans shall be operating and balanced.
4. All pumps, boilers and chillers operating and balanced.
5. All miscellaneous mechanical systems (unit heaters, fan coil units, cabinet heaters, etc.) operating.
6. All temperature control systems operating, programmed and calibrated.
7. Pipe insulation complete, pipes labeled and valves tagged.
8. Fire damper and fire/smoke damper access doors labeled in accordance with specifications.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineer for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION

SECTION 230503 - THROUGH PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 REFERENCES

- A. UL 263 - Fire Tests of Building Construction and Materials
- B. UL 723 - Surface Burning Characteristics of Building Materials
- C. ANSI/UL 1479 - Fire Tests of Through Penetration Firestops
- D. UL 2079 - Tests for Fire Resistance of Building Joint Systems
- E. UL Fire Resistance Directory Through Penetration Firestop Systems (XHEZ)
- F. Intertek / Warnock Hersey - Directory of Listed Products
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials
- H. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Firestops
- I. The Building Officials and Code Administrators National Building Code
- J. 1997 Uniform Building Code
- K. DELIVERY, STORAGE, AND HANDLING
- L. Store, protect and handle products on site. Accept material on site in factory containers and packing. Inspect for damage. Protect from deterioration or damage due to moisture, temperature changes, contaminants, or other causes. Follow manufacturer's instructions for storage.
- M. Install material prior to expiration of product shelf life.

1.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through the following fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire partitions, fire barriers, and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.

- B. For through-penetration firestop systems exposed to light, traffic, moisture, or physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
- C. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. For through-penetration firestop systems in air plenums, provide products with flame-spread and smoke-developed indexes of less than 25 and 50, respectively, as determined per ASTM E 84.

1.3 MEETINGS

- A. Pre-installation meeting: A pre-installation meeting shall be scheduled and shall include the Construction Manager, General Contractor, all Subcontractors associated with the installation of systems penetrating fire barriers, Firestopping Manufacturer's Representative, and the Owner.
 - 1. Review foreseeable methods related to firestopping work.
 - 2. Tour representative areas where firestopping is to be installed; inspect and discuss each type of condition and each type of substrate that will be encountered, and preparation to be performed by other trades.

1.4 WARRANTY

- A. Provide one year warranty on parts and labor.
- B. Warranty shall cover repair or replacement of firestop systems which fail in joint adhesion, cohesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, general durability, or appear to deteriorate in any manner not clearly specified by the manufacturer as an inherent quality of the material.

PART 2 - PRODUCTS

Penetrating Item	UL System No.
No Penetrating Item	FC 0000-0999*
Metallic Pipe or Conduit	FC 1000-1999
Non-Metallic Pipe or Conduit	FC 2000-2999
Electrical Cables	FC 3000-3999
Cable Trays	FC 4000-4999
Insulated Pipes	FC 5000-5999
Bus Duct and Misc. Electrical	FC 6000-6999
Duct without Damper and Misc. Mechanical	FC 7000-7999
Multiple Penetrations	FC 8000-8999
*Alternate method of firestopping is patching opening to match original rated construction.	

Penetrating Item	UL System No.
No Penetrating Item	WL 0000-0999*
Metallic Pipe or Conduit	WL 1000-1999
Non-Metallic Pipe or Conduit	WL 2000-2999
Electrical Cables	WL 3000-3999
Cable Trays	WL 4000-4999
Insulated Pipes	WL 5000-5999
Bus Duct and Misc. Electrical	WL 6000-6999
Duct without Damper and Misc. Mechanical	WL 7000-7999
Multiple Penetrations	WL 8000-8999
*Alternate method of firestopping is patching opening to match original rated construction.	

Penetrating Item	UL System No.
No Penetrating Item	CAJ 0000-0999*
Metallic Pipe or Conduit	CAJ 1000-1999
Non-Metallic Pipe or Conduit	CAJ 2000-2999
Electrical Cables	CAJ 3000-3999
Cable Trays	CAJ 4000-4999
Insulated Pipes	CAJ 5000-5999
Bus Duct and Misc. Electrical	CAJ 6000-6999
Duct without Damper and Misc. Mechanical	CAJ 7000-7999
Multiple Penetrations	CAJ 8000-8999
*Alternate method of firestopping is patching opening to match original rated construction.	

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Ensure all surfaces that contact seal materials are free of dirt, dust, grease, oil, rust, or loose materials. Clean and repair surfaces as required. Remove laitance and form-release agents from concrete.
- B. Ensure substrate and penetrating items have been permanently installed prior to installing firestopping systems. Ensure penetrating items have been properly spaced and have proper clearance prior to installing firestopping systems.
- C. Surfaces to which sealing materials are to be installed must meet the selected UL or Intertek / Warnock Hersey system substrate criteria.
- D. Prime substrates where recommended in writing by through-penetration firestop system manufacturer. Confine primer to area of bond.

3.2 CLEANING AND PROTECTING

- A. Clean excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not cause damage.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

3.3 IDENTIFICATION

- A. Provide and install labels adjacent to each firestopping location. Label shall be provided by the firestop system supplier and contain the following information in a contrasting color:
 - 1. The words "Warning - Through Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Firestop System Supplier; UL or listed by Intertek / Warnock Hersey system number; date installed; contractor name and phone number; manufacturer's representative name, address, and phone number.

3.4 INSPECTION

- A. All penetrations shall be inspected by the manufacturer's representative to ensure proper installation.
- B. Access to firestop systems shall be maintained for examination by the Authority Having Jurisdiction at their request.
- C. 2 Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued and firestop installations comply with requirements.
- D. The Contractor shall allow for visual destructive review of 5% of installed firestop systems (minimum of one) to prove compliance with specifications and manufacturer's instructions and details. Destructive system removal shall be performed by the Contractor and witnessed by the Architect/Engineer and manufacturer's factory representative. The Architect/Engineer shall have sole discretion of which firestop system installations will be reviewed. The Contractor is responsible for all costs associated with this requirement including labor and material for removing and replacing the installed firestop system. If any firestop system is found to not be installed per manufacturer's specific instructions and details, all firestop systems are subject to destructive review and replacement at the Architect/Engineer's discretion and the Contractor's expense.

END OF SECTION

DIVISION 23 05 05

HVAC BASIS OF DESIGN SYSTEMS NARRATIVE

PART 1 GENERAL

1.01 INTRODUCTION

- A. The purpose of this section is to define the design and delivery approach upon which the Contractor is to base a budget and bid for preconstruction and construction services. Specifically the services for the mechanical work, including but not limited to: general provisions, applicable codes, coordination requirements, submittal requirements, shop drawing requirements, quality assurance, testing adjusting balancing requirements, commissioning requirements, completion requirements, and the warranty requirements.
- B. All work under this section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions, and Division 01 – General Requirements, and shall include all mechanical sections specified herein.
- C. This section includes a general narrative description of Division 23 systems with specific equipment and component criteria that are to be included in the project.
- D. Specific conflicts between drawings, this specification section, and other specification sections will not be used to define project or cost exclusions. Exclusions based on document conflicts will be accepted or rejected in the Engineer of Record's formal response to bid clarification requests or Requests for Information (RFIs).

1.02 APPLICABLE CODES AND STANDARDS

- A. Wherever an International, National, or Uniform Code is referenced in this Narrative, it means the 2021 WA State version of that code, including any local amendments, is the design standard for this Project. For example where the IFC is referenced, the 2021 WA State Fire Code will be used.
- B. Design and installation shall comply with rules and regulations of the following:

APPLICABLE WASHINGTON STATE BUILDING CODES			
ENERGY CODE	2021 WASHINGTON STATE ENERGY CODE (SEC) FOR COMMERCIAL BUILDINGS	WAC 51-11C	EFFECTIVE MARCH 15, 2021
BUILDING CODE	2021 INTERNATIONAL BUILDING CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-50	EFFECTIVE MARCH 15, 2021
ACCESSIBILITY CODE	2021 INTERNATIONAL BUILDING CODE WITH WASHINGTON STATE AMENDMENTS CHAPTER 11 AND ICC A117.1-2009	WAC 51-50	EFFECTIVE MARCH 15, 2021
SEISMIC CODE	ASCE 7-2016 AS REFERENCED BY 2018 INTERNATIONAL BUILDING CODE	WAC 51-50	EFFECTIVE MARCH 15, 2021
FIRE CODE	2021 INTERNATIONAL FIRE CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-54A	EFFECTIVE MARCH 15, 2021
MECHANICAL CODE	2021 INTERNATIONAL MECHANICAL CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-52	EFFECTIVE MARCH 15, 2021
PLUMBING CODE	2021 UNIFORM PLUMBING CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-56	EFFECTIVE MARCH 15, 2021
BOILER CODE	WASHINGTON STATE BOILER CODE	WAC 296-104	
ELECTRICAL CODE	2020 NATIONAL ELECTRICAL CODE WITH 2020 WASHINGTON AMENDMENTS (NFPA 70)	WAC 296-46B	EFFECTIVE NOVEMBER 1, 2020
ELECTRICAL	ELECTRICIANS AND ELECTRICAL INSTALLATIONS	RCW CHAPTER 19.28	
NFPA STANDARDS	NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARDS AS REFERENCED BY THE CODES ABOVE OR AS SPECIFICALLY LISTED BELOW		

1.03 ORDER-OF-PRECEDENCE PROVISIONS

- A. In the case of inconsistency or ambiguities in design documents (all specifications and documents), compliance with the more stringent design requirement among conflicting criteria is required.
- B. If provided, alternate pricing for compliance with less stringent criteria will be evaluated in addition to the mandatory baseline most stringent criteria.
- C. Provide notice upon discovering potential design conflicts prior to bid where possible.

1.04 PROJECT DELIVERY

- A. This project is to be delivered design build. The Design Build Contractor will be the Engineer of Record and will create and stamp fully coordinated design documents for the project. The design build Engineer of Record is solely responsible for reviewing and vetting all design decisions with the Owner and Architect prior to installation.
- B. Pricing Set Bid Notes
 1. The intent is to procure MEP pricing packages that cover the full project though the documents are not at 100% CD level.
 2. Reference current MEP narratives as well as architectural and structural drawings.
 3. The architectural floor plans provided are not final. Pricing shall allow for equipment relocations due to minor interior layout modifications.
 4. Pricing is to include all MEP provisions as needed to completely buildout the project as defined in all referenced documents.
 5. Provide specific scope clarification requests through the Owner's bid clarification request process.

6. Bids will include a detailed list of scope exclusions.
 7. Provide breakout additive pricing for specific scope as required to address perceived scope gaps in the project documents.
 8. IMEG will participate in the Subcontractor selection process by reviewing proposals, interviewing, and strategizing with the team. Primary goals are to thoroughly identify potential gaps and contingency requirements and to build a strong partnership with the Subcontractors and GC.
- C. IMEG scope includes delivery of this Division 23 - HVAC Basis of Design Systems Narrative. Design efforts beyond this milestone are by Mechanical Contractor (MC).
- D. The Design Build Engineer of Record will create Construction Document drawings starting at the end of Design Development phase using Revit and Level 100 per AIA Level of Development (LOD) Document 2014 at a minimum beginning with the design development phase effort. Level 200 and 300 LOD are to be provided where needed for detailed coordination during the CD phase (mechanical rooms, typical constricted ceiling spaces, other space constrained areas). Shared model coordination with architectural, structural, and all trades is required.
1. Utilize the BIM model to print 2D Design development and CD phase drawings
 2. Use the 3D BIM model throughout the design by the entire project team to facilitate collaboration and coordination. The information contained in the model will be used to create Construction Documents.
 3. Give the 3D BIM design model to the Owner as a record model of the original design at the end of the project. Any modifications to the model to accommodate facilities management or other purposes are at the discretion of the Owner and outside the scope of this contract.
- E. Detailing coordination: The MC will produce a 3D model of all systems. The Contractors will coordinate their shop drawings with other trades. The MC will be lead in this effort and will get signed agreements on shop drawings from MEP and other Subcontractors prior to starting work. The MC is responsible for all trade coordination effort as required for shop drawing completion.
- F. Detailing coordination: There will be no change orders for field interference coordination modifications.

- G. If there is a conflict between design documents and the request for proposal (RFP), the Contractor will identify the discrepancy and request a clarification prior to RFP response.
- H. Submittals
 - 1. Transmittal Form indicating the following: project, Contractor, Subcontractor, Vendor, Supplier, specification section, submittal number, and submittal revision number.
 - 2. Complete equipment and materials submittals shall be provided in electronic format. PDFs should be searchable and bookmarks are required for each submitted product. Submittals shall be complete with all components included and customized to this Project's requirements. Include warranty provisions for all equipment. All submittals require Owner team approval prior to purchase.
 - 3. Equipment Submittals: Include only submittal information for equipment and products being used in Project scope. Consistent manufacturer should be used for similar products (i.e. all dampers from a single manufacturer, all GRDs from a single manufacturer, etc.).
 - 4. Materials Submittals: Include only submittal information for materials being used in Project scope. Identify the system and/or application in which each material is being used.
 - 5. Product submittals will all be subject to review under the requirements of ESDS submittal review requirements.
- I. The architectural floor plans provided are not final. Pricing shall allow for equipment relocations due to minor interior layout modifications.
- J. The budget/estimate response proposals will identify scope gaps the Contractor perceives and provide breakout pricing to cover these gaps.
- K. The MC shall submit final electronic as-built drawings to the General Contractor (GC) for submittal to Owner within agreed upon time frames.
- L. O&Ms: Provide hard copy if requested by Owner and electronic copies of O&Ms for all systems within two weeks of substantial completion.
- M. The mechanical systems will be designed to include scope of work for full standalone compliance with the Energy Code. This includes the Energy Code mandatory provisions.

N. Codes, Permits, Inspections, and Fees:

1. All work and materials shall be in accordance with requirements of all applicable local and state codes, statutes, standards, and other regulations.
2. The codes shall be construed as establishing a minimum or base level of requirements. Contract Documents shall not be construed to permit or direct work not in conformance with codes, statutes, standards, and other regulations. Where provisions of the various regulations conflict with each other, or with the Contract Documents, the more stringent provisions shall be included in contract pricing. Conflict shall be resolved with the Architect and Authorities Having Jurisdiction (AHJ) prior to completing the design.
3. Where the Contract Documents call for material or construction of a better quality or higher capacity than required by the codes, statutes, standards, and other regulations, the provisions of the Contract Documents shall take precedence over the requirements of the codes and standards.
4. Material and equipment within the scope of the UL Testing Laboratory Service shall be listed by the Underwriters Laboratories for the purpose for which they are used and shall bear their listing mark. ETL or CSA shall be allowed if acceptable to the AHJs.
5. Mechanical, Electrical, and Plumbing Subcontractors are to include all permit fees and are responsible for document intake.
6. MC shall call for all inspections by the local AHJs when they become due and shall not cover any work until approved by these authorities.

1.05 MISCELLANEOUS SCOPE ITEMS

- A. The MC is to review the Energy, Div 21, 22, 26, 27, and 28 narratives for scope impacts.
 1. IMEG has attempted to delineate the scope of work between Contractors. Where there are questions or inconsistencies in scope delineation or scope overlap, please notify IMEG so this can be resolved prior to bid. The GC is responsible for final verification of Contractor scope delineation based on the most cost-effective approach for the Project.
 2. Below is a list of typical items that need to be coordinated between Contractors:
 - a. Condensate piping and connections – provided by PC

- b. Controls wiring
 - c. Electric heaters – calculated by MC, provided by PC
 - d. Heat tracing with controller
 - e. Heat tracing insulation
 - f. Freeze protection
 - g. Smoke detectors
- B. The Contractor is to provide complete pricing based on the scope described herein, the architectural drawings, and the other indicated references.
- C. Property line and interior acoustical calculations will be by the architectural design team's Acoustical Consultant prior to permit submittal. Acoustical Consultant to provide the requisite analysis to assure the team of acceptable acoustical performance of each system.
- D. The Structural Engineer is responsible for all structural design and calculations required for the supporting structure of all mechanical equipment and systems for permit intake.
- E. MC shall include structural tie-down calculations for all equipment as required by the IBC and ASCE 7. This is a deferred permit submittal.
- F. MC is to provide fire stopping of all through and membrane penetrations as required by the IBC and other applicable codes. Floor penetrations to include fire rated sleeves with either a 2" stand off water dam (Holdrite Pro Series Water Dam, Hilti-CFS-CID MD or approved equal), or a sleeving system with a built-in mid body waterproofing seal with a factory-provided W rating (Hilti CFS-680).
- G. All ductwork, piping, plumbing, and equipment are to be seismically restrained as required by the IBC.
- H. The Contractors will provide phenolic tags identifying each specific piece of equipment. Final tagging is to be approved by the Owner.
- I. All piping will be labeled extensively in compliance with accepted industry standards and building standards. Final labeling is to be approved by the Owner.

1.06 COORDINATION

- A. Installation will be in full compliance with acoustical specifications. The acoustical specification is to be fully followed regardless of conflicts with statements herein.
- B. The clear height per IBC 406.2.2 for each floor level is 7'-0", but other applicable ADA and code criteria require installation at no less than 7'-0". Vehicle pedestrian areas accommodating van-accessible parking required by Section 1106.5 of the IBC shall conform to ICC A117.1. Verify all ADA clearance requirements.
- C. All duct routing and equipment locations shall be coordinated with full design team.
- D. MC shall coordinate a minimum 42" clearance or more in front of mechanical equipment access panels for servicing as required by applicable code, NEC, and the AHJ.
- E. Cutting, framing, patching and painting of wall, ceiling, and floor openings shall be by Others.
- F. Final painting of grilles, registers, and diffusers, as may be required by the Architect, shall be done in the field by Others.
- G. Electrical Contractor (EC) shall provide magnetic motor starters for all equipment $\frac{3}{4}$ HP and greater unless an electrically commutated motor (ECM) is provided. Provide service and disconnect per code, and do all power wiring, including connecting to equipment. Holding coil circuit shall be powered by EC (120/1 unless indicated otherwise).
- H. Duct smoke detectors are not all shown on the mechanical plans. Duct smoke detectors are furnished by the EC. The Fire Alarm Engineer of Record is responsible for determining all duct smoke detector requirements. The MC is responsible for installing the duct detectors in the ductwork.
- I. Access panels are not yet shown. All access panels in walls and/or ceilings are furnished by the MC and installed by Others. MC to coordinate required locations and sizes with the Architect and GC.
- J. A fire and/or smoke detection and alarm system, as may be required by the Owner, Architect, or AHJs, is the responsibility of the EC.
- K. All conduit, line voltage, and low voltage smoke and fire alarm wiring for interlocks on all makeup air units, fire smoke dampers, exhaust systems, etc. are by the EC.
- L. Unit nameplate short circuit current rating (SCCR) to meet or exceed ampere interrupting capacity (AIC) rating of panel served. All small packaged equipment to be

listed for a minimum of 5,000 AIC. Large equipment to be listed for a minimum of 64,000 AIC unless noted otherwise. Final rating is per EC coordination study.

- M. During ensuing design phases, it is the responsibility of the project Acoustical Consultant to provide the requisite analysis of mechanical systems to assure the team of acceptable acoustical performance of each system. The MC is required to submit all systems information in a timely manner to the Acoustical Consultant as needed to assure designs comply with criteria. The MC will coordinate in a timely manner to incorporate acoustical recommendations prior to building permit submittal.

1.07 ENERGY CODE COMPLIANCE PATH

- A. The project is pursuing Energy C406 Prescriptive Compliance Path. See the 2021 WSEC Stand Alone Energy Narrative for further details.
- B. No C406 options related to mechanical systems are being pursued as part of the C406 compliance strategy for the project.

1.08 2021 ENERGY CODE C409.1 ENERGY METERING AND ENERGY CONSUMPTION MANAGEMENT

- A. The building is less than 25,000 SF and therefore does not require a meter and data procurement system.

1.09 2021 ENERGY CODE C411 RENEWABLE ENERGY

- A. Refer to the 2021 WSEC Energy Compliance Requirements Narrative for information related to C411 Renewable Energy Requirements.

1.10 SUSTAINABILITY PROTOCOLS

- A. Evergreen Sustainable Development Standard (ESDS)
 - 1. The project will achieve ESDS v4.1 certification. MC shall be involved in coordination efforts required for which points are to be achieved.
- B. The project is not pursuing any other green rating system.

PART 2 PRODUCTS

2.01 HVAC SYSTEMS GENERAL

- A. All ductwork is to be constructed and installed to appropriate SMACNA standards.

- B. All ductwork is to be insulated per Energy Code requirements.
- C. A complete engineered seismic restraint, hanger, and vibration isolation package will be provided by the MC. Fully stamped and engineered packages provided by a single vendor (such as ISAT) is preferred.
- D. All air intakes and exhaust outlets are to be located with no less than code minimum required separations from openings, intakes, grade, property lines, etc. Some project specific minimum distance requirements may be greater than code minimum if identified within this document. Final locations are subject to approval through the shop drawing submittal review process prior to construction.
- E. HVAC fan motors are to be selected so that normal operation is not in the motor service factor.
- F. Per Energy Code Section C403.8.4, all fractional HP fan motors for fans that are 62 watts or greater shall have electronically commutated motors or shall have a motor efficiency of at least 70% when rated in accordance with Department of Energy (DOE) 10 Code of Federal Regulations (CFR) 431. These motors shall also have the means to adjust the motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of varying motor speed.
- G. Fan power for Dedicated Outdoor Air Systems (DOAS) will comply with Energy Code Section C403.3.5.2. Total combined fan power is the sum of the fan power for each supply, exhaust, and other fans used for ventilation. For DOAS with one or more fan or fan arrays with fan electrical input power < 1 kW, the total combined fan power will not exceed 1 W per CFM of outdoor air.
- H. Per Energy Code Section C403.3.5.1 ERVs not serving Group R-2 dwelling units or other DOAS with energy recovery ventilation will have minimum 68% sensible recovery effectiveness or minimum 60% enthalpy effectiveness.
- I. Per Energy Code Section C403.8.4 and Table C403.8.4 Heat Recovery Ventilators (HRVs) and ERVs with an input power less than 1 HP will meet minimum 1.2 CFM/W efficacy where the CFM is outdoor air CFM and the watts are the total of all fans in the unit.
- J. System filtration efficiencies will comply with requirements per IMC Section 605.4 and as required per mandatory and selected credits for ESDS compliance path.
- K. HVAC motors shall meet the NEMA premium efficiency standard.

- L. All exterior ductwork is to be completely coated on all sides with RCD Corp. #15 weather barrier coating by MC. Ductwork to be prepared and weather barrier coating to be installed per manufacturer recommendations.
- M. All equipment attached to structure with isolators will have flex connections to ductwork. For general purpose indoor applications provide Duro Dyne DDFDC Neoprene flex connectors. For general purpose outdoor applications provide Duro Dyne DDFDC Durolon with Hypalon coating flex connectors.

2.02 BACK OF HOUSE AND MISCELLANEOUS SPACES

- A. Water Service Entry Room: Provide complete temperature controlled ventilation system including room intake and exhaust motorized dampers, louvers, thermostat, and exhaust fan to control temperature rise due to continual running and motor heat output from the domestic booster pumps. Provide a wall heater for freeze protection.
- B. Janitor/Maintenance Room: Exhausted via a corridor ERV. Refer to Corridor Supply Air section for more information. Janitor room locations are to be determined.
- C. Trash Room Exhaust System:
 - 1. There are no enclosed trash rooms. Trash containers are located outdoors adjacent to the surface parking lot. No exhaust is required.
- D. Community Laundry Room:
 - 1. There is one Communal Laundry Room on each floor.
 - 2. Dryer exhaust ducts will be routed in a dedicated chase behind the dryers to a common exhaust plenum with motorized damper at the exterior wall exhaust termination louver. Provide a backdraft damper at each dryer exhaust duct prior to common exhaust plenum.
 - 3. MC shall provide secondary dryer vent cleanouts in easily accessible locations to allow for maintenance and cleaning of dryer vent ducts.
 - 4. Dryer exhaust ducts shall have no internal protrusions.
 - 5. Flexible or semi-rigid materials are not permitted for usage in dryer exhaust vents. Per ESDS Section 7.09 all dryer exhaust ductwork must be rigid-type ductwork from the dryer connection point to the exhaust termination.

6. A makeup air exterior louvered opening shall be provided to allow transfer air from outside. Makeup air motorized damper operation shall be interlocked with either a pressure sensor within the laundry room or to a current sensor on each dryer in the laundry room served by the damper. Makeup air for Level 1 Laundry Room is from shared louver on Level 2 and through a vertical chase.
7. The Engineer of Record/Design Build Subcontractor will provide a table in the drawings showing each dryer vent's calculated total equivalent length, standard radius elbow quantity, and long radius elbow quantity.
8. If the MC's dryer vent layouts reflected in the shop drawings exceed the calculated dryer exhaust lengths due to field coordination requirements, the Engineer of Record is to be notified by the MC. Equivalent length calculations are to be modified by the Engineer of Record as needed to reflect the coordinated dryer vent layouts and to comply with the dryer manufacturer's maximum equivalent length.
9. Provide a permanent label within 6' of the dryer per IMC 504.8.5 visible to building maintenance personnel with dryer model and equivalent length allowance for the installed dryer vent.
10. Each Laundry Room has a dedicated ERV to provide room exhaust and supply air. Provide with combination termination fitting (BOD: Broan V14695).

E. Electrical Rooms:

1. Main Electrical Room
 - a. There are no transformers in this room, therefore no cooling is required.

2.03 STAIRWELL SHAFTS

- A. The EC will provide electric cabinet heaters at the bottom level of both stairwells. Integral thermostats will be provided. Cabinet surface mount or recess requirements will be coordinated by the EC. MC will size and schedule the heaters.
- B. Stairs are not pressurized as they do not serve a floor more than 75 feet above the lowest level of Fire Department vehicle access per IBC 403.5.4.

2.04 GARAGE SUPPLY AND EXHAUST

- A. Parking is at a surface lot at the street level and is not enclosed. Exhaust is not required.

2.05 DWELLING UNIT HEATING SYSTEMS – ELECTRIC HEAT

- A. No mechanical cooling is provided to dwelling units.
- B. The EC will provide the heaters and thermostats.
- C. The MC shall size and specify the residential electric heaters and coordinate layouts with the Architect. Heater sizing to comply with WSEC Section C403.1.4 Exception 2 for dwelling and sleep units.
 - 1. Bathrooms located on the perimeter without fenestration will be provided with a 250 W wall heater as allowed per WSEC Section C403.1.4 Exception 2.3. BOD: King PAW Wall Heater
- D. All units shall be heated via electric heating units. Baseline product approach for living areas and bedrooms is King KCV Cove heaters. Manufacturers other than King may be utilized if approved as an equivalent substitution.
 - 1. The Design Building Contractor (EOR) is responsible for all heat load calculations and heater sizing/selections. Heater sizing will comply with Energy Code Section C403.1.4 Exception 2 for Dwelling and Sleeping Units.
- E. Thermostats - Remote mounted 7-day programmable thermostats shall be provided in the primary living space of each residence (King Model ESP MAX22 for 208V). Remote mounted manual digital display thermostats shall be provided in the bedrooms (King Model ES MAX22 for 208V). Thermostats shall be line voltage (208V) and rated for 22 amps.

2.06 DWELLING UNIT VENTILATION: IN-UNIT ERV

- A. Balanced airflow with heat recovery for supply and exhaust system is required per IMC and Energy Code. Provide one energy recovery ventilator (ERV) for each dwelling unit.
- B. All ductwork is to be constructed and installed to appropriate SMACNA standards.
- C. Ductwork shall be a minimum of 26 gauge or as required by IMC.
- D. Ventilation to each dwelling unit will be provided by an individual ERV in each residential unit. The MC will provide an Energy Recovery Ventilator (ERV) in all Residential Dwelling units with a minimum sensible recovery effectiveness of 60% in accordance with Section C403.7.6 per Energy Code Section C403.3.5.1 Exception 3. Minimum ERV effectiveness will also be sufficient to provide a minimum of 55°F ventilation supply air at winter design conditions.

1. Per the requirements of Energy Code Table C403.8.4, the ERV shall meet the minimum efficacy of 1.2 CFM/W.
- E. Each habitable space within the dwelling unit will be provided with supply ventilation air. Ventilation air to be supplied in parallel with the heating system.
- F. Exhaust the bathroom with the ERV. The code required kitchen exhaust will be from the intermittent range hood ducted exhaust system.
- G. Ducted Dwelling Unit ERV:
 1. Manufacturer basis of design: Broan BLP150E75NS-HW
 - a. Approved equal may be submitted with confirming RFI with the understanding that all design changes shall be handled by MC in the shop drawing process.
 2. ERV unit to be installed in last perimeter joist bay. Coordinate joist bay depth with structural.
 - a. ERV unit will be hard-wired.
 - b. Outdoor air and exhaust air will have R-8 insulation. They will be located in the last perimeter joist bay and connect to the combination termination fitting, provided by Others (BOD: Broan V14695). Combination termination fitting location to comply with IMC Section 401.4.3. Inlet and outlet area to be sized to achieve a maximum free area velocity of 500 feet per minute per IMC Sections 403.4.6.1 and 403.4.6.2.
 - c. All ductwork supplying to dwelling unit and exhausting from bathroom is to be routed in joists. Provide ceiling radiation dampers on the supply grilles and exhaust grilles wherever they penetrate a rated floor/ceiling assembly.
 - d. Provide full-size rated access panel below the ERV, minimum dimensions of 36x24.
 - e. Coordinate with structural engineer if mounting ERV in other than last joist bay.
 - f. Coordinate any ducts that penetrate beams within floor/ceiling assembly with structural engineer prior to install.

3. ERV controls shall include 2-speed operation. The ERV shall operate continuously on low speed to satisfy the whole house ventilation requirements and high speed (boost mode) shall be activated by an occupancy sensor. High speed shall be set to operate for 20 min after the switch is deactivated.
4. A whole house fan "off" switch shall be provided. Provide signage adjacent to the fan switch notifying the occupants of 24/7 ventilation operation in accordance with IMC Section 403.4.5. Signage to read "LEAVE ON UNLESS OUTDOOR AIR QUALITY IS VERY POOR." Fan switch to be located on inside wall of coat closet at unit entry at same mounting height as light switches. Provide fan switch with semicircular toggle switch guard (non-lockable) to prevent accidental switch-off. Switch installation by EC.
5. Provide a supply grille for each habitable space and aluminum bathroom exhaust grille.
6. System filtration efficiencies will comply with requirements per IMC Section 605.4 and as required per mandatory and selected credits for ESDS compliance path.
7. The selected model shall comply with Energy Code. Where required motors shall be electronically commutated motors.
8. Purchase with factory isolation kit.

2.07 RESIDENCE EXHAUST SYSTEMS

- A. Exhaust ductwork pricing assumptions shall accommodate location changes within the unit floor plan as the architectural plans are not finalized.
- B. All ductwork is to be constructed and installed to appropriate SMACNA standards.
- C. The residence ventilation is by means of ERVs.
- D. Range exhaust ductwork is to be routed through soffits.
- E. Exhaust terminations shall be 3' minimum from building openings and property lines per IMC Chapter 5.
- F. Duct sizing
 1. Range exhaust duct size = 6" minimum
 2. Bathroom exhaust duct size = 4" minimum

G. Bathroom Exhaust:

1. The bathroom is exhausted via the in-unit ERV. Refer to Dwelling Unit Ventilation: In-Unit ERV section for more details.

H. Kitchen Range Hood:

1. The kitchen range hood is provided by Others. The Architect will specify the hood as part of the appliance package. The MC will provide a duct system that delivers manufacturer-specified minimum CFM. Per ESDS Section 7.07a, range exhaust hoods must be Energy Star labeled.
2. Ductwork to the perimeter and connection to the range hood is by the MC.
3. Operational exhaust rate and CFM requirements for the range hood vary by kitchen type and range type per IMC Tables 403.4.7 and Table 403.4.7.3.
 - a. Continuous exhaust in an open kitchen is not permitted.
 - b. Continuous exhaust in an enclosed kitchen requires minimum 5 ACH based on the kitchen volume.
 - c. Intermittent exhaust in open kitchens requires:
 - 1) Minimum 65% capture efficiency or minimum 160 CFM for a range hood over an electric range
 - 2) Minimum 80% capture efficiency or minimum 250 CFM for a range hood over a combustion range
4. Per IMC 403.4.7.2.4 range exhaust hoods are limited to maximum sound rating of 3 sones at airflow settings not less than 100 CFM and at intended static pressure per HVI 916 Section 7.2.
5. Range exhaust airflow will be tested and verified in accordance with IMC Section 403.4.7.3.1.

- I. Residential exhaust termination shrouds or louvers will be provided by Others. Backdraft dampers for range exhaust are by MC. Screens for range exhaust are by MC. Termination details within the shroud are by MC. Backdraft dampers will be Famco with gasketed edge seal for quiet performance. Gravity backdraft dampers for residential exhaust systems shall be provided with a gasketed seal per Energy Code Section C403.7.8.3 Exception 2.

2.08 CORRIDOR SUPPLY AIR

- A. Each corridor will be served by (1) ERV each. ERVs will be located at the far end of each wing.
 - 1. Each ERV will use a combination termination fitting (BOD: Broan V14695) that meets separation requirements per WSMC Section 401.4.
 - 2. ERV BOD: Broan BLP150E75NS-HW
 - 3. The ERV will also exhaust the Janitor Closet on its associated floor.
- B. The MC will provide an Energy Recovery Ventilator (ERV) with a minimum sensible recovery effectiveness of 68% or minimum enthalpy recovery ratio of 60%. Minimum ERV effectiveness will also be sufficient to provide a minimum of 55°F ventilation supply air at winter design conditions.
 - 1. Per the requirements of Energy Code Table C403.8.4, the ERV shall meet the minimum efficacy of 1.2 CFM/W.
- C. The corridor ERVs will shutdown upon any return air smoke detection.
- D. Accessories include supply fan EC motor, local space temperature controller, and standalone controls.
- E. System filtration efficiencies will comply with requirements per IMC Section 605.4 and as required per mandatory and selected credits for ESDS compliance path.
- F. Supply grilles will be Titus MCD or equivalent manufacturer's.
 - 1. Include cable operated damper (COD) or electronically operated balancing damper (EOD) at corridor supply for balancing.
 - 2. The supply grille will not include an opposed blade damper (OBD) without approval by the Acoustical Consultant.
- G. Wall heaters will be provided by EC in the corridor at each level and sized to comply with Energy Code Section C403.1.4 Exception 1. See Plans for heater counts.

2.09 CONTROLS

- A. Each HVAC system will be provided with standalone controls. There will be no BMS or DDC controls for the building.

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

- A. All work contracted for must be accepted by all applicable inspectors including site Superintendent, GC quality control personnel, Owner's Representative, or their assignees.
- B. As-builts: Provide Owner with electronic as-built drawings within two weeks of substantial completion. As-builts will reflect all changes from the construction drawing set and will comply with Energy Code project completion requirements.
- C. O&Ms: Provide hard copy and electronic copies of O&Ms for all systems within two weeks of substantial completion.

3.02 TESTING AND INSPECTION

- A. All testing, balancing, startup and commissioning is by the MC. All hydronic and air systems including all heat pumps, dwelling ceiling fans, range hoods, etc. will have water and airflow measurement and balancing conducted by the MC.
- B. All commissioning will be in compliance with the methodologies and practices outlined in Energy Code Section C408. Commissioning will also comply with ESDS mandatory commissioning requirements and optional credits being pursued as part of the ESDS compliance path.
- C. A 3rd party commissioning agent (CxA) will execute Commissioning of the MEP systems in accordance with Energy Code Section C408. These requirements apply to all residential and non-residential systems.
- D. The members of the commissioning team consist of the Commissioning Authority (CxA), the Owner's Representative (OR), the designated representative of the Owner's Construction Management firm (CM) (if applicable), the GC, the Architect and Engineer of Record, the MC, the EC, the Testing and Balancing (TAB) representative, and any other installing Subcontractors or Suppliers of equipment. Project Superintendent and Subcontractors, Installers, Suppliers, and Specialists deemed appropriate by the CxA or others. If known, the Owner's building or plant Operator/Engineer is also a member of the Commissioning Team.
- E. The CxA may assist with problem-solving deficiencies, but ultimately that responsibility resides with the A/E, GC, and the Subcontractors. The primary role of the CxA is in regards to Divisions 22, 23, and 26 and is to develop and coordinate the

execution of a testing plan, observe and document performance—that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents.

- F. The MC will fully participate in the commissioning process as follows:
1. The MC will participate in all commissioning meetings.
 2. MC will verify that coordination, installation, quality control, and final testing have been completed such that installed systems and equipment comply with Construction Documents.
 3. The MC will execute and document complete calibration of sensors and actuators and point-to-point testing of control systems.
 4. Provide preliminary and final TAB reports indicating all actual field values recorded to the Commissioning Authority prior to initiation of functional testing. TAB will not be complete until the TAB report is accepted by the A/E/Ownership team.
 5. Provide Commissioning Authority with controls system wiring diagrams and narrative sequences of operation in time for use in preparing the functional test procedures.
 6. Generate and provide blank pre-functional tests and checklists for review by CxA. Incorporate changes recommended by the CxA.
 7. MC is to execute pre-functional performance testing (FPTs) in an effort to eliminate deficiencies prior to final testing and witness witnessing stage and inform CxA that the system(s) are ready for witness testing.
 8. Execute final FPTs to be witnessed and documented by the CxA.
- G. The Contractor will be expected to fully execute the Cx process.
- H. Per Energy Code Section C403.10.2.3, all ductwork designed to operate at a static pressure in excess of 3 inches of water column shall be subjected to a high pressure duct leak test. This scope is by MC.
- I. Owner training will be provided by the installing Contractor.

END OF SECTION

SECTION 230529 - HVAC SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Hangers, Supports, and Associated Anchors.
- B. Flashing and Sealing of Equipment and Pipe Stacks.

1.2 REFERENCES

- A. ANSI/ASME B31.9 - Building Services Piping.
- B. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- C. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
- D. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- E. MSS SP-127 - Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

1.3 WORK FURNISHED BUT INSTALLED UNDER OTHER SECTIONS

- A. Furnish sleeves and hanger inserts to General Contractor for placement into formwork.

PART 2 - PRODUCTS

2.1 PIPE AND STRUCTURAL SUPPORTS

- A. Hangers and Clamps:
 - 1. Oversize all hangers, clamps, and supports on insulated piping to allow insulation and jacket to pass through unbroken. This applies to both hot and cold pipes.
 - 2. Hangers in direct contact with bare copper pipe shall include plastic pipe insert similar to Unistrut Cush-A-Clamp, Hydra-Zorb, nVent Cushion Clamp or Eaton Vibra-Clamp within their temperature limits of -65F to +225F.
 - 3. On all insulated piping, provide a semi-cylindrical metallic shield and vapor barrier jacket.
 - 4. Ferrous hot piping 4 inches and larger shall have steel saddles tack welded to the pipe at each support with a depth not less than specified for the insulation. Factory fabricated inserts may be used.
- B. Upper (Structural) Attachments:

1. Unless otherwise shown, upper attachments for hanger rods or support struts shall be as follows:
 - a. Wood Anchors: Tension wood rod hanger for suspending 3/8" threaded rod. Zinc plated carbon steel.
 - 1) Minimum allowable tension loads for Douglass Fir/Southern Pine:
 - a) 3/8" diameter rod; 2-1/2" shank: 600 lb/590 lb.
 - b) Load values are based on full shank penetration into wood member. Minimum edge distance 3/4". Minimum end distance 3-1/4".
 - 2) Limitations:
 - a) Truss: Do not hang from wood trusses without truss manufacturer or Structural Engineer^{TMTM}s approval.
 - b) Sheetrock/Gypsum Ceiling: When drilling through non-wood materials (e.g., sheet rock, gypsum, etc.), increase shank length by depth of non-wood materials.
 - c) Plywood Flooring/Roofing: Do not hang from plywood floor or roofing.
 - d) Spacing: Refer to wood structure spacing of hangers.
 - 3) Products:
 - a) Simpson RWV
 - b) DeWALT
 - c) ITI Sammys GT25

2.2 FOUNDATIONS, BASES, AND SUPPORTS

A. Basic Requirements:

1. Furnish and install foundations, bases, and supports (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for mechanical equipment.
2. All concrete foundations, bases and supports, shall be reinforced. All steel bases and supports shall receive a prime coat of zinc chromate or red metal primer. After completion of work, give steel supports a final coat of gray enamel.

B. Supports:

1. Provide sufficient clips, inserts, hangers, racks, rods, and auxiliary steel to securely support all suspended material, equipment and conduit without sag.
2. Hang heavy equipment from concrete floors or ceilings with Architect/Engineer-approved concrete inserts, furnished and installed by the Contractor whose work requires them, except where indicated otherwise.

C. Grout:

1. Grout shall be non-shrinking premixed (Master Builders Company "Embecco"), unless otherwise indicated on the drawings or approved by the Architect/Engineer.
2. Grout under equipment bases, around pipes, at pipe sleeves, etc., and where shown on the drawings.

2.3 OPENINGS IN FLOORS, WALLS AND CEILINGS

- A. Coordinate all openings with other Contractors.
- B. Hire the proper tradesman and furnish all labor, material and equipment to cut openings in or through existing structures, or openings in new structures that were not installed, or additional openings. Repair all spalling and damage to the satisfaction of the Architect/Engineer. Make saw cuts before breaking out concrete to ensure even and uniform opening edges.
- C. Said cutting shall be at the complete expense of each Contractor. Failure to coordinate openings with other Contractors shall not exempt the Contractor from providing openings at Contractor's expense.
- D. Do not cut structural members without written approval of the Architect or Structural Engineer.

2.4 SLEEVES AND LINTELS

- A. Each Contractor shall provide sleeves and lintels for all duct and pipe openings required for the Contractor's work in masonry walls and floors, unless specifically shown as being by others.
- B. Fabricate all sleeves from standard weight black steel pipe or as indicated on the drawings. Provide continuous sleeve. Cut or split sleeves are not acceptable.
- C. Fabricate all lintels for masonry walls from structural steel shapes or as indicated on the drawings. Have all lintels approved by the Architect or Structural Engineer.
- D. Sleeves through the floors on exposed risers shall be flush with the ceiling, with planed squared ends extending 1" above the floor in unfinished areas, and flush with the floor in finished areas, to accept spring closing floor plates.
- E. Openings through unexcavated floors and/or foundation walls below the floor shall have a smooth finish with sufficient annular space around material passing through opening so slight settling will not place stress on the material or building structure.
- F. Install all sleeves concentric with pipes. Secure sleeves in concrete to wood forms. This Contractor is responsible for sleeves dislodged or moved when pouring concrete.
- G. Where pipes rise through concrete floors that are on earthen grade, provide 3/4" resilient expansion joint material (e.g., foam, rubber, asphalt-coated fiber, bituminous-impregnated felt, or cork) wrapped around the pipe, the full depth of concrete, at the point of penetration. Secure to prevent shifting during concrete placement and finishing.
- H. Size sleeves large enough to allow expansion and contraction movement. Provide continuous insulation wrapping.

I. Wall Seals ("Link-Seals"):

1. Underground foundation wall penetrations and where shown on the drawings, pipes passing through walls, ceilings, or floors shall have their annular space (sleeve or drilled hole - not tapered hole made with knockout plug) sealed by properly sized sealing elements consisting of a synthetic rubber material compounded to resist aging, ozone, sunlight, water and chemical action.
2. Sleeves, if used, shall be at least 2 pipe sizes larger than the service pipe and shall include a waterstop/anchor around the mid section of the sleeve, continuously welded to or integral formed with the sleeve. Sleeve material options based on fluid carrying pipe design temperature.
3. Pressure shall be maintained by stainless steel bolts and other parts. Pressure plates may be of composite material for Models S and OS.
4. Sealing element shall be as follows:

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40F to 250F
T	High/Low Temperature (Steam)	Silicone	-67F to 400F
T	Fire Seals (1 hour)	Silicone	-67F to 400F
FS	Fire Seals (3 hours)	Silicone	-67F to 400F
OS	Oil Resistant/Stainless	Nitrile	-40F to 210F

5. Manufacturers:

- a. Garlock Pipeline Technologies (GPT) "Link-Seals"
- b. O-Z/Gedney Company
- c. Calpico, Inc.
- d. Innerlynx
- e. Metraflex
- f. Flexicraft

2.5 PIPE ANCHORS

- A. Provide all items needed to allow adequate expansion and contraction of all piping. All piping shall be supported, guided, aligned, and anchored as required.

2.6 FINISH

- A. Prime coat exposed steel hangers and supports. Hangers and supports in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

END OF SECTION

SECTION 230548 - HVAC VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Vibration Isolation.
- B. Flexible Connectors.

1.2 EQUIPMENT SUPPLIERS' INSPECTION

- A. The vibration isolation vendor shall inspect and approve the installation of the vibration isolators and shall submit a report to the Engineer and Owner which verifies that all of the M2-M4 mountings and H1-H3 hangers have been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection, and measured static deflection of the isolators provided.

PART 2 - PRODUCTS

2.1 HANGERS

- A. Type H1:
 - 1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.
 - 2. Static deflection shall be at least 0.15" at calculated load and 0.35" at maximum rated load.
 - 3. Provide hangers with end connections as required for hanging ductwork or piping.
 - 4. Manufacturers:
 - a. Mason "HD"
 - b. Kinetics "RH"
 - c. Aeroflex "RHD"
 - d. Vibration Eliminator Co. "IC/3C/3CTD"
 - e. Vibro Acoustics "RH"

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install all products per manufacturer's recommendations.

- B. Provide vibration isolation as indicated on the drawings and as described herein.
- C. Clean the surface below all mountings that are not bolted down and apply adhesive cement equal to Mason Type WG between mounting and floor. If movement occurs, bolt mountings down. Isolate bolts from baseplates with neoprene washers and bushings.
- D. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection of the isolator under the weight of the installed equipment - not the maximum rated deflection of the isolator.
- E. Support equipment to be mounted on structural steel frames with isolators under the frames or under brackets welded to the frames. Where frames are not needed, fasten isolators directly to the equipment.
- F. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support points that require multiple hangers, such as rectangular ducts or pipes supported on a strut rack.

3.2 PIPE ISOLATION

- A. Install flexible connectors in all piping connected to vibration producing equipment. This includes all fans, base-mounted pumps, compressors, etc. Absence of flexible connectors on piping diagrams does not imply that they are not required.
- B. Provide sufficient piping flexibility for vibrating refrigerant equipment, or furnish flexible connectors with appropriate temperature and pressure ratings.
- C. Support piping to prevent extension of flexible connectors.

END OF SECTION

SECTION 230550 - SEISMIC REQUIREMENTS FOR EQUIPMENT AND SUPPORTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Seismic Requirements.

1.2 REFERENCES

- A. ASHRAE - A Practical Guide to Seismic Restraint.
- B. Technical Manual 5-809-10, NAVFAC P-355, Air Force Manual 88-3, Chapter 13.
- C. ASCE 7-02, Chapter 9.
- D. ASCE 7-05, Chapter 13. ASCE 7-10, Chapter 13. ASCE 7-16, Chapter 13.
- G. ASCE 7-22, Chapter 13
- H. SMACNA - Seismic Restraint Manual Guidelines for Mechanical Systems.
- I. NFPA 13 - Installation of Sprinkler Systems.
- J. NFPA 14 - Standpipe and Hose Systems.

1.3 TESTING AND INSPECTION

- A. Special Inspection and Testing shall be done in accordance with Chapter 17 of the WA State Building Code.
- B. The Contractor shall employ a Special Inspection Agency to perform the duties and responsibilities specified in Section 1704 and 1705.
- C. Work performed on the premises of a fabricator approved by the building official need not be tested and inspected. The fabricator shall submit a certificate of compliance that the work has been performed in accordance with the approved plans and specifications to the building official and the Architect and Engineer of Record.
- D. The Special Inspection Agency shall furnish inspection reports to the building official, the Owner, the Architect, the Engineer of Record, and the General Contractor. The reports shall be completed and furnished within 48 hours of inspected work. A final signed report stating whether the work requiring special inspection was, to the best of the Special Inspection Agency's knowledge, in conformance with the approved plans and specifications shall be submitted.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site. Accept material on site in factory containers and packing. Inspect for damage. Protect from damage and contamination by maintaining factory packaging until installation. Follow manufacturer's instructions for storage.

1.5 DESIGN REQUIREMENTS

- A. This project is subject to the seismic bracing requirements of the International Building Code 2015, 2018, 2021 edition.
- B. This project is subject to the seismic bracing requirements of California Building Code Health Care Access and Information (HCAI) Division of State Architect (DSA) Interpretation of Regulations.
- C. The following criteria are applicable to this project:
 - 1. Seismic Use Group: I, II, III
 - 2. Occupancy Category: I, II, III, IV
 - 3. Risk Category: I, II, III, IV
 - 4. Seismic Importance Factor: $I_E = 1.0, 1.25, 1.5$
 - 5. Seismic Design Category: A, B, C, D, E, F
 - 6. Component Amplification Factors (a_p) and Component Response Modification Factors (R_p) shall be taken from Table 1621.3 in IBC 2000, 9.6.3.2 in ASCE 7-02, 13.6-1 in ASCE 7-05, 13.5-1 in ASCE 7-10, 13.5-1 in ASCE 7-16, 13.5-1 in ASCE 7-22 for the individual equipment or system being restrained.
 - 7. Component Importance Factors (I_p) shall be taken from Section 1621.1.6 in IBC 2000, 9.6.1.5 in ASCE 7-02, 13.1.3 in ASCE 7-05, 13.1.3 in ASCE 7-10, 13.1.3 in ASCE 7-16, 13.1.3 in ASCE 7-22 for the individual equipment or system being restrained.
 - 8. The total height of the structure and the height of the system to be restrained within the structure shall be determined in coordination with architectural plans and the General Contractor.
- D. Forces shall be calculated with the above requirements and Equation 16-67, 68, & 69 in section 1621.1.4 of IBC 2000, unless exempted by 1621.1.1, 9.6.1.3-1, -2, and -3 of ASCE 7-02, unless exempted by 9.6.1, 13.3-1, -2, and -3 of ASCE 7-05, unless exempted by 13.1.413.3-1, -2, and -3 of ASCE 7-10, unless exempted by 13.1.4, 13.3-1, -2, and -3 of ASCE 7-16, unless exempted by 13.1.4, 13.3-1, -2, and -3 of ASCE 7-22, unless exempted by 13.1.4. Equipment shall meet International California Building Code and ASCE 7 seismic qualification requirements in concurrence with ICC ES AC156 Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems.
- F. All seismic anchorage and bracing shall comply with the St. Louis County Rules & Regulations on Anchorage & Sway Bracing - Mechanical, Electrical & Plumbing (MEP) System Components.
- G. All seismic anchorage and bracing shall comply with FM Global Property Loss Prevention Data Sheet 1-11, Fire Following Earthquakes.

1.6 COORDINATION

- A. Coordinate layout and installation of seismic bracing with building structural systems and architectural features, and with mechanical, fire-protection, electrical and other building features in the vicinity.
- B. Coordinate concrete bases with building structural system.

1.7 WARRANTY

- A. Provide one-year warranty on parts and labor for manufacturer defects and installation workmanship.

PART 2 - PRODUCTS

2.1 SUPPLIERS

- A. Following is a partial list of manufacturer/supplier contact information for seismic restraints:
 - 1. B-Line Systems, Inc. (800) 851-7415, www.b-line.com.
 - 2. Unistrut Corporation <http://www.unistrut.us/>
 - 3. Mason Industries, Inc. www.mason-ind.com.
 - 4. Loos & Co., Inc. (800) 321-5667, www.loosnaples.com.
 - 5. Tolco (909) 737-5599, www.tolco.com
 - 6. ISAT 877.523.6060, www.isatsb.com
 - 7. Vibro-Acoustics (416) 291-7371 , <https://virs.vibro-acoustics.com/>

2.2 SEISMIC DESIGN CRITERIA

- A. This section describes the requirements for seismic restraint of systems and equipment related to continued operation of the facility after a design seismic event.
- B. Definitions

2.3 SEISMIC BRACING AND SUPPORT OF SYSTEMS AND COMPONENTS

- A. General:
 - 1. Seismic restraint designer shall coordinate all attachments with the Structural Engineer of Record; refer to submittal requirements.
 - 2. The seismic restraint design shall be based on actual equipment data obtained from manufacturer's submittals or the manufacturer. The equipment manufacturer shall verify and provide written certification the attachment points on the equipment can accept the combination of seismic, weight, and other imposed loads.
 - 3. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
 - 4. Analysis shall detail anchoring methods, bolt diameter, embedment, and weld length.
 - 5. All seismic restraints and combination isolator/restraints shall have verification of their seismic capabilities witnessed by an independent testing agency.

- B. Friction from gravity loads shall not be considered resistance to seismic forces.
- C. Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14 for the building seismic requirements.
- D. Housekeeping Pads:
 - 1. Reinforced housekeeping pads shall be provided to handle shear, tension, and compression forces with proper reinforcement, doweling, and attachments connecting the pad to the structural slab.
 - 2. New Bases for Existing Buildings: In addition to forces noted above, proper bonding of new equipment bases to existing concrete floors shall include: Existing concrete shall be thoroughly cleaned, scarified, and a bonding agent applied, in accordance with manufacturer's instructions, prior to placing new concrete. Bonding agent shall be "Weld-Crete" as manufactured by the Larsen Products Corporation or "Nitobond Acrylic" as manufactured by Fosroc Inc. or approved equivalent.

2.4 SEISMIC RESTRAINT AND CONSTRUCTION OF EQUIPMENT

- A. Equipment supplied for the project shall be designed to meet the requirements of lateral forces calculated using the applicable code and method described above.
- B. The following is a partial list of equipment that shall be restrained and that shall be constructed to meet seismic forces described in this section:
 - 1. Pumps
 - 2. Tanks
 - 3. Air Handling Units
 - 4. Boilers

2.5 MATERIALS

- A. Use the following materials for restraints:
 - 1. Indoor Dry Locations: Steel, zinc plated.
 - 2. Outdoors and Damp Locations: Galvanized steel.
 - 3. Corrosive Locations: Stainless steel.

2.6 ANCHORAGE AND STRUCTURAL ATTACHMENT COMPONENTS

- A. Strength: Defined in reports by ICC Evaluation Service or another agency acceptable to authorities having jurisdiction.
- B. Concrete and Masonry Anchor Bolts and Studs: Steel-expansion wedge type. Comply with IBC, ACI and ICC ES requirements for cracked concrete anchors.
- C. Concrete Inserts: Steel-channel type.
- D. Through Bolts: Structural type, hex head, high strength. Comply with ASTM F3125, Grade A 325.

- E. Welding Lugs: Comply with MSS SP-69, Type 57.
- F. Bushings for Floor-Mounted Equipment Anchors: Neoprene units designed for seismically rated rigid equipment mountings, and matched to the type and size of anchor bolts and studs used.
- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for seismically rated rigid equipment mountings, and matched to the type and size of attachment devices used.

2.7 SEISMIC BRACING COMPONENTS

- A. Slotted Steel Channel: 1-5/8-by-1-5/8-inch cross section, formed from 0.1046-inch-thick steel, with 9/16-by-7/8-inch slots at a maximum of 2 inches o.c. in webs, and flange edges turned toward web.
 - 1. Materials for Channel: ASTM A 1011, GR 33.
 - 2. Materials for Fittings and Accessories: ASTM A 635, ASTM A 576, or ASTM A 36.
 - 3. Fittings and Accessories: Products of the same manufacturer as channels and designed for use with that product.
 - 4. Finish: Baked, rust-inhibiting, acrylic-enamel paint applied after cleaning and phosphate treatment, unless otherwise indicated.
- B. Cable-Type Bracing Assemblies: Zinc-coated, high-strength steel wire rope cable attached to steel thimbles, brackets, and bolts designed for cable service.
 - 1. Arrange units for attachment to the braced component at one end and to the structure at the other end.
 - 2. Wire Rope Cable: Comply with ASTM A 603. Use 49- or 133-strand cable with a minimum strength of 2 times the calculated maximum seismic force to be resisted.
- C. Hanger Rod Stiffeners: Slotted steel channels with internally bolted connections to hanger rod.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to the applicable code sections and Authority Having Jurisdiction for the exact seismic restraint requirements of piping, ductwork, conduit, equipment, etc.
- B. Layout of transverse and longitudinal bracing shall follow recommendations of approved design standards listed in Part 1 of this specification section.
- C. All rigid floor mounted equipment shall have a resilient media between the equipment mounting hole and the anchor bolt in concrete.
- D. All seismic restraint systems shall be installed in strict accordance with the manufacturer's written instructions and all certified submittal data.

- E. Installation of seismic restraints shall not cause any change in position of equipment, piping, or ductwork, resulting in stresses or misalignment.
- F. No rigid connections between equipment and the building structure shall be made that degrade the noise and vibration-isolation system specified.
- G. Do not install any equipment, piping, duct, or conduit that makes rigid connections with the building unless isolation is not specified.
- H. Coordinate work with all other trades to avoid rigid contact with the building. Any conflicts with other trades that will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions shall be brought to the Architect/Engineer's attention prior to specific equipment selection.
- I. Prior to installation, bring to the Architect/Engineer's attention any discrepancies between the specifications and the field conditions, or changes required due to specific equipment selection.
- J. Bracing may occur from flanges of structural beams, upper truss cords of bar joists, cast in place inserts, or International Code Council approved seismic anchors for installation in concrete.
- K. Cable restraints shall be installed slightly slack to avoid short-circuiting the isolated suspended equipment, ductwork, piping, or conduit.
- L. Cable assemblies shall be installed taut on non-isolated systems. Solid braces may be used in place of cables on rigidly attached systems only.
- M. Do not install cables over sharp corners.
- N. Brace support rods when necessary to accept compressive loads. Welding of compression braces to the vertical support rods is not acceptable.
- O. Provide reinforced clevis bolts when required.
- P. The vibration isolation manufacturer shall furnish integral structural steel bases as required. Independent steel rails are not acceptable.
- Q. Post-Installed anchors shall be provided to meet seismic requirements.
- R. Vertical pipe risers flexibly supported to accommodate thermal motion and/or pipe vibration shall be guided to maintain pipe stability and provide horizontal seismic restraint.
- S. Seismic restraints shall be mechanically attached to the system. Looping restraints around the system is not acceptable.
- T. Piping crossing building seismic or expansion joints, passing from building to building, or supported from different portions of the building shall be installed to allow differential support displacements without damaging the pipe, equipment connections, or support connections. Pipe offsets, loops, anchors, and guides shall be installed as required to provide required motion capability and limit motion of adjacent piping.

- U. Water tanks shall be secured to their saddles by welding or proper concrete attachment, and those saddles shall be properly attached to the structure.
- V. Brace all terminal units with water coils as required by the building code and provide flexible connection to the coil if bracing is required.
- W. Independently brace duct mounted equipment (terminal units, in-line fans, etc.) and the associated suspended ductwork.
- X. Do not brace a system to two different structures such as a wall and a ceiling.
- Y. Provide appropriately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire seal systems in fire-rated walls.
- Z. Positively attach all roof mounted equipment to roof curbs. Positively attach all roof curbs to building structure.
- AA. Exposed seismic supports in occupied areas shall be guarded or covered to protect occupants.
- BB. Coordinate seismic bracing of architecturally exposed ductwork with the Architect/Engineer.

3.2 SEISMIC RESTRAINT EXCLUSIONS

- A. Refer to the applicable code sections and Authority Having Jurisdiction for allowable exclusions.

END OF SECTION

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SECTION 230553 - HVAC IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Identification of products installed under Division 23.

1.2 REFERENCES

- A. ASTM B-1, B-3, and B-8 for copper conductors.
- B. ASTM D-1248 for Polyethylene Extrusion Materials, ICEA S-70-547 Weatherproof Resistant Polyethylene Conductors, ICEA S-61-402/NEMA WC5 Thermoplastic Insulated Wire & Cable, ICEA S-95-658/NEMA WC70 Non-Shielded 0 - 2kV Cables.
- C. UL 1581 Standard for Electrical Wires, Cables, and Flexible Cords.

PART 2 - EXECUTION

2.1 INSTALLATION

- A. Install all products per manufacturer's recommendations.
- B. Degrease and clean surfaces to receive adhesive for identification materials.
- C. Equipment:
 - 1. All equipment not easily identifiable such as controls, relays, gauges, etc.; and all equipment in an area remote from its function such as air handling units, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas.
 - 2. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.
 - 3. Mechanical equipment that is not covered by the U.S. National Appliance Energy Conservation Act (NAECA) of 1987 shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of ASHRAE 90.1.
- D. Miscellaneous:
 - 1. Attach self-adhesive vinyl labels at all duct access doors used to reset fusible links or actuators on fire, fire/smoke, or smoke dampers. Lettering shall be a minimum of 1/2" high. Labels shall indicate damper type.
 - 2. Provide engraved plastic tags at all hydronic or steam system make-up water meters.

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Peninsula Housing Authority

Permit Set
Jul-10-2026

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjusting, and balancing of energy recovery systems.
- B. Measurement of final operating condition of HVAC systems.

1.2 REFERENCES

- A. AABC - National Standards for Total System Balance, Seventh Edition.
- B. ADC - Test Code for Grilles, Registers, and Diffusers.
- C. AMCA - Publication 203-90; Field Performance Measurement of Fan Systems.
- D. ASHRAE - 2019 HVAC Applications Handbook; Chapter 39, Testing, Adjusting and Balancing.
- E. ASHRAE/ANSI - Standard 111-2008; Practices for Measurement, Testing, Adjusting and Balancing of Building HVAC&R Systems.
- F. NEBB - Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems, Ninth Edition, 2019.
- G. SMACNA - HVAC Systems; Testing, Adjusting and Balancing (latest edition).
- H. TABB - International Standards for Environmental Systems Balance.

1.3 SUBMITTALS

- A. Submit copies of report forms, balancing procedures, and the name and qualifications of testing and balancing agency for approval within 30 days after award of Contract.
- B. Electronic Copies:
 - 1. Submit a certified copy of test reports to the Architect/Engineer for approval. Electronic copies shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Copies that are not legible will be returned to the Contractor for resubmittal. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
 - 2. Electronic file size shall be limited to a maximum of 10MB. Larger files shall be divided into files that are clearly labeled as "1 of 2", "2 of 2", etc.

1.4 REPORT FORMS

- A. Submit reports on AABC, SMACNA or NEBB forms. Use custom forms approved by the Architect/Engineer when needed to supply specified information.
- B. Include in the final report a schematic drawing showing each system component, including balancing devices, for each system. Each drawing shall be included with the test reports required for that system. The schematic drawings shall identify all testing points and cross-reference these points to the report forms and procedures.
- C. Refer to PART 4 for required reports.

1.5 WARRANTY/GUARANTEE

- A. The TAB Contractor shall include an extended warranty of 90 days after owner receipt of a completed balancing report, during which time the Owner may request a recheck of terminals, or resetting of any outlet, coil, or device listed in the test report. This warranty shall provide a minimum of 24 manhours of onsite service time. If it is determined that the new test results are not within the design criteria, the balancer shall rebalance the system according to design criteria.
- B. Warranty/Guarantee must meet one of the following programs: TABB International Quality Assurance Program, AABC National Project Performance Guarantee, NEBB's Conformance Certification.

1.6 SCHEDULING

- A. Coordinate schedule with other trades. Provide a minimum of seven days' notice to all trades and the Architect/Engineer prior to performing each test.
- B. Project will be constructed in phases. Provide balancing report after each phase is complete.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All procedures must conform to a published standard listed in the References article of this section. All equipment shall be adjusted in accordance with the manufacturer's recommendations. Any system not listed in this specification but installed under the contract documents shall be balanced using a procedure from a published standard listed in the References article.
- B. The Balancing Contractor shall incorporate all pertinent documented construction changes (e.g. submittals/shop drawings, change orders, RFIs, ASIs, etc.) and include in the balancing report.
- C. Recorded data shall represent actual measured or observed conditions.

- D. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing is complete, close probe holes and patch insulation with new materials as specified. Restore vapor barrier and finish as specified.
- E. Permanently mark setting of valves, dampers, and other adjustment devices allowing for settings to be restored. Set and lock memory stops.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, plugging test holes, and restoring thermostats to specified settings.
- G. The Balancing Contractor shall measure terminal air box air flow, and the TCC shall adjust DDC readout to match. Refer to Section 230900 for additional information.
- H. Installations with systems consisting of multiple components shall be balanced with all system components operating.

3.2 EXAMINATION

- A. Before beginning work, verify that systems are complete and operable. Ensure the following:
 - 1. General Equipment Requirements:
 - a. Equipment is safe to operate and in normal condition.
 - b. Equipment with moving parts is properly lubricated.
 - c. Temperature control systems are complete and operable.
 - d. Proper thermal overload protection is in place for electrical equipment.
 - e. Direction of rotation of all fans and pumps is correct.
 - f. Access doors are closed and end caps are in place.
 - 2. Duct System Requirements:
 - a. All filters are clean and in place. If required, install temporary media.
 - b. Duct systems are clean and free of debris.
 - c. Fire/smoke and manual volume dampers are in place, functional and open.
 - d. Air outlets are installed and connected.
 - e. Duct system leakage has been minimized.
 - 3. Pipe System Requirements:
 - a. Coil fins have been cleaned and combed.
 - b. Hydronic systems have been cleaned, filled, and vented.
 - c. Strainer screens are clean and in place.
 - d. Shutoff, throttling and balancing valves are open.
- B. Report any defects or deficiencies to Architect/Engineer.
- C. Promptly report items that are abnormal or prevent proper balancing.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.

- E. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to the Architect/Engineer for spot checks during testing.
- B. Instruments shall be calibrated within six months of testing performed for project, or more recently if recommended by the instrument manufacturer.

3.4 INSTALLATION TOLERANCES

- A. $\pm 10\%$ of scheduled values:
 - 1. Adjust air inlets and outlets to $\pm 10\%$ of scheduled values.
 - 2. Adjust piping systems to $\pm 10\%$ of design values.
- B. $\pm 5\%$ of scheduled values:
 - 1. Adjust fume exhaust systems to $\pm 5\%$ of scheduled values.
 - 2. Adjust supply and exhaust air-handling systems for space pressurization to $\pm 5\%$ of scheduled values, and to provide proper pressurization.
- C. $\pm 5\%$ of scheduled values
 - 1. Adjust outdoor air intakes to within $+ 5\%$ of scheduled values.
 - 2. Adjust exhaust air through energy recovery equipment to within $+ 5\%$ of scheduled values.
- D. Adjust supply, return, and exhaust air-handling systems to $+10\% / -5\%$ of scheduled values.

3.5 ADJUSTING

- A. After adjustment, take measurements to verify balance has not been disrupted or that disruption has been rectified.
- B. Once balancing of systems is complete, at least one damper or valve must be 100% open.
- C. After testing, adjusting and balancing are complete, operate each system and randomly check measurements to verify system is operating as reported in the report. Document any discrepancies.
- D. Contractor responsible for each motor shall also be responsible for replacement sheaves. Coordinate with contractor.
- E. Contractor responsible for pump shall trim impeller to final duty point as instructed by this contractor on all pumps not driven by a VFD. Coordinate with contractor.

3.6 SYSTEM PERFORMANCE REPORT

- A. After the conclusion of balancing operations, utilize the building DDC system or install portable data loggers to simultaneously record temperatures and humidity during summer and winter conditions for a seven-day period, continuous over a weekend, and including at least one period of operation at outside conditions within 5F wet bulb temperature of maximum summer design condition and within 10F dry bulb temperature of minimum winter design condition.
- B. Design Conditions: Per WA State Energy code (C) (C) Report of test results shall include original recording and three reproductions.

3.7 SUBMISSION OF REPORTS

- A. Fill in test results on appropriate forms.

PART 4 - SYSTEMS TO BE TESTED, ADJUSTED AND BALANCED

4.1 Verification of existing systems.

- A. Perform a pre-balance of systems serving the area of construction prior to the start of any other work. Do not make adjustments to the systems. If the systems are not operating at maximum capacity, temporarily drive system to maximum and take readings for the system. Return the system to its original state when measurements are complete.

- 1. Exhaust Fan
 - a. Drawing symbol.
 - b. Location.
 - c. Manufacturer and model.
 - d. Flow rate (cfm).
 - e. Total static pressure. (Indicate measurement locations).
- 2. Air Terminal (Inlet or Outlet):
 - a. Room number/location.
 - b. Terminal type and size.
 - c. Velocity.
 - d. Flow rate (cfm)

4.2 GENERAL REQUIREMENTS

- A. Title Page:
 - 1. Project name.
 - 2. Project location.
 - 3. Project Architect.
 - 4. Project Engineer (IMEG Corp.).
 - 5. Project General Contractor.
 - 6. TAB Company name, address, phone number.
 - 7. TAB Supervisor's name and certification number.

8. TAB Supervisor's signature and date.
9. Report date.

B. Report Index

C. General Information:

1. Test conditions.
2. Nomenclature used throughout report.
3. Notable system characteristics/discrepancies from design.
4. Test standards followed.
5. Any deficiencies noted.
6. Quality assurance statement.

D. Instrument List:

1. Instrument.
2. Manufacturer, model, and serial number.
3. Range.
4. Calibration date.

END OF SECTION

SECTION 230713 - DUCTWORK INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Ductwork Insulation.
- B. Insulation Jackets.

1.2 REFERENCES

- A. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. ANSI/ASTM C553 - Mineral Fiber Blanket and Felt Insulation.
- C. ANSI/ASTM C612 - Mineral Fiber Block and Board Thermal Insulation.
- D. ASTM E84 - Surface Burning Characteristics of Building Materials.
- E. ASTM E136 - Standard Test Method for the Behavior of Materials in a Vertical Tube Furnace at 750C.
- F. ASTM E814 - Fire Tests of Through Penetrations Firestops.
- G. ASTM E2336-04 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.
- H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- I. National Commercial & Industrial Insulation Standards - 1999 Edition - as published by Midwest Insulation Contractors Association and endorsed by National Insulation Contractors Association.
- J. NFPA 96 - Standard for the Installation of Equipment for Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.
- K. NFPA 255 - Surface Burning Characteristics of Building Materials.
- L. UL - XHEZ - Through Penetration Firestop Systems.
- M. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors.
- N. UL 263 - Full Scale External Fire Tests with Hose Stream.
- O. UL 723 - Surface Burning Characteristics of Building Materials.

- P. UL 1479 - Fire Tests of Through Penetrations Firestops.

PART 2 - PRODUCTS

		R-VALUE PER THICKNESS								
	THICKNESS	0.5	1	1.5	2	2.5	3	4	5	
TYPE	K-FACTOR	R-VALUE								
Flexible Fiberglass										
Outside Wrap	0.28			5.4	7.1	8.9	10.7	14.3	17.9	
Semi-Rigid Fiberglass										
Board Wrap	0.25			6.0	8.0	10.0	12.0	16.0	20.0	
Flexible Fiberglass										
Liner	0.28	1.8	3.6	5.4	7.1	8.9	10.7	14.3	17.9	
Rigid fiberglass liner	0.23		4.3	6.5	8.7	10.9	13.0	17.4	21.7	
Double Wall										
Ductwork	0.27		3.7	5.6	7.4	9.3	11.1	14.8	18.5	
Flexible High Temp										
Rigid Preformed										
Fiberglass Acoustical										
Liner	0.23		4.3	6.5	8.7	10.9	13.0	17.4	21.7	

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions, codes, and industry standards.
- B. Install materials after ductwork has been tested.
- C. Clean surfaces for adhesives.
- D. Provide insulation with vapor barrier when air conveyed may be below ambient temperature.
- E. Continue insulation with vapor barrier through penetrations unless code prohibits.
- F. Provide 2" wide, 24" high, 26 gauge, galvanized sheet metal corner protection angles for all externally insulated ductwork extending to a floor or curb.

3.2 SCHEDULE

- A. Refer to Ductwork Application Schedule on Drawings in Section 233100 for scheduling of insulation.

END OF SECTION

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Description
- B. Responsibilities
- C. Related Work
- D. Test Equipment

1.2 DESCRIPTION

- A. The purpose of this section is to specify Division 23 responsibilities in the commissioning process.
- B. The systems to be commissioned are listed in Section 019100.
- C. Commissioning requires the participation of the Division 23 Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019100. Division 23 Contractor shall be familiar with all parts of Section 019100 and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.3 RESPONSIBILITIES

- A. Refer to Section 019100.

1.4 RELATED WORK

- A. Specific commissioning requirements are given in the following sections of these specifications. All the following sections apply to the Work of this section.
 - 1. Section 017823 - Operations and Maintenance
 - 2. Section 017900 - Demonstration and Training
 - 3. Section 019100 - Commissioning
 - 4. Section 210800 - Commissioning of Fire Suppression
 - 5. Section 220800 - Commissioning of Plumbing
 - 6. Section 260800 - Commissioning of Electrical
 - 7. Section 270800 - Commissioning of Communications
 - 8. Section 280800 - Commissioning of Electronic Safety and Security

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Contractor shall provide all test equipment necessary to fulfill the testing requirements of this Division. This equipment includes, but is not limited to, the following:
 - 1. Handheld temperature and relative humidity meter.
 - 2. Infrared thermometer gun.
 - 3. Analog differential pressure gauge and associated tubing.
 - 4. Portable computer with access to the building automation system.
- B. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the related specifications. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5F and a resolution of +/- 0.1F.
 - 2. Pressure sensors shall have an accuracy of +/- 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.
 - 3. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.
- C. Refer to Section 019100 for additional Division 23 requirements.

PART 3 - EXECUTION

- A. Refer to Section 019100.

END OF SECTION

SECTION 230900 - CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Complete System of Automatic Controls.
- B. Control Devices, Components, Wiring and Material.
- C. Instructions for Owners.
- D. Remodeling.
- E. Critical Environment Controls (refer to Section 230920).

1.2 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts Maximum).
- D. ANSI/NFPA 70 - National Electrical Code.
- E. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
- F. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
- G. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning.
- H. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- I. ANSI/ASTM B32 - Solder Metal.
- J. ASTM B280 - Seamless Copper Tube for Air Conditioning & Refrigeration Field Service.
- K. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.

1.3 SUBMITTALS

- A. Equipment Coordination:
 - 1. The Controls Contractor shall obtain approved equipment submittals from other contractors to determine equipment wiring connections, to choose appropriate controllers, and to provide programming.

2. Control valve selections shall be based on flow rates shown in approved shop drawings.
3. Coordinate the control interface of all equipment with the equipment manufacturers prior to submittal submission.

B. Record Documents:

1. Submit record documentation per Section 230500.
2. Provide a complete set of "as-built" drawings and application software on CDs. Provide drawings as AutoCAD~~ccc~~ or Visio~~ccc~~ compatible files. Provide two copies of the "as-built" drawings with revisions clearly indicated in addition to the documents on compact disk. All as-built drawings shall also be installed on the FMCS server in a dedicated directory. Provide all product data sheets in PDF format.
3. Provide all completed testing and commissioning reports and checklists, along with all trend logs for each system identified in the points lists.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.
- B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.5 AGENCY AND CODE APPROVALS

- A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.
 1. UL-916; Energy Management Systems.
 2. EMC Directive 89/336/EEC (European CE Mark).
 3. FCC, Part 15, Subpart J, Class A Computing Devices.

1.6 ACRONYMS

- A. Acronyms used in this specification are as follows:
 1. B-AAC BACnet Advanced Application Controller
 2. B-ASC BACnet Application Specific Controller
 3. BTL BACnet Testing Laboratories
 4. DDC Direct Digital Controls
 5. FMCS Facility Management and Control System
 6. GUI Graphic User Interface
 7. IBC Interoperable BACnet Controller
 8. IDC Interoperable Digital Controller
 9. LAN Local Area Network
 10. NAC Network Area Controller
 11. ODBC Open DataBase Connectivity
 12. OOT Object Oriented Technology
 13. OPC Open Connectivity via Open Standards

14. PICS Product Interoperability Compliance Statement
15. PMI Power Measurement Interface
16. POT Portable Operator's Terminal
17. TCC Temperature Control Contractor
18. TCS Temperature Control System
19. WAN Wide Area Network
20. WBI Web Browser Interface

1.7 SUMMARY

- A. Provide new standalone FMCS for this project.

1.8 SYSTEM DESCRIPTION

- A. The entire TCS shall be comprised of a network of interoperable, standalone digital controllers communicating via the following protocol to an NAC. Temperature Control System products shall be as specified below.
- B. Provide materials and labor necessary to connect factory supplied control components.
- C. Provide central and remote hardware, software, and interconnecting wire and conduit.
- D. The FMCS shall include automated alarming software capable of calling e-mail compatible cellular telephones and pagers. The e-mail alarm paging system shall be able to segregate users, time schedules, and equipment and be capable of being programmed by the Owner.
- E. For the dedicated configuration tool provided, it is preferable that it be launched from within the applicable Network Management Software. If not, include any software required for controller configuration as a leave-behind tool with enough license capability to support the installation.
- F. For each operator workstation provided, furnish one legal copy of all software tools, configuration tools, management tools, and utilities used during system commissioning and installation. All tools shall be readily available in the market. Contractor shall convey to the Owner all software tools and their legal licenses at project closeout.
- G. Connection:
 1. System shall be a complete hard-wired system. Wireless control systems/functions are NOT acceptable.

1.9 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

1.10 WARRANTY

- A. Refer to Section 230500 for warranty requirements.
- B. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Owner.
- C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.
- D. Update all software and back-ups during warranty period and all user documentation on the Owner's archived software disks.

1.11 WARRANTY ACCESS

- A. The Owner shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS

- A. Rectangular Control Dampers - Standard Construction:
 - 1. Test leakage and pressure drop per AMCA 500.
 - 2. Frame: Hat-shaped channel, minimum 12 gauge extruded aluminum, and minimum 4" deep. Caulk or weld seams to prevent leakage.
 - 3. Blades: Minimum 12 gauge extruded aluminum airfoil design, minimum 6" wide, and overlapping blades and blade seals (overlapping blade seals only is unacceptable).
 - 4. Shaft: Non-cylindrical, solid aluminum or zinc plated steel with opening in blade to match profile of shaft. Shaft shall be securely fastened to the blade and of sufficient length to mount direct-coupled actuator. Damper manufacturer shall provide drive pin extensions and outboard bearing support brackets as required.
 - 5. Bearings: Acetal (Delrin/Celcon) inner bearing fixed to an aluminum shaft, rotating within a polycarbonate outer bearing inserted in the frame. Provide thrust bearings for vertical damper applications.
 - 6. Blade Seals: Extruded silicone gaskets secured in an integral slot within the blade.
 - 7. Side Seals: Stainless steel compression type or extruded silicone gasket secured in an integral slot within the frame.
 - 8. Linkage: Shall be concealed in the frame, constructed of aluminum or corrosion-resistant zinc plated steel, and securely fastened to shaft. Blades linked for opposed operation, unless noted otherwise on the drawings. Blades shall close evenly. Use one direct-coupled actuator per damper section. Jack-shafting is not acceptable.
 - 9. Size Limits: 48" maximum horizontal blade length, 24 square foot maximum area per damper. Total cross-sectional area of dampers in ducts shall be at least as large as the duct without the use of blank-off sections.
- B. Carbon Monoxide Sensors:

1. Solid-state gas sensor/transmitter, NEMA 1 gasketed enclosure, normal operating temperature 0F to 120F, normal relative humidity operation 5-95%, $\pm 5\%$ accuracy, and detection range of 0-400 ppm.
2. Provide 4-20 mA output from the sensor to the FMCS system.
3. Provide local alarm whenever carbon monoxide level exceeds 100 ppm.
4. It shall be compatible with **BACnet LonWorks** network interface and shall input these values to the network area controller.
5. Install in accordance with OSHA requirements.
6. Unit shall be factory calibrated and shall be re-calibrated after installation per manufacturer's recommendations.

C. Combination Carbon Monoxide/Nitrogen Dioxide Sensors:

1. Solid-state gas sensor/transmitter for each gas, NEMA 1 gasketed enclosure, normal operating temperature 0F to 120F, normal relative humidity operation 5-95%, $\pm 5\%$ accuracy, and detection range of 0-200 ppm.
2. Provide separate 4-20 mA output from the sensor to the FMCS system for each gas.
3. Provide local alarm whenever carbon monoxide level exceeds 100 ppm or nitrogen dioxide level exceeds 5 ppm.
4. It shall be compatible with **BACnet LonWorks** network interface and shall input these values to the network area controller.
5. Install in accordance with OSHA requirements.
6. Unit shall be factory calibrated and shall be re-calibrated after installation per manufacturer's recommendations.

7. Thermostat and Sensor Enclosures:

a. Heavy Duty Enclosure:

- 1) Perforated steel, tamperproof locking thermostat and control device enclosure.
- 2) Box shall be nominally 8"x6"x2" deep or sized as required to fit devices to be enclosed.
- 3) Perforated cover shall be 16 gauge steel with maximum 3/16" perforations on maximum 1/4" staggered centers for a 55% free area.
- 4) Secure to wall from inside of box. Cover shall be secured by tamperproof screws to frame.
- 5) Color shall match electrical devices. Verify color with the Electrical Contractor.

8. Twist Timers:

- a. Switch shall be rated for 20 amps at 125 volts (10 amps at 277 volts) and fit standard 2-1/2" deep electrical box.
- b. Provide time cycle noted on the drawings or in the specifications; up to 12 hours.

9. Drain Pan Condensate Overflow Switch: Float with integral magnet overflow switch conforming to UL508. No standby power required.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.
- B. Install system and materials in accordance with manufacturer's instructions.
- C. Drawings of the TCS and FMCS network are diagrammatic only. Any apparatus not shown but required to meet the intent of the project documents shall be furnished and installed without additional cost.
- D. Install all operators, sensors, and control devices where accessible for service, adjustment, calibration, and repair. Do not install devices where blocked by piping or ductwork. Devices with manual reset or limit adjustments shall be installed below 6'-0" if practical to allow inspection without using a ladder.
- E. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed ADA mounting requirements.
- F. Provide valves over 3/4" size with position indicators and pilot positioners where sequenced with other controls.
- G. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.
- H. After completion of installation, test and adjust control equipment.
- I. Check calibration of instruments. Recalibrate or replace.
- J. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section.
- K. Labels For Control Devices:
 - 1. Provide labels indicating service of all control devices in panels and other locations.
 - 2. Labels may be made with permanent marking pen in the control panels if clearly legible.
 - 3. Use engraved labels for items outside panel such as outside air thermostats.
 - 4. Labels are not required for room thermostats, damper actuators and other items where their function is obvious.
- L. VFDs:
 - 1. This project includes several variable frequency drives to control the flow of fans and/or pumps based on a control variable.
 - 2. Verify output signal required, 4-20 mA or 0-10V dc, with the EC.

3. If VFD has a bypass feature, auxiliary contacts on the drive may not be used for motor status. A separate relay must be used to indicate motor rotation in either hand or auto positions.
4. If a separate current transmitter or switch is indicated for status, install this device between the VFD and the motor. In this case, the drive status may be connected to the auxiliary contacts in the VFD.
5. Some devices, such as low limits and fire alarm shutdown relays, must be hardwired to the fan motor. Make connections such that fan will shut down whether in hand or auto position if the unit has a bypass feature.

M. Airflow Stations:

1. The transmitter shall be installed at a location that is protected from weather, water, and vibration.
2. Mount transmitter where they can easily be read (36" to 66" above floor). Do not fasten transmitters directly to ductwork or compromise duct insulation.
3. The manufacturer's authorized representative shall visit the project site during construction prior to station installations to confirm all submitted sizes, mounting requirements and locations. Size adjustments shall be made at no additional cost. The representative shall meet on site with the TCC to support and train them on proper installation procedures and calibration.
4. Install labels at each sensor and transmitter identifying its service.

3.2 COMMISSIONING

- A. Upon completion of the installation, this Contractor shall load all system software and start up the system. This Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.
- B. This Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the FMCS system operation.
- C. This Contractor shall prove that the controls network is functioning correctly and within acceptable bandwidth criteria and shall test the system with an approved protocol analysis tool. Provide a log and statistics summary showing that each channel is within acceptable parameters. Each channel shall be shown to have at least 25% spare capacity for future expansion.
- D. Upon completion of the performance tests described above, repeat these tests, point by point, as described in the validation log above in the presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- E. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.3 PREPARATION FOR BALANCING

- A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).
- B. Check the calibration and setpoints of all controllers.
- C. Check the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
- D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless specified. Observe that heating cannot begin at TAB reheat terminals until the unit is at the minimum CFM.
- E. Verify the operation of all interlock systems.

3.4 TEST AND BALANCE COORDINATION

- A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
- B. The Contractor shall provide a minimum of four (4) hours training for the Balancing Contractor in the use of these tools.
- C. In addition, the Contractor shall provide a qualified technician to assist in the test and balance process until the first 20 terminal units are balanced.
- D. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

3.5 DEMONSTRATION AND ACCEPTANCE

- A. At completion of installation, provide two days minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

END OF SECTION

SECTION 230905 - SMALL EQUIPMENT CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Complete System of Automatic Controls.
- B. Control Devices, Components, Wiring and Material.
- C. Instructions for Owners.
- D. Remodeling.

1.2 REFERENCES

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ANSI/ASHRAE Standard 135-2016: BACnet® - A Data Communication Protocol for Building Automation and Control Networks, including all amendments.
- D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 volts Maximum).
- E. ANSI/NFPA 70 - National Electrical Code.
- F. ANSI/NFPA 90A - Installation of Air-Conditioning and Ventilation Systems.
- G. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
- H. ASHRAE 85 - Automatic Control Terminology for Heating, Ventilating, Air Conditioning.
- I. IEEE 802.15.4 - Standard for Low Rate Wireless Networks
- J. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- K. ANSI/ASTM B32 - Solder Metal.
- L. ASTM B280 - Seamless Copper Tube for Air Conditioning & Refrigeration Field Service.
- M. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
- N. FCC CFR 47 - Radio Frequency Devices.
- O. Federal Information Processing Standards (FIPS) Publication 197 - AES-128 Advanced Encryption Standard.

- P. Federal Information Processing Standards (FIPS) Publication 198 - HMAC Keyed Hash Message Authentication Code.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage, and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.
- B. Factory-Mounted Components: Where control devices specified in this section are indicated to be factory mounted on equipment, arrange for shipping control devices to unit manufacturer.

1.4 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

- A. Automatic Dampers.

1.5 AGENCY AND CODE APPROVALS

- A. All products shall have the following agency approvals. Provide verification that the approvals exist for all submitted products with the submittal package.
 - 1. UL-916; Energy Management Systems.
 - 2. C-UL listed to Canadian Standards Association C22.2 No. 205-M1983 "Signal Equipment."
 - 3. EMC Directive 89/336/EEC (European CE Mark).
 - 4. FCC, Part 15, Subpart J, Class A Computing Devices.

1.6 ACRONYMS

- A. Acronyms used in this specification are as follows:
 - 1. B-AAC - BACnet Advanced Application Controller
 - 2. B-ASC - BACnet Application Specific Controller
 - 3. BTL - BACnet Testing Laboratories
 - 4. DDC - Direct Digital Controls
 - 5. FMCS - Facility Management and Control System
 - 6. GUI - Graphic User Interface
 - 7. IBC - Interoperable BACnet Controller
 - 8. IDC - Interoperable Digital Controller
 - 9. LAN - Local Area Network
 - 10. NAC - Network Area Controller
 - 11. ODBC - Open DataBase Connectivity
 - 12. WNAC - Wireless Network Area Controller
 - 13. OOT - Object Oriented Technology
 - 14. OPC - Open Connectivity via Open Standards
 - 15. PICS - Product Interoperability Compliance Statement
 - 16. TCC - Temperature Control Contractor
 - 17. TCS - Temperature Control System
 - 18. WAN - Wide Area Network
 - 19. WBI - Web Browser Interface

1.7 SUMMARY

- A. All labor, material, equipment and software not specifically referred to herein or on the plans that is required to meet the intent of this specification shall be provided without additional cost to the Owner.
- B. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.

1.8 SYSTEM DESCRIPTION

- A. The entire TCS shall be comprised of a network of interoperable, standalone digital controllers communicating via the following protocol to an NAC. Temperature Control System products shall be as specified below.
- B. Provide materials and labor necessary to connect factory-supplied control components.

1.9 SOFTWARE LICENSE AGREEMENT

- A. The Owner shall be the named license holder of all software and applications associated with any and all incremental work on the project(s). In addition, the Owner shall receive ownership of all job-specific configuration documentation, data files, configuration tools, and application-level software developed for the project. This shall include, but is not limited to, all custom, job-specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN/WAN/intranet and/or Internet connected routers and devices. Provide the Owner with all required IDs and passwords for access to any component or software program. The Owner shall determine which organizations shall be named in the SI organization ID ("**orgid**") of all software licenses. Owner shall be free to direct the modification of the "**orgid**" in any software license, regardless of supplier.

1.10 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to ensure that the Work will be carried out in an orderly fashion. It is this Contractor's responsibility to check the Contract Documents for possible conflicts between the Work of this section and that of other crafts in equipment location; pipe, duct and conduit runs; electrical outlets and fixtures; air diffusers; and structural and architectural features.

1.11 WARRANTY

- A. Refer to Section 230500 for warranty requirements.
- B. Within the warranty period, any defects in the work provided under this section due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by this Contractor at no expense to the Owner.
- C. Warranty requirements include furnishing and installing all FMCS software upgrades issued by the manufacturer during the one-year warranty period.

- D. Update all software and back-ups during warranty period and all user documentation on the Owner's archived software disks.

1.12 WARRANTY ACCESS

- A. The Owner shall grant to this Contractor reasonable access to the TCS and FMCS during the warranty period.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Verify that systems are ready to receive work. Beginning of installation means installer accepts existing conditions.
- B. Install system and materials in accordance with manufacturer's instructions.
- C. Verify locations of wall-mounted devices (such as thermostats, temperature and humidity sensors, and other exposed sensors) with drawings and room details before installation. Coordinate mounting heights to be consistent with other wall-mounted devices. Maximum height above finished floor shall not exceed 48".
- D. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room.
- E. After completion of installation, test and adjust control equipment.
- F. Check calibration of instruments. Recalibrate or replace.
- G. Furnish and install conduit, wire, and cable per the National Electric Code, unless noted otherwise in this section. All hardware, software, equipment, accessories, wiring (power and sensor), relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational FMCS system, but not shown on the electrical drawings, are the responsibility of the TCC.
- H. Remodeling:
 - 1. All room devices as indicated on the drawings shall be removed by this Contractor. The Contractor shall also prepare the wall for finishes. Preparing the wall shall include patching old anchor holes (after the anchoring device has been removed) and sanding the wall to remove old paint outlines remaining from original devices. The wall shall be painted to match the existing wall prior to the installation of the new room device. If wall covering requires patching, the Contractor shall furnish new wall covering to match existing. If new wall covering is not available to match existing, the Contractor shall furnish a white acrylic or Plexiglas plate, 1/4" thick and sized to cover the void.

I. Labels For Control Devices:

1. Provide labels indicating service of all control devices in panels and other locations.
2. Labels may be made with permanent marking pen in the control panels if clearly legible.

3.2 PREPARATION FOR BALANCING

- A. Verify that all dampers are in the position indicated by the controller (e.g., open, closed or modulating).
- B. Check the calibration and setpoints of all controllers.
- C. Check the locations of all thermostats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
- D. Check that all sequences operate as specified. Verify that no simultaneous heating and cooling occurs, unless specified. Observe that heating cannot begin at TAB reheat terminals until the unit is at the minimum CFM.
- E. Verify the operation of all interlock systems.

3.3 TEST AND BALANCE COORDINATION

- A. The Contractor shall furnish a single set of all tools necessary to interface to the control system for test and balance purposes.
- B. The tools used during the test and balance process shall be returned at the completion of the testing and balancing.

3.4 DEMONSTRATION AND ACCEPTANCE

- A. At completion of installation, provide four hours minimum instruction for operators. Demonstrate operation of all controls and systems. Describe the normal operation of all equipment.

3.5 INSTALLATION OF SENSORS

- A. Install sensors in accordance with the manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for the environment within which the sensor operates.
- C. 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.
- D. Averaging sensors and low limits shall be installed at the top of the assembly with the element on a slight downward incline away from the sensor making a serpentine pattern over the cross-sectional area with elements spaced not over 12" apart and within 6" of the top and bottom of the area.
- E. All pipe-mounted temperature sensors shall be installed in immersion wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.

- F. Install outdoor air temperature sensors on exterior of north wall, complete with sun shield at designated location approved by Architect/Engineer. TCC shall prime and paint the device enclosure. Color selection by Architect.

END OF SECTION

SECTION 233100 - DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Galvanized Ductwork
- B. Ductwork Sealants
- C. Rectangular Ductwork
- D. Round and Flat Oval Ductwork
- E. Exposed Ductwork (Rectangular, Round, or Oval)
- F. Flexible Duct
- G. Leakage Testing
- H. Ductwork Penetrations
- I. Duct Cleaning
- J. Painting

1.2 REFERENCES: Conform to all applicable requirements of the following publications:

- A. ADC Flexible Duct Performance and Installation Standards, 3rd Edition 1996.
- B. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- C. ANSI/AWS A5.11M (1997) - Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding.
- D. ASHRAE - Handbook Systems and Equipment; Chapter 19 - Duct Construction.
- E. ASHRAE - Handbook Fundamentals; Chapter 21 - Duct Design.
- F. ASHRAE 170 (latest published edition) - Ventilation of Health Care Facilities.
- G. ASTM A90 - Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
- H. ASTM A167- Stainless & Heat-Resisting Chromium-Nickel Steel Plate, Sheet, & Strip.

- I. ASTM A653 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- J. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
- K. ASTM B209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- L. ASTM E90-02 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
- M. ASTM E413-87 - Classification for Rating Sound Insulation.
- N. AWS A5.14M (1997) - Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods.
- O. AWS D9.1M/D9.1 - Sheet Metal Welding Code.
- P. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.1.
- Q. IECC - International Energy Conservation Code (latest published edition)
- R. NADCA ACR - Assessment, Cleaning, and Restoration of HVAC Systems.
- S. NADCA Standard 05 - Requirements for the Installation of Service Openings in HVAC Systems.
- T. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
- U. NFPA 90B - Installation of Warm Air Heating and Air- Conditioning Systems.
- V. NFPA 96 - Ventilation Control and Fire Protection of Commercial Cooking Equipment.
- W. SCAQMD Rule 1168 - South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications.
- X. SMACNA - Air Duct Leakage Test Manual.
- Y. SMACNA - HVAC Duct Construction Standards.
- Z. SMACNA - Phenolic Duct Construction Standard 022.
- AA. SMACNA - Round Industrial Duct Construction Standards - 1999 Edition.
- BB. UL 181 - Factory-Made Air Ducts and Air Connectors.
- CC. UL 181A - Closure Systems for Use with Rigid Air Ducts and Air Connectors

- DD. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors.
- EE. UL 1978 - Standard for Grease Ducts.
- FF. UL 2221 - Standard for Tests of Fire Resistive Grease Duct Enclosure Assemblies.
- GG. USGBC - Leadership in Energy and Environmental Design (LEED) Rating System.
- HH. CMC - California Mechanical Code
- II. CBC - California Building Code

1.3 SUBMITTALS

- A. Submit shop drawings per Section 230500.
- B. Submittals in this Section demonstrate compliance with duct fabrication standards and product requirements.
- C. Duct Layout Drawings (Coordination Input):
Prepare detailed duct layout drawings indicating proposed routing, fittings, elevations, dimensions including insulation thickness, hangers, access doors, and coordination with structural and architectural elements. These drawings are intended to serve as the ductwork basis for the coordination drawing process defined in Section 230500. Duct layout drawings may be submitted for general conformance with design intent when requested, but will not be reviewed for full multi-trade coordination. Duct layout drawings are not coordination drawings and do not relieve the Contractor of responsibility to comply with Section 230500.
 - 1. Duct layout drawings shall include, at a minimum, the following information: 1/4" minimum scale complete with the following information:
 - 2. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
 - 3. Differentiate ducts that are wrapped. Include insulation thickness, type of insulation, and acoustical lagging.
 - 4. Room names and numbers, ceiling types, and ceiling heights.
 - 5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.
 - 6. Verify clearances and interferences with other trades prior to preparing drawings. IMEG will provide electronic copies of ventilation drawings for contractor's use if the contractor signs and returns the "Electronic File Transfer" waiver. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for this submittal. Refer also to Section 230500.
- D. Duct Leakage Test Summary Report: Upon completion of the pressure test described in Part 3, the Contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.

1.4 DEFINITIONS

- A. Duct Sizes shown on drawings are inside clear dimensions. Maintain clear dimensions inside any lining.
- B. Transitions are generally not shown in single-line ductwork. Where sizes change at a divided flow fitting, the larger size shall continue through the fitting.
- C. Exterior Duct: Ductwork located outside the conditioned envelope including exposed ductwork above the roof, outside exterior walls, in attics above insulated ceilings, inside parking garages, and crawl spaces.
- D. Interior Duct: Ductwork located within the conditioned envelope including return air plenums and indirectly conditioned spaces.

1.5 COORDINATION DRAWINGS

- A. Comply with coordination drawing requirements of Section 230500. Provide ductwork layout information necessary to support the overall coordination drawing process. Ductwork shall serve as the baseline system for coordination with piping, electrical, fire protection, and other trades. Duct layout drawings prepared under this Section may be used as the ventilation contractor's coordination file and incorporated into the composite coordination drawings package required by Section 230500.
- B. Duct drawings shall be at 1/4" minimum scale complete with the following information:
 - 1. Actual duct routing, ductwork fittings, actual sheet metal dimensions including insulation liner and wrap, duct hanger and support types, ductwork accessories, etc. with lengths and weights noted.
 - 2. Differentiate ducts that are lined or wrapped. Include insulation thickness, type of insulation, and acoustical lagging.
 - 3. Location and size of all duct access doors.
 - 4. Room names and numbers, ceiling types, and ceiling heights.
 - 5. Indicate location of all beams, bar joists, etc. along with bottom of steel elevations for each member.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS AND SUPPORTS

- A. Rectangular Duct - Single Wall:
 - 1. General Requirements:
 - a. All ductwork gauges and reinforcements shall be as listed in SMACNA Duct Construction Standards Chapter 2. Where necessary to fit in confined spaces, furnish heaviest duct gauge and least space consuming reinforcement.
 - b. Transitions shall not exceed the angles in Figure 4-7.

B. Round and Flat Oval Spiral Seam Ductwork - Single Wall:

1. Conform to applicable portions of Rectangular Duct Section. Round or flat oval ductwork may be substituted for rectangular ductwork where approved by the Architect/Engineer. The spiral seam ductwork shall meet the standards set forth in this specification. The ductwork shall meet or exceed the specified cross-sectional area and insulation requirements. The substitution shall be coordinated with all other trades prior to installation.
2. Flat oval duct in negative pressure applications shall have flat sides reinforced as required for rectangular ducts of the same gauge with dimensions equal to the flat span of the oval duct.
3. 90-degree elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
4. Duct and fittings shall meet the required minimum gauges listed in Chapter 3 of the SMACNA requirements for the specified pressure class. Ribbed and lightweight duct are not permitted.
5. Ductwork shall be suitable for velocities up to 2,000 fpm.
6. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.
7. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.
8. Ducts with minor axis less than 22" shall be spiral seam type. Larger ducts may be rolled, longitudinal welded seam type. SMACNA seams RL-2 and RL-3 are not permitted.
9. Reinforce flat oval ducts with external angles. Internal tie rods are permitted only as indicated for rectangular ductwork.

C. Round Snap-Lock Seam Ductwork - Single Wall:

1. Factory sealed snap-lock pipe. Transverse and longitudinal seams shall contain factory-applied self-sealing EPDM and co-polymer gasket. Snap-lock shall conform to SMACNA RL-8. Duct and gasket material shall meet the flame/smoke spread rating of 25/50 per ASTM-E84.
2. G-60 galvanized coating meeting ASTM A653 and ASTM A90 G-90 galvanized steel aluminum meeting ASTM B209 Alloy 3003 Temper H14 304 stainless steel meeting ASTM A480 2B Finish.
3. Snap-lock seams are only permitted on systems between -1"w.c. and 2"w.c. pressure class.
4. 90-degree elbows shall be smooth radius or have a minimum of five sections with mitered joints and R/D of at least 1.5.
5. Duct and fittings shall meet the required minimum gauges listed in Chapter 3 of the SMACNA requirements for the specified pressure class.
6. Divided flow fittings may be made as separate fittings or factory installed taps with sound, airtight, continuous welds at intersection of fitting body and tap.
7. Spot weld and bond all fitting seams in the pressure shell. Coat galvanizing damaged by welding with corrosion resistant paint to match galvanized duct color.
8. Manufacturers:
 - a. GreenSeam Industries.

D. Hangers and Supports General Requirements:

1. Hanger and support materials shall be as defined within Materials and Application Specific section below.
 - a. Aircraft cable and slip cable hangers are acceptable for ducts up to 18" diameter. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. Corner saddles are required when supporting rectangular ductwork.
 - b. Manufacturers; Supports:
 - 1) Gripple
 - 2) Ductmate
 - 3) Duro Dyne
 - 4) Architect/Engineer approved
 - c. Aircraft cable with 2-point support in standard horseshoe arrangement. Protective sleeve tubing shall be used on the cable when supporting duct with exterior insulation. 8'-0" OC and as required by CMC/UMC and SMACNA guidelines.
2. Integral Corner Connector Hanger: Integral hanger and corner assembly for use with TDC/TDF style duct flanges. Die stamped offset hanger connects to the flanged corner assembly. For use with aircraft cable or 1/4" or 3/8" diameter threaded rods. Tested to hold up to 1,400 lbs.. Install per manufacturer's ratings and instructions.
 - a. Manufacturers; Supports:
 - 1) EZ Hanger

2.2 MATERIAL AND APPLICATION SPECIFIC

A. Galvanized Steel:

1. General Requirements:
 - a. Duct and reinforcement materials shall conform to ASTM A653 and A924.
 - b. Interior Ductwork and reinforcements: G60 galvanized (0.60 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise.
 - c. Exterior Ductwork: G90 galvanized (0.90 ounces per square foot total zinc coating for two sides per ASTM A90) unless noted otherwise. G60 is not acceptable for exterior use.
 - d. Ductwork reinforcement shall be of galvanized steel.
2. Duct Hangers and Support Material:
 - a. Ductwork hangers and supports shall be of galvanized or painted steel.
 - b. All fasteners shall be galvanized or cadmium plated.

- c. Elbows up to 30 degrees shall be mitered two-piece type. Elbows 31 degrees to 50 degrees shall be mitered three-piece type. Elbows 51 degrees to 90 degrees shall be mitered five-piece type. All elbows shall have a minimum centerline R/D of 1.5. Elbows 10" in diameter and smaller may be die-formed.
- d. Expanders in horizontal ducts shall be eccentric type with a minimum length of (diameter change x 10) and shall maintain a positive pitch for drainage to the fume hood or exhaust outlet. Expanders in ducts over 30 degrees from horizontal shall be concentric with a minimum length of (diameter change x 5).
- e. Ducts shall maintain the maximum possible pitch toward their inlets unless a different drainage location is indicated on the drawings. If at least 1/8" per foot pitch cannot be maintained, notify the Architect/Engineer before installing ductwork or other items with which ductwork may conflict.
- f. All welds shall conform to AWS D9.1M. Welds shall be Gas Tungsten Arc Weld (TIG) or Gas Metal Arc Weld (MIG) type. All filler metal shall conform to AWS A5.9 or A5.22 and be AWS Classification ER308L or ER308LSi with a carbon content of not over 0.03%.
- g. Supports shall not penetrate duct surfaces. Ductwork shall be completely leak-tight from the inlet to the discharge to the atmosphere, at pressures up to 10" w.g.. Install caps to seal the ductwork for pressure testing. Plug all spray and drain connections when testing ductwork.
- h. Where flanged joints are indicated, they shall have 1/4" "Gore-Tex Joint Sealant" gaskets (W. L. Gore & Associates, Industrial Products Division, 100 Airport Road, Box 1550, Elkton, MD 21921 (410) 392-4440 or (410) 392-3200). PTFE gaskets are also acceptable.
- i. Furnish one 50' spool of gasket material or 10 spare gaskets of each size used to the Owner for future use.

B. Fire Resistive Ductwork and Accessories

1. General Requirements:

- a. Furnish and install a complete system of Duct Type B Fire Resistive Ductwork, including fan enclosures, hangers and accessories, in all areas indicated on the contract documents.
- b. Supply a complete Fire Resistive Duct system in accordance with the Fire Resistive Duct manufacturer's requirements and test approvals. Provide all ductwork, fan enclosures, fittings and accessories to make a complete and operational system in all respects.
- c. Provide an Underwriter's Laboratory (UL), Intertek (ETL), or similar IAS Accredited laboratory classified fire resistive assembly as indicated on the drawings. Ratings are in terms of hourly rating. The assembly shall provide the fire rating for the duct systems per as required herein.
- d. Provide an ASTM E119 listed low profile shaft assembly featuring Duct Type B Fire Resistive Vertical Riser Duct as listed by Intertek FIL-FMF 120-09 and FIL-FMF 120-10 Ductwork shall be Type 304L stainless steel, 16 gauge (1.6 mm) minimum.
- e. Systems shall utilize galvanized or stainless steel with endothermic coating and welded, or flanged and gasketed joints. When reduced or zero-clearance to combustibles is required, one or more layers of insulation, tested and certified to ASTM E136 or ASTM E84, as applicable, are required. Details of the complete assembly shall be submitted by the Contractor for approval.

- f. Ductwork shall be fabricated in accordance to the relevant Fire Resistive Duct manufacturer's construction standards. All details shall be furnished to the contractor for absolute clarity and single source responsibility with the manufacturer of this system. All Fire Resistive Duct shall be Duct Type B tested to fire inside and fire outside in accordance with ISO 6944 (Duct Type A is not acceptable). ASTM E2816 equivalent shall be Condition C or Condition D (Condition A or Condition B is not acceptable).
 - 1) All Fire Resistive Ductwork shall be scheduled on the plans for scope:
 - a) Smoke Control Pressurization and Exhaust Duct shall be 2-4 Hour Duct Type B Fire Rated Duct.
 - b) Supply, return, exhaust duct cross over and collection systems shall be 2-4 Hour Duct Type B Fire Rated Duct.
 - c) Pressurization Life Safety systems shall be 2-4 Hour Duct Type B Fire Rated Duct.
 - d) Vertical risers replacing drywall shafts, ASTM E119 low profile riser-shaft assembly. Approved Intertek (ETL) listing FIL-FMF 120-09 and FIL-FMF 120-10.
- 2. Duct Hangers and Support Material:
 - a. Duct supports and hangers are an integral part of the Fire Resistive Duct System and as such the design of the hanger system shall be designed by the Fire Resistive Duct manufacturer.
 - b. The use of straps or cable type hangers are not allowed on Fire Resistive Duct systems.
- 3. Acceptable Manufacturers
 - a. Flambar/Conquest Firespray

2.3 DUCTWORK SEALANTS

- A. One-part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20F to +175F, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30F to +175F and 2000-hour minimum UV resistance per ASTM G-53.
- B. Two-part joint sealers shall consist of a minimum 3" wide mineral-gypsum compound impregnated fiber tape and a liquid sealant. Sealant system shall meet the following requirements: maximum 48-hour cure time, service temperature of 0F to 200F, resistant to mold, mildew, and water, flame spread rating below 25 and smoke developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Joint sealers for use on exterior weather exposed ductwork shall be rated for -30F to +175F and 2000-hour minimum UV resistance per ASTM G-53.
- C. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-inch wide, listed and marked UL 181A-P, having minimum 60 oz/inch peel adhesion to steel, and service temperature range from -20F to +250F.

- D. Adhesives and Sealants: All sealers, adhesives, and sealants shall comply with the low emitting material limits of the following standards:
1. LEED v4 - Low Emitting Materials - Adhesives and Sealants.
 2. CDPH Standard Method V1.1-2010 - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions VOC from Indoor Sources Using Environmental Chambers Version 1.1.
 3. South Coast Air Quality Management District Rule 1168 - Adhesive and Sealant Applications. All adhesives and sealants wet-applied on site shall comply with the applicable chemical content requirements of SCAQMD Rule 1168.
 4. South Coast Air Quality Management District Rule SCAQMD 1113 - Wet Applied Paints and Coatings. All paints and coatings wet-applied on site must meet the applicable VOC limits of SCAQMD Rule 1113.
- E. Where pressure sensitive tape is called for on drawings and specifications for sealing flexible ductwork, tape shall be minimum 2.5-inch wide, UL 181 B-FX listed, and marked tape having minimum 60 oz/inch peel adhesion to steel and service temperature range from -20F to +250F.
1. Manufacturers, Pressure-Sensitive Tape:
 - a. Venture Tape 1581A
 - b. Compac #340
 - c. Scotch Foil Tape 3326
 - d. Polyken 339

2.4 FLEXIBLE DUCT

- A. Flexible duct shall be listed and labeled as UL 181 Class 1 Air Duct Material, and shall comply with NFPA 90A and 90B, and meet GSA, FHA and other U.S. Government agency standards. Flexible duct shall bear the ADC Seal of Certification.
- B. Flame Spread/Smoke Developed: Not over 25/50.
- C. Stretch all flexible duct to prevent sags and reduce air friction. Shorten and reinstall all sagging or loose flexible duct. Avoid sharp elbows. Elbows shall maintain 1.5 diameter centerline turning radius.
- D. Install per the SMACNA Flexible Duct Manual. Secure inner layer with draw band. Wrap with pressure sensitive tape for protection prior to installing draw band. Pressure sensitive tape alone is not acceptable.
- E. Standard:
1. Flexible duct shall have corrosion-resistant wire helix, bonded to an inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2", 3/4 lb/cf density fiberglass insulation blanket, sheathed in a vapor barrier of metalized polyester film laminated to glass mesh.

2. Flexible duct shall have polymer wire helix, bonded to an inner liner that prevents air from contacting the insulation, covered with minimum 1-1/2" thick, 3/4 lb/cf density fiberglass insulation blanket, sheathed in a vapor barrier of polyester film laminated to glass mesh. Usage: MRI rooms.
3. Usage:
 - a. Take-offs from supply ducts to inlets of terminal air boxes. Do not exceed 36" in length.
 - b. Connections to air inlets and outlets. Do not exceed 5'-0", 6'-0" in length.

F. Radius Forming Elbows:

1. Flexible plastic radius forming elbow for use with flexible ducts to create 90deg elbow. One size for 6" to 16" diameter ducts. UL listed for return plenum spaces.
2. Usage: All supply air terminals with flexible ductwork connection.
3. Installation: Attach to flex duct and secure draw bands without crushing flex duct to form smooth radius elbow. Suspend radius forming elbow to structure. Install per manufacturer's instructions.
4. Acceptable Manufacturers:
 - a. Hart & Cooley - Smartflow
 - b. Thermaflex - Flexflow
 - c. Titus - Flexright

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide openings in ducts for thermometers and controllers.
- B. Locate ducts with space around equipment for normal operation and maintenance.
- C. Do not install ducts or other equipment above electrical switchboards or panelboards. This includes a dedicated space extending 25 feet from the floor to the structural ceiling with width and depth equal to the electrical equipment. Unless intended to serve these rooms, do not install any ductwork or equipment in electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms.
- D. Provide temporary closures of metal or taped polyethylene on open ducts to prevent dust from entering ductwork.
- E. Supply ductwork shall be free of construction debris, and shall comply with Level "B", "C" of the SMACNA Duct Cleanliness for New Construction Guidelines.
- F. Repair all duct insulation and liner tears.
- G. Install manual volume dampers in branch supply ducts so all outlets can be adjusted. Do not install dampers at air terminal device or in outlets, unless specifically shown.

- H. Insulate terminal air box reheat coils. Seal insulation tight to form a tight vapor barrier.
- I. Install flexible duct in accordance with the ADC Flexible Duct Performance and Installation Standards.
- J. Install all exterior ductwork per SMACNA Fig. 6-3. Where drawings do not indicate otherwise, ductwork seams and joints shall be sealed watertight and pitched to shed water.
- K. Support all duct systems in accordance with the SMACNA HVAC Duct Construction Standards: Metal and Flexible and the SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, where applicable. Refer to Section 230550 for seismic requirements.
- L. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by California Building Codes.
- M. Adhesives, sealants, tapes, vapor retarders, films, and other supplementary materials added to ducts, plenums, housing panels, silencers, etc. shall have flame spread/smoke developed ratings of under 25/50 per ASTM E84, NFPA 255, or UL 723.
- N. All duct support shall extend directly to building structure. Do not support ductwork from pipe hangers unless coordinated with piping contractor prior to installation. Do not allow lighting or ceiling supports to be hung from ductwork or ductwork supports.

3.2 DUCTWORK SEALING

- A. General Requirements:
 - 1. Openings, such as rotating shafts, shall be sealed with bushings or similar.
 - 2. Pressure sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification.
 - 3. All connections shall be sealed including, but not limited to, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed.
 - 4. Mastic-based duct sealants shall be applied to joints and seams in minimum 3 inch wide by 20 mil thick bands using brush, putty knife, trowel, or spray, unless manufacturer's data sheet specifies other application methods or requirements.
- B. All ducts systems, regardless of pressure class, shall be Seal Class A as defined by Section 5-1 of SMACNA HVAC Air Duct Leakage Test Manual per the Energy Code, unless specifically noted otherwise. Seal Class A shall include sealing of all transverse joints, longitudinal seams, and duct wall penetrations with welds, gaskets, mastics, or fabric-embedded mastic system. Joints are inclusive of, but not limited to, girth joints, branch and sub-branch intersections, duct collar tap-ins, fitting subsections, louver and air terminal connections to ducts, access door and access panel frames and jambs, duct, plenum, and casing abutments to building structures.
- C. Double-wall ductwork: Install insulation end fittings at all transitions from double to single-wall construction.

D. Special Requirements for Dedicated Outside Air Systems (DOAS):

1. Apply aluminum-based adhesive sealant tape at non-flanged joints on ducts serving dedicated outside air supply (DOAS) and exhaust system in addition to Class A sealant.
2. Apply aluminum-based adhesive sealant tape on TAB boxes (all seams and joints of the box and duct connections) serving dedicated outside air supply (DOAS) system.

3.3 TESTING

A. Interior Duct - Less than 3" WG (positive or negative):

1. Leak testing of these pressure classes is not normally required for interior ductwork (inside the building envelope). However, leak tests will be required if, in the opinion of the Architect/Engineer, the leakage appears excessive. All exterior ductwork shall be tested. If duct has outside wrap, testing shall be done before it is applied.
2. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
3. Seal ducts to bring the air leakage into compliance.
4. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

B. Interior Duct - 3" WG and Above (positive or negative):

1. A minimum of 25% of interior ductwork (inside the building envelope) shall be tested. The Owner or designated representative shall select the sections to be tested. If duct has outside wrap, testing shall be done before it is applied.
2. Duct system shall be completely pressure tested. If duct has outside wrap, testing shall be done before it is applied.
3. Duct system shall be completely pressure tested or aerosol sealed and tested. If duct has outside wrap, testing shall be done before it is applied.
4. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
5. Seal ducts to bring the air leakage into compliance.
6. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

C. Exterior Duct - 1/2" WG and Above (positive or negative):

1. All exterior ductwork (outside the building envelope) shall be completely pressure tested. If duct has outside wrap, testing shall be done before it is applied.
2. All exterior ductwork (outside the building envelope) shall be completely pressure tested or aerosol sealed and tested. If duct has outside wrap, testing shall be done before it is applied.
3. Leak test shall be at the Contractor's expense and shall require capping and sealing all openings.
4. Seal ducts to bring the air leakage into compliance.
5. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing.

D. Pressure Test Procedure:

1. Testing shall be as listed in the latest edition of the SMACNA HVAC Duct Leakage Manual, with the following additional requirements:
 - a. The required leakage class for Seal Class A, rectangular ducts, shall be 4; round shall be 2.
 - b. Test pressure shall be the specified duct pressure class. Testing at reduced pressures and converting the results mathematically is not acceptable. This is required to test the structural integrity of the duct system.
 - c. If any leak causes discernible noise at a distance of 3 feet, that leak shall be eliminated, regardless of whether that section of duct passed the leakage test.
 - d. All joints shall be felt by hand, and all discernible leaks shall be sealed.
 - e. Totalling leakage from several tested sections and comparing them to the allowable leakage for the entire system is not acceptable. Each section must pass the test individually.
 - f. Contractor shall notify the Architect/Engineer five business days prior to pressurizing ductwork for testing. Failure to notify the Architect/Engineer of pressure testing may require the contractor to repeat the duct pressure test after proper notification.
 - g. Upon completion of the pressure test, the contractor shall submit an air duct leakage test summary report as outlined in the SMACNA HVAC Duct Leakage Test Manual.
 - h. All access doors, taps to terminal air boxes, and other accessories and penetrations must be installed prior to testing. Including terminal air boxes in the test is not required.
 - i. Positive pressure leakage testing is acceptable for negative pressure ductwork.

E. Aerosol Sealed and Tested Procedure:

1. Duct Preparation:
 - a. Inspect air distribution systems for major leakage sites and significant accumulation of debris.
 - b. Remove all debris and significant dust and dirt (greater than 1/8 inch deep) in air distribution system using NADCA approved duct cleaning method.
 - c. Ensure adequate structural support for new and existing ductwork, including structural integrity of all mechanical duct joints and transitions per SMACNA standards.
 - d. Temporarily remove or protect from aerosol particles building controls, fire and smoke sensors as recommended by manufacturer.
 - e. Temporarily disable fire alarms and notify appropriate authorities.
 - f. Temporarily isolate air-moving equipment and block off air inlets and outlets, and other devices and appurtenances as recommended by the manufacturer.
 - g. Protect occupied spaces from aerosol particles using manufacturer procedures.
 - h. All work shall be done in a substantial and workmanlike manner by factory trained technicians.
2. Duct Sealing:
 - a. Repair all major leakage sites greater than 1/2 inch across using mastic and fiberglass mesh tape per SMACNA standards.

- b. Mastic and fiberglass mesh tape shall meet UL 181 standards.
 - c. Seal existing ductwork from the inside using automated aerosolized sealant injection.
 - 1) Manufacturer: Aeroseal LLC, 225 Byers Rd., Miamisburg, OH 45342, 937-428-9300, www.aeroseal.com
 - 2) Application must be performed by a manufacturer approved service provider.
 - 3) Sealant shall comply with UL Outline Scope 1381.
 - 4) Sealant must cure with 2 hours with no VOC off-gassing thereafter.
 - 5) Sealant shall remain elastic after curing.
 - 6) Sealant shall be deposited substantially at areas of leakage only.
 - d. Provide pre-sealing, post-sealing and sealing profile reports for all duct sections sealed.
 - e. Repair all injection and test holes in existing ductwork using patching plates sealed tight per SMACNA standards.
 - f. Any injection ports in duct board shall be made and repaired using pumpkin-cuts.
 - g. Any insulation (internal or external) shall be replaced on the patching plate.
3. Duct Testing:
- a. Provide pre-sealing and post-sealing leakage profile reports indicating percentage reduction of leakage for supply, return and exhaust ductwork and shafts.
 - b. Use manufacturer calibrated blower fan box with digital manometer to measure leakage before and after sealing.
 - c. Following completion of air handling unit installations, duct repairs, and duct sealing, test all ductwork to ensure that the air distribution system is properly sealed.
 - 1) The supply ducts shall have air losses of less than 3% of the total air flow volume measured at the fan or air-moving device.
 - 2) The return ducts shall have air losses of less than 3% of the total air flow volume measured at the fan or air-moving device.
 - 3) The exhaust ducts shall have air losses of less than 5% of the total air flow volume measured at the fan or air-moving device.
 - 4) Ducts shall be leak tested at a static pressure that is as close as possible to the system average operating static pressure. Duct test pressure should not exceed the lesser of the duct static pressure construction class, the duct system design static pressure or 2.5 in. w.g.
4. Duct Reassembly and Cleanup:
- a. Reinstall building controls and smoke detectors.
 - b. Enable fire alarms and notify appropriate authorities.
 - c. Remove blocking, reinstall grills and registers, and enable air handling fans.
 - d. Cleanup sealant residue that may have adhered to surfaces in occupied areas as recommended by the Manufacturer.
 - e. All work shall be done in a substantial and workmanlike manner by factory-trained technicians
5. Warranty:
- a. The Contractor shall warrant that the aerosol sealant application will be free of defects for a period of 3 years from date of the sealing application. If defects should occur during this period, the Contractor shall repair or replace the defective duct seals, including the direct labor costs for performing the repair or replacement, at no additional cost to the Owner.

3.4 DUCTWORK CLEANING

A. General:

1. This section applies to the cleaning of ductwork and HVAC system components.
2. The HVAC system cleaning contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA) or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.
3. The HVAC system cleaning contractor shall furnish all necessary equipment, materials, and labor to adequately perform the specified services.
4. The HVAC system cleaning contractor shall be capable of remediation of exposed damaged insulation in air handlers and/or ductwork requiring replacement.
5. Regulatory Requirements:
 - a. Contractor shall submit to the Owner SDS for all chemical products proposed to be used in the cleaning process.

B. Perform the services specified here in accordance with current NADCA standards.

C. System Component Inspections and Site Preparations:

1. Prior to beginning any cleaning work, perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment needed. The cleanliness inspection should include air handling units, other air moving equipment, and ductwork. In systems with multiple air handling units, a representative sample of the units should be inspected.
2. Coordinate any system shutdowns with the Owner a minimum of 24 hours in advance of any needed shutdowns.
3. The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification, or other debris. Follow the Owner's infection control policy where contamination is suspected and/or where even small amounts of contaminant may be of concern.
4. Damaged system components found during the inspection shall be documented and brought to the attention of the Owner and Architect/Engineer.
5. Conduct a site evaluation, and establish a specific, coordinated plan detailing how each area of the building will be protected during each phase of the project.

D. HVAC System Cleaning Requirements:

1. Collect debris removed during cleaning and take precautions to avoid dispersing debris from cleaning operations outside the HVAC system.
2. Use HEPA filters if particulate collection equipment exhausts inside the building.
3. When particulate collection equipment exhausts outside the building, precautions shall be taken to locate the equipment downwind and away from all air intakes and other points of entry into the building.
4. Cleaning operations shall be undertaken only with particulate collection equipment in place, including adequate filtration to contain debris removed from the HVAC system.
5. Take measures to control odors, mist, and vapors during the cleaning process.

6. All HVAC system components must be visibly clean as defined in the NADCA Standards.
7. Volume dampers, control dampers, and other mechanical devices inside the HVAC system must have their positions marked prior to cleaning and, upon completion, must be restored to their marked positions.
8. Service Openings:
 - a. Use existing service openings where possible.
 - b. Create openings where needed. Seal openings per the original duct pressure and leakage classification after use.
 - c. Closures must not significantly restrict or alter the system airflow.
 - d. Closures must be insulated to prevent heat transfer and condensation.
 - e. Openings must not compromise the structural integrity of the system.
 - f. Openings shall conform to applicable NFPA and SMACNA standards, and NADCA Standard 05.
 - g. Do not cut openings in flexible duct. Disconnect flexible duct at the ends as needed for proper cleaning and inspection.
 - h. Clearly mark all service openings that can be reopened and mark their locations in the final report.
9. Clean all connected inlets and outlets.

END OF SECTION

SECTION 233300 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Manual Volume Dampers.
- B. Fire Dampers.
- C. Ceiling Fire Dampers.
- D. Fire/Smoke Dampers.
- E. Control/Fire/Smoke Dampers.
- F. Backdraft Dampers.
- G. Duct Access Doors.

1.2 REFERENCES

- A. AMCA Guide for Commissioning and Periodic Performance Testing of Fire, Smoke and Other Life Safety Related Dampers.
- B. ASTM E477-20 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- C. ASTM E2336-04 - Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems.
- D. NFPA 72 - National Fire Alarm and Signaling Code
- E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
- F. NFPA 90A - Installation of Air-Conditioning and Ventilating Systems.
- G. NFPA 92 - Standard for Smoke Control Systems.
- H. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives.
- I. SMACNA - HVAC Duct Construction Standards (latest edition).
- J. UL 33 - Heat Responsive Links for Fire-Protection Service.
- K. UL 555 - Fire Dampers and Ceiling Dampers.
- L. UL 555C - Ceiling Dampers.

- M. UL 555S - Leakage Rated Dampers for Use in Smoke Control Systems.
- N. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

PART 2 - PRODUCTS

2.1 MANUAL VOLUME DAMPERS

- A. Fabricate in accordance with SMACNA Duct Construction Standards, and as indicated.

2.2 FIRE/SMOKE DAMPERS (FSD)

- A. General:
 - 1. Furnish and install fire/smoke dampers in ducts, where shown on the drawings, at the point where they pass through a fire/smoke partition and in all other locations required by the local Fire Department, the National Fire Protection Association Pamphlet No. 90A, UL 2043, and all other applicable codes.
 - 2. Fire Resistance Rating: Assemblies shall be 1-1/2 hour rated under UL Standard 555 unless noted otherwise on drawings.
 - 3. Airflow Rating: Dynamic rated at 2000 fpm and 4" WC.
- B. Fusible Link: Fire dampers shall be held open by a fusible link rated at 165F unless otherwise called for on the drawings or by local codes.
- C. Access Door: Locate access door in ductwork for visual inspection and on the latch side to replace link easily. Each access door shall have a label with letters at least 1/2" high reading "FIRE/SMOKE DAMPER".

2.3 BACKDRAFT DAMPERS

- A. Gravity backdraft dampers, size 18 inches x 18 inches or smaller, furnished with air moving equipment, may be air moving equipment manufacturer's standard construction.
- B. Fabricate multi-blade, parallel action gravity balanced backdraft dampers of extruded aluminum, with blades of maximum 6 inch width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90-degree stop, and plated steel pivot pin; adjustment device to permit setting for varying differential static pressure.
- C. Models:
 - 1. Ruskin CBD4
 - 2. Arrow 655
 - 3. Safe-Air/Dowco BRL

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Installation Requirements:

1. Install accessories in accordance with manufacturer's instructions.
2. Where duct access doors are located above inaccessible ceilings, provide ceiling access doors. Coordinate location with the Architect/Engineer.
3. Coordinate and install access doors provided by others.
4. Provide access doors for all equipment requiring maintenance or adjustment above an inaccessible ceiling. Minimum size shall be 24" x 24".
5. Provide duct test holes where indicated and as required for testing and balancing purposes.

B. Manual Volume Damper:

1. Provide manual volume dampers at points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts where indicated on drawings and as required for air balancing. Use splitter dampers only where indicated.
2. Provide ceiling access doors for manual volume dampers. When manual volume dampers are located above an inaccessible ceiling and an access door cannot be installed, provide a remote-controlled volume control device for operation of the damper. Coordinate location with the Architect/Engineer.

C. Fire Damper, Fire Smoke Damper, Smoke Damper:

1. Installation:
 - a. Provide fire dampers, combination fire and smoke dampers, and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves and duct connections.
 - b. Provide ceiling access doors for smoke and/or fire dampers. Coordinate location with the Architect/Engineer.
 - c. Provide manufacturer's maintenance instructions to Owner.

END OF SECTION

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SECTION 233416 - CENTRIFUGAL FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. In-line Centrifugal Fans.
- B. Cabinet Fans.
- C. Fan Energy Index (FEI): Fans shall meet or exceed the minimum FEI scheduled at the specified airflow, pressure, and air density (duty point). In no case shall the FEI at the specified duty point fall below 1.0, 1.1.

1.2 REFERENCES

- A. AMCA 99 - Standards Handbook.
- B. AMCA 208 - Calculation of the Fan Energy Index (FEI).
- C. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- E. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- F. ANSI/AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- G. ANSI/AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- H. SMACNA - HVAC Duct Construction Standards (latest edition).

1.3 SUBMITTALS

- A. Submit shop drawings per Section 230500. Include data on all fans and accessories. Submit sound power levels for both fan inlet and outlet at rated capacity. Submit motor ratings and electrical characteristics, plus motor and electrical accessories. Submit multi-speed fan curves including minimum and maximum fan speed with specified operating points clearly plotted. Submit the Fan Energy Index (FEI) at the selected duty point.
- B. Submit operation and maintenance data. Include instructions for lubrication, motor and drive replacement, and spare parts list.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FAN

- A. Fan Description: In-Line Single inlet, single width. backward inclined wheel.
- B. Construction:
 - 1. Wheel: Backward inclined, non-overloading, all aluminum wheel and hub. Dynamically balanced.
 - 2. Housing: Galvanized steel construction with stainless steel or cadmium plated fasteners and galvanized steel belt guard.
- C. Protection:
 - 1. Belt guards with tachometer knockouts on indoor fans. Removable weather covers on outdoor fans.

2.2 CABINET FANS

- A. Housing:
 - 1. Cleaned, phosphatized and painted with enamel or constructed entirely of galvanized steel.
 - 2. Removable access panels for fan removal.
- B. Motors and Drives:
 - 1. Manufacturer:
 - a. Greenheck
 - b. Cook
 - c. Aerovent

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Prime all fan parts after cleaning, but prior to assembly. Apply a second finish coat to all exterior surfaces and all accessible interior surfaces after assembly. Apply rust preventative coating to shafts.
 - 2. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
 - 3. Install flexible connections between fan and ductwork. Install metal bands of connectors parallel with minimum 1" flex between ductwork and fan while running.
 - 4. Provide safety screen where inlet or outlet is exposed. Screens shall meet OSHA regulations for size of openings.

EKLUND at GALES
Peninsula Housing Authority

Permit Set
Jul-10-2026

END OF SECTION

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SECTION 233700 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grilles And Registers.
- B. Louvers.
- C. Goosenecks.

1.2 QUALITY ASSURANCE

- A. Test and rate performance of air inlets and outlets per ASHRAE 70.
- B. Test and rate performance of louvers per AMCA 500L-99.
- C. All air handling and distribution equipment mounted outdoors shall be designed to prevent rain intrusion into the airstream when tested at design airflow and with no airflow, using the rain test apparatus described in Section 58 of UL 1995.

1.3 REFERENCES

- A. AMCA 500-L-12 - Laboratory Methods of Testing Louvers for Rating.
- B. ANSI/ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Inlets and Outlets.
- C. ANSI/ASHRAE/IES Standard 90.1 (latest published edition) - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ASHRAE 170 (latest published edition) - Ventilation of Health Care Facilities.
- E. SMACNA - Duct Construction Standards.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 230500.
- B. Submit schedule of inlets and outlets indicating type, size, location, application, and noise level.
- C. Review requirements of inlets and outlets as to size, finish, and type of mounting prior to submitting product data and schedules of inlets and outlets.

1.5 REGULATORY REQUIREMENTS

- A. Conform to ANSI/NFPA 90A.

- B. Conform to ASHRAE 90.1.

1.6 EXTRA STOCK

- A. Provide clean filters in all filter return grilles at time of installation.
- B. Provide one additional set of replacement filters for all filter return grilles. Deliver to Owner at job site.

PART 2 - PRODUCTS

2.1 AIR TERMINALS - GRILLES AND REGISTERS

- A. Reference to a grille means an air supply, exhaust or transfer device without a damper.
- B. Reference to a register means an air supply, exhaust or transfer device with a damper.
- C. The type of unit, margin, material, finish, etc., shall be as shown on the drawing schedule and suitable for the intended use.
- D. All margins shall be compatible with ceiling types specified (including 'Thin-Line' T-bar lay-in grid system). Any discrepancies in contract documents shall be brought to the attention of the Architect/Engineer, in writing, prior to Bid Date. Submission of Bid indicates ceiling and air inlet and outlet types have been coordinated.
- E. The capacity and size of the unit shall be as shown on the drawings.
- F. All units shall handle the indicated cfm as shown on the drawings while not exceeding an NC level of 25, referenced to 10-12 watts with a 10 dB room effect. Noise in classrooms may not exceed 35 dBA or 55 dBC per ANSI Standard S12.60-2002 and ASHRAE 70.
- G. Screw holes for surface fasteners shall be countersunk for a neat appearance. Provide concealed fasteners for installation in lay-in ceilings and as specified on the drawings.
- H. Manufacturers:
 - 1. Tuttle & Bailey
 - 2. Titus
 - 3. Price
 - 4. Nailor

2.2 LOUVERS - FIXED - ALUMINUM

- A. Louvers shall be minimum 4" deep and constructed of extruded aluminum. Blade, jamb and sill thickness shall be minimum 0.081". Blades shall be spaced at a maximum of 5.1" apart.
- B. Louvers shall be of the drainable blade design with water collected on the leading edge of the blade and diverted to the jamb.
- C. Louvers shall be furnished with aluminum bird screen mounted on the inside surface.

- D. Size, cfm, finish and pressure drop for louvers shall be as scheduled on the drawings.
- E. AMCA Certified performance for 48" x 48" samples with intake airflow of 8,000 cfm shall not exhibit more than 0.19" pressure drop. Maximum water penetration shall be 0.01 ounces per square foot at the scheduled intake velocity based on 15 minute test duration when subjected to a water flow rate of 0.25 gal/min as described under the Water Penetration Test in AMCA 500-L-07.
- F. Contractor shall provide the General Contractor with the correct sizes and locations of all louvers required in masonry walls.
- G. Louvers shall be sealed around perimeter to avoid moisture penetration between the louver frame and wall.
- H. Louvers shall be suitable for duct connection.
- I. Manufacturers:
 - 1. Ruskin - "ELF375DX"
 - 2. Greenheck - ESD "403"

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General Installation Requirements:
 - 1. Install items in accordance with manufacturers' instructions.
 - 2. Install seismic restraints according to SMACNA's "Kitchen Equipment Fabrication Guidelines, Appendix 1, Guidelines for Seismic Restraints for Kitchen Equipment".
 - 3. Check location of inlets and outlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.
 - 4. Install diffusers to ductwork with air tight connections.
 - 5. Flexible ducts shall NOT be joined to flat-oval connections. Provide sheet metal oval-to-round transitions where required.
 - 6. Supply air diffusers in operating rooms (Class B and C surgery) shall be opened and cleaned before the space is used.
 - 7. Supply grille and register blades shall be aimed in the field to provide adequate air distribution in the space. All return grilles and registers blades shall be oriented to minimize sight distance beyond installed device.
- B. Volume Damper:
 - 1. Provide manual volume dampers on duct take-off to diffusers when there are multiple connections to a common duct. Locate volume dampers as far as possible from the air inlet or outlet.
- C. Maintaining Duct Cleanliness:

1. When grilles, registers, and diffusers are installed, Contractor shall prevent construction dust, dirt, and debris from entering ductwork as required by Section 230500.

END OF SECTION

SECTION 234000 - AIR CLEANING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Filters and Filter Media.

1.2 REFERENCES

- A. ANSI/UL 586 - Test Performance of High Efficiency Particulate, Air Filter Units.
- B. ANSI/UL 867 - Standard for Electrostatic Air Cleaners.
- C. ANSI/UL 900 - Test Performance of Air Filter Units.
- D. ANSI/UL 2998 - Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners.
- E. ASHRAE 26 - Guideline for Field Testing of General Ventilation Devices and Systems for Removal Efficiency In-Situ by Particle Size and Resistance to Flow.
- F. ASHRAE 52.2 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter. Appendix J (for MERV-A rating)
- G. ANSI/NFPA 70 - National Electrical Code.

1.3 EXTRA STOCK

- A. Provide a total of three (3) sets of filters for all units.
 - 1. Provide clean filters in all units at time of installation.
 - 2. Provide clean filters in all units at project final completion after all interior finishes are complete.
 - 3. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all products per manufacturers' instructions.
- B. Seal filter media to prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

- C. Do not operate fan systems without filters.
- D. Install static pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and calibrate. Every filter bank, including packaged units, shall have a filter gauge.
- E. Install four (4) high efficiency filter test holes, two upstream and two downstream, at all high efficiency filter banks in air handling units and ductwork (85% efficiency and higher). Coordinate location of test holes with Owner.

END OF SECTION

SECTION 260500 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Requirements applicable to all Division 26 Sections. Also refer to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.
- C. REFERENCES
- D. NFPA 70 - National Electrical Code (NEC) with 2020 Washington Amendments
- E. Washington State Electrical Code - RCW Chapter 19.28

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Electrical Systems.
- B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Electrical Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- D. Description of Systems shall be as follows:
 - 1. Electrical power system to and including luminaires, equipment, motors, devices, etc.
 - 2. Electrical power service system from the Utility Company to and including service entrance equipment, distribution and metering.
 - 3. Grounding system.
 - 4. Fire alarm system.
 - 5. Clock and program system.
 - 6. Security system.
 - 7. Technology Systems as described in the Suggested Matrix of Scope Responsibility.
- E. Work Not Included:
 - 1. Temperature control wiring for plumbing and HVAC equipment (unless otherwise indicated) will be by other Contractors.

1.3 DIVISION OF WORK BETWEEN MECHANICAL, ELECTRICAL, and CONTROL CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described at any location on the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described on the contract documents on bid day. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
1. "Mechanical Contractors" refers to the Contractors listed in Division 21/22/23 of this Specification.
 2. Motor Power Wiring: The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.
 3. Motor Control Wiring: The wiring associated with the remote operation of the magnetic coils of magnetic motor starters or relays, or the wiring that permits direct cycling of motors by means of devices in series with the motor power wiring. In the latter case, the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually connected into the motor power wiring through a manual motor starter.
 4. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, relays, etc., generally represent the types of equipment associated with motor control wiring.
 5. Motor control wiring is single phase and usually 120 volts. In some instances, the voltage will be the same as the motor power wiring. When the motor power wiring exceeds 120 volts, a control transformer is usually used to give a control voltage of 120 volts.
 6. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two-position, as opposed to wiring that directly powers or controls a motor used to drive equipment such as fans, pumps, etc. This wiring will be from a 120-volt source and may continue as 120 volt, or be reduced in voltage (24 volt), in which case a control transformer shall be furnished as part of the temperature control wiring.
 7. Control Motor: An electric device used to operate dampers, valves, etc. It may be two-position or modulating. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages may be encountered.
 8. Low Voltage Technology Wiring: The wiring associated with the technology systems, used for analog or digital signals between equipment.
 9. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation or mounting of telecommunications/technology information outlets.
- C. General:

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractors' responsibilities related to electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been selected and submittals approved. Therefore, the electrical drawings show only known wiring related to such items. All wiring not shown on the electrical drawings, but required for mechanical systems, is the responsibility of the Mechanical Contractor.
2. Where the drawings require the Electrical Contractor to wire between equipment furnished by the Mechanical Contractor, such wiring shall terminate at terminals provided in the equipment. The Mechanical Contractor shall furnish complete wiring diagrams and supervision to the Electrical Contractor and designate the terminal numbers for correct wiring.
3. Control low (24V) and control line (120V) voltage wiring, conduit, and related switches and relays required for the automatic control and/or interlock of motors and equipment, including final connection, are to be furnished and installed under Divisions 21, 22 and 23. Materials and installation to conform to Class 1 or 2 requirements.
4. The Electrical Contractor shall establish electrical utility elevations prior to fabrication and installation. The Electrical Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Luminaires.
 - b. Gravity flow piping, including steam and condensate.
 - c. Sheet metal.
 - d. Cable trays, including access space.
 - e. Other piping.
 - f. Conduits and wireway.

D. Mechanical Contractor's Responsibility:

1. Assumes responsibility for internal wiring of all equipment furnished by the Mechanical Contractor.
2. Assumes all responsibility for miscellaneous items furnished by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.
3. Assumes all responsibility for Temperature Control wiring, if the Temperature Control Contractor is a Subcontractor to the Mechanical Contractor.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Temperature Control Contractor's or Subcontractor's Responsibility:

1. Wiring of all devices needed to make the Temperature Control System functional.
2. Verifying any control wiring on the electrical drawings as being by the Electrical Contractor. All wiring required for the Control System, but not shown on the electrical drawings, is the responsibility of the Temperature Control Contractor or Subcontractor.

3. Coordinating equipment locations (such as PE's, EP's, relays, transformers, etc.) with the Electrical Contractor, where wiring of the equipment is by the Electrical Contractor.

F. Electrical Contractor's Responsibility:

1. Furnishes and installs all combination starters, manual starters and disconnect devices shown on the Electrical Drawings or indicated to be by the Electrical Contractor in the Mechanical Drawings or Specifications.
2. Installs and wires all remote-control devices furnished by the Mechanical Contractor or Temperature Control Contractor when so noted on the Electrical Drawings.
3. Furnishes, installs, and connects all relays, etc., for automatic shutdown of certain mechanical equipment (supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

G. General (Electrical/Technology):

1. "Electrical Contractor" as referred to herein shall be responsible for scope listed in Division 27/28 of this specification when the "Suggested Matrix of Scope Responsibility" indicated work shall be furnished and installed by the EC. Refer to the Contract Documents for this "Suggested Matrix of Scope Responsibility".
2. The purpose of these Specifications is to outline the Electrical and Technology Contractor's work responsibilities as related to Telecommunications Rough-in, conduit, cable tray, power wiring and Low Voltage Technology Wiring.
3. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals approved. Therefore, only known wiring, conduits, raceways and electrical power related to such items is shown on the Technology drawings. Other wiring, conduits, raceways, junction boxes and electrical power not shown on the Technology Drawings but required for operation of the systems is the responsibility of the Technology Contractor and included in said Contractor's bid.
4. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Technology systems, the final installation shall not be until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.
5. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Technology Wiring, installation shall not begin prior to a coordination review of the cable tray shop drawings by the Technology Contractor.

H. Technology Contractor's Responsibility:

1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being furnished and installed by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility".

3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the telecommunications ground bar.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

- A. Provide coordination drawings showing the complete, coordinated installation of mechanical, electrical, plumbing, fire protection, and other systems within available building spaces.
- B. Definitions:
 1. Coordination Drawings: Coordination drawings are defined as composite drawings or models that incorporate work of multiple trades and demonstrate coordinated routing, elevations, and clearances.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
 2. Provide one complete, composite coordination drawing package for each building area, system, or phase demonstrating fully coordinated conditions.
 3. The composite coordination drawing package may be created from multiple trade-specific electronic files; however, the final deliverable shall clearly represent a single coordinated installation.
 4. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.
- C. Participation:
 1. The Contractor shall be responsible for coordinating all trades and preparing coordination drawings.

2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of ventilation drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

D. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

E. General:

1. Provide coordination drawing files to the Architect/Engineer for review of identified conflicts. The Architect/Engineer will not act as the project coordinator and is not responsible for coordination of the work. The Architect/Engineer will review only clearly identified conflicts submitted by the Contractor and will not perform clash detection or coordination. The Architect/Engineer will not compile or reconcile multiple trade files and will rely on the Contractor's composite coordination drawing package.
2. The Contractor remains solely responsible for coordination regardless of any review or comment provided by the Architect/Engineer.
3. A plotted set of coordination drawings shall be available at the project site.

4. Coordination drawings are not shop drawings and are not subject to approval. Receipt of review of coordination drawings does not constitute approval of routing, layout, means, methods, sequencing, or constructability.
5. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
6. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
7. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
8. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
9. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
10. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
11. Complete the coordination drawing process and obtain documented sign-off from all participating trades confirming that coordination drawings have been reviewed and coordinated prior to installation. Sign-off shall consist of signatures on the composite coordination drawing package or a coordination log identifying participating trades and acceptance of the coordinated layout.
12. Do not begin installation of work in an area until coordination drawings for that area are complete and trade sign-offs have been obtained.
13. Submit unresolved coordination conflicts to the Architect/Engineer for direction prior to installation. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination. Conflicts identified after installation due to incomplete coordination shall be corrected at no additional cost to the Owner.
14. Complete the coordination drawing process and obtain sign-off of the drawings by all contractors prior to installing any of the components.
15. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Contractor's Responsibility Prior to Submitting Pricing/Bid Data:

1. The Contractor is responsible for constructing complete and operating systems. The Contractor acknowledges and understands that the Contract Documents are a two-dimensional representation of a three-dimensional object, subject to human interpretation. This representation may include imperfect data, interpreted codes, utility guides, three-dimensional conflicts, and required field coordination items. Such deficiencies can be corrected when identified prior to ordering material and starting installation. The Contractor agrees to carefully study and compare the individual Contract Documents and report at once in writing to the Architect/Engineer any deficiencies the Contractor may discover. The Contractor further agrees to require each subcontractor to likewise study the documents and report at once any deficiencies discovered.
2. The Contractor shall resolve all reported deficiencies with the Architect/Engineer prior to awarding any subcontracts, ordering material, or starting any work with the Contractor's own employees. Any work performed prior to receipt of instructions from the Architect/Engineer will be done at the Contractor's risk.

B. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer are acceptable.

C. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the city of Port Angeles and the State of Washington Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of The Peninsula Housing Authority..
3. If there is a discrepancy between the codes and regulations and these specifications, the Architect/Engineer shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time for this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.
5. All changes to the system made after the letting of the contract to comply with codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.
6. If there is a discrepancy between manufacturer's recommendations and these specifications, the manufacturer's recommendations shall govern.
7. If there are no local codes having jurisdiction, the 2020 National Electrical Code with 2020 Washington Amendments shall be followed.

D. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses, except as noted.

2. Abide by all laws, regulations, ordinances, and other rules of the State or Political Subdivision where the work is done, or as required by any duly constituted public authority.
3. Pay all charges for permits or licenses.
4. Where applicable, all fixtures, equipment and materials shall be listed by Underwriter's Laboratories, Inc. or a nationally recognized testing organization.

E. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of raceways to best fit the layout of the job. Conduit entry points for electrical equipment including, but not limited to, panelboards, switchboards, switchgear and unit substations, shall be determined by the Contractor unless noted in the contract documents.
3. Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc., may not be shown, but where required by other sections of the specifications or required for proper installation of the work, such items shall be furnished and installed.
4. If an item is either shown on the drawings or called for in the specifications, it shall be included in this contract.
5. The Contractor shall determine quantities and quality of material and equipment required from the documents. Where discrepancies arise between drawings, schedules and/or specifications, the greater and better-quality number shall govern.
6. Where used in electrical documents the word "furnish" shall mean supply for use, the word "install" shall mean connect up complete and ready for operation, and the word "provide" shall mean to supply for use and connect up complete and ready for operation.

F. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

1.6 WEB-BASED PROJECT SOFTWARE

- A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.
- B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.
- C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.

- D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.7 SUBMITTALS

Referenced Specification Section	Submittal Item	Coordination Drawing
26 05 13	Wire and Cable	
26 05 17	Electric Heat Trace and Snow Melt	
26 05 23	Manufactured Wiring Assemblies	
26 05 26	Grounding and Bonding	
26 05 33	Conduit and Boxes	+> 1.5"
26 05 35	Surface Raceways	
26 05 36	Cable Trays	Yes
26 05 53	Electrical Identification	
26 09 13	Energy Metering and Management System	
26 09 33	Lighting Control System	
26 20 00	Service Entrance	
26 22 00	Dry Type Transformers	Yes
26 23 00	Low-Voltage Switchgear	Yes
26 24 13	Switchboards	Yes
26 24 16	Panelboards	Yes
26 27 16	Cabinets and Enclosures	Yes
26 27 26	Wiring Devices	Ceiling mount
26 27 29	Electric Vehicle Charging Station	
26 28 11	Arc Reduction Earthing System	
26 28 13	Fuses	
26 28 16	Disconnect Switches	Yes
26 28 21	Contactors	Yes
26 29 23	Variable Frequency Drives	Yes
26 31 00	Solar Photovoltaic Systems	Yes
26 43 00	Surge Protection Devices	
26 51 00	Lighting	Yes
26 51 19	LED Lighting	Yes
28 31 00	Fire Alarm and Detection Systems	Yes
Drawings	Clock System	
Drawings	Photocells, Timeclocks, Relays	

- A. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:

1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number

- c. Contractor's name and address
 - d. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
- a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., electrical, plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data
 - j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Addenda items have been incorporated.
 - 2) Catalog numbers and options match those specified.

- 3) Performance data matches that specified.
 - 4) Electrical characteristics and loads match those specified.
 - 5) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 6) Dimensions and service clearances are suitable for the intended location.
 - 7) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 8) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
 15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
 - a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal, excluding mailing.
 16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

17. Contractor agrees that Shop Drawing Submittals processed by the architect are not Change Orders, that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Architect that the Contractor understands the design concept and demonstrate its understanding by indicating which equipment and material it intends to furnish and install and by detailing the fabrication and installation methods it intends to use.

B. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 26 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 26 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.8 CHANGE ORDERS

- A. Change order work shall not proceed until authorized.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING and MAINTENANCE

- A. Exercise care in transporting and handling to avoid damage to materials. Store materials on the site to prevent damage.
- B. Protect equipment, components, and openings with airtight covers and exercise care at every stage of storage, handling, and installation of equipment to prevent airborne dust and dirt from entering or fouling equipment to include, but not limited to:
1. Distribution equipment - branch panels, distribution panels, switchboards, motor control centers, etc.
 2. Variable frequency drives.
 3. Transformers, ventilated.
 4. Electronic equipment, UPS, harmonic filters, power factor correction.
 5. Lighting luminaires and lighting control systems.

- C. Equipment and components that are visibly damaged or have been subject to environmental conditions prior to building turnover to Owner that could shorten the life of the component (for example, water damage, humidity, dust and debris, excessive hot or cold storage location, etc.) shall be repaired or replaced with new equipment or components without additional cost to the building owner.
- D. Keep all materials clean, dry and free from damaging environments.
- E. Coordinate the installation of heavy and large equipment with the General Contractor and/or Owner. If the Electrical Contractor does not have prior documented experience in rigging and lifting similar equipment, they shall contract with a qualified lifting and rigging service that has similar documented experience. Follow all equipment lifting and support guidelines for handling and moving.
- F. Contractor is responsible for moving equipment into the building and/or site. Contractor shall review site prior to bid for path locations and any required building modifications to allow movement of equipment. Contractor shall coordinate the work with other trades.

1.10 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.
- B. The following network connected equipment shall be equipped with restricted access protocols:
 - 1. Adjustable trip overcurrent protection devices
 - 2. Power monitoring and control
 - 3. Electrical controls
 - 4. Lighting control system
 - 5. Variable frequency drives
 - 6. Fire alarm and automatic detection

1.11 WARRANTY

- A. Provide one-year warranty for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all work in this specification Division shall commence on the date the project is occupied by the Owner, not from the date of completion of the work.
- C. Warranty requirements extend to correction, without cost to the Owner, of all work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage due to defects or nonconformance with contract documents excluding repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.12 INSURANCE

- A. This Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.13 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the manufacturer for which a catalog number is given is the basis for job design and establishes the quality.
- B. Equivalent equipment manufactured by the other listed manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meet all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor assumes all costs incurred as a result of using the offered material, article or equipment, on the Contractors part or on the part of other Contractors whose work is affected.
- D. Voluntary add or deduct prices for alternate materials may be listed on the bid form. These items will not be used in determining the low bidder. This Contractor assumes all costs incurred as a result of using the offered material or equipment on the Contractors part or on the part of other Contractors whose work is affected.
- E. All material substitutions requested after the final addendum must be listed as voluntary changes on the bid form.

1.14 PROJECT COMMISSIONING

- A. The Contractor shall work with the Commissioning Agent (CxA) as described in Section 01 91 00 and 26 08 00 and provide all services as described in the Commissioning Plan.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All items of material having a similar function (e.g., safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers) shall be of the same manufacturer unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 EXCAVATION, FILL, BACKFILL, COMPACTION

A. General:

1. Prior to the commencement of any excavation or digging, the Contractor shall verify all underground utilities with the regional utility locator. Provide prior notice to the locator before excavations. Contact information for most regional utility locaters can be found by calling 811.
2. The Contractor shall do all excavating, filling, backfilling, compacting, and restoration in connection with the work.

B. Excavation:

1. Make all excavations to accurate, solid, undisturbed earth, and to proper dimensions.
2. If excavations are carried in error below indicated levels, concrete of same strength as specified for the foundations or thoroughly compacted sand-gravel fill, as determined by the Architect/Engineer shall be placed in such excess excavations under the foundation. Place thoroughly compacted, clean, stable fill in excess excavations under slabs on grade, at the Contractor's expense.
3. Trim bottom and sides of excavations to grades required for foundations.
4. Protect excavations against frost and freezing.
5. Take care in excavating not to damage surrounding structures, equipment or buried pipe. Do not undermine footing or foundation.
6. Perform all trenching in a manner to prevent cave-ins and risk to workmen.
7. Where original surface is pavement or concrete, the surface shall be saw cut to provide clean edges and assist in the surface restoration.
8. If satisfactory bearing soil is not found at the indicated levels, immediately notify the Architect/Engineer or their representative, and do no further work until the Architect/Engineer or their representative gives further instructions.
9. Excavation shall be performed in all ground conditions, including rock, if encountered. Bidders shall visit the premises and determine the soil conditions by actual observations, borings, or other means. The cost of all such inspections, borings, etc., shall be borne by the bidder.

10. If a trench is excavated in rock, a compacted bed with a depth of 3" (minimum) of sand and gravel shall be used to support the conduit unless masonry cradles or encasements are used.
11. Mechanical excavation of the trench to line and grade of the conduit or to the bottom level of masonry cradles or encasements is permitted, unless otherwise indicated on the electrical drawings.
12. Mechanical excavation of the trench to line and grade where direct burial cables are to be installed is permitted provided the excavation is made to a depth to permit installation of the cable on a fine sand bed at least 3 inches deep.

C. Dewatering:

1. Furnish, install, operate and remove all dewatering pumps and pipes needed to keep trenches and pits free of water.

D. Underground Obstructions:

1. Known underground piping, conduit, feeders, foundations, and other obstructions in the vicinity of construction are shown on the drawings. Review all Bid Documents for all trades on the project to determine obstructions indicated. Take great care in making installations near underground obstructions.
2. If objects not shown on the drawings are encountered, remove, relocate, or perform extra work as directed by the Architect/Engineer.

E. Fill and Backfilling:

1. No rubbish or waste material is permitted for fill or backfill.
2. Provide all necessary sand and/or CA6 for backfilling.
3. Native soil materials may be used as backfill if approved by the Geotechnical Engineer.
4. Dispose of the excess excavated earth as directed.
5. Backfill materials (native soil material, sand, and/or CA6) shall be suitable for required compaction, clean and free of perishable materials, frozen earth, debris, earth with a high void content, and stones greater than 4 inches in diameter. Water is not permitted to rise in unbackfilled trenches.
6. Backfill all trenches and excavations immediately after installing of conduit, or removing forms, unless other protection is directed.
7. Around piers and isolated foundations and structures, backfill and fill shall be placed and consolidated simultaneously on all sides to prevent wedge action and displacement. Spread fill and backfill materials in 6" uniform horizontal layers with each layer compacted separately to required density.
8. For conduits that are not concrete encased, lay all conduits on a compacted bed of sand at least 3" deep. Backfill around conduits with sand, in 6" layers and compact each layer.
9. Conduits that are concrete encased or in a ductbank, conduit spacers, and cradles shall be installed on a bed of compacted CA-6 gravel. Refer to conduit section for backfilling and ductbank requirements.
10. Backfill with native soil material (if approved) or sand up to grade for all conduits under slabs or paved areas. All other conduits shall have sand backfill to 6" above the top of the conduit.

11. Place all backfill above the sand in uniform layers not exceeding 6" deep. Place then carefully and uniformly tamp each layer to eliminate lateral or vertical displacement.
12. Where the fill and backfill will ultimately be under a building, floor or paving, each layer of fill shall be compacted to 95% of the maximum density as determined by AASHTO Designation T-99 or ASTM Designation D-698. Moisture content of soil at time of compaction shall not exceed plus or minus 2% of optimum moisture content as determined by AASHTO T-99 or ASTM D-698 test.
13. After backfilling of trenches, no superficial loads shall be placed on the exposed surface of the backfill until a period of 48 hours has elapsed.

F. Surface Restoration:

1. Where trenches are cut through graded, planted or landscaped areas, the areas shall be restored to the original condition. Replace all planting and landscaping features removed or damaged to its original condition. At least 6" of topsoil shall be applied where disturbed areas are to be seeded or sodded. All lawn areas shall be sodded unless seeding is called out in the drawings or specifications.
2. Concrete or asphalt type pavement, seal coat, rock, gravel or earth surfaces removed or damaged shall be replaced with comparable materials and restored to original condition. Broken edges shall be saw cut and repaired as directed by Architect/Engineer.

3.3 ARCHITECT/ENGINEER OBSERVATION OF WORK

A. The contractor shall provide seven (7) calendar days' notice to the Architect/Engineer prior to:

1. Placing fill over underground and underslab utilities.
2. Covering exterior walls, interior partitions and chases.
3. Installing hard or suspended ceilings and soffits.

B. The Architect/Engineer will review the installation and provide a written report noting deficiencies requiring correction. The contractor's schedule shall account for these reviews and show them as line items in the approved schedule.

C. Above-Ceiling Final Observation:

1. All work above the ceilings must be complete prior to the Architect/Engineer's review. This includes, but is not limited to:
 - a. All junction boxes are closed and identified in accordance with Section 260553 Electrical Identification.
 - b. Luminaires, including ceiling-mounted exit and emergency lights, are installed and operational.
 - c. Luminaire whips are supported above the ceiling.
 - d. Conduit identification is installed in accordance with Section 260553 Electrical Identification.
 - e. Luminaires are suspended independently of the ceiling system when required by these contract documents.
 - f. All wall penetrations have been sealed.

2. To prevent the Above-Ceiling Final Observation from occurring too early, the Contractor shall review the status of the work and certify, in writing, that the work is ready for the Above-Ceiling Final Observation.
3. It is understood that if the Architect/Engineer finds the ceilings have been installed prior to this review and prior to seven days elapsing, the Architect/Engineer may not recommend further payments to the contractor until full access has been provided.

3.4 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.
- C. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.
- D. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- E. The instructions shall include:
 1. Maintenance of equipment.
 2. Start-up procedures for all major equipment.
 3. Description of emergency system operation.
- F. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can be present if desired.
- G. Minimum hours of instruction time for each item and/or system shall be as indicated in each individual specification section.
- H. Operating Instructions:
 1. Contractor is responsible for all instructions to the Owner's representatives for the electrical and specialized systems.
 2. If the Contractor does not have staff that can adequately provide the required instructions, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.5 RECORD DOCUMENTS

- A. The following paragraphs supplement Division 1 requirements.
- B. Maintain at the job site a separate and complete set of electrical drawings and specifications with all changes made to the systems clearly and permanently marked in complete detail.

- C. Mark drawings and specifications to indicate approved substitutions; Change Orders, and actual equipment and materials used. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should this Contractor fail to complete Record Documents as required by this contract, this Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record changes daily and keep the marked drawings available for the Architect/Engineer's examination at any normal work time.
- E. Upon completing the job, and before final payment is made, give the marked-up drawings to the Architect/Engineer.
- F. Record actual routing of conduits exceeding 2 inches.
- G. Paint all equipment that is marred or damaged prior to the Owner's acceptance. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier if available. All equipment shall have a finished coat of paint applied unless specifically allowed to be provided with a prime coat only.
- H. Equipment in finished areas that will be painted to match the room decor will be painted by others. Should this Contractor install equipment in a finished area after the area has been painted, the Contractor shall have the equipment and all its supports, hangers, etc., painted to match the room decor. Painting shall be performed as described in project specifications.
- I. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard finish, free from scratches, abrasions, chippings, etc.
- J. Equipment in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chipping, etc. If color option is specified or is standard to the unit, verify with the Architect the color preference before ordering.
- K. Paint all equipment in unfinished areas such as boiler room, mechanical spaces, and storage rooms. Equipment furnished with a suitable factory finish need not be painted; provided the factory applied finish is not marred or spattered. If so, equipment shall be refinished with the same paint as was factory applied.
- L. All electrical conduit and equipment, fittings, hangers, structural supports, etc., in unfinished areas, such as equipment and storage room area, shall be painted two (2) coats of oil paint of colors selected by the Architect.
- M. Do NOT paint electric conduits in crawl spaces, tunnels, or spaces above suspended ceilings except that where conduit is in a damp location give exposed threads at joints two coats of sealer after joint is made up.

- N. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, paint all raceway and equipment with the following:
 - 1. Bare Metal Surfaces - Apply one coat of metal primer suitable for the metal being painted. Finish with two coats of Alkyd base enamel paint.
 - 2. Plastic Surfaces - Paint plastic surfaces with two coats of semi-gloss acrylic latex paint.

3.6 ADJUST AND CLEAN

- A. Thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Clean all foreign paint, grease, oil, dirt, labels, stickers, etc. from all equipment.
- C. Remove all rubbish, debris, etc., accumulated during construction from the premises.

3.7 SPECIAL REQUIREMENTS

- A. Coordinate the installation of all equipment, controls, devices, etc., with other trades to maintain clear access area for servicing.
- B. Install all equipment to maximize access to parts needing service or maintenance. Review the final location, placement, and orientation of equipment with the Owner's representative prior to setting equipment.
- C. Installation of equipment or devices without regard to coordination of access requirements and confirmation with the Owner's representative will result in removal and reinstallation of the equipment at the Contractor's expense.
- D. Raceway and Cable Routing Restrictions: Raceways and cable are restricted from being routed in the following locations, unless serving the space or permitted by the authority having jurisdiction.
 - 1. Elevator machine rooms and hoistways.
 - 2. Exit enclosures.
 - 3. Other areas restricted by code.
 - 4. Technology, data, server rooms.
 - 5. Fire pump and sprinkler rooms.
 - 6. Normal power in emergency power equipment rooms: Limited to feeders and branch circuits serving the emergency power equipment located in the room.
 - 7. Emergency power in normal power equipment rooms: Limited to feeders and branch circuits serving the normal power equipment located in the room.

3.8 INDOOR AIR QUALITY (IAQ) MAINTENANCE FOR OCCUPIED FACILITIES UNDER CONSTRUCTION

- A. Within the Limits of Construction:

1. The Electrical Contractor shall coordinate all work with the contractor responsible for IAQ.
 2. The means, methods and materials used by the Electrical Contractor shall be coordinated with the contractor responsible for IAQ and shall comply with the IAQ requirements set forth in Division 1 and Division 21/22/23 of these specifications.
- B. Outside the Limits of Construction:
1. IAQ shall be the responsibility of the electrical contractor for work that is required outside the limits of construction.
 2. The Electrical Contractor is responsible for the IAQ set forth in Division 1 and Division 21/22/23 of these specifications.
 3. The Electrical Contractor shall review and coordinate all IAQ plans and procedures with the owner's IAQ representative.
- C. Contractors shall make all reasonable efforts to prevent construction activities from affecting the air quality of the occupied areas of the building or outdoor areas near the building. These measures shall include, but not be limited to:
1. General Contractor shall erect and maintain dust barriers throughout the construction work. These barriers shall be reasonably airtight and shall prevent entry into the construction zone by unauthorized persons. Reasonably airtight means construction equivalent to full-height temporary or permanent walls with joints taped or sealed, and shafts and other penetrations sealed as well as possible. Fire resistant polyethylene is acceptable; if flame spread/smoke developed ratings are demonstrated to conform to the applicable building codes and licensing acts.
 2. The Contractor shall continuously maintain the construction zone under a negative pressure of at least 0.01" w.g. minimum relative to all adjacent areas of the building.
 - a. Exhaust fans used for this purpose shall filter air and discharge it outdoors or to the least populated area adjacent to the construction work using negative air machines designed specifically for this purpose. All filtration for air recirculated back into the building shall be HEPA (99.97% DOP efficiency) for work adjacent to healthcare or elderly facilities. If no work is adjacent to these areas, 95% filtration is acceptable. Filtering air discharged to outdoors shall be accomplished with 30% filters.
 - b. If air is discharged outdoors, maintain all required distances to doors, windows, air intakes, etc.
 - c. If high levels of Volatile Organic Compounds (VOC's) or odors are released, activated carbon or equivalent filtration shall also be employed. Exhaust shall not discharge near doors, air intakes, pedestrians, gathering areas, or operable windows.
 - d. Adjusting existing air handling equipment to assist in pressure control is acceptable, if approved by the Owner and the authority having jurisdiction.
 - e. Seal return, exhaust, and supply air openings in or near the construction zone that serve existing air handling systems, and rebalance the systems for proper operation. If this is impractical, add filters at the intakes of sufficient cross sectional area to minimize the pressure drop and avoid the need for rebalancing.

- f. Maintain pressure control one hour before and after all construction periods, and 24 hours per day in healthcare or elderly facilities.
3. All contractors shall endeavor to minimize the amount of contaminants generated during construction. Methods to be employed shall include, but not be limited to:
 - a. Minimizing the amount of dust generated.
 - b. Reducing solvent fumes and VOC emissions.
 - c. Maintain good housekeeping practices, including sweeping and periodic dust and debris removal. There should be no visible haze in the air.
4. Request that the Owner designate an IAQ representative.
5. Review and receive approval from the Owner's IAQ representative for all IAQ-related construction activities and negative pressure containment plans.
6. Inform the IAQ representative of all conditions that could adversely impact IAQ, including operations that will produce higher than normal dust production or odors.
7. Schedule activities that may cause IAQ conditions that are not acceptable to the Owner's IAQ representative during unoccupied periods.
8. Request copies of and follow all Owner's IAQ and infection control policies.
9. Unless no other access is possible, the entrance to construction site shall not be through the existing facility.
10. To minimize growth of infectious organisms, do not permit damp areas in or near the construction area to remain for over 24 hours.
11. In addition to the criteria above, provide measures as recommended in the SMACNA "IAQ Guidelines for Occupied Buildings under Construction".

3.9 SYSTEM STARTING AND ADJUSTING

- A. The electrical systems shall be complete and operating. System startup, testing, adjusting, and balancing to obtain satisfactory system performance is the responsibility of the Contractor. This includes all calibration and adjustment of electrical controls, balancing of loads, troubleshooting and verification of software, and final adjustments that may be needed.
- B. Complete all manufacturer-recommended startup procedures and checklists to verify proper equipment operation and does not pose a danger to personnel or property.
- C. All operating conditions and control sequences shall be tested during the start-up period. Testing all interlocks, safety shut-downs, controls, and alarms.
- D. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.10 FIELD QUALITY CONTROL

A. General:

1. Conduct all tests required during and after construction. Submit test results in NETA format, or equivalent form, that shows the test equipment used, calibration date, tester's name, ambient test conditions, humidity, conductor length, and results corrected to 40°C.
2. Supply necessary instruments, meters, etc., for the tests. Supply competent technicians with training in the proper testing techniques.
3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Replace shorted or grounded wires and cables.
4. Any wiring device, electrical apparatus or luminaire, if grounded or shorted on any integral "live" part, shall have all defective parts or materials replaced.
5. Test cable insulation of service and panel feeder conductors for proper insulation values. Tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free of short circuits and grounds and have an insulation value not less than Electrical Code Standards. Take readings between conductors, and between conductors and ground.
6. If the results obtained in the tests are not satisfactory, make adjustments, replacements, and changes as needed. Then repeat the tests, and make additional tests, as the Architect/Engineer or authority having jurisdiction deems necessary.

B. Ground Resistance:

1. Conduct service ground resistance tests using an approved manufactured ground resistance meter. Submit to the Architect/Engineer a proposed test procedure including type of equipment to be used. (The conventional ohmmeter is not an acceptable device.)
2. Make ground resistance measurements during normal dry weather and not less than 48 hours after a rain. Ground resistance values shall be verified by the Architect/Engineer at the time the readings are taken.
3. If the ground resistance value obtained is more than the value set forth in Section 260526, the following shall be done to obtain the value given:
 - a. Verify that all connections in the service ground system are secure.
 - b. Increase the depth to which ground rods are driven by adding section lengths to the rods and retest. If the resistance is still excessive increase the depth by adding an additional rod section and retest.
 - c. If the resistance is still excessive, furnish and install additional ground rods, spaced not less than 20 feet from other ground rods unless otherwise noted on plans, and connect into the ground electrode system. Retest.
 - d. Review results with the Architect/Engineer.
4. Before final payment is made to the Contractor submit a written report to the Architect/Engineer including the following:
 - a. Date of test.
 - b. Number of hours since the last rain.
 - c. Soil condition at the time of the test in the ground electrode location. That is: dry, wet, moist, sand, clay, etc.

- d. Diagram of the test set-up showing distances between test equipment, ground electrode, auxiliary electrodes, etc.
- e. Make, model, and calibration date of test equipment.
- f. Tabulation of measurements taken and calculations made.

C. Ground-Fault Equipment Performance Testing:

- 1. Test: Perform ground-fault performance testing when system is installed. The test process shall use primary current injection per manufacturer instruction and procedures. Perform test for the following:
 - a. Service disconnects
 - b. Solid state molded case circuit breakers and solid-state insulated case circuit breakers equipped with ground fault protection.
 - c. Fusible switches with ground fault relay protection.
 - d. Outside branch circuits and feeders.
 - e. Code required.
- 2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.

D. Arc Energy Reduction Equipment Performance Testing:

- 1. Test: Perform arc energy protection performance testing when system is installed. The test process shall use primary current injection or approved method per manufacturer instructions and procedures. Perform test for the following:
 - a. All arc energy reduction systems installed.
- 2. Report: Provide copy of test result report with Operation and Maintenance manuals. Provide report to Authority Having Jurisdiction when requested.

E. Other Equipment:

- 1. Give other equipment furnished and installed by the Contractor all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, voltage complies with equipment nameplate rating, and full load amperes are within equipment rating.

F. If any test results are not satisfactory, make adjustments, replacements and changes as needed and repeat the tests and make additional tests as the Architect/Engineer or authority having jurisdiction deem necessary.

G. Contractor shall thermographic study all electrical gear, switchboard, panelboards, etc. at the end of construction to identify any unusual conditions/heating within the equipment. Coordinate with Owner/Architect/Engineer to have an Owner/Architect/Engineer representative present during testing.

- H. Report shall include color printouts, in binder, of pictures taken to use as a baseline reading after building is occupied.
- I. Upon completion of the project, the Contractor shall provide amperage readings for all panelboards and switchboards and turn the results over to the Owner for "benchmark" amperages.

3.11 UTILITY REBATE

- A. Submit utility rebate forms, where offered at project location, with rebate items completed. Rebate may include lighting, lighting controls, variable speed drives, heat pumps, package terminal A/C, air conditioners, chillers, water heaters, programmable thermostats, and motors.
- B. Contractor must submit notification of any value engineering or product substitution that will affect the utility rebate amount prior to approval.

READINESS CERTIFICATION PRIOR TO FINAL JOBSITE OBSERVATION

To prevent the final job observation from occurring too early, we require that the Contractor review the completion status of the project and, by copy of this document, certify that the job is indeed ready for the final job observation. The following is a typical list of items that represent the degree of job completeness expected prior to requesting a final job observation.

1. Penetrations of fire-rated construction fire sealed in accordance with specifications.
2. Electrical panels have typed circuit identification.
3. Smoke and fire/smoke dampers are wired and have been tested.
4. Per Section 260500, cable insulation test results have been submitted.
5. Per Section 260500, medium voltage testing report has been submitted.
6. Per Section 260500, ground resistance test results have been submitted.
7. Operation and Maintenance manuals have been submitted as per Section 260500.
8. Bound copies of approved shop drawings have been submitted as per Section 260500.
9. Report of instruction of Owner's representative has been submitted as per Section 260500.
10. Fire alarm inspection and testing report has been submitted as per Sections 26 05 00 and 28 31 00.
11. Start-up reports from factory representative have been submitted as per Section 260500.

Accepted by:

Prime Contractor _____

By _____ Date _____

Upon Contractor certification that the project is complete and ready for a final job observation, we require the Contractor to sign this agreement and return it to the Architect/Engineer so that the final observation can be scheduled.

It is understood that if the Architect/Engineer finds the job not ready for the final observation and that additional trips and observations are required to bring the project to completion, the costs incurred by the Architect/Engineers for additional time and expenses will be deducted from the Contractor's contract retainage prior to final payment at the completion of the job.

END OF SECTION

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DIVISION 26 05 05

ELECTRICAL BASIS OF DESIGN SYSTEMS NARRATIVE

PART 1 - GENERAL

1.01 INTRODUCTION

- A. The purpose of this section is to define the design approach upon which the contractor is to base a budget/estimate and establish the design criteria, and design submittals, which will be required in the preparation and execution of the design.
- B. All work under this section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions, and Division 01 – General Requirements, and shall include all mechanical sections specified herein.
- C. This section includes a general narrative description of Division 26 systems with specific equipment and component criteria that are to be included in the project. Reference all other specification sections, floor plans, drawing notes, drawing equipment schedules, and drawing matrices for additional equipment and project criteria.

1.02 APPLICABLE CODES AND STANDARDS

- A. Design and construction shall comply with the following Codes:

APPLICABLE WASHINGTON STATE BUILDING CODES			
ENERGY CODE	2021 WASHINGTON STATE ENERGY CODE (SEC) FOR COMMERCIAL BUILDINGS	WAC 51-11C	EFFECTIVE MARCH 15, 2021
BUILDING CODE	2021 INTERNATIONAL BUILDING CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-50	EFFECTIVE MARCH 15, 2021
ACCESSIBILITY CODE	2021 INTERNATIONAL BUILDING CODE WITH WASHINGTON STATE AMENDMENTS CHAPTER 11 AND ICC A117.1-2009	WAC 51-50	EFFECTIVE MARCH 15, 2021
SEISMIC CODE	ASCE 7-2016 AS REFERENCED BY 2018 INTERNATIONAL BUILDING CODE	WAC 51-50	EFFECTIVE MARCH 15, 2021
FIRE CODE	2021 INTERNATIONAL FIRE CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-54A	EFFECTIVE MARCH 15, 2021
MECHANICAL CODE	2021 INTERNATIONAL MECHANICAL CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-52	EFFECTIVE MARCH 15, 2021
PLUMBING CODE	2021 UNIFORM PLUMBING CODE WITH WASHINGTON STATE AMENDMENTS	WAC 51-56	EFFECTIVE MARCH 15, 2021
BOILER CODE	WASHINGTON STATE BOILER CODE	WAC 296-104	
ELECTRICAL CODE	2020 NATIONAL ELECTRICAL CODE WITH 2020 WASHINGTON AMENDMENTS (NFPA 70)	WAC 296-46B	EFFECTIVE NOVEMBER 1, 2020
ELECTRICAL	ELECTRICIANS AND ELECTRICAL INSTALLATIONS	RCW CHAPTER 19.28	
NFPA STANDARDS	NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) STANDARDS AS REFERENCED BY THE CODES ABOVE OR AS SPECIFICALLY LISTED BELOW		

1.03 RELATED DOCUMENTS

- A. Architectural, Civil, Structural, and MEP Drawings and Narratives

1.04 ORDER-OF-PRECEDENCE PROVISIONS

- A. In the case of inconsistency or ambiguities in design documents (all specifications and drawings), compliance with the strictest design requirement among conflicting criteria is required.
- B. If provided, alternate pricing for compliance with less strict criteria will be evaluated in addition to the mandatory baseline strictest criteria.
- C. Provide notice upon discovering potential design conflicts prior to bid where possible.

1.05 GENERAL ELECTRICAL PROVISIONS

- A. Definitions:
 - 1. Electrical Contractor – This term as used in the Contract Documents shall be considered as synonymous with Electrical Contractor, or the Contractor where in reference to providing, furnishing, and/or installing electrical equipment or systems.
 - 2. Low Voltage Contractor- This term may be used in the Contract documents to refer to the low voltage systems integrator for telecommunications, security systems or Fire Alarm.
 - 3. Complete System: The Contract Documents do not attempt to address all materials, devices, equipment, and work that shall be required for completion of the electrical systems. All materials, devices, equipment, and work not addressed in the Contract Documents shall be provided by the Contractor to provide complete and functional systems, shall meet the applicable industry standards, and shall be equal or better than that normally provided for similar buildings in the same geographical area.
 - 4. The Electrical/ Low Voltage Contractor is responsible for providing the finished electrical work, tested, and ready for normal operation.
 - 5. Unless otherwise noted, all materials shall be new. Electrical Contractor shall properly store all materials and equipment in order to protect materials from physical damage or damage due to the elements or corrosion.

6. Materials shall be provided, installed, and/or used in conformance with the manufacturer's recommendations. If manufacturer's recommendations are not in conformance with the intent of the Contract Documents, obtain clarification from the Architect and Engineer prior to proceeding.
7. Coordination: Check drawings of other trades to verify spaces in which work shall be installed. Establish exact locations of piping and ducts in such a manner as to conform to structure, avoid obstructions, and keep openings and passageways clear. Lines that must pitch or that must have a constant elevation, shall have the right-of-way over lines not so restricted. Maintain maximum headroom. If space conditions appear inadequate, notify the Architect before proceeding with the work. Make reasonable modifications in the work without extra cost as needed to prevent conflict with work of other trades and for proper execution of the work.
8. For installation of equipment furnished by Others, that requires electrical connection, Electrical Contractor shall obtain rough-in dimensions from approved shop drawings, by measurement from the actual equipment to be installed, or as otherwise directed by the Architect. Provide all electrical services to and within equipment in a manner that maintains accessibility, operation, as well as maintenance and repair options.
9. Contractor shall ensure adequate equipment space and required clearances based on actual equipment selected for installation. Any modifications required to accommodate electrical equipment selected shall be at the Contractor's expense.
10. Drawings and Narratives shall be considered as a single entity, identified as the Contract Documents. Consider work indicated in one as required by both.

B. Codes, Permits, Inspections, and Fees:

1. The Electrical / Low Voltage Contractor shall obtain all permits and inspections and pay all fees required by State and Local authorities, except as noted.
2. All work and materials shall be in accordance with requirements of all applicable local and state codes, statutes, standards and other regulations. Date of regulations shall be as adopted by local authorities at the time of permit intake, unless indicated otherwise.
3. The codes shall be construed as establishing a minimum or base level of requirements. Contract Documents shall not be construed to permit or direct work not in conformance with codes, statutes, standards and other regulations. Where provisions of the various regulations conflict with each other, or with the Contract Documents, the more stringent provisions shall be included in contract pricing. Conflict shall be

resolved with the Architect and Authorities Having Jurisdiction (AHJ) prior to completing the design.

4. Where the Contract Documents call for material or construction of a better quality or higher capacity than required by the codes, statutes, standards, and other regulations, the provisions of the Contract Documents shall take precedence over the requirements of the codes and standards.
5. Material and equipment within the scope of the UL Testing Laboratory Service shall be listed by the Underwriters Laboratories for the purpose for which they are used and shall bear their listing mark. ETL or CSA shall be allowed if acceptable to the Authorities Having Jurisdiction (AHJs).

C. Construction Coordination Drawings

1. It shall be the Contractor's responsibility to work out and coordinate all conflicts and to provide all transitions and offsets required to facilitate installation of work. Provide construction coordination drawings for congested areas requiring close coordination with other trades and the general construction. Electrical work that is fully coordinated and that can be installed generally per the contract documents will not require coordination drawings. Failure to provide coordination drawings, when needed, shall be considered nonperformance, and progress payments will be suspended until the drawings are reviewed and accepted by the Architect/Owner.
2. The construction coordination drawings shall show all related trades, structure, and ceiling, walls, and partitions. Provide cross sections of all congested areas.
3. The final as-built drawings shall be submitted at the completion of the project for record purposes in hard copy as well as AutoCAD electronic files.

D. Submittals and Trade Coordination

1. The Contractor shall coordinate their shop drawings with other trades prior to shop drawing approval and construction.
2. No cutting or drilling of joists or beams will occur without Structural Engineer approval.
3. Architectural drawings shall be checked for ceiling heights, walls, and cabinets that are intended to conceal work of this section. Where conflicts occur, the Architect shall be notified prior to rough-in or installation of the work. Location of exposed work such as diffusers, grilles, and piping outlets shall take precedence over concealed work.

4. Submittals: Mark submittal literature and show drawings clearly, and include all equipment and material shown on drawings and specified. Indicate the following:
 - a. Index, followed by specification reference and/or drawing reference for which literature is submitted for review.
 - b. Manufacturer's name and address, and supplier's name, address and phone number.
 - c. Catalog designation or model number.
 - d. Rough-in data and dimensions and cut sheets clearly identifying the specific model and options.
 - e. Installation as well as operation and maintenance manuals with specific model and features applicable to this installation identified.
 - f. Warranties.
 - g. Spare parts lists as recommended by manufacturer for equipment.
 - h. Factory certifications.
 - i. Troubleshooting guides.
 - j. Complete customized listing of characteristics, equipment, accessories, etc., specified.
 - k. Indicate whether item is "As Specified" or "Proposed Substitution". Indicate any deviations on submittal. Indicate any deviations on submittal. Mark out all non-applicable items and/or clearly identify applicable items. The terminology "As Specified" used without clearly identifying applicable items is not acceptable. Show exactly what will be provided and include options or deletions.
 - l. Contractor agrees that Shop Drawings Submittals processed by the architect are not Change Orders, that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Architect that the Contractor understands the design concept and demonstrate its understanding by indicating which equipment and material it intends to furnish and install and by detailing the fabrication and installation methods it intends to use.
 - m. Contractor further agrees that if deviations, discrepancies, or conflicts between Shop Drawings and Specifications are discovered either prior to or after Shop Drawing Submittals are processed by the Architect, the Design Drawings and Specifications shall control and shall be followed.
 - n. Shop drawings shall be provided for all voice/data and power work, including detailed layout drawings of all devices and raceways.

- o. Warranty period to extend for one year from date the project is occupied by the Owner, not from the date of completion of the work. Warranty not applicable to defective items due to faulty work of subsequent trades.
- p. As-builts: Contractor shall maintain up to date as-built drawings showing all construction installation with any/all design changes. Drawings shall be maintained in the project office for inspection by the Architect/Owner at any time. Provide Owner with reproducible and electronic (AutoCAD and PDF files) as-built drawings within 4 weeks of substantial completion.
- q. Provide manufacturers product, installation and warranty information for all products supplied with signed contract documents per an agreed upon schedule at the time of contract award. This is of particular importance for GC to forward appropriate information to Subcontractors to facilitate coordinated installation of his products.

PART 2 - SYSTEMS

2.01 GENERAL ELECTRICAL DESIGN CRITERIA

A. Load Calculations:

- 1. The load calculation assumes a VRF mechanical system for residential unit heating/cooling, as well as a gas cooktop/electric oven for cooking in all units and a central hot water system. A dummy load for heat (4w/sf) and for gas cooking (8kw) is included so the optional NEC calculation may be utilized per 2023 NEC 220.80.
- 2. If furnished, Sizing for residential stepdown transformers is based on the same unit calculation as described above.

B. Electrical Service:

- 1. The building is in City of Port Angeles and will be served via a secondary electrical service that comprises a pad mounted transformer furnished and installed by the Port Angeles Public Utilities.
- 2. The Electrical Contractor shall provide the secondary connections between the pad mounted service transformer and the main electrical room. The contractor shall furnish and install all conduit, conductors, trenching, and backfilling associated with all secondary conductors. Contractor shall include coordination with local power

utility company to determine responsibility matrix for electrical service and adjust bid accordingly.

3. 1200A switchboard will be utilized to service both the residential units and house loads. Residential units will be powered via 800A metering center located inside the main electrical room
4. House loads will be powered one (1) 600A panel fed from the service switchboard and located in the electrical room on level 01
5. Provide grounding and bonding as required by NEC article 250.

C. The service voltage to the building will be 120/208V, 3 Phase, 4 Wire

2.02 SECONDARY ELECTRICAL DISTRIBUTION SYSTEM:

- A. Load calculations will be continued through the design process to ensure service sizes are sufficient. All final electrical room layouts to be detailed by EC and confirmed with selected gear manufacturer.
- B. Provide a digital meter and circuit breaker in the house switchboard to serve the required future electric vehicle charging capacity per City code.
- C. Provide fully rated electrical distribution equipment. Contractor to obtain available fault from utility company prior to order of switchgear, distribution, and panels and adjust AIC ratings accordingly prior to bid. No exceptions. Series rated meter stacks for the residential units are allowed.
- D. 208Y/120V-3Ph panelboards shall be provided to serve house power, lighting loads and other loads. House power panels shall be 3-phase, four wire, sized to accommodate the designed systems, with minimum 25% spare panel circuit breakers and load capacity.
 1. Neutral Bus: Provide 100% rated neutral for 208Y/120V branch panels.
 2. Ground Bus: Provide code sized ground bus.
 3. Bus Bars: Panels shall have copper bus bars or copper clad Aluminum.
- E. Load center panels shall be provided at 100 or 125 amp 1-phase with MLO (AIC rating TBD based upon AFC from utility, but not less than 10,000A) to serve residential units. All branch circuits for residential spaces must be equipped with Arc Fault Circuit Interrupters (AFCI) circuit breakers installed in accordance with NEC. Size of panel varies

with square foot size of unit and quantity of electrical connections. Provide pre-finished white in lieu of standard finish for unit load centers.

2.03 GROUNDING:

- A. Provide a complete National Electrical Code (NEC) grounding system, including UFER ground. Ground conductors shall be sized in accordance with the (NEC).
- B. Ground conductors shall be provided for all feeders and branch circuits, except for lighting branch circuits. Conduit or raceway shall not be sole means for equipment grounding.

2.04 EQUIPMENT CONNECTIONS:

- A. Provide the following equipment connections as listed, but not limited to:
 - 1. HVAC equipment.
 - 2. Plumbing equipment.
 - 3. 120V power connections for irrigation control system.
 - 4. Empty raceway for irrigation control system.
 - 5. 120V smoke and CO alarms in residential units.
 - 6. Owner furnished equipment.
 - 7. Circuit Loading: Each 20 amp circuit shall not be loaded to more than 80% or 16A for a 120V circuit, unless circuit feeds a single piece of equipment. Circuit load shall be calculated in compliance with the following:
 - a. Lighting: The volt-ampere rating of each fixture connected, in accordance with the NEC.
 - b. Convenience Receptacles: 180 VA per duplex receptacle.
 - c. Dedicated Receptacle: Nameplate rating of equipment connected.
 - d. Motors and all hard wired equipment: Nameplate rating of equipment connected.
 - 8. Provide all interconnect wiring between controls, equipment, and major mechanical and electrical equipment, except where identified "By Owner".
 - 9. Provide all disconnects for mechanical, plumbing, and electrical equipment in accordance with the NEC.

10. Label all receptacles, equipment hard wire connections, and power junction boxes with the appropriate panel name and circuit number.

2.05 EMERGENCY POWER SYSTEM:

- A. Emergency power system shall consist of individual battery/inverter units installed in selected light fixtures for egress lighting to maintain average of 1.0-fc and a minimum of 0.1-fc light level along egress path as per NFPA 101. Refer to architectural drawings for final path of egress.

2.06 RESIDENCE HVAC SYSTEMS

- A. Refer to mechanical narrative for residential HVAC systems and required connections.

2.07 RESIDENCE EXHAUST SYSTEMS

- A. Refer to mechanical narrative for residential HVAC systems and required connections.

2.08 MECHANICAL & PLUMBING EQUIPMENT CONNECTIONS:

- A. Provide wiring, starters (except where available integral to the equipment), disconnects and OCP devices. See mechanical drawings/ narratives for equipment.
- B. Refer to mechanical and plumbing plans for exact locations.
- C. Coordinate with mechanical criteria and Mechanical Contractor to provide complete power wiring and connections for all required mechanical equipment. Provide control power for mechanical system control.
- D. Electrical Contractor to provide Emergency Power Off (EPO) button to shunt trip boilers at each entrance to boiler room as required by State and local codes, (WAC 296-104-303 and 2005 Seattle Boiler and Pressure Vessel Code Section 170). Shut down is to comply with the requirements of AMSE CSD-1 Code Part CE.
- E. Provide GFCI connections to all heat trace equipment. Refer to plumbing narrative for heat trace requirements. Outdoor heat trace for hot water heating system will need to be on the optional standby branch of emergency power.

- F. Provide motor controls for mechanical equipment in accordance with the Trade Coordination Schedule requirements.
- G. Provide all disconnect switches, fused or non-fused, in accordance with the requirements of the NEC.
- H. Electrical contractor to provide 120V circuits for control panels provided by Mechanical for controls contractor.
- I. Refer to Div 22 and 23 narratives for electrical requirements and equipment schedules.

2.09 ENERGY METERING AND ENERGY CONSUMPTION MANAGEMENT

- A. Each house panel shall be provided with energy metering system to separately meter house lighting, receptacles and HVAC loads.

2.10 ENERGY CODE C411 RENEWABLE ENERGY AND SOLAR READINESS

- A. New PV system will be required per WSEC C411.1, On-site renewable energy systems requirements for new buildings and additions larger than 10,000 ft² of gross conditioned floor area.
- B. PV system sizing criteria is 0.5 watts rated peak PV energy production per square foot of conditioned space at minimum, which will require installing 7.5KW PV system based on 15,000-SF gross conditioned area.
- C. Contractor shall provide PV system, rough-in, power cabling and NEC 705 load-side source connection system via CB installed inside the service switchboard.
- D. In addition, and per Energy Code C411.3 - Option 1., 40% of facility roof space shall be designated for solar readiness zone. PV system can be installed inside of this zone.
- E. Contractor to provide additional space within the main switchboard at the end of the bus for future PV in compliance with C411.3.7 interconnection.

2.11 MISCELLANEOUS

- A. Doors

1. Provide electrical connections to all ADA doors.
2. Coordinate all electrical requirements with the Architect

B. Security/ Access Control

1. Provide electrical connections to Access Control and CCTV systems. Coordinate power requirements to the CCTV and access control systems with equipment provider. Coordinate head-end equipment location with Client.

2.12 UNIT POWER AND LOW VOLTAGE FEEDER ROUTING

- A. Unit power feeders shall not be routed through another unit.

2.13 WIRING DEVICES:

- A. Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for given applications which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards.
1. In residential units, provide 20A rated receptacles in the Kitchens and baths; 15A elsewhere.
- B. Receptacles: Comply with UL 498 and NEMA WD 1, 20A, 125 Volt, Duplex - NEMA 5-20R, Heavy Duty in commercial and common areas; Residential grade in units.
- C. Dedicated Receptacles: Comply with NEMA and voltage recommendations from manufacturer of equipment to be installed. Provide dedicated circuits and dedicated, 20A receptacles for Owner furnished equipment with a load 1200W or greater.
- D. Ground-Fault Circuit Interrupter (GFCI) Receptacles: Provide "feed-thru" type ground-fault circuit interrupter, with integral heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide GFCI protection for all receptacles located where within six feet of the outside edge of a sink or in wet areas. In residences provide GFCI circuit breakers in lieu of receptacles, so that all devices are accessible and consistent throughout the space.
- E. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Code requires all receptacles in the units to be Tamper resistant.
- F. Equipment Disconnect Toggle Switches: NEMA WD 1, totally enclosed with rectangular bodies of thermosetting plastic and a mounting strap. Handles shall be white. Wiring terminals shall be of the screw type, side wired. Switches shall be rated quiet-type, 120/277 volts, with number of poles indicated and shall be fully rated for the ampere rating of the installed equipment. Not more than one switch shall be installed in a single gang position. Toggle switches for motor disconnecting means shall be motor rated snap switches, heavy duty, specification grade.
- G. Provide maximum of eight (8) general convenience receptacles per 20 amp, 120 volt circuit along with AFCI circuit breaker for residential units only as required by the NEC 2017.
- H. Provide dedicated circuit for the smart box panel provided with AFCI breaker.
- I. Receptacles shall be installed 18" above finished floor (AFF) to center of receptacle, unless noted otherwise.
- J. Residential Unit Receptacles – Baseline approach: Provide receptacles in residential units as required by NEC section 210.50. Receptacles shall be provided at the following areas, but are not limited to:
1. Every 12' on center and no more than 6' from wall breaks in all bedroom and living areas,
 2. (1) receptacle in every hallway longer than 10',
 3. (1) receptacle in foyers at walls 3' or greater in width and at 12' on center in foyer,
 4. (1) dedicated laundry receptacle,
 5. (1) Receptacle at all kitchen islands and peninsular countertops 24" or greater. Receptacle shall be located no more than 12" below the countertop with no more than a 6" overhang
 6. Within 3' of every restroom water basin
 7. Every 4' on center at kitchen counters for all counters that are 12" or wider
 8. Electrical contractor shall refer and coordinate with interior, architectural, and other discipline drawings when developing final device layouts per NEC 210.50. All device locations should be coordinated with other equipment, pocket doors, window and column locations, and construction details prior to rough in.

9. Provide (1) USB outlet in every bedroom at bedside table outlet location, at the kitchen counter and at each desk location.
10. Provide switched outlet in bedrooms instead of overhead lighting.

K. Additional Unit Requirements:

1. EC to provide and install air button switch for all garbage disposals located on kitchen islands. Kitchens without islands will receive regular on/off switch.
2. Unit panels are assumed to be located behind the bedroom door where possible.
3. Refer to architectural drawings for assumed kitchen appliance connections required.

L. Receptacles shall be installed 18" above finished floor (AFF) to center of receptacle, unless noted otherwise.

M. Coordinate the location of all electrical items with architectural and mechanical layout to avoid interference etc. Any items installed that will not allow the installation of the designed features shall be connected at no additional cost.

N. Label all receptacles, equipment hard wire connections, and power junction boxes with the appropriate panel name and circuit number in all building areas, except residential units.

O. Refer to section 261400 for additional details.

2.14 LIGHTING SYSTEMS:

A. Scope of New Work:

1. Provide new lighting and controls that comply with the City codes referenced below.
2. Provide 100% LED lighting package for an energy efficient design.
3. Electrical engineer of record shall be responsible for lighting summary permit forms, emergency egress lighting layouts and photometrics, exit sign layouts, circuiting, code required control specifications and wiring diagrams.

B. Lighting Allowance:

1. GC/Owner to provide lighting allowance for interior and exterior lighting and controls.

A. Applicable Codes & Guidelines for New Lighting:

1. 2021 Washington State Energy Code – Interior Lighting:

- a. The 2021 Washington State Energy Code (WSEC) shall be applicable for all interior lighting.
- b. Provide an energy efficient lighting design with a lighting power density that is less than the WSEC Table C405.4.2(2) Interior Lighting Power Allowances: Space-By-Space Method
- c. Table C405.4.2(2) Interior Lighting Power Allowances: Applicable Spaces
- d. Interior common area hardwired lamps (retrofit) must have a minimum efficacy of 60 lumens per watt per WSEC section C405.4.1.

Primary Interior Function	Allowed Watts/SF Option 2 C406.2.3.2 Targets: 20% LPD Reduction	Allowed Watts/SF Option 1 C406.2.3.1 Targets: 10% LPD Reduction	Allowed Watts/SF Code Baseline
Corridors	0.32	0.36	0.41
Electrical / Mechanical Rooms	0.34	0.38	0.43
Laundry/Wash Room	0.42	0.48	0.53
Stairwell	0.39	0.44	0.49
Storage Rooms			
< 50 SF	0.41	0.46	0.51
50+ SF	0.30	0.34	0.38
Dwelling/ Sleeping Units	Code Baseline requirement: No less than 90% of the installed lamps must have a minimum efficacy of 65 lumens per watt or luminaires with a minimum efficacy of 45 lumens per watt per WSEC section C405.1.1.		

	C406 requirement: No less than 95% of the installed luminaires must have a minimum efficacy of 90 lumens per watt per SEC section C406.2.3.3.

2. 2021 Washington State Energy Code – Exterior Lighting

- a. The 2021 Washington State Energy Code (WSEC) shall be applicable for all exterior lighting which includes all building mounted exterior lighting and site lighting.
- b. Project is classified under Zone 2 of Table C405.5.3(1) in the Washington State Energy Code. Zone 2 best describes this project's location in a predominantly residential area with limited nighttime use.
- c. Provide an energy efficient lighting design that complies with WSEC Table C405.5.3(2) Lighting Power Allowances for Building Exteriors.

<u>Primary Exterior Function</u>	<u>Zone 2</u>	<u>Zone 3</u>
Walkways less than 10ft wide	0.07 Watts/ Linear Foot	0.10 Watts/ Linear Foot
Uncovered Parking Areas and Drives	0.026 Watts/SF	0.037 Watts/SF
Entry/ Exit Doors	9.8 Watts/ linear foot of opening	14.0 Watts/ linear foot of opening
Entry Canopies	0.126 Watts/SF	0.180 Watts/SF
Building Facades	0.075 Watts/SF of gross above grade wall area.	0.113 Watts/SF of gross above grade wall area.

3. IESNA Illumination Recommendations

- a. Target illumination values for all interior and exterior spaces are recommended in the IESNA Handbook.
- b. IESNA Lighting Handbook (2020 Edition) Recommended Foot Candles:
- c. ANSI/IES RP-28-20 Recommended Practice

Primary Function	Recommended Foot-Candles
Corridors	5 average at the floor
Entry Vestibule	15 average at the floor (Day) 4 average at the floor (Night)
Laundry	30 average at 42" AFF
Stairwells	10 minimum at treads
Storage Spaces / Janitor Closet	5-10 average at the floor
Mechanical Rooms	20 average at the floor
Electrical Rooms	30 average at 30" AFF
Exterior Walkways	3-5 average at the floor
Entrance Canopy	3-4 average at the floor
Exterior Exits/Entrances	3-4 average at the floor
Exterior Parking	0.2 average at the floor

4. IBC Illumination for Egress Requirements

- a. Engineer of record shall provide photometric calculations to ensure that under normal power, illumination levels are not less than 1 foot-candle at designated paths of egress. Under emergency power, illumination levels shall be an average of 1 foot-candle and a minimum of 0.1 foot-candle at all designated paths of egress. Refer to IBC section 1008.1-1008.3.5 for additional information.
- b. Per IBC reference to ASME 17.1, all elevator lobby thresholds shall have 10FC of emergency illumination when the elevator is in service.
- c. Electrical contractor to provide UL-924 devices as required for all emergency egress illumination.
- d. Refer to Section 2.05 for emergency lighting power requirements.

5. Lighting Controls – 2021 **Washington** Energy Code Requirements: Interior and Exterior Lighting Controls:
 - a. Provide code compliant lighting controls in accordance with the IMEG Control Sequence of Operations.
 6. Provide one of the following lighting control systems for common area interior lighting and exterior lighting.
 - a. nLight by Acuity
 - b. Athena by Lutron
 - c. Wattstopper DLM by Legrand
 - d. Or Equal control system.
 7. Provide Claro style wall switches for any interior lighting areas with standalone controls.
 8. See IMEG Basis of Design luminaire schedule and luminaire cutsheet package for dimming protocol designation per luminaire
 9. See IMEG electrical drawing set for control sequence of operations
- B. Lighting Concepts Space by Space
1. See IMEG electrical drawing set for lighting layouts and luminaire specifications
- C. Extra Materials
1. Furnish extra materials described below that match lighting products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Lamps: 10% of each type and size used.
 - b. Diffusers and Lenses: Furnish at least one of each type.
 - c. Drivers: Furnish one of each type.
 - d. Globes and Guards: Furnish one of each type.

PART 3 - EXECUTION

3.01 PREPARATION & INSTALLATION

- A. All work contracted for must be accepted by all applicable inspectors including site superintendent, GC quality control personnel, owner's representative (IMEG) or their assigns.
- B. As-builts: provide owner with electronic as-built drawings within two weeks of substantial completion. As-builts will reflect all changes from the construction drawing set and will comply with 2021 Washington Energy Code project completion requirements.
- C. O&Ms: provide hard copy and electronic copies of O&Ms for all systems within two weeks of substantial completion.

3.02 TESTING & INSPECTION

- A. A third party will act in the role of Project Commissioning Authority (CxA) and will participate with the EC in final execution of functional testing for the electrical systems in accordance with 2021 Washington State Energy Code section 1416 commissioning. These requirements apply to all residential and non-residential systems.
- B. Test the entire electrical installation to ensure compliance with the Contract Documents.
- C. All inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.
 - 1. American Society for Testing and Materials – ASTM
 - 2. International Electrical Testing Association – NETA
 - 3. National Fire Protection Association – NFPA
 - 4. 2021 Washington State Energy Code (including but not limited to Section 1513.8 and 1416.)
 - 5. State and *Local* Codes and Ordinances.
- D. The EC is responsible for all test, balance, and startup of electrical systems.
- E. The EC is responsible for coordination study and arc-flash studies.
- F. The EC will create functional witness tests for the electrical systems for review by the CxA. The contractor will incorporate the review comments. The EC will execute all pre-functional testing to assure system readiness for final functional testing.
- G. Installing contractors will document deficiencies and provide equipment, materials, and labor necessary to correct deficiencies found during the commissioning process to fulfill contract and warranty requirements.
- H. The Contractor shall be responsible for implementing all final settings and adjustments of protective devices and electrical equipment in accordance with Manufacturer recommended or Engineer's specified values.
- I. Any system material or workmanship which is found defective on the basis of electrical tests shall be reported directly to the Engineer and shall be corrected by the Contractor at no additional cost to the Owner.
- J. The Contractor shall maintain a written record of all tests and upon completion of the project. Assemble and certify a final test report. The test report shall include:
 - 1. Summary of the Project
 - 2. Description of the equipment tested
 - 3. Description of tests performed on each equipment or system
 - 4. Test results
 - 5. All conclusions and recommendations

- 6. An appendix including appropriate test forms
- 7. List of *test* equipment used and calibration date

- K. Owner training will be provided by the EC.

- L. The contractor will be expected to fully comply with the observation process and no change orders will be accepted for the contractor's participation.

- M. The contractor will provide Section 1416 mandated documentation at the appropriate stages of planning, testing, and project closeout.

- N. The EC will provide mandated life safety system testing as needed.

- O. Owner training will be provided by the installing contractor.

END OF SECTION

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SECTION 260513 - WIRE AND CABLE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building Wire - Copper
- B. Building Wire - Aluminum or Copper-Clad Aluminum
- C. Cabling for remote control, signal, and power limited circuits
- D. Metal-clad cable (MC)
- E. Nonmetallic-sheathed cable (NM)

1.2 RELATED WORK

- A. Section 260553 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

- A. NEMA WC 70 - Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy
- B. 2020 NFPA 70 - National Electrical Code (NEC) with 2020 Washington amendments Chicago Building (Electrical) Code
- C. UL 44 - Thermoset-Insulated Wires and Cables
- D. UL 83 - Thermoplastic-Insulated Wires and Cables
- E. UL 854 - Service-Entrance Cables
- F. UL 1581 - Standard for Electrical Wires, Cables, and Flexible Cords

PART 2 - PRODUCTS

2.1 BUILDING WIRE - COPPER

- A. Feeders and Branch Circuits 8 AWG and Smaller: Copper, solid or stranded conductor, 600-volt insulation, THHN/THWN, unless otherwise noted on the drawings.
- B. Motor Feeder from Variable Frequency Drives: Copper conductor, 600-volt XHHW-2 insulation, stranded conductor, unless otherwise noted on the drawings. Three conductor stranded copper, 600-volt XHHW-2 insulation, with copper ground and overall helical copper tape shield. Shield shall be terminated at both ends of cable with an approved termination.

- C. Control Circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN.

2.2 BUILDING WIRE - ALUMINUM OR COPPER-CLAD ALUMINUM

- A. Feeders and Branch Circuits 6 AWG and larger: Aluminum, AA-8000 series alloy, compact stranded conductor, 600-volt insulation, USE-2/RHH/RHW-2 or XHHW-2.
- B. Feeders and Branch Circuits 6 AWG and larger in Underground Conduit: Aluminum, AA-8000 series alloy, compact stranded conductor, 600-volt insulation, USE-2/RHH/RHW-2.
- C. Feeders and Branch Circuits 8 AWG and smaller, aluminum conductors not allowed.
- D. Aluminum conductors shall be terminated with compression lugs, copper plated terminal pins, or manufacturer approved method. Apply anti-oxidation paste. Torque test conductor connections and terminations to manufacturer's recommended values.
- E. Aluminum conductors shall NOT be allowed for the following:
 - 1. When prohibited by the manufacturer of the equipment.
 - 2. Grounding and Bonding.

2.3 CABLING FOR REMOTE CONTROL, SIGNAL, AND POWER LIMITED CIRCUITS

- A. Wire for the following specialized systems shall be as designated on the drawings, or elsewhere in these specifications. If not designated on the drawings or specifications, the system manufacturer's recommendations shall be followed.
 - 1. Fire alarm
 - 2. Low voltage switching and lighting control
 - 3. Other specialized cabling, signal, and power limited cabling. Refer to the appropriate Division 23, 27, or 28 requirements; including, but not limited, to the following:
 - a. Information Technology Backbone and Horizontal Cabling, Division 27.
 - b. Electronic Access Control, Intrusion Detection Systems, Video Surveillance, Division 28.
- B. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600-volt insulation, rated 60C, individual conductors twisted together, shielded, and covered with a PVC jacket.
- C. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- D. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300-volt insulation, rated 60C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.4 FIRE-RATED AND CIRCUIT INTEGRITY (CI) CABLE AND ASSEMBLIES

A. Acceptable fire-rated cables and listed assemblies:

1. MC Cable: Copper conductor, 600V thermoset, low smoke zero halogen silicone rubber insulation, continuously welded corrugated copper armor for equipment grounding conductor, rated 90C, UL listed 2196. MC fire rated cable shall not be used for branch circuits that required redundant equipment ground paths per code.
2. Fire rated cable in EMT or IMC raceway: Copper conductor, 300-volt or ethernet power-limited circuit cables low smoke zero halogen (LSZH), rated 105C. Assembly including raceway shall be UL listed 2196 and UL circuit integrity (FHIT).

2.5 METAL-CLAD CABLE (MC)

- A. Conductors shall be copper, 600-volt insulation, THHN. Metal clad cable shall be constructed in strict accordance with Underwriters Laboratories, Inc. Standard for Metal-Clad Cables, UL 1569, exterior of metal interlocked armor.
- B. Minimum conductor size for branch circuit wiring shall be 12 AWG, with larger wires used where specified.
- C. Metal-clad cables may be used for branch circuit wiring as defined in the Electrical Code, subject to acceptance by State and local codes.

2.6 NONMETALLIC-SHEATHED CABLE

A. Nonmetallic-Sheathed Cable, Size 14 through 4 AWG:

1. Copper conductor, 600-volt insulation, rated 90C, Type NM. Nonmetallic-sheathed cable shall be constructed in strict accordance with Underwriters Laboratories, Inc. Standard for Nonmetallic-sheathed Cables, UL 719.
2. An equipment grounding conductor shall be provided with circuit conductors in all cables. Size per Electrical Code.
3. Nonmetallic-sheathed cables may be used for branch circuit wiring as defined in the Electrical Code. Nonmetallic-sheathed cables shall not be used for other circuits.

PART 3 - EXECUTION

3.1 WIRE AND CABLE INSTALLATION SCHEDULE

A. Above Accessible Ceilings:

1. Metal clad cable, Type MC, 1/2" size with minimum #12 conductors and ground, shall be allowed for flexible whips to individual luminaires on non-essential circuits. The flexible whips shall be between 18" to 72" in length per Electrical Code.

B. Above Grade: All conductors installed above grade shall be type "THHN".

- C. Underground or In Slab: All conductors shall be type "THWN" or "XHHW".
- D. Low Voltage Cable (less than 100 volts): Low voltage cables in ducts, plenums, and other air handling spaces shall be plenum listed. Low voltage cables in non-accessible areas shall be installed in conduit. Low voltage cable may be installed without conduit in accessible areas using the following types of cable supports. Cable support types/systems shall comply with the warranty requirements of the low voltage cable manufacturer.
 - 1. J-hooks
 - 2. Bridle rings with saddle supports

3.2 CONTRACTOR CHANGES

- A. The basis of design is copper conductors installed in raceway based on ambient temperature of 30C,. Service entrance conductors are based on copper conductor installed in underground electrical ducts,
- B. The Contractor shall be responsible for derating and sizing conductors and conduits to equal or exceed the ampacity of the basis of design circuits, if other than the basis of design.
- C. Underground electrical duct ampacity rating shall be in accordance with NEC Table 310.16 (2011 - 2017 edition 310.15(B)(16)) or calculated in accordance with Annex B Application Information for Ampacity Calculation The calculations and a sketch of the proposed installation shall be submitted prior to any conduit being installed.
- D. Conductor length(s) listed on plans and schedules. The drawings are diagrammatic with intent to convey the components of the electrical distribution system. Conductor length(s) when listed on plans and schedules are for engineering calculation purposes. Conductor length(s) shall NOT be used for bidding purposes.
- E. Record drawing shall include the calculations and sketches.

3.3 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring 100 volts or greater.
- B. Low voltage control wiring, use no wire smaller than 18 AWG for low voltage control wiring below 100 volts.
- C. Use 10 AWG conductor for 20 ampere, 120-volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277-volt branch circuit home runs longer than 200 feet.
- D. The ampacity of multiple conductors in one conduit shall be derated per the Electrical Code. In no case shall more than 4 conductors be installed in one conduit to such loads as motors larger than 1/4 HP, panelboards, motor control centers, etc.
- E. Where installing parallel feeders, place an equal number of conductors for each phase of a circuit in same raceway or cable.

- F. Splice only in junction or outlet boxes.
- G. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- H. Make conductor lengths for parallel circuits equal.
- I. All conductors shall be continuous in conduit from last outlet to their termination.
- J. Care shall be taken so as not to subject the cable or wire to high mechanical stresses that would cause damage to the wire and cable.
- K. At least six (6)-inch loops or ends shall be left at each outlet for installation connection of luminaires or other devices.
- L. All wires in outlet boxes not connected to fixtures or other devices shall be rolled up, spliced if continuity of circuit is required, and insulated.

3.4 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.
- B. Where reels of cable or wire are used, they shall be set up on jacks close to the point where the wire or cable enters the conduit or duct so that the cable or wire may be unreeled and run into the conduit or duct with a minimum of change in the direction of the bend.
- C. Conductor Supports in Vertical Raceways:
 - 1. Support conductors in vertical raceways in accordance with the Electrical Code Spacing of Conductors Supports.

3.5 CABLE INSTALLATION

- A. Provide protection for exposed cables where subject to damage.
- B. Cable fittings, connectors, and supports shall be listed.
- C. Run all open cable parallel or perpendicular to walls, ceilings, and exposed structural members. Follow the routing as illustrated on the drawings as closely as possible. Cable routing on drawings scaled 1/4"=1'-0" or less shall be considered diagrammatical, unless noted otherwise. The correct routing, when shown diagrammatically, shall be chosen by the Contractor based on information in the contract documents; in accordance with the manufacturer's written instructions, applicable codes, the NECA's "Standard of Installation", recognized industry standards; and coordinated with other contractors.
- D. Open cable shall be supported by the appropriate size J-hooks or other means if called for on the drawings. Wire and cable from different systems shall not be installed in the same J-hook. J-hooks shall be sized with 20% spare capacity. J-hooks shall provide proper bend radius support for data cable and fiber cables.

- E. Open cable installed above suspended ceilings shall not rest on the suspended ceiling construction, nor utilize the ceiling support system for wire and cable support.
- F. J-hook support spans shall be based on the smaller of the manufacturer's load ratings and code requirements. In no case shall horizontal spans exceed 5 feet and vertical spans exceed 4 feet. All J-hooks shall be installed where completely accessible and not blocked by piping, ductwork, inaccessible ceilings, etc. J-hooks shall be independently rigidly attached to a structural element. J-hooks shall be installed to provide 2" horizontal separation and 6" vertical separation between systems.
- G. Underground installations; direct buried and conductors within raceways. Provide a warning ribbon with tracer wire at least twelve inches above the underground raceway.
- H. Open cable shall only be installed where specifically shown on the drawings or permitted in these specifications.

3.6 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice and tap only in accessible junction boxes.
- B. Use solderless, tin-plated copper, compression terminals (lugs) applied with circumferential crimp for conductor terminations, 8 AWG and larger.
- C. Use solderless pressure connectors with insulating covers for copper wire splices and taps in exterior locations, 8 AWG and larger. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- D. Lever style insulated splicing connectors, reversible, listed. Application limited to 14-10 awg, stranded/solid, copper conductor, and manufacturer's listing. Obtain Engineer/Owner written approval by Request For Information RFI or addendum prior to use. Example manufacturers Wago lever nuts, Ideal lever connectors.
- E. Thoroughly clean wires before installing lugs and connectors.
- F. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- G. Phase Sequence: All apparatus shall be connected to operate in the phase sequence A-B-C representing the time sequence in which the phase conductors so identified reach positive maximum voltage.
- H. As a general rule, applicable to switches, circuit breakers, starters, panelboards, switchgear and the like, the connections to phase conductors are intended thus:
 - 1. Facing the front and operating side of the equipment, the phase identification shall be:
 - a. Left to Right - A-B-C
 - b. Top to Bottom - A-B-C

- I. Connection revisions as required to achieve correct rotation of motors shall be made at the load terminals of the starters or disconnect switches.
- J. Use antioxidant joint compound on all aluminum conductor terminations. Apply antioxidant joint compound per manufacturer's recommendations.

3.7 MC AND NONMETALLIC-SHEATHED CABLE INSTALLATION

- A. MC shall NOT be used for circuits serving the Essential Electrical System.
- B. Cable shall be supported by an approved means every 4.5' and within 12" of outlet boxes, junction boxes, cabinets, or fittings.
- C. Cable may be unsupported in the following conditions:
 - 1. Cable is no longer than 2' in length at terminals where flexibility is necessary.
 - 2. Cable is not more than 4.5' from the last point of support for connections within an accessible ceiling to light fixtures or equipment.
- D. Conductor ampacity shall be derated as required by the Electrical Code where more than three current carrying conductors are used.
- E. Each 120 and 277-volt circuit shall have a dedicated neutral conductor. Neutral conductors shall be considered current-carrying conductors for cable derating.
- F. Bending radius shall comply with the requirements listed in the Electrical Code for the type and size of cable being installed, but shall not be less than 5-times the diameter of the cable in any case.
- G. At cable terminations, a fitting shall be provided to protect wires from abrasion, unless the design of the outlet boxes or fittings is such as to afford equivalent protection, and, in addition, an insulating bushing or its equivalent protection shall be provided between the conductors and the armor.
- H. All wiring devices supplied by nonmetallic-sheathed cables shall be mounted in an outlet box.

3.8 FIELD QUALITY CONTROL

- A. Inspect wire and cable for physical damage and proper connection.
- B. Torque test conductor connections and terminations to manufacturer's recommended values.
- C. Provide documentation of the manufacturer's recommended lug torque value for copper and aluminum conductors, the date the lugs were torqued, and installed torque readings. Documentation indicating that the torque wrench has been calibrated not more than 30 days prior to tightening of lugs shall be provided.
- D. Protection of wire and cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any wire or cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited to, overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid, or compound that could come in contact with the cable, cable jacket, or cable termination components.

END OF SECTION

SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Equipment grounding system
- B. Bonding system

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC) with 2020 Washington Amendments

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 260500.
- B. Product Data: For the following:
 - 1. Ground rods.
 - 2. Chemical electrodes.

1.4 SUMMARY

- A. This section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

PART 2 - PRODUCTS

2.1 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section 260513 "Wire and Cable".
- B. Material: Copper,.
- C. Equipment Grounding Conductors: Insulated. Refer to Section 260553 for insulation color.
- D. Isolated Ground Conductors: Insulated. Refer to Section 260553 for insulation color.
- E. Underground Conductors: Bare, tinned, stranded, unless otherwise indicated.
- F. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.

3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

G. GB; Grounding Bar:

1. Bare, annealed copper bars of rectangular cross section, with insulators. 1/4" x 2", length of technology or applicable room.

H. IBT; Intersystem Bonding Termination:

1. Copper bar, 1/4" x 2" x 24". Provide with wall mounting brackets, insulators and pre-tapped holes.
2. Manufacturers:
 - a. Harger GBI Series.
 - b. Erico EGB Series.

2.2 CONNECTOR PRODUCTS

- A. Comply with UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Connectors: Hydraulic compression type], in kit form, and selected per manufacturer's written instructions.
- C. Bolted Connectors: Bolted-pressure-type connectors.

2.3 GROUNDING ELECTRODES

- A. Ground Rods Copper-clad steel
- B. Chemical Electrodes: Copper tube, straight or L-shaped, filled with nonhazardous chemical salts, terminated with a 4/0 bare conductor. Provide backfill material recommended by manufacturer.
- C. Concrete-Encased Grounding Electrode (Ufer): Fabricate according to Electrical Code, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG or 20 feet of 1/2" steel reinforcing bar.

PART 3 - EXECUTION

3.1 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- D. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- E. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically non-continuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- F. Underground Connections: or Hydraulic compression connection. Use for underground connections, except those at test wells.
- G. Connections at Test Wells: Use compression-type connectors on conductors and make two bolted- and clamped-type connections between conductors and ground rods.
- H. Connections at back boxes, junction boxes, pull boxes, and equipment terminations: The equipment grounding conductor(s) associated with all circuits in the box shall be connected together and to the box using a suitable grounding screw. The removal of the respective receptacle, luminaire, or other device served by the box shall not interrupt the grounding continuity. The connection to the non-metallic boxes shall be made to any metallic fitting or device requiring grounding.
- I. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- J. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.2 INSTALLATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Each grounding conductor that passes through a below grade wall must be provided with a waterstop.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then use a bolted clamp. Bond straps directly to the basic structure, taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. In raceways, use insulated equipment grounding conductors.
- E. Underground Grounding Conductors: Use tinned copper conductor, No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.
- F. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, below access floors, and elsewhere as indicated, with bolted connections to form a continuous ground path.

3.3 EQUIPMENT GROUNDING SYSTEM

- A. Comply with Electrical Code, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by Electrical Code are indicated.
- B. Install equipment grounding conductors in all feeders and circuits. Terminate each end on a grounding lug or bus.
- C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by Electrical Code:
 - 1. Lighting and receptacle circuits. Terminate each end on a grounding lug or bus.
 - 2. Single-phase and three-phase motor and appliance branch circuits.
 - 3. Flexible raceway runs, including FMC and LFMC.
 - 4. Metal-clad cable runs.
- D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

3.4 BONDING SYSTEM

- A. Exterior Metallic Pull and Junction Box Covers, Metallic Hand Rails: Bond to grounding system using flexible grounding conductors.

- B. Water Heater, Heat-Tracing, Metal Well Casing, and Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, well casing, connected equipment, and components.
- C. Connect bonding conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.
- D. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated bonding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location. Leave 10 feet of slack conductor at terminal board.
- E. Telecom Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bar.
- F. Equipment Ground Conductor Continuity: All spliced equipment grounding conductors in junction boxes, cabinets, and distribution equipment shall be connected together and bonded to the metal enclosure.
- G. Remote control, signaling, and fire alarm circuits shall be bonded in accordance with the most recent version of the National Electric Code.

3.5 GROUNDING ELECTRODE SYSTEM

- A. Provide bonding at Utility Company's metering equipment and pad mounted transformer.
- B. Ground Rods: Install at least two rods spaced at least 20 feet from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 12 inches below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
- C. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- D. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters, filtering devices, and similar equipment. Connect to pipe with grounding clamp connectors.

- E. Concrete-Encased Grounding Electrode (Ufer): Install concrete-encased grounding electrode encased in at least 2 inches of concrete horizontally within the foundation that is in contact with the earth. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

3.6 CONCRETE OR WOOD BUILDING GROUNDING SYSTEM

- A. Provide a copper common grounding electrode conductor for the attachment of multiple separately derived systems in accordance with Electrical Code. Individual grounding conductor taps from the separately derived systems to the common grounding electrode shall be sized in accordance with Electrical Code. All tap connections shall be made in an accessible location in such a manner that common grounding electrode conductor remains without a splice or joint.

3.7 EQUIPOTENTIAL (MULTI-POINT) GROUNDING SYSTEM

- A. The non-current-carrying metal parts of equipment, raceways and other enclosures shall be bonded to the grounding system.

3.8 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
 - 1. Measure ground resistance from system neutral connection at service entrance to convenient ground reference points using suitable ground testing equipment. Resistance shall not exceed 5 ohms.

END OF SECTION

SECTION 260527 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and Equipment Supports
- B. Fastening Hardware
- C. Concrete Housekeeping Pads

1.2 QUALITY ASSURANCE

- A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

1.3 REFERENCES

- A. UL 62275 - Cable Management Systems - Cables Ties for Electrical Installations

1.4 COORDINATION

- A. Coordinate size, shape and location of concrete pads with section on Cast-in-Place Concrete or Concrete Topping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Allied Support Systems
- B. Cooper B-Line
- C. Erico, Inc.
- D. Hilti
- E. Power Fasteners
- F. Orbit Industries

2.2 MATERIAL

- A. Support Channel: Hot-dip galvanized] for wet/damp locations; painted steel for interior/dry locations. .
- B. Anchorage and Structural Attachment Components:

1. Beam clamps for Steel Beams and Joists:
 - a. Single sided beam clamp hangers may be used for applications not requiring double sided beam clamps; listed above
 2. Masonry Anchors: Fasten to concrete masonry units with expansion anchors or self-tapping masonry screws. For expansion anchors into hollow concrete block, use sleeve-type anchors designed for the specific application. Do not fasten in masonry joints. Do not use powder actuated fasteners, wooden plugs, or plastic inserts.
- C. Conduit Sleeves and Lintels:
1. Each Contractor shall provide, to the General Contractor for installation, lintels for all openings required for the Contractor's work in masonry walls and conduit sleeves for floors, unless specifically shown as being by others.
 2. Refer to Structural plans and specifications for lintel requirements and sizes.
- D. Concrete Housekeeping Pads:
1. Concrete bases for all floor mounted equipment and wall mounted equipment which is surface mounted and extends to within 6" of the finished floor, unless shown otherwise on the drawings, shall be 3-1/2" thick concrete.
 2. Bases shall extend 3" on all sides of the equipment (6" larger than factory base).
 3. Where the base is less than 12" from a wall, the base shall be carried to the wall to prevent a "dirt-trap".
 4. Concrete materials and workmanship required for the Contractor's work shall be provided by the Contractor. Materials and workmanship shall conform to the applicable standards of the Portland Cement Association. Reinforce with 6" x 6", W1.4-W1.4 welded wire fabric. Concrete shall withstand 3,000 pounds compression per square inch at twenty-eight days.
- E. Rooftop Support System:
1. Provide pre-fabricated roof supports for all conduit and equipment installed above the roof. Support all conduit and equipment a minimum of 4" above roof.
 2. Support system shall be compatible with single ply, bituminous, metal, and spray foam roof systems. The base shall be rounded to prevent damage to the roof, and drainage holes shall prevent ponding of water in the support.
 3. All metal components shall be hot dipped galvanized. Mounting hardware shall be stainless steel or hot dipped galvanized. Support shall be UV, corrosion, and freeze/thaw resistant. Support shall include orange paint, reflective safety orange accents, or similar markings for increased visibility.
 4. Products:
 - a. Anvil International HBS-Base Series
 - b. Cooper B-Line Dura-Blok
 - c. Erico Caddy Pyramid 50, 150, 300, or 600 (to match load).
- F. Cable Ties:

1. Cables ties, Listed and Labeled for cable management applications, securement and support, Type 1, 11, 2, 21.
2. Acceptable Applications: Low Voltage Wire and Cabling.
 - a. Bundle wires and cables within cable trays, auxiliary gutters, and similar applications for organization.
3. Cable ties, Listed and Labeled for securement and support, Type 2S, 21S.
4. Acceptable Applications: Low Voltage Wire, Cabling, Flexible Conduit, and Flexible Tubing.
 - a. Bundle wires and cables within cable trays, auxiliary gutters, and similar applications for organization.
 - b. Organize and support wiring and cables within equipment and distribution systems.
5. Cable ties, special ratings for suitable application and environment.
 - a. Exterior, wet/damp locations, direct sunlight.
 - b. Plenum rated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors in concrete and beam clamps on structural steel.
- B. Trapeze support installation: Cut hanger rods back at trapeze supports so they do not extend more than 3/4" below bottom face of lowest fastener and blunt any sharp edges.
- C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.
- D. Do not fasten supports to ceiling systems, piping, ductwork, mechanical equipment, or conduit, unless otherwise noted.
- E. Do not use powder-actuated anchors without specific permission.
- F. Do not drill structural steel members.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. In wet locations and on all building floors below exterior earth grade install free-standing electrical equipment on concrete pads.

- I. Install cabinets and panelboards with minimum of four anchors. Provide horizontal backing/support framing in stud walls for rigid mounting.
- J. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- K. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- L. Refer to Section 260533 for special conduit supporting requirements.

END OF SECTION

SECTION 260533 - CONDUIT AND BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Rigid metallic conduit and fittings (RMC)
- B. Electrical metallic tubing and fittings (EMT)
- C. Flexible metallic conduit and fittings (FMC)
- D. Liquidtight flexible metallic conduit and fittings (LFMC)
- E. Rigid polyvinyl chloride conduit and fittings (PVC)
- F. Wall and ceiling outlet boxes
- G. Electrical connection
- H. Pull and junction boxes
- I. Rough-ins
- J. Foundation - Underground Sleeves and Seals
- K. Accessories

1.2 RELATED WORK

- A. Section 260553 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated
 - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated and Fittings
 - 3. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing
 - 4. ANSI C80.6 - Intermediate Metal Conduit, Zinc Coated
 - 5. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports
 - 6. ANSI/NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
- B. Federal Specifications (FS):
 - 1. A-A-50553A - Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall (EMT) Type
 - 2. A-A-55810 - Specification for Flexible Metal Conduit

- C. NECA "Standards of Installation"
- D. National Electrical Manufacturers Association (NEMA):
 - 1. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
 - 2. RN 1 - Polyvinyl chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit, Rigid Aluminum Conduit, and Intermediate Metal Conduit
 - 3. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit
 - 4. TC 9 - Fittings for PVC Plastic Utilities Duct for Underground Installation
- E. NFPA 70 - National Electrical Code (NEC) with 2020 Washington Amendments
- F. Underwriters Laboratories (UL): Applicable Listings
 - 1. UL 1 - Flexible Metal Conduit
 - 2. UL 6 - Rigid Metal Conduit
 - 3. UL 360 - Liquid Tight Flexible Steel Conduit
 - 4. UL514-B - Conduit Tubing and Cable Fittings
 - 5. UL651-A - Type EB and a PVC Conduit and HDPE Conduit
 - 6. UL797 - Electrical Metal Tubing
- G. American Standard of Testing and Materials (ASTM):
 - 1. ASTM D 570 - Standard Test Method for Water Absorption of Plastics
 - 2. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics
 - 3. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics under Flexural Load in the Edge Wise Position
 - 4. ASTM D 2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
 - 5. ASTM D 2447 - Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
 - 6. ASTM D 3350 - Standard Specification for Polyethylene Plastic Pipe and Fittings Material
- H. Definitions:
 - 1. Fittings: Conduit connection or coupling.
 - 2. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only.
 - 3. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.
 - 4. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and/or floors.
 - 5. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.

6. Above Grade: Not directly in contact with the earth. For example, an interior wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.
7. Slab: Horizontal pour of concrete used for a floor or sub-floor.

1.4 SUBMITTALS

- A. Include fittings and conduits 1.5" and larger in coordination files. Include all in--floor and underfloor conduit in coordination files. Refer to Section 260500 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 RIGID METALLIC CONDUIT (RMC) AND FITTINGS

A. Manufacturers:

1. Atkore Allied Tube & Conduit
2. Nucor
3. Electroline
4. Western Tube
5. Wheatland Tube Co
6. or approved equal.

B. Manufacturers of RMC Conduit Fittings:

1. ABB/Thomas & Betts
2. Eaton/Crouse-Hinds
3. Electroline
4. Emerson Appleton & OZ Gedney
5. Hubbell Raco and Killark
6. NSI Bridgeport
7. Orbit Industries
8. Wesco Regal
9. or approved equal.

C. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted.

D. Fittings and Conduit Bodies:

1. End Bell Fittings: Malleable iron, hot dip galvanized, threaded flare type with provisions for mounting to form.
2. Expansion Joints: Malleable iron and hot dip galvanized providing a minimum of 4 inches of movement. Fitting shall be watertight with an insulating bushing and a bonding jumper.
3. Expansion Joint for Concrete Encased Conduit: Neoprene sleeve with bronze end coupling, stainless steel bands and tinned copper braid bonding jumper. Fittings shall be watertight and concrete-tight.

4. Conduit End Bushings: Malleable iron type with molded-on high impact phenolic thermosetting insulation. Where required elsewhere in the contract documents, bushing shall be complete with ground conductor saddle and clamp. High impact phenolic threaded type bushings are not acceptable.
5. All other fittings and conduit bodies shall be of malleable iron construction and hot dip galvanized.

2.2 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

- A. Minimum Size Electrical Metallic Tubing: 3/4 inch, unless otherwise noted.
- B. Manufacturers of EMT Conduit:
 1. Allied Tube & Conduit
 2. Calbond Calpipe
 3. Nucor
 4. Electroline
 5. Western Tube
 6. Wheatland Tube Co
 7. or approved equal.
- C. Fittings and Conduit Bodies:
 1. 2" Diameter or Smaller: Compression or steel set screw type of steel designed for their specific application.
 2. Larger than 2": Compression or steel set screw type of steel designed for their specific application.
 3. Manufacturers of EMT Conduit Fittings:
 - a. ABB/Thomas & Betts
 - b. Eaton/Crouse-Hinds
 - c. Electroline
 - d. Emerson Appleton & OZ Gedney
 - e. Hubbell Raco and Killark
 - f. NSI Bridgeport
 - g. Orbit Industries
 - h. Wesco Regal

2.3 FLEXIBLE METALLIC CONDUIT (FMC) AND FITTINGS

- A. Minimum Size Galvanized Steel: 3/4 inch, unless otherwise noted. Lighting branch circuit wiring to an individual luminaire may be a manufactured, UL listed 3/8" flexible metal conduit and fittings with #14 AWG THHN conductors and an insulated ground wire. Maximum length of 3/8" FMC shall be six (6) feet.
- B. Manufacturers:
 1. ABB/Thomas & Betts
 2. Anamet Electrical
 3. Atkore American Flex AFC and Flexicon
 4. Electri-Flex Co

5. Electroline
6. Southwire Alfex
7. or approved equal.

C. Fittings and Conduit Bodies:

1. Threadless hinged clamp type, galvanized zinc coated cadmium plated malleable cast iron or screw-in type, die-cast zinc.
2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
3. Manufacturers:
 - a. ABB/Thomas & Betts
 - b. Eaton/Crouse-Hinds
 - c. Electroline
 - d. Emerson Appleton & OZ Gedney
 - e. Hubbell Raco and Killark
 - f. NSI Bridgeport
 - g. Orbit Industries
 - h. Wesco Regal
 - i. or approved equal.

2.4 LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS

A. Manufacturers:

1. ABB/Thomas & Betts
2. Anamet Electrical
3. Atkore American Flex AFC and Flexicon
4. Electri-Flex Co
5. Electroline
6. Southwire Alfex
7. or approved equal.

B. Construction: Flexible steel, approved for conduit ground, zinc coated, threadless type formed from a continuous length of spirally wound, interlocked zinc coated strip steel and an extruded PVC cover.

C. Fittings and Conduit Bodies:

1. Watertight, compression type, galvanized zinc coated cadmium plated malleable cast iron, UL listed.
2. Fittings and conduit bodies shall include plastic or cast metal inserts supplied by the manufacturer to protect conductors from sharp edges.
3. Manufacturers:
 - a. ABB/Thomas & Betts
 - b. Eaton/Crouse-Hinds
 - c. Electroline
 - d. Emerson Appleton & OZ Gedney

- e. Hubbell Raco and Killark
- f. NSI Bridgeport
- g. Orbit Industries
- h. Wesco Regal
- i. or approved equal.

2.5 RIGID NON-METALLIC CONDUIT (PVC) AND FITTINGS

- A. Minimum Size Rigid Smooth-Wall Nonmetallic Conduit: 3/4 inch, unless otherwise noted.
- B. Acceptable Manufacturers:
 - 1. ABB/Carlson
 - 2. Chevron Phillips Chemical Company
 - 3. Cantex, J.M. Mfg.
 - 4. Atkore Heritage Plastics
 - 5. or approved equal.
- C. Construction: Schedule 40 and Schedule 80 rigid polyvinyl chloride (PVC), UL labeled for 90C.
- D. Fittings and Conduit Bodies: NEMA TC 3; sleeve type suitable for and manufactured especially for use with the conduit by the conduit manufacturer.
- E. Plastic cement for joining conduit and fittings shall be provided as recommended by the manufacturer.

2.6 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, 16 gauge (approximately 0.0625 inches), with 1/2-inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: ANSI/NEMA OS 2.
- C. Cast Boxes: Nema FB1, Type FD, Aluminum, cast ferrous alloy, or stainless steel deep type, gasketed cover, threaded hubs.
- D. Outlet boxes for luminaires to be not less than 1-1/2" deep, deeper if required by the number of wires or construction. The box shall be coordinated with surface luminaires to conceal the box from view or provide a finished trim plate.
- E. Switch outlet boxes for local light control switches, dimmers and occupancy sensors shall be 4 inches square by 2-1/8 inches deep, with raised cover to fit flush with finish wall line. Multiple gang switch outlets shall consist of the required number of gang boxes appropriate to the quantity of switches comprising the gang. Where walls are plastered, provide a plaster raised cover. Where switch outlet boxes occur in exposed concrete block walls, boxes shall be installed in the block cavity with a raised square edge tile cover of sufficient depth to extend out to face of block or masonry boxes.

- F. Technology Rough-in(s): Backboxes for technology rough-in on walls shall be minimum of 4 inches square and 2-1/8 inches deep with single gang raised cover to fit flush with finished wall line.
- G. Wall or column receptacle outlet boxes shall be 4 inches square with raised cover to fit flush with finished wall line. Boxes in concrete block walls shall be installed the same as for switch boxes in block walls.

2.7 ECONN; ELECTRICAL CONNECTION

- A. Electrical connection to equipment and motors, sized per Electrical Code. Coordinate requirements with contractor furnishing equipment or motor. Refer to specifications and general installation notes for terminations to motors.

2.8 JB; PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.
- B. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- C. Cast Metal Boxes for Underground Installations: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless steel cover screws.
- D. Flanged type boxes shall be used where installed flush in wall.

2.9 TECHNOLOGY ROUGH-IN

- A. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate, unless otherwise noted.

2.10 ROUGH-IN

- A. Provide with one (1) flush mount double gang box with single gang plaster ring and appropriate cover plate,
- B. Conduit stubbed to above the lay-in ceiling.
- C. RI-TECH; Technology Rough-in:
 - 1. Rough-in shall have one (1) 1" conduit.

Model	Service	Element Material	Temperature Range
S	Standard (Stainless)	EPDM	-40F to
T	Fire Seals (1 hour)	Silicone	-67F to
FS	Fire Seals (3 hours)	Silicone	-67F to 400F
OS	Oil Resistant / Stainless	Nitrile	-40F to 210F

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION SCHEDULE AND SIZING

- A. In the event the location of conduit installation represents conflicting installation requirements as specified in the following schedule, a clarification shall be obtained from the Architect/Engineer. If this Contractor is unable to obtain a clarification as outlined above, concealed rigid galvanized steel conduit installed per these specifications and the Electrical Code shall be required.
- B. Installation Schedule: Refer to drawings.
- C. Corrosive Environments: Refer to installation schedule on drawings.
- D. Size conduit as shown on the drawings and specifications. Where not indicated in the contract documents, conduit size shall be according to the Electrical Code. Conduit and conductor sizing shall be coordinated to limit conductor fill to less than 40%, maintain conductor ampere capacity as required by the Electrical Code (to include enlarged conductors due to temperature and quantity derating values) and to prevent excessive voltage drop and pulling tension due to long conduit/conductor lengths.
- E. Minimum Conduit Size (Unless Noted Otherwise):
 - 1. Above Grade: 3/4 inch. (The use of 1/2 inch would be allowed for installation conduit to individual light switches, individual receptacles and individual fixture whips from junction box.)
 - 2. Below Grade 5' or less from Building Foundation: 3/4 inch.
 - 3. Below Grade More than 5' from Building Foundation: 3/4 inch.
 - 4. Telecommunication Conduit: 1 inch.
 - 5. Controls Conduit: 3/4 inch.
- F. Conduit sizes shall change only at the entrance or exit to a junction box, unless specifically noted on the drawings.

3.2 CONDUIT ARRANGEMENT

- A. In general, conduit shall be installed concealed in walls, in finished spaces and where possible or practical, or as noted otherwise. Conduit shall be installed parallel or perpendicular to walls, ceilings, and exposed structural members. In unfinished spaces, mechanical and utility areas, conduit may run either concealed or exposed as conditions dictate and as practical unless noted otherwise on drawings. Installation shall maintain headroom in exposed vicinities of pedestrian or vehicular traffic.
- B. Exposed conduit on exterior walls or above roof will not be allowed without prior written approval of Architect/Engineer. A drawing of the proposed routing and a photo of the location shall be submitted 14 days prior to start of conduit rough-in. Routing shall be shown on coordination drawings.
- C. Conduit shall not share the same cell as structural reinforcement in masonry walls.

- D. Contractor shall adapt Contractor's work to the job conditions and make such changes as required and permitted by the Architect/Engineer, such as moving to clear beams and joists, adjusting at columns, avoiding interference with windows, etc., to permit the proper installation of other mechanical and/or electrical equipment.
- E. Contractor shall cooperate with all contractors on the project. Contractor shall obtain details of other contractor's work to ensure fit and avoid conflict. Any expense due to the failure of This Contractor to do so shall be paid for in full by Contractor. The other trades involved as directed by the Architect/Engineer shall perform the repair of work damaged as a result of neglect or error by This Contractor. The resultant costs shall be borne by This Contractor.

3.3 CONDUIT SUPPORT

- A. Conduit runs installed above a suspended ceiling shall be properly supported. In no case shall conduit rest on the suspended ceiling construction, nor utilize ceiling support system for conduit support.
 - 1. Support wire used to independently support raceway and wiring systems above suspending ceilings shall be supported on both ends, minimum 12 gauge suspended ceiling support wire, and distinguishable from ceiling support systems by color (field paint), tagging, or equivalent means.
- B. Conduit shall not be supported from ductwork, water, sprinkler piping, or other non-structural members, unless approved by the Architect/Engineer. All supports shall be from structural slabs, walls, structural members, and bar joists, and coordinated with all other applicable contractors, unless noted otherwise.
- C. Conduit shall be held in place by the correct size of galvanized one-hole conduit clamps, two-hole conduit straps, patented support devices, clamp back conduit hangers, or by other means if called for on the drawings.
- D. Support individual horizontal raceways with separate, malleable-iron pipe hangers or clamps.
- E. Spring-steel conduit clips specifically designed for supporting single conduits or tubing may be used in lieu of malleable-iron hangers for 1-1/2" and smaller raceways serving lighting and receptacle branch circuits above accessible ceilings and for securing raceways to slotted channel and angle supports.
- F. Group conduits in parallel runs where practical and use conduit racks or trapeze hangers constructed of steel channel, suspended with threaded solid rods or wall mounted from metal channels with conduit straps or clamps.
- G. Do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center when attaching to metal roof decking (excludes concrete on metal deck). This 25 lbs. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.
- H. Arrange supports in vertical runs so the weight of raceways and enclosed conductors is carried entirely by raceway supports, with no weight load on raceway terminals.

- I. Supports for metallic conduit shall be no greater than 10 feet. A smaller interval may be used if necessitated by building construction, but in no event shall support spans exceed the Electrical Code requirements. Conduit shall be securely fastened within 3 feet of each outlet box, junction box, device box, cabinet, or fitting.
 - J. Supports of flexible conduit shall be within 12 inches of each outlet box, junction box, device box, cabinet, or fitting and at intervals not to exceed 4.5 feet.
 - K. Supports for non-metallic conduit shall be at sufficiently close intervals to eliminate any sag in the conduit. The manufacturer's recommendations shall be followed, but in no event shall support spans exceed the Electrical Code requirements.
 - L. Where conduit is to be installed in poured concrete floors or walls, provide concrete-tight conduit inserts securely fastened to forms to prevent conduit misplacement.
 - M. Finish:
- 3.4 Trim all ends of exposed field fabricated steel hangers, slotted channel and threaded rod to within 1" of support or fastener to eliminate potential injury to personnel unless shown otherwise on the drawings.
- A. Conduit Connections:
 - 1. Shorter than standard conduit lengths shall be cut square using industry standards. The ends of all conduits cut shall be reamed or otherwise finished to remove all rough edges.
 - 2. Where conduits with tapered threads cannot be coupled with standard couplings, then approved split or Erickson couplings shall be used. Running threads will not be permitted.
 - 3. Install expansion/deflection joints where conduit crosses structure expansion/seismic joints.
 - B. Conduit terminations for all low voltage wiring shall have nylon bushings installed on each end of every conduit run.
 - C. Conduit Bends:
 - 1. Use a hydraulic one-shot conduit bender or factory elbows for bends in conduit 2" in size or larger. All steel conduit bending shall be done cold; no heating of steel conduit shall be permitted.
 - 2. All bends of rigid polyvinyl chloride conduit (PVC) shall be made with the manufacturer's approved bending equipment. The use of spot heating devices will not be permitted (i.e. blow torches).
 - 3. A run of conduit shall not contain more than the equivalent of four (4) quarter bends (360 degrees), including those bends located immediately at the outlet or body.
 - 4. Telecommunications conduits shall have no more than two (2) 90-degree bends between pull points and contain no continuous sections longer than 100 feet. Insert pull points or pull boxes for conduits exceeding 100 feet in length.
 - a. A third bend is acceptable if:
 - 1) The total run is not longer than (33) feet.

- 2) The conduit size is increased to the next trade size.
5. Telecommunications pull boxes shall not be used in lieu of a bend. Align conduits that enter the pull box from opposite ends with each other. Pull box size shall be twelve (12) times the diameter of the largest conduit. Slip sleeves or gutters can be used in place of a pull box.
6. Telecommunications Conduit(s): Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.
7. Rigid polyvinyl chloride conduit (PVC) runs longer than 100 feet or runs which have more than two 90-degree equivalent bends (regardless of length) shall use rigid metal or RTRC factory elbows for bends.
8. Use conduit bodies to make sharp changes in direction (i.e. around beams).

D. Conduit Placement:

1. Conduit shall be mechanically continuous from source of current to all outlets. Conduit shall be electrically continuous from source of current to all outlets, unless a properly sized grounding conductor is routed within the conduit. All metallic conduits shall be bonded per the Electrical Code.
2. Route exposed conduit and conduit above suspended ceilings (accessible or not) parallel/perpendicular to the building structural lines, and as close to building structure as possible. Wherever possible, route horizontal conduit runs above water and steam piping.
3. Route conduit through roof openings provided for piping and ductwork where possible. If not provided or routing through provided openings is not possible, route through roof jack with pitch pocket. Coordinate roof penetrations with other trades.
4. Conduits, raceway, and boxes shall not be installed in concealed locations in roof decking nor installed less than 1.5" below bottom of roof decking.
5. Raceways located in wet/damp locations shall be arranged to drain. Avoid moisture traps where possible. Where unavoidable, provide a junction box with drain fitting at conduit low point.
6. All conduits through walls shall be grouted or sealed into openings. CONTRACTOR SHALL BE RESPONSIBLE FOR ALL OPENINGS REQUIRED IN MASONRY OR EXTERIOR WALLS UNDER THIS DIVISION. A QUALIFIED MASON AT THE EXPENSE OF THIS CONTRACTOR SHALL REPAIR ALL OPENINGS TO MATCH EXISTING CONDITIONS.
7. Seal interior of conduit at exterior entries, air handling units, coolers/freezers, etc., and where the temperature differential can potentially be greater than 20F to prevent moisture penetration. Seal shall be placed where conduit enters warm space. Conduit seal fitting shall be a drain/seal, with sealing compound, identified for use with cable and raceway system.
8. Do not route conduits across each other in slabs on grade.
9. Contractor shall provide suitable mechanical protection around all conduits stubbed out from floors, walls or ceilings during construction to prevent bending or damaging of stubs due to carelessness with construction equipment.
10. Telecommunications conduits that protrude through the structural floor shall be installed 1 to 3" above finished floor (AFF).

11. Telecommunications conduits that enter into Telecommunications rooms below the finished ceiling shall terminate a minimum of 4" below ceiling and as close to the wall as possible.
12. Telecommunications conduits that are below grade and enter into a building shall terminate a minimum of 4" above finished floor (AFF) and as close to the wall as possible.

3.5 CONDUIT TERMINATIONS

- A. Where conduit bonding is indicated or required in the contract documents, the bushings shall be a type sized for the conduit and ground bonding conductor as manufactured by O-Z/Gedney, Appleton, Thomas & Betts, Burndy, Regal, Orbit Industries or approved equal.
- B. Threaded conduits (example RMC, IMC) without threaded termination fittings or hubs shall be threaded for one (1) lock nut on the outside and one (1) opposing lock nut and Malleable Insulated Grounding Bushing MGIB on the inside of the box/enclosure.
- C. Where conduits terminate in boxes with knockouts, they shall be secured to the boxes with lock nuts and provided with approved screw type tinned iron bushings or fittings with plastic inserts.
- D. Where conduits terminate in boxes, fittings, or bodies with threaded openings, they shall be tightly screwed against the shoulder portion of the threaded openings.
- E. Rigid polyvinyl chloride conduit (PVC) shall be terminated using fittings and bodies produced by the manufacturer of the conduit, unless noted otherwise. Prepare conduit as per manufacturer's recommendations before joining. All joints shall be solvent welded by applying full even coat of plastic cement to the entire areas that will be joined. Turn the conduit at least a quarter to one half turn in the fitting and let the joint cure for 1-hour minimum or as per the manufacturer's recommendations.
- F. All conduit ends shall be sealed with plastic immediately after installation to prevent the entrance of any foreign matter during construction. The seals shall be removed and the conduits blown clear of all foreign matter prior to any wires or pull cords being installed.

3.6 RIGID POLYVINYL CHLORIDE CONDUIT (PVC) OVERHEAD CONDUIT INSTALLATION

- A. Conduit shall be installed away from high temperature piping and equipment.
- B. Conduit shall be installed to prevent exposure to ultraviolet radiation.
- C. Proper allowances shall be made for expansion and/or contraction of the conduit during installation.
- D. Supports shall be made from non-corroding materials and spacing shall not be greater than the listing in the Electrical Code, but also shall not exceed the manufacturer's recommendations depending on the expected surface temperature.

3.7 UNDERGROUND CONDUIT INSTALLATION

- A. Conduit Connections:

1. Conduit joints in a multiple conduit run shall be staggered at least one foot apart.

B. Conduit Bends (Lateral):

1. Conduits shall have long sweep radius elbows instead of standard elbows wherever special bends are indicated and noted on the drawings, or as required by the manufacturer of the equipment or system being served.
2. Telecommunications conduit bend radius shall be six times the diameter for conduits under 2" and ten times the diameter for conduits over 2". Where long cable runs are involved, sidewall pressures may require larger radius bends. Coordinate with Architect/Engineer prior to conduit installation to determine bend radius.

C. Conduit Elbows (vertical):

1. Minimum metal or RTRC elbow radiuses shall be 30 inches for primary conduits (greater than 600V) and 18 inches for secondary conduits (less than 600V). Increase radius, as required, based on pulling tension calculation requirements.

D. Conduit Placement:

1. Conduit runs shall be pitched a minimum of 4" per 100 feet to drain toward the terminations. Duct runs shall be installed deeper than the minimum wherever required to avoid any conflicts with existing or new piping, tunnels, etc.
2. For parallel runs, use suitable separators and chairs installed not greater than 4' on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement or backfilling.
3. Where concrete is required, the materials for concreting shall be thoroughly mixed to a minimum $f'c = 2500$ and immediately placed in the trench around the conduits. No concrete that has been allowed to partially set shall be used.
4. Before the Contractor pulls any cables into the conduit, Contractor shall have a mandrel 1/4" smaller than the conduit inside diameter pulled through each conduit and if any concrete or obstructions are found, the Contractor shall remove them and clear the conduit. Spare conduit shall also be cleared of all obstructions.
5. Conduit terminations in manholes, masonry pull boxes, or masonry walls shall be with malleable iron end bell fittings.
6. All spare conduits not terminated in a covered enclosure shall have its terminations plugged as described above.
7. Ductbanks and conduit shall be installed a minimum of 24" below finished grade, unless otherwise noted on the drawings or elsewhere in these specifications.
8. All non-metallic conduit installed underground outside of a slab shall be rigid.

E. Horizontal Directional Drilling:

1. Entire drill path shall be accurately surveyed, with entry and exit stakes placed and coordinated with other contractors. If using a magnetic guidance system, entire drill path shall be surveyed for any surface geo-magnetic variations or anomalies.
2. Any utility locates within 20 feet of the bore path shall have the exact location physically verified by hand digging or vacuum excavation. Restore inspection holes to original condition after verification.

- F. Underground Electrical Lines: For exterior underground service feeder, other power feeders and branch circuits, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 to 8 inches below grade. A single plastic line marker is permitted when the width of the common trench does not exceed 16 inches; provide a second plastic line marker to mark each edge of the trench when 16 inches of width is exceeded.
- G. Raceway Seal (Exterior to Raceway):
1. All power, telecommunication, electrical conduits and innerducts shall be sealed between the raceway and the building foundation. The raceway penetration shall be sealed liquid-tight, water-tight, non-corrosive.
 2. Below Grade Installation Options:
 - a. Cast-in-place concrete installation.
 - b. Hydraulic cement, hydraulic grout, hydraulic epoxy.
 - c. Foundation - Underground Sleeves and Seals; refer to Part 2-Products for product information.
 3. Above Grade Installation Options:
 - a. Masonry grout for masonry applications.
 - b. Caulk Sealant, interior/exterior rated, color per architect. Refer to architectural specifications for additional requirements. Approved Manufacturers include Sachco, Tremco Vulkem, Sika or approved equal when not specified by architectural scope.
- H. Raceway Seal (Interior to Raceway, with Cables or Empty):
1. All power, telecommunication, electrical conduits and innerducts, including those with cables, shall be sealed at the building and vault entry. The seal shall prevent the entry of liquids or gases. Seal must be compatible with conductors and raceway system. Spare or unused raceways shall also be sealed.
 2. Installation Schedule, nominal size:
 - a. 2" or less: Duct Seal Bushing or Duct Sealnt
 - b. 2-1/2" through 4": Duct Seal Bushing
 - c. 5" and 6": Wall Sleeve Duct Seal System

3.8 BOX INSTALLATION SCHEDULE

- A. Galvanized steel boxes may be used in:
1. Concealed interior locations above ceilings and in hollow studded partitions.
 2. Exposed interior locations in mechanical rooms and in rooms without ceilings; higher than 8' above the highest platform level.
 3. Direct contact with concrete except slab on grade.

3.9 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on the drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on the Contract Drawings are approximate, unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Avoid interferences with ductwork, piping, structure, equipment, etc. Recessed luminaires shall not be used as access to outlet, pull, and junction boxes. Where installation is inaccessible, provide access doors. Coordinate locations and sizes of required access doors with the Architect/Engineer and General Contractor.
- D. Locate and install to maintain headroom and to present a neat appearance.
- E. Coordinate locations with Heating Contractor to avoid baseboard radiation cabinets.

3.10 OUTLET BOX INSTALLATION

- A. Install sound insulation pads on all five sides of the back of all boxes in sound-rated wall assemblies. Sound-rated wall assemblies are defined as partition types carrying a Sound Transmission Class (STC) rating.
- B. The Contractor shall anchor switch and outlet box to wall construction so that it is flush with the finished masonry, paneling, drywall, plaster, etc. The Contractor shall check the boxes as the finish wall surface is being installed to assure that the box is flush. (Provide plaster rings as necessary.)
- C. Mount at heights shown or noted on the drawings or as generally accepted if not specifically noted.
- D. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- E. Provide knockout closures for unused openings.
- F. Support boxes independently of conduit.
- G. Install boxes in walls without damaging wall insulation.
- H. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes, and below baseboard radiation.
- I. Position outlets to locate luminaires as shown on reflected ceiling drawings.
- J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioned to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

- L. Provide cast outlet boxes in exterior locations and wet locations, and where exposed rigid or intermediate conduit is used.

3.11 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.

3.12 EXPOSED BOX INSTALLATION

- A. Boxes shall be secured to the building structure with proper size screws, bolts, hanger rods, or structural steel elements.
- B. On brick, block and concrete walls or ceilings, exposed boxes shall be supported with no less than two (2) Ackerman-Johnson, Paine, Phillips, or approved equal screw anchors or expansion shields and round head machine screws. Cast boxes shall not be drilled.
- C. On steel structures, exposed boxes shall be supported to the steel member by drilling and tapping the member and fastening the boxes by means of round head machine screws.
- D. Boxes may be supported on steel members by APPROVED beam clamps if conduit is supported by beam clamps.
- E. Boxes shall be fastened to wood structures by means of a minimum of two (2) wood screws adequately large and long to properly support. (Quantity depends on size of box.)
- F. Wood, plastic, or fiber plugs shall not be used for fastenings.
- G. Explosive devices shall not be used unless specifically allowed.

END OF SECTION

SECTION 260535 - SURFACE RACEWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Auxiliary gutters (metal wireways)
- B. Auxiliary gutters (non-metallic wireways)

1.2 REFERENCES

- A. FS W-C-582 - Conduit, Raceway, Metal, and Fitting; Surface

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Section 260500.
- B. Include product data for auxiliary gutters, and accessories.

PART 2 - PRODUCTS

2.1 METAL WIREWAYS AND TROUGHS

- A. General purpose Oil-tight and dust-tight Rain-tight type wireway, with knockouts without knockouts.
- B. Size: 4", 6", 8" x 4", 6", 8" with lengths as noted on the drawings. Actual lengths required shall be determined from actual site measurements and not from scaling drawings.
- C. Cover: Hinged Screw applied Flanged and gasketed cover.
- D. Connector: Slip-in construction; Flanged; hinged cover. screw applied cover.
- E. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold down straps, end caps, and other fittings to match and mate with wireways as required for a continuous enclosed complete system.
- F. Finish: Rust inhibiting primer coat. Coordinate paint color with Architect.
- G. Manufacturers:
 - 1. Hoffman F30G
 - 2. Square D 5100
 - 3. Hubbell-Wiegmann.

2.2 NON-METALLIC WIREWAYS AND TROUGHS

- A. Fiberglass polyester, extruded and fabricated to size and shape indicated, with without knockouts. Gasketed cover with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Flanged connections with stainless-steel screws and oil-resistant gaskets.
- B. Size: 4" x 4" and 6" x 6". Actual lengths required shall be determined from actual site measurements and not from scaling the drawings.
- C. PVC plastic, extruded and fabricated to size and shape indicated, with snap on cover and mechanically coupled connections with plastic fasteners.
- D. Fittings and Accessories: Include couplings, offsets, elbows, adapters, hold down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.
- E. Finish: Standard manufacturer's gray.
- F. Manufacturers:
 - 1. Hoffman F25 Series or pre-approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION - WIREWAY AND TROUGH

- A. Bolt auxiliary gutter to steel channels fastened to the wall or in self-supporting structure. Install level.
- B. Gasket each joint in oil-tight gutter.
- C. Mount rain-tight gutter in horizontal position only.
- D. Coordinate installation with other trades on project to avoid interferences. Relocation of equipment shall be at Contractor's expense at the direction of the Architect/Engineer to resolve interference problems.

END OF SECTION

SECTION 260536 - CABLE TRAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Cable trays
- B. Cable tray accessories

1.2 QUALITY ASSURANCE

- A. Electrical Code Compliance: Comply with Electrical Code as applicable to construction and installation of cable tray and cable channel systems.
- B. NFPA Compliance: Comply with NFPA 70B, "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC) with 2020 Washington Amendments
- B. ASTM A510 - Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
- C. ASTM B633 - Specification for Electrodeposited Coatings of Zinc on Iron and Steel
- D. NEMA VE 1 - Metallic Cable Tray Systems
- E. NEMA VE 2 - Cable Tray Installation
- F. IEC 61914 Cable Cleats for Electrical Installations

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 260500.
- B. Indicate tray type, dimensions, support points, clamps, hangers, connectors, fittings, accessories and finishes.
- C. Submit manufacturer's installation instructions under provisions of Section 260500.
- D. Include cable tray in composite electronic coordination files. Refer to Section 260500 for coordination drawing requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging.

- B. Store materials in a dry area indoors, protecting from damage and in accordance with manufacturer's instructions.

1.6 TESTING AND COMMISSIONING

- A. Visually inspect each cable tray ground connection for mechanical continuity.
- B. Visually inspect each structural suspension point for specified loading and spacing.
- C. Submit notification of testing and results under provisions of Section 260500.

1.7 COORDINATION

- A. Coordinate layout and installation of cable trays and suspension system with other construction, including structural members, light fixtures, HVAC equipment, fire suppression systems, and partition assemblies.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all cable tray with all fittings and mounting hardware.
- B. Accessories and Fittings: Manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- C. Refer to manufacturers installation instructions and specific product data below for additional information.

2.2 WELDED WIRE MESH CABLE TRAYS

- A. Wire mesh type cable tray: 2" loading depth, 6" width. Provide trapeze support with plastic retainer.
 - 1. Manufacturers:
 - a. B-Line
 - b. Mono-Systems
 - c. Cope
 - d. Cablofil Inc.
 - e. Hubbell HBT
- B. Tray: Continuous, rigid, welded steel wire mesh cable tray with continuous top wire safe edge with T-weld.
- C. Wire mesh shall be welded at all intersections.
- D. Material: Carbon steel wire, 0.197" minimum wire diameter, ASTM A510, Grade 1008. Wire shall be welded, formed and surface treated.

- E. Finish: Finish shall be applied after welding and bending of mesh. Finish shall be electro-plated zinc galvanizing: ASTM B633, Type I, SC-1.
- F. Provide grounding clip for continuous grounding of tray.
- G. Accessories: Provide all supporting, hanging, tee, cross, level change, reducing, drop outs, expansion splice plates (thermal expansion/contraction) and miscellaneous hardware as required for a complete and functioning installation to manufacturer's recommendations.
- H. Load Span Criteria: Install and support cable management system in accordance with span load criteria of L/240.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation: In conformance with NEMA VE 2 requirements and in accordance with manufacturer's instructions.
- B. Support cable tray at each connection point, at the end of each run, and at other points to maintain spacing between supports of 8 ft. maximum.
- C. Cut standard straight sections to length in field.
- D. Tray shall be electrically continuous from source to termination and shall not change elevation, direction or otherwise expose cables to travel without support.
- E. Tray shall be field cut using the manufacturer's approved cutting device and methods. Cutting device shall be an offset blade bolt cutter. The use of standard bolt cutters is strictly prohibited.
- F. Bends in tray shall be accomplished by utilizing manufacturer's cutting guides.
- G. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.
- H. Provide bonding continuity between cable tray sections, fittings and conduit terminations in accordance with manufacturer's instructions.
- I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- J. Remove burrs and sharp edges from cable trays.
- K. Seal penetrations through fire and smoke barriers.
- L. Install capped sleeves for future cables through firestop sealed cable tray penetrations of fire and smoke barriers as shown on drawings.

- M. Install cable trays with sufficient space to permit access for installing cables. Install tray bottom within 18" of access ceiling paneling for ease of access. Adjust mounting height only momentarily for field coordination with other trades and systems as required.
- N. Provide and maintain a minimum 12" height of dedicated access space above the cable tray. Coordinate the installation with other trades to minimize conflicts of the dedicated access space.
- O. Provide separation of cables of different systems, such as power, telecommunications, fire alarm system, security systems and audio or visual systems. Install barriers between power and low voltage cables.

END OF SECTION

SECTION 260542 - EQUIPMENT WIRING SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

- A. NEMA WD 1 - General Purpose Wiring Devices
- B. NEMA WD 6 - Wiring Device Configurations
- C. NFPA 70 - National Electrical Code (NEC) with 2020 Washington Amendments

PART 2 - PRODUCTS

2.1 CORDS AND CAPS

- A. Straight-blade Attachment Plug: NEMA WD 1.
- B. Locking-blade Attachment Plug: NEMA WD 5.
- C. Attachment Plug Configuration: Match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: Oil-resistant thermoset insulated Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for hard usage in damp locations.
- E. Cord Size: Suitable for connected load of equipment and rating of branch circuit over-current protection.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 PREPARATION

- A. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.

3.3 INSTALLATION

- A. Use wire and cable with insulation suitable for temperatures encountered in heat-producing equipment.

- B. Install pre-finished cord set where connection with attachment plug is indicated or specified, or use attachment plug with suitable strain-relief clamps.
- C. Provide suitable strain-relief clamps for cord connections to outlet boxes and equipment connection boxes.
- D. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with manufacturer's instructions. Provide interconnecting wiring where indicated.
- E. Install disconnect switches, controllers, control stations, and control devices such as limit switches and temperature switches as indicated. Connect with conduit and wiring as indicated.

END OF SECTION

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Adhesive Markings and Field Labels
- B. Nameplates and Signs

1.2 RELATED SECTIONS AND WORK

- A. Section 260500 - Basic Electrical Requirements

1.3 REFERENCES

- A. NFPA 70E - Standard for Electrical Safety in the Workplace
- B. NFPA 70 - National Electrical Code (NEC) with 2020 Washington State Amendments
- C. ANSI A13.1 - Standard for Pipe Identification
- D. ANSI Z535.4 - Standard for Product Safety Signs and Labels

1.4 QUALITY ASSURANCE

- A. Electrical identification products shall be suitable for the environment installed. Identification labels damaged by the environment due to ultraviolet light fading, damp or wet conditions, physical damage, corrosion, or other conditions shall be replaced with labels suitable for the environment.

1.5 SUBMITTALS

- A. General: Submit the following in accordance with Division 1 Specification Sections and under provisions of Section 260500.
 - 1. Product Data for each type of product specified.
 - 2. Schedule of nomenclature to be used for identification signs and labels for each piece of equipment including, but not limited to, the following equipment types as specified in Division 26.

PART 2 - PRODUCTS

2.1 ADHESIVE MARKINGS AND FIELD LABELS

- A. Adhesive Marking Labels for Raceway: Pre-printed, flexible, self-adhesive vinyl labels with legend indicating voltage and service (Lighting, Power, HVAC, Communications, Control, Fire).

- B. Underground Plastic Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4 mil thick, printed legend indicating type of underground line, manufactured for direct burial service. Tape shall contain a continuous metallic wire to allow location with a metal detector.

2.2 NAMEPLATES AND SIGNS

- A. Engraved, Plastic-Laminated Labels, Signs and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Labels shall be punched for mechanical fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.
- B. Install identification devices in accordance with manufacturer's written instruction and requirements of Electrical Code.
- C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work. All mounting surfaces shall be cleaned and degreased prior to identification installation.
- D. Circuit Identification: Tag or label conductors as follows:
 - 1. Multiple Power or Lighting Circuits in Same Enclosure: Where multiple branch circuits are terminated or spliced in a box or enclosure, label each conductor with source and circuit number.
 - 2. Multiple Control Wiring and Communication/Signal Circuits in Same Enclosure: For control and communications/signal wiring, use wire/cable marking tape at terminations in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tape.
 - 3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- E. Apply Danger, Warning, Caution and instruction signs as follows:
 - 1. Install Danger, Warning, Caution or instruction signs where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.
 - 2. 'Danger' indicates a hazardous situation which, if not avoided, will result in death or serious injury. ANSI standard red background, white letters.

3. 'Warning' indicates a hazardous situation which, if not avoided, could result in death or serious injury. ANSI standard orange background, black letters.
 4. 'Caution' indicates a hazardous situation which, if not avoided, may result in minor or moderate injury. ANSI standard yellow background, black letters.
 5. Emergency Operating Signs: Install, where required by Electrical Code, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect, engraved laminate signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- F. Apply circuit/control/item designation labels of engraved plastic laminate for pushbuttons, pilot lights, alarm/signal components, and similar items, except where labeling is specified elsewhere.
- G. Install labels parallel to equipment lines at locations as required and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- H. Install ARC FLASH WARNING signs on all power distribution equipment per Section 260573.
- I. Install ARC FLASH WARNING signs on all switchboards, switchgear, distribution panels, branch panelboards, industrial control panels, and motor control centers.
1. Sample Label:

! WARNING
ARC FLASH AND SHOCK HAZARD
APPROPRIATE PPE REQUIRED
FAILURE TO COMPLY CAN RESULT IN DEATH OR INJURY
REFER TO NFPA 70E
 2. Include:
 - a. NOMINAL VOLTAGE
 - b. Arc Flash Boundary
 - c. Available incident energy calculated in the analysis and the corresponding working distance, or the arc flash personal protective equipment (PPE category) for the equipment, but not both.
 - d. Date of short circuit assessment, use publication date of drawings or Power System Study report.
- J. Underground Electrical Lines: For exterior underground service feeder, other power feeders and branch circuits, control, signal, and communication lines, install continuous underground plastic line marker located directly above line at 6 (150mm) to 8 (205mm) inches below grade. A single plastic line marker is permitted when the width of the common trench does not exceed 16 inches; provide a second plastic line marker to mark each edge of the trench when 16 inches of width is exceeded.

3.2 FEEDER AND BRANCH CIRCUIT DIRECTORIES

- A. Product:
 - 1. Adhesive labels and field markings
- B. Feeder Directories Branch: Provide each feeder, branch circuit, feeder modification, and branch circuit modification with a typed circuit directory label. Refer to technical equipment specification sections for additional requirements. Include the following with each label:
 - 1. Load Description: Lighting, receptacles, specific equipment, spare, space, or similar description.
 - 2. Location: Room name, number, location.
- C. Provide a factory or custom clear plastic sleeve for each branch panel directory and secure to inside panel cover. Three ring binders with individual circuit directories for each applicable branch panel may be substituted when AHJ approved, all branch panels are within the same room and within sight of the binder, and the binder is supplied with three printed copies of each directory, an electronic editable copy of the directors is saved to USB within the binder, and the binder is permanently secured an adjacent wall with a chain or metal cable with adequate length to reference the binder within the working clearance space of each applicable panel. Provide a wall mounted drop-in office bin to store the binder.

3.3 LIGHTING CONTROL AND RECEPTACLE COVER PLATES

- A. Product:
 - 1. Adhesive labels and field markings
- B. Identification material to be a clear, 3/8-inch Kroy tape or Brother self-laminating vinyl label with black letters. Embossed Dymo-Tape labels are not acceptable. Permanently affix identification label to cover plates, centered above the receptacle openings.

3.4 CONDUIT AND EXPOSED CABLE LABELING

- A. Product:
 - 1. Adhesive labels and field markings
- B. Conduit Identification: Pre-printed, flexible, self-adhesive vinyl labels with legend at 20 foot (6 meter) intervals to identify all conduits run exposed or located above accessible ceilings. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible, or separated by enclosures, walls, partitions, ceilings, and floors. Labels for multiple conduits shall be aligned.
 - 1. Fire Alarm: Indicate "FIRE ALARM".
 - 2. Security System: Indicate "Security".
 - 3. Telephone System: Indicate "Telephone".
- C. Blank conduit ends or outlet boxes for future extension of system shall have permanent identification marker indicating purpose of conduit or box and where the raceway originated.

3.5 BOX LABELING

- A. Products:
 - 1. Adhesive labels and field markings
- B. Identify Junction, Pull and Connection Boxes: Labeling shall be 3/8-inch Kroy tape OR Brother self-laminating vinyl label, letters/numbers.
- C. All junction, pull, and connection boxes shall be identified as follows:
 - 1. For power and lighting circuits, indicate system voltage and identity of contained circuits ("120V, 1LA1-3,5,7").

3.6 CONDUCTOR COLOR CODING

- A. Products:
 - 1. All wire and cables shall be color coded by the manufacturer.
 - 2. All wires and cables, 6 AWG or larger, used in motor circuits, main feeders, sub-main feeders, and branch circuits shall be coded by the application of plastic tape. The tape shall be 3-M, Plymouth or Permacel in colors specified below. The tape shall be applied at each conductor termination with two 1-inch tape bands at 6-inch centers. Contractor option to use colored cabling in lieu of the tape at each end for conductor 6 AWG to 500 KCM. Wire and cables smaller than 6 AWG shall be color coded by the manufacturer.
- B. Color coding shall be applied at all panels, switches, junction boxes, pull boxes, vaults, manholes etc., where the wires and cables are visible and terminations are made. The same color coding shall be used throughout the entire electrical system, therefore maintaining proper phasing throughout the entire project.
- C. Where more than one nominal voltage system exists in a building or facility, each ungrounded conductor of a multi-wire branch circuit, where accessible, shall be identified by phase and system.
- D. Conductors shall be color coded as follows:
 - 1. 208Y/120 Volt, 4-Wire:
 - a. A-Phase - Black
 - b. B-Phase - Red
 - c. C-Phase - Blue
 - d. Neutral - White for feeders. White with matching black, red, blue tracer stripe for branch circuits.
 - e. Ground Bond - Green
 - 2. Grounding Conductors:
 - a. Equipment grounding conductors, main/system/supply-side bonding jumpers: Green.

3. Cabling for Remote Control, Signal, and Power Limited Circuits:

- a. Fire Alarm: Red.
- b. Low Voltage Switching: Per manufacturer recommendations and code requirements.

3.7 CONTROL EQUIPMENT IDENTIFICATION

A. Products:

- 1. Nameplates and signs

B. Identification shall be provided for all connections to equipment furnished by this Contractor, other contractors, or the Owner.

C. Labeling shall include:

- 1. Equipment type and contract documents designation of equipment being served.
- 2. Location of equipment being served if it is not located within sight.
- 3. Voltage and phase of circuit(s).
- 4. Panel and circuit number(s) serving the equipment.
- 5. Method of automatic control, if included ("AUTO CONTROL BY FMCS").
- 6. Available fault current; refer to one-line diagram or panel schedule of panel serving equipment.
- 7. Sample Label:

EXHAUST FAN EF-1 ("LOCATED ON ROOF")
480V, 3-PHASE
FED FROM "1HA1-1"
AUTO CONTROL BY FMCS

3.8 EQUIPMENT CONNECTION IDENTIFICATION

A. Products:

- 1. Nameplates and signs

B. Provide identification for hard wired electrical connections to equipment such as disconnects switches, starters, etc. Plug and cord type connections do not require this specific label.

C. Identification shall be provided for all connections to equipment furnished by this Contractor, other contractors, or the Owner. The following list of equipment is specifically being listed to receive an equipment connection label; this list does not limit the equipment that shall receive a label:

- 1. Mechanical heating, ventilation, and air conditioning equipment; chillers, boilers, pumps, air handling ventilation units, condensing units, unit heaters, and similar equipment
- 2. Plumbing equipment
- 3. Fire protection equipment

D. Labeling shall include:

1. Equipment type and contract documents designation of equipment being served
2. Voltage and rating of the equipment.
3. Panel and circuit numbers(s) serving the equipment

3.9 POWER DISTRIBUTION EQUIPMENT IDENTIFICATION

A. Products:

1. Nameplates and signs

B. Provide identification on the front of all power distribution equipment such as panelboards, switchboards, switchgear, etc. Labels shall be visible on the exterior of the gear, correspond to the one-line diagram nomenclature, and identify each cubicle of multi-section gear.

1. Labeling shall include:

- a. Equipment type and contract documents designation of equipment.
- b. Voltage of the equipment.
- c. Name of the upstream equipment and location of the upstream equipment if it is not located within sight.
- d. Rating and type of the overcurrent protection device serving the equipment if it is not located within sight ("FED BY 400A/3P BREAKER").
- e. Sample Label:

DISTRIBUTION PANEL DP-H1
480Y/277V
FED FROM SWITCHBOARD "SB-1" (LOCATED IN MAIN ELEC ROOM)

C. Arc Energy Reduction Label:

1. Provide a separate engraved plastic laminate label centered at the top of each vertical section of the electrical gear indicating the following when applicable.
 - a. Label: "This equipment is designed with a system listed below".
 - b. Applicable Systems:
 - 1) Zone-selective interlocking system for selective coordination and arc energy reduction
 - 2) Differential relaying system for selective coordination and arc energy reduction
 - 3) Arc energy reducing maintenance switch
 - 4) Energy reducing active arc flash mitigation system

D. Adjustable-Trip Over Current Protection Label:

1. Provide a separate engraved plastic laminate label adjacent to each overcurrent projection device with adjustable trip settings. Provide label separate from load identification label.
 - a. Label:

- 1) Long-time delay:
- 2) Long-time pickup:
- 3) Short-time delay:
- 4) Short-time pickup:
- 5) Instantaneous:
- 6) Ground fault delay:
- 7) Ground fault:

b. Sample Label:

Long-time delay: 10.0
Long-time pickup: 1.0
Short-time delay: 0.15
Short-time pickup: 5.0
Instantaneous: 2.0
Ground fault delay: 0.25
Ground fault: 50.0

3.10 GROUNDING AND BONDING

A. Products:

1. Nameplates and Signs.

B. Grounding Electrode Interdependence. Provide warning identification where the removal of a grounding connection in power source or distribution equipment interrupts the grounding electrode connection to other power sources or equipment.

1. Sample:

- a. WARNING. SHOCK HAZARD IF GROUNDING ELECTRODE CONDUCTOR OR BONDING JUMPER CONNECTION IN THIS EQUIPMENT IS REMOVED. OTHER ENERGIZED POWER SOURCE(S) DEPENDENT ON THESE CONNECTIONS.

3.11 ELECTRICAL WORKING CLEARANCE IDENTIFICATION

A. Products:

1. Safety Yellow paint and custom stencils

B. Provide custom identification of electrical equipment working clearances in mechanical, electrical, storage, janitorial, and similar non-public areas.

C. Identification shall include a painted rectangular box (on the finished floor) in front of the electrical equipment to define the code-required working clearance. Provide additional diagonal stripping inside the rectangle box. All painted stripping shall be safety yellow paint with 3 inch wide stripes.

1. Width of area: Width of equipment or as required by code
2. Depth of area: Depth as required by code

3.12 DWELLING UNIT IDENTIFICATION

A. Products:

1. Nameplates and signs

- B. Emergency Disconnect (exterior), provide EMERGENCY DISCONNECT label on exterior emergency disconnect, red background, white letters, 1/2" high letters, or as required by code. The identification nameplate shall be engraved plastic-laminate label.

END OF SECTION

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SECTION 260800 - COMMISSIONING OF ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Description
- B. Responsibilities
- C. Related Work
- D. Test Equipment

1.2 DESCRIPTION

- A. The purpose of this section is to specify Division 26 responsibilities in the commissioning process.
- B. The systems to be commissioned are listed in Section 019100.
- C. Commissioning requires the participation of the Division 26 Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019100. Division 26 Contractor shall be familiar with all parts of Section 019100 and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.3 RESPONSIBILITIES

- A. Refer to Section 019100.

1.4 RELATED WORK

- A. Specific commissioning requirements are given in the following sections of these specifications. All the following sections apply to the Work of this section.
 - 1. Section 019100 - Commissioning
 - 2. Section 220800 - Commissioning of Plumbing
 - 3. Section 230800 - Commissioning of HVAC
 - 4. Section 280800 - Commissioning of Electronic Safety and Security

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Contractor shall provide all test equipment necessary to fulfill the testing requirements of this Division. This equipment includes, but is not limited to, the following:
 - 1. Test equipment required for NETA Acceptance Testing.

2. Light meter.
 3. Sound level meter.
 4. Digital multimeter capable of measuring voltage (AC/DC), current, and resistance.
 5. Power quality and energy analyzer capable of capturing waveform (3 phase) and data recording.
- B. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the related specifications. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.
- C. Refer to Section 019100 for additional Division 26 requirements.

PART 3 - EXECUTION

- A. Refer to Section 019100.

END OF SECTION

SECTION 260913 - ENERGY METERING AND MANAGEMENT SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Energy Meter and Management System, EMMS
- B. Branch Circuit Power Meter, BCPM

1.2 RELATED SECTIONS AND WORK

- A. Section 262413 - Switchboards
- B. Section 262416 - Panelboards
- C. Division 23: Section 230900 - Controls.

1.3 QUALITY ASSURANCE

- A. Manufacturer: Company with three (3) years of experience in power measurements and controls.

1.4 REFERENCES

- A. ANSI C12 - Code for Electrical Metering
- B. ANSI C57.13 - Requirements for Instrument Transformers
- C. NFPA 70 - National Electrical Code, Definitions Article 100
 - 1. Energy Management System EMS
 - 2. Power Control System PCS

1.5 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 260500.
- B. Provide product catalog data sheets as shop drawings.
 - 1. Produce a product catalog data sheet for each system component shown or not shown but required for the operation of the system.
 - 2. Product data shall include individual meter capabilities, potential transformer PT, and current transformer CT ratings for all items for compliance with specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 260500.

- B. Store and protect products under provisions of Section 260500.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit Operation, Maintenance, and Installation Manuals under provisions of Section 260500.
- B. Include submittal shop drawings information.
- C. Include revised record drawings of the installed system.
- D. Include manufacturer representative system setup and commissioning report.

1.8 WARRANTY

- A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.
- B. Furnish and install software upgrades issued by the manufacturer during the warranty period.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric Square D
 - 1. BCPM; PowerLogic BCPM
- B. Eaton Power Xpert
 - 1. EMMS; Power Xpert Series, Brightlayer Platform
 - 2. BCPM; Power Xpert Branch Circuit Monitor PXBCM
- C. ABB
 - 1. EMMS; M4M Series
 - 2. BCPM; EQ Series
- D. Siemens
 - 1. EMMS; EnergyIP Series
 - 2. BCPM; SEM3 Embedded Micro Metering Series
- E. Electro Industries / Gauge Tech
 - 1. EMMS;; EnergyPQA / HMIPQA+
 - 2. BCPM; MP200 Series

2.2 ENERGY METER AND MANAGEMENT SYSTEM

- A. The EMMS shall be connected by means of an Ethernet high-speed backbone. The high-speed network shall consist of gateways, switches, patch cords, backbone cabling, and associated required equipment.
- B. Ethernet gateways or communications cards shall be provided and installed by the EMMS vendor as required. Ethernet network connections shall be established using industry standard Ethernet protocol, such as TCP/IP.
- C. Ethernet Backbone, Cabling, Patch Cords: Minimum Cat 6 or per manufacturer requirements.
 - 1. Ethernet cabling distances shall not exceed 295 feet: Provide Cat 6 cable in 3/4" conduit. Cable color selection by Owner.
 - 2. Distances equal to or exceeding 295 feet: Provide six-strand multimode fiber optics installed in 1-1/4" conduit, and interface hardware.
 - 3. Ethernet Cabling Jacket Color: Selection by Owner.
 - 4. Ethernet Cabling Raceway: 3/4" conduit minimum.
- D. Ethernet Gateways:
 - 1. The Ethernet gateways shall be modular in design to allow for easy future expansion or modification of the system. Ethernet gateway shall support Ethernet UTP (10/100 Mbps). Each Ethernet gateway shall provide a web-based interface for device configuration, diagnostics, and access for users to power monitoring information from any location on a local area network (LAN) or wide area network (WAN).

2.3 EMMS APPLICATION SOFTWARE

- A. The EMMS manufacturer shall supply application software that provides the operator access to all meter data, systems reports, captured waveforms, and logged data.
- B. All software shall be configured by the vendor and delivered ready to use. The configuration shall include preparation of all required graphics, displays, and interactive one-line diagrams. When additional devices are added in the future, the user shall be able to add the communication address and device type, and the software shall automatically display all data from the device in a format identical to that used by existing devices of the same type.
- C. Energy Meter Load Categories. Metered energy usage shall be compiled into the following categories. The EMMS may require the sum, subtraction, or similar mathematical manipulation of individual meter inputs to properly report energy usage for the following load categories.
 - 1. HVAC
 - 2. Lighting, Interior Common Areas
 - 3. Lighting, Exterior Site
 - 4. Receptacle Plug Load
- D. Application software shall be supplied to support system configuration, monitoring of the devices, data logging, alarming, and other operations associated with the EMMS. The software provided shall include the following software option(s):

1. System Monitoring (multiple devices at a time):
 - a. Application designed to monitor the entire system of power monitoring devices in the background for alarms, events, and data logging, allowing the operator to perform other tasks with the workstation.

2.4 ENERGY METERING AND MONITORING DEVICE AND COMPONENT CHARACTERISTICS

- A. Distribution system integrated meters and components, including system display units, and metering devices shall be installed by the manufacturer, and wired and tested in the equipment as indicated on the drawings. All control power, Current Transformers CT, Potential Transformers PT, and data communications cabling and harnesses shall be factory wired within the equipment enclosure.
- B. Field cabling and termination requirements. Provide factory installed terminal blocks for field wiring when required. The manufacturer installation drawings shall clearly identify all interconnection field wiring, cabling types, and associated requirements.
- C. Provide control transformers, current transformers, and fused potential transformers sized as required.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Distribution system integrated meters and components, including system display units, metering devices, shall be installed by the manufacturer, and wired and tested in the equipment as indicated on the drawings. All control power, Current Transformers CT, Potential Transformers PT, and data communications cabling and harnesses shall be factory wired within the equipment enclosure.
- B. Field Cabling and Termination Requirements. Provide factory installed terminal blocks for field wiring when required. The manufacturer installation drawings shall clearly identify all interconnection field wiring, cabling types, and associated requirements.
- C. Provide manufacturer recommended cabling and system interconnections to individual meters and other scheduled systems.
- D. Provide manufacturer recommended cabling and communication gateways between the EMMS, meters, and components with other systems including lighting control systems,] and other specialized energy management reporting and management systems as scheduled on the drawings].
- E. All wiring, gateways, and programming required for system setup and integration with other systems shall be provided by the Electrical Contractor.

3.2 FACTORY REPRESENTATIVE PREINSTALLATION, STARTUP, AND COMMISSIONING

- A. Conduct a preinstallation meeting prior to the installation of any electrical power meters. Attendance is required by all affected installers (contractor), as well as the manufacturer's commissioning engineer.
- B. The Electrical Contractor shall have a factory service engineer present for the preinstallation, start-up, field calibration, and check-out of the Energy Meter and Management System EMMS. Factory service engineer shall be required to return to the site for recalibration or setup should the system not function as specified during the system commissioning. All costs shall be a part of this Contract.
- C. Preinstallation Meeting. Electrical contractor and factory service engineer shall co-conduct a preinstallation meeting with the electrical contractor and any other pertinent stakeholders prior to installing any metering equipment.
- D. Verify settings, parameters, and adjustments with other contractors prior to startup. Make all adjustments and settings to coordinate with controls and equipment.
- E. Test setup and communication of each individual metered point.
- F. Provide two-party review and verification of meter load category designations. Verify each metered point is contributing the appropriate sum, subtraction, or similar mathematical contribution to the appropriate load categories and total facility energy profile. Meter tags are provided with subscripts on the plans when applicable.
 - 1. H - HVAC
 - 2. L - Lighting, Interior
 - 3. S - Lighting, Exterior Site
 - 4. A complete working demonstration of the EMMS shall represent the completion of the setup and commissioning process.

3.3 TRAINING

- A. The Electrical Contractor shall have a factory service engineer present for Owner training. Training shall not commence until the completion of the system startup and commissioning phase. Provide a minimum of one (1) day for training with the total duration and quantity of sessions being coordinated with the Owner personnel.
- B. Provide an overview and demonstration of the EMMS system. Provide hands-on exercises to enable personnel to assume operating responsibilities of the system after training completion.
- C. Provide documentation of training including date, time, training agenda, training attendance, instructor contact information, user questions during training, and documentation of instructor answers for each applicable question. Submit training documentation to Architect / Engineer / Owner.

END OF SECTION

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SECTION 260916 - ELECTRICAL CONTROLS AND RELAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Relays and Timers

PART 2 - PRODUCTS

2.1 CONTROL RELAYS

- A. Mount relays in separate NEMA 1 enclosure
- B. R-Power Relay:
 - 1. Visible contacts, coil burden less than 10 V.A. 208 volt A.C. coil, 600-volt A.C. contacts, 2 normally open contacts, 30 10-amp continuous contacts electrically held.
 - 2. Manufacturers:
 - a. Square D Type C Class 8501 CO
 - b. Eaton
 - c. ABB
 - d. Siemens
- C. General Purpose Relay:
 - 1. 120 volt continuous duty coil, 1 N.O. and 1 N.C. contacts, electrically held, 12-amp, 240 volt rated contacts. Provide compatible plug-in base socket.
 - 2. Manufacturers:
 - a. Square D Class 8501 Type K
 - b. Eaton
 - c. ABB
 - d. Siemens

2.2 TIME RELAYS

- A. Time relays: shall be rated and shall be electric type. Time period shall be adjustable.
- B. Time relays shall be mounted in NEMA 1, 4 enclosures in the control terminal cabinet motor control center.
- C. Manufacturers:
 - 1. Square D Class 9050 Type RE7
 - 2. Eaton
 - 3. ABB

4. Siemens

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate with Mechanical Division 23 in connection of control conduit.

END OF SECTION

SECTION 260933 - LIGHTING CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Lighting Control Overview
- B. Electrical Plan Symbols
- C. Device Color and Coverplates
- D. Standalone Line and Low Voltage Lighting Controls
 - 1. Wall switches and wall dimmers
 - 2. Sensors (occupancy, vacancy, daylighting, photocell, auxiliary power packs, etc.)
- E. Network-Based Lighting Controls (specification architectural grade, networked, intelligent, commonly centralized and/or distributed components)
- F. Automatic Load Control Relays
 - 1. Automatic Load Control Relay, Individual Luminaire - Integral (ALCR3)
- G. Time Clock Switches (Standalone)

1.2 RELATED SECTIONS

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of directly comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:
 - 1. Specification Section 262416 Panelboards (panelboard enclosure and interior bussing used for lighting control panels)
 - 2. Specification Section 262821 Contactors
 - 3. Specification Section 265119 LED Lighting
 - 4. Electrical Drawings: Electrical Coversheet, plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

1.3 RELATED WORK

- A. Section 019100 - Commissioning
- B. Direct Digital Control System (DDCS) control schemes, diagrams, and scope of work for HVAC Interface with Lighting Control requirements.

1.4 QUALITY ASSURANCE

- A. Manufacturers shall be regularly engaged in the manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.
- B. All components and assemblies are to be factory pre-tested prior to delivery and installation.

1.5 REFERENCES

- A. FCC Rules and Regulations, Part 15, Subpart J - Radio Frequency Interference
- B. FS W S 896 Switch, Toggle
- C. NEMA WD 1 - General Color Requirements for Wiring Devices
- D. NEMA WD 7 - Occupancy Motion Sensors
- E. Washington State Energy Code (WSEC) 2021
- F. NFPA 70 - National Electrical Code (NEC)
- G. UL Standard 916 Energy Management Equipment
- H. UL 924 - Emergency Lighting and Power Equipment
- I. UL 20 - Standards for General-Use Snap Switches
- J. UL 98 - Enclosed and Dead-Front Switches
- K. UL 917 - Clock Operated Switches
- L. UL 1008 - Transfer Switch Equipment
- M. UL 1472 - Solid-State Dimming Controls

1.6 SUBMITTALS

- A. Submit product data under provisions of Section 260500.

- B. Submit a comprehensive package including devices, hardware, software, product specification, finishes, dimensions, installation instructions, component replacement instructions, warranty, system software requirements, and roles and responsibilities of all persons and groups involved in installation, execution, and commissioning.
 - C. Provide floor plan showing location, orientation, and coverage area of each control device, sensor, and controller/interface. For areas requiring multiple sensor devices for appropriate coverage, submit specific manufacturer-approved sensor layout as an overlay directly on the project drawings, either in print or approved electronic form. Sensor coverage patterns shall have a 20% overlap.
 - D. Submit a list of devices and equipment that will be installed for each sequence of operation.
 - E. Submit project specific control wiring diagrams showing all equipment, line voltage, and control wiring requirements for all components including, but not limited to, dimmers, relays, low voltage switches, automatic sensors, control stations, dimmer panels, and communication interfaces and programming instructions for each sequence of operation. Include network cable specification and end-of-line termination details, if required.
 - F. Lighting Control Stations: The manufacturer/vendor shall provide control station shop drawings showing arrangement of controls, dimensioned elevations, wiring diagram, and recommended backboxes. Label each applicable submittal with the applicable Sequence Of Operation SOO description. Submit data sheets on the switches, dimmers, sensors, buttons, etc. contained in the control station.
 - G. Nameplate Labels and Custom Engraving: Submit sample label/engraving text for review for each applicable Lighting Sequence Of Operation SOO. Include reference to applicable SOO description. Provide stencil templates for each device requiring stenciling.
 - H. Project specific network riser diagram including floor and building level details. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.
 - I. Network / Internet Connected Equipment: These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ('Network Capability'). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be constructed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner. Provide Owner written consent and instructions as a submittal.
- 1.7 EXTRA STOCK
- A. Web App for Owner Provided Devices: Assist Owner with the download and setup of the web application programming tool on ten (10) Owner provided cellphones, tablets, and similar devices when available and applicable to the specific lighting control system.
 - B. Commissioning Dongles: Provide ten (10) spare commissioning dongle devices for room controller, sensor, and relay programming when applicable to the specific lighting control system.

- C. Lighting Control Software / Web Application Shortcut: Provide installation of software or setup of web app shortcuts on two (2) Owner provided computers when available and applicable to the specific lighting control system.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit project record documents under provisions of Section 260500.
- B. Accurately record location of all controls and devices. Include description of switching sequences and circuiting arrangements.

1.9 OPERATION AND MAINTENANCE DATA

- A. Submit emergency, operation, and maintenance data under provisions of Section 260500. Data shall also include the following:
 - 1. Schedule for routine maintenance, inspection, and calibration of all lighting control devices and system components. Recommended schedule for inspection and recalibration of sensors.
 - 2. Complete narrative describing intended operation and sequence for each control scenario and system component, updated to reflect all changes resulting from commissioning of systems. Narrative shall indicate recommended settings for devices where applicable.
 - 3. Replacement part numbers for all system components.
- B. Identify installed location and labeling for each luminaire controlled by automated lighting controls.
- C. Submit software operating and maintenance manuals, program software backup on compact disc or compatible media with data files, device address list, and a printout of software application and graphic screens, where applicable.

1.10 SYSTEM DESCRIPTION

- A. Performance Statement: The specification section and lighting design documents describe the minimum material quality, required features, and operational performance requirements of the lighting control system. The documents do not convey every component, relay, wire, and equipment connection required. The Contractor and lighting control manufacturer/vendor are solely responsible for determining all system components, wiring, and programming required for a complete and operational system based on the performance based requirements of the documents.
- B. Lighting Sequence Of Operation (SOO): The Sequence Of Operation (SOO) describes the required lighting control operation and performance in each space. The Sequence Of Operation descriptions are included on the drawings.
- C. Drawings: The drawings include the Sequence Of Operation (SOO), luminaire schedule, location of control devices, sensors, and identification of control zones, and branch power circuiting. Control wiring and manufacturer/vendor specific components are NOT shown, but shall be submitted with the shop drawing submittals.

1.11 COMMISSIONING

- A. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative Architect/Engineer and the Commissioning Agent. Project closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Division 1 for detailed commissioning requirements.
- B. The Contractor shall provide all services necessary for compliance with the WSEC Section C408 Commissioning. The commissioning shall include, but not be limited to, a commissioning plan, preliminary commissioning report, construction documents, manuals, final commissioning report, and lighting system functional testing.
- C. This project will have selected building systems commissioned. The Contractor is responsible to execute commissioning. The commissioning process, equipment, and systems to be commissioned are defined in Division 1. A third-party Commissioning Agent will direct the commissioning process.
- D. The Contractor shall notify the Commissioning Agent, Architect/Engineer and Owner's Representative ten (10) working days prior to scheduled commissioning date.
- E. The commissioning process requires meeting attendance. Refer to Division 1 for meeting requirements.
- F. The system shall be functionally tested by a factory-authorized engineer and comply with the Sequence of Operation prior to system commissioning. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system.

1.12 WARRANTY

- A. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of two (2) years from date of commissioning.
- B. Automatic (occupancy, vacancy), daylight sensors, and controls shall have a five (5) year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROL OVERVIEW

- A. Lighting Control System: As defined in the System Description, the design documents describe the operational performance requirements of the lighting control system. The Lighting Control System has been categorized into the following groups. Refer to the Electrical Symbol Key, this specification section, and the drawings to determine the appropriate lighting control category when more than one is applicable to the project:

1. Standalone Lighting Control Devices: Independent (standalone) devices traditionally operating at line or low voltage, field configurable with other standalone devices to provide an overall lighting control system.
 2. Network-Based Lighting Controls: Integrated system comprised of switch stations, sensors, room controls, control panels, dimmer racks, and accessories, operating at line and/or low voltage, configures as an integrated overall 'intelligent' lighting control system for advanced architecturally based lighting control systems. Lighting control zones commonly associated with one or more branch power circuits within the same control zone.
- B. All system components and materials of similar function (e.g., switches, dimmers, sensors, contactors, relays, etc.) shall be of the same manufacturer, unless specifically stated otherwise on drawings or elsewhere in the specifications. Lighting control switches, systems, and components shall be listed.
- C. The functions described in the lighting sequence of operation shall dictate the actual lighting control device required to accomplish the functions described for the space, unless otherwise noted.
- D. Emergency Lighting Override Control: Lighting control equipment coupled with remote emergency power sources (external to luminaire) require ALCR devices for emergency (life safety) compliance. An emergency lighting control bypass is required for every individual lighting control zone-circuit but not shown on plans. Refer to this specification for ALCR and BCELTS descriptions. Refer to the sequence of operation lighting control descriptions on the plans for additional requirements. Refer to UL 924, UL 1008.

2.2 ELECTRICAL PLAN SYMBOLS

- A. Refer to Electrical Coversheet for Electrical Symbols list and device specification tag.
1. Standalone Lighting Control Devices: Control station commonly defined by an alpha character with subscripts.
 2. Network-Based Lighting Controls: Control station defined by keynoted dimming switch.
 - a. Example Control Designations: z1, z2, z3
 3. Sensors, Relays, Accessories: Common plan symbols are used for automatic (occupancy, vacancy), and daylighting sensors. The control designations (z1, z2, z3 or ez1, ez2, ez3) and identification of a standalone control station in the space defines the basis-of-design intent category of the lighting control sensors and accessories.
 - a. Example, a standalone automatic sensor OC device is the basis of design when shown in the same room as a standalone S single pole light switch with or without a, b, c control designations.

2.3 DEVICE COLOR AND COVERPLATES

- A. All switches and lighting controls shall be complete with coverplates that match material and color of the wiring device coverplates in the space. When the coverplate is proprietary to the device/manufacture and do not match the wiring device coverplates, the architect shall select the coverplate color and materials from the standard coverplate options.
- B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
- C. Install nameplate identification as indicated in Section 260553.
- D. Plate-securing screws shall be metal with head color matching the wall plate finish.

2.4 STANDALONE LINE AND LOW VOLTAGE LIGHTING CONTROLS

- A. Standalone Lighting Control System Description: The standalone lighting control system includes individual devices, components, and accessories for lighting controls.
- B. The lighting control system manufacturer shall be responsible to assure coordination and compatibility between all system devices, components, and accessories.
- C. Global System Typography: The system shall be provided with the following global system characteristics. When multiple exclusive options are listed the manufacturer/vendor may submit a system based on either criterion unless otherwise noted. When the drawings identify a specific option (typically identified with a subscript) provide the specific option as scheduled on the drawings.
 - 1. Automatic Sensor Control Devices, Component, and Accessories: Field adjustable Occupancy or Vacancy.
- D. Overview:
 - 1. Wall Switches and Wall Dimmers:
 - a. UL listed with integral air-gap switch for on/off control, integral EMI/RFI suppression, non-viewable heat sink, dimmer to match device color.
 - b. Dimmer compatibility and wiring with the load being controlled shall be verified by Contractor prior to purchase and installation.
- E. SW-1P; Single Pole Switch:
 - 1. Single throw, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.
- F. SW-2P; Two Pole Switch:
 - 1. Single throw, two pole, 120/277-volt, 20-amp maintained contact. Toggle handle, side and back wired.

G. SW-3W; Three-way Switch:

1. Single throw, 120/277 volt, 20 amp. Toggle handle, side and back wired.

H. SW-D; Dimmer (Standalone):

1. Contractor / vendor to provide dimmer based on rating required, compatible with wiring, lighting load being controlled. Verify compatibility with luminaire prior to light control prior to purchase and installation.
2. Electronic Driver Dimmer, 120 or 277 volt per application, 0-10 V control, decora style linear slide operator with positive off, IEC 60629 compliant. Mounted in dedicated backbox.
 - a. Manufacturers: Compatible with Luminaire Driver

I. SW-LS-PC; Exterior Photo Sensors (Standalone):

1. Contractor / vendor to provide sensor based on sequence of operation requirements. Verify compatibility with lighting control system prior to purchase and installation.
2. Subscripts: Subscripts are used to define the device type:
3. Exterior photocell sensor, 120/277 volt, 1800 VA minimum standard SPST formed contact zero-crossing closure, ambient sensor range 5 - 1,500 foot-candles, adjustable setpoint, adjustable deadband, adjustable time delay, weatherproof enclosure with threaded base for box installation and toolless twist-lock removable/replaceable photo eye assembly, -30°F to +130°F operation. Provide with lens cover that can be applied for system testing during daylight conditions.
4. Installation: Mount sensor to face North-East.
5. Manufacturers Room-Based or Network-Based:

J. SW-OC-# and SW-VC-#; Automatic Sensors (Standalone):

1. Combination Devices: Subscripts identify combination type devices when applicable. The contractor shall provide the combination device or provide multiple device(s) to meet the functionality when the manufacturer does not offer the required functionality with a single device. Manufacturer verified layouts shall include a 20% overlap of coverage patterns.
2. General Description: Wall- or ceiling-mounting, solid-state units with a separate power supply/relay unit.
 - a. Operation - Occupancy: Occupancy sensors turn lights 'on' when covered area is occupied and turn lights 'off' with a time delay when unoccupied, unless otherwise indicated.
 - b. Operation - Vacancy: Vacancy sensors require a manual switch operation to turn lights 'on' with a time delay when occupied to turn lights 'off'.
 - c. Mounting:
 - 1) Sensor: Suitable for mounting in any position on a standard outlet box.

- 2) Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure. Mount relay above accessible ceiling near entry door to room or area.
 - 3) Time Delay and Sensitivity Adjustments: Recessed and concealed.
 3. Indicator: LED to show when motion is being detected during testing and normal operation of the sensor.
 4. Bypass Switch: Override the on function in case of sensor failure.
 5. Power Supply and Child Packs: Provide as required for sensor quantity and switching scheme. Mount to standard 1/2" knockout on electrical box above accessible ceiling near entry door to room or area. Sensor power shall be from emergency circuit if emergency lighting is in the area.
 6. Detection Coverage (Room): Detect occupancy anywhere in an area based on hand motion.
 7. Detection Coverage (Corridor): Detect occupancy based on a half-step motion.
 - a. (A); Ultrasonic Two-Sided Corridor Coverage Automatic Sensor: Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.
 - b. Blank (or D); Dual Technology 360 Degree Coverage Automatic Sensor: Combination of PIR and ultrasonic or acoustic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be selectable in the field by operating controls on unit. Frequency greater than 40 KHz. Dual sensing verifications (requires both technologies to activate), either technology maintains on status. Integrated ambient light level sensor (2 to 200 FC range), adjustable sensitivity and time delay, integrated isolated relay contact]. Sensor shall control all circuits in area, unless noted otherwise.
 - c. (P); Passive Infrared, 360 Degree Coverage Pattern Ceiling Mount Automatic Sensor: Passive infrared, zero crossing circuitry, integrated ambient light sensor (4 to 190 FC Range), adjustable sensitivity and time delay, integral isolated relay contact. Sensor shall control all circuits in the area unless noted otherwise.
 - d. (U); Ultrasonic 360 Degree Coverage, Ceiling Mounted, Automatic Sensor: Detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage. 20' x 20' Hand Motion Coverage Pattern. Frequency greater than 32 KHz solid state, adjustable sensitivity and time delay, integral isolated 1-amp relay contact, temperature and humidity resistant receivers. Sensor shall control all circuits in area, unless noted otherwise.
- 2.5 NETWORK-BASED LIGHTING CONTROL SYSTEM; LCD (SW-NETW) CONTROL STATIONS
- A. Manufacturers: Manufacturers as listed below meet the qualifications as outlined in this specification. Contractor is responsible for verifying that selected manufacturer is capable of furnishing the complete system as specified herein.
1. Lutron
 2. Legrandt

3. Wattstopper
 4. ILC Controls.
- B. Network-Based Lighting Control System Description: The Network-Based lighting control system is a network of devices, components, and accessories for lighting controls and integrated control with other systems. The system includes system controller (server or cloud-based), room controllers (network hubs), control stations, sensors (occupancy, vacancy, daylighting, etc.), switching/dimming modules, programming, 365/7 day scheduling, and associated wiring.
- C. The lighting control system manufacturer shall be responsible to assure coordination and network compatibility between all system devices, components, and accessories.
- D. Global System Typography: The system shall be provided with the following global system characteristics. When multiple exclusive options are listed the manufacturer/vendor may submit a system based on either criterion unless otherwise noted. When the drawings identify a specific option (typically identified with a subscript) provide the specific option as scheduled on the drawings.
1. System Controllers (Room Controllers): Distributed controllers located above accessible ceilings or Central relay / dimming / contactor control panels located in electrical branch closets.
 2. Exterior (Site) Lighting Control System Network Connectivity for System Devices, Components, and Accessories: Physical low voltage cabling or wireless network.
 3. Power Source for System Devices, Component, and Accessories: AC power pack supply.
 4. Automatic Sensor Control Devices, Components, and Accessories: Field adjustable Occupancy or Vacancy.
- E. Lighting Control System (Physical Server, Central Station, or Cloud-Based Access):
1. Workstation: Provide lighting master control station with portable tablet with Wi-Fi connectivity. Install master workstation in location shown on drawings or as coordinated with the owner.
- F. Master Lighting Control System / Distributed Room Controllers / Centralized Control Panels - Network Mesh and Independent Operation: The system network shall allow distributed room controllers and centralized control panels to continue local control station functionality and previously scheduled events if disconnected from the master system network. Sensors, wall stations, devices, components, and accessories supported by the local room controllers and centralized control panels shall also remain functional based on previously programmed criteria.
- G. Programming and Commissioning Dongle (Removable Style): Provide and permanently install a programming dongle for each room controller when a field removable dongle type device is required for programming and commissioning of the system. The programming dongle shall be permanently installed to allow for ease of programming the controller without above ceiling access.

- H. Centralized Relay / Dimming / Contact Controllers: Wall or floor mounted cabinets, integral switching relays and dimmers, integral main circuit breaker disconnect, integral branch circuit overcurrent protection, integral UL924 to bypass lighting controls during an emergency condition, remote fire alarm override, network connected.
 - 1. Installation: Install in locations shown on plans or coordinate with other equipment in electrical rooms, janitor closets, and similar back-of-house support spaces when not shown on the plans.
- I. Exterior Site Lighting - Wireless Network: A wireless mesh network is an acceptable lighting control option when included in the list of acceptable Global System Typography descriptions listed above. Provide each applicable exterior site luminaire with a wireless receiver/repeater to establish a wireless mesh network. Wireless systems without a mesh network protocol are not acceptable.
- J. Control Devices: All automatic sensors (ultrasonic, PIR, dual technology, daylighting, photocell, timers), control stations, and other system components shall be provided with the system and designed to operate on system network. Sensors shall be powered from power supplies, modules, packs, or Power Over Ethernet POE. Refer to the Standalone Line and Low Voltage Lighting Controls section of this specification for sensor performance descriptions (not duplicated in this section).
- K. Power Supplies (Modules, Packs, etc.): Provide power supplies for control devices. Power supply shall provide physical separation of 120/277 volt line voltage wiring and low voltage control wiring. Provide supplementary power supplies when required for multiple control devices. Provide switch or dimmed control as required by the Sequence Of Operation SOO.
 - 1. Installation: Install adjacent to wall room controller when applicable, near the entry door when applicable, and above the finished accessible ceiling. As an alternative, the controller may be mounted above the finished accessible ceiling of the adjacent space when the associated ceiling space is not accessible. Provide low voltage wiring to applicable control devices and control stations.
- L. Device Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type, rated 20A, 125-volt AC for tungsten filaments and 20A, 277-volt AC for electronic ballasts, minimum 50,000 cycles at rated capacity. Provide supplemental relays when required. (Example, occupancy sensor control of receptacle outlets or VAV/TAB HVAC units located in the same space.
- M. Receptacle Outlet Control: Provide auxiliary relay to control receptacle outlets located in the control space. Refer to the drawings and sequence of operation schedule for requirements.
- N. Central Lighting Control Features and Functions:
 - 1. Dimming system presets shall be programmable via preset/fader station directly at the control panel, or via network-based workstation software. Dimming presets shall have discrete fade times with 0.1 second resolution, programmable from zero to 24 hours, and shall be selectable via button, fader, clock event, macro or network interface.

2. Clock events shall be activated by calendar schedule, by day type and/or specific day programming, including every day, weekday, weekend, S, M, T, W, H, F, S, Holiday. Clock events shall also be activated by astronomical events, which will compensate for daylight savings time and will have programmable setback periods relative to sunrise and sunset.
3. The system shall be capable of implementing On commands, Off commands, Raise (dimming) commands, Lower (dimming) commands for any relay, group or zone by means of digital wall switches, specification grade line voltage type wall switches, photocell, web-based software or other devices connected to programmable inputs in a lighting control panel.
4. Channels for grouping relays shall be provided, each with an associated pushbutton to toggle the channel ON/OFF and a terminal block for a separate dry contact input. Any number of relays in the panel can be assigned to each channel, with overlapping allowed. Channels shall be set up via communication line communications and networking. Each channel pushbutton shall provide LED status indication. The panel shall also have the ability to assign functions to relays independently of the channels. Panels shall be addressable with DIP switches or other local means to set panel address.
5. System shall accept any type of switch input, including momentary or maintained.
6. System shall support by relay or zone the "blink warning" function. System shall be capable of flashing lights Off/On prior to the lights being turned Off. The warning interval time between the flash and the final lights off signal shall be definable for each zone. Occupant shall be able to override any scheduled Off sweep using local wall switches within the occupied space. Occupant override time shall be locally and remotely programmable and shall not exceed two (2) hours.
7. System shall provide temporary override conditions for each relay or dimmer so that lights can always be turned on.
8. All programming and scheduling shall be able to be done locally at the parent lighting control panel and remotely via the Internet. Remote connection to the lighting control system shall provide real-time control and real-time feedback. Lighting control system shall be able to be monitored by and take commands from a remote PC. At any time, should the remote PC go offline, all system programming uploaded to the lighting control system shall continue to operate as intended.
9. All programs, schedules, time of day, etc., shall be held in non-volatile memory for a minimum of two (2) years at power failure. At restoration of power, lighting control system shall implement programs required by current time and date.

O. Ethernet Connection Port - Interoperability:

1. System shall include an Ethernet port for connection to Owner's TCP/IP network, permitting remote management of system from local or wide area network connection.
2. Contractor shall coordinate with technology vendor to provide an Ethernet connection to (LCP) panel as specified by manufacturer.

P. SW-LCPN-#; Network-Based Lighting Control Panel / Rack / Cabinet (LCPN-#):

1. Refer to drawings for schedule of Network-Based lighting control panel configuration, voltage, and ratings.
2. Dimmer / Relay Capacity: Refer to schedule
3. Manufacturer: Network-Based Lighting Controller manufacturer

4. Dimming / Switched Relay Performance Requirements
 5. Dimmers: Refer to Dimmer controlled Zone(s) for additional requirements
 6. Switched Relay: Refer to Switched Relay Controlled Zone(s) for additional requirements
- Q. Cabinet: Steel with hinged, locking door. Barriers separate low-voltage and line-voltage components.
1. System Power Supply: Transformer and full-wave rectifier with filtered DC output for panel, controllers, and control devices.
- R. LCD Lighting Control Station:
1. Refer to the Lighting Sequence Of Operation (SOO) for the minimum quantity of scenes required and a description of each control scene. Refer to Network Based lighting control station schedules on drawings for station configuration requirements.
 2. Manufacturer: Network Based Lighting Controller manufacturer.
 3. Dimming (BLANK) or Switch (S) Stations: Modular, momentary pushbutton, with addressable capabilities to control the scene or luminaires assigned to the switch. The switch shall be able to actuate the functions based on the described sequence of operation and intended functions.
 4. Backlit color liquid crystal display (LCD) shall operate using buttons, faders, and other images on separate programmable control pages via touchscreen interface.
 5. Raise, Lower, Integral Fader Control: Provide control station with manual raise and lower fader control for each control zone of lighting control. Faders may be physical sliders, up/down buttons, or graphical touch screen format. Fader range shall match full range of dimmer specification.
 6. LCD station contrast and brightness shall be adjustable. It shall be possible to program the station to dim during periods of inactivity.
- S. (PCS) Portable Control Station Lighting Control Station:
1. Refer to the Lighting Sequence Of Operation (SOO) for the minimum quantity of scenes required and a description of each control scene. Refer to Network Based lighting control station schedules on drawings for station configuration requirements.
 2. Manufacturer: Network Based Lighting Controller manufacturer.
 3. Dimming (BLANK) or Switch (S) Stations: Modular, momentary pushbutton, with addressable capabilities to control the scene or luminaires assigned to the switch. The switch shall be able to actuate the functions based on the described sequence of operation and intended functions.
 4. Portable control console with minimum 10-foot cable and interface plug.
 5. Raise, Lower, integral fader control: Provide control station with manual raise and lower fader control for each control zone of lighting control. Faders may be physical sliders, up/down buttons, or graphical touch screen format. Fader range shall match full range of dimmer specification.
 6. Connector station receptacle, flush mounted, to allow portable console to communicate with lighting control system. Mounts in industry standard backbox.
- T. Global Operational Sequences:

1. Fire Alarm and Automatic Detection Sequence: A fire alarm system 'alarm' or 'drill' shall initiate an override of the local lighting control. The lighting in the following spaces shall be overridden to 100 percent "on" in the following areas: Corridors, hallways, stairways, spaces equipped with exit signs, main entrance first responder entrance, other egress paths, and occupancy spaces of Assembly. Provide provisions to add additional spaces to this applicable list as directed by the Authority Having Jurisdiction AHJ or Engineer.

U. Dimming / Relay Performance Requirements:

1. The component's maximum current rating shall be at least two times the dimmer's/relay's rated operating current.
2. Capable of withstanding repetitive in-rush current of 50 times operating current without impacting lifetime of dimmer/relay. Design and test dimmers/relays to withstand line-side surges without impairment to performance.
3. Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.

V. Dimmer Controlled Zone(s):

1. Provide branch circuit breaker for each relay module. Circuit breakers shall be fully magnetic so that trip current is not affected by ambient temperature. Circuit breakers shall be rated for 100 percent switching duty.
2. Each dimmer module shall use a solid-state relay (SSR) consisting of two SCRs in an inverse parallel configuration, and all required gating circuitry on the high-voltage side of an integral opto-coupled control voltage isolator.
3. Toroidal filters shall limit objectionable harmonics, reduce lamp filament sing, and limit RF interference on line and load conductors. Rise times ranging from 200 to 500 microseconds shall be available depending upon model number selected.
4. Power efficiency for standard dimmers shall be at least 96 percent at full load, with a no-load loss of three (3) volts RMS.
5. Plug-in modules shall contain a magnetic circuit breaker and a relay rated to withstand hot patching of loads without tripping.
6. Each dimmer to incorporate electronic "soft-start" default at initial turn-on that smoothly ramps lights up to the appropriate levels within 0.5 seconds.
7. Control all light sources in smooth and continuous manner. Dimmers with visible steps are not acceptable.
8. Each dimmer to be assigned a load type that will provide a proper dimming curve for the specific light source.
9. Possess ability to have load types assigned per circuit, configured in field.
10. Minimum and maximum light levels user adjustable on output-by-output basis.
11. Line Voltage Dimmers: Meet following load-specific requirements
12. Magnetic Low Voltage (MLV) Transformer
13. Contain circuitry designed to control and provide a symmetrical AC waveform to input of magnetic low voltage transformers per UL 1472, Section 5.11.
14. Dimmers using unipolar load current devices (such as FETs or SCRs) to include DC current protection in the event of a single device failure.
15. Electronic Low Voltage (ELV) Transformer

16. Dimmer to operate electronic low voltage transformers via reverse phase control. Alternately, forward phase control dimming may be used if dimming equipment manufacturer has recommended specific ELV transformers being provided.
17. Magnetic Transformers: UL listed for use with normal (low) power factor magnetic transformers.

W. Low Voltage Dimming Modules: Meet the following requirements

1. Coordination between low voltage dimming module and line voltage relay: Capable of being electronically linked to single zone.
2. Single low voltage dimming module; capable of controlling following light sources:
 - a. 0-10V analog voltage signal
 - b. PWM IEC 60929

X. Switched Relay Controlled Zone(s):

1. Circuit Breaker: Provide branch circuit breaker for each relay module. Circuit breakers shall be fully magnetic so that trip current is not affected by ambient temperature. Circuit breakers shall be rated for 100 percent switching duty.
2. Relays: Mechanically latched unless otherwise indicated; split-coil, momentary-pulsed type, rated 20A, for tungsten filaments and NEMA for electronic ballast rated. Rated for 1,000,000 ON/OFF cycles at rated capacity.
3. Load switched in manner that prevents arcing at mechanical contacts when power is applied to and removed from load circuits.
4. Fully rated output continuous duty for inductive, capacitive, and resistive loads.

Y. Plug-in modules shall contain a magnetic circuit breaker and a relay rated to withstand hot patching of loads without tripping.

Lighting Load	Load A	Load B
Step 1:	On	Off
Step 2:	Off	On
Step 3:	On	On
Step 4:	Off	Off

2.6 AUTOMATIC LOAD CONTROL RELAY (ALCR) (INDIVIDUAL LUMINAIRE - INTEGRAL)

- A. This section includes information related to factory and field installed ALCR devices intended for individual luminaires.
- B. ALCR3; Automatic Load Control Relay ALCR, 120/277 volt, dry/damp listed, 32F to 113F (0C to 45C) operating temperature, plenum NEMA 1 rated, test button with visual indicator, remote test and fire alarm control, listed for factory or field installation within luminaire, UL924 listed latest edition, Electrical Code Article 700 compliant.
 1. Rating: 3 Amp LED driver, ballast, or incandescent.

2. Lighting Control Coordination: Provide ALCR device compatible with designated lighting zone controls. Example: Switched, 0-10 volt dimming, DALI control, 2 wire dimming, or DMX.
3. Operation:
 - a. ALCR device shall allow the same local lighting control devices to control both the normal lights and emergency designated lighting. Devices that require separate local lighting controls for the normal and designated emergency lighting are NOT allowed.
 - b. ALCR device shall monitor the normal power circuit and shunt/bypass the local lighting controls upon loss of power, remote test switch, or fire alarm override to provide full lumen output for designated emergency lighting.
 - c. ALCR device shall return designated emergency lighting to local lighting control after a 15-minute delay upon return of normal power or remote test/fire alarm override release.
 - d. Performance Equivalent by Other Components: A limitation of equivalent comparable products may require some of the required functions of the ALCR device to be provided by an alternative component of the lighting control system. The following functions may be performed by alternative components of the lighting control system when the device is listed for the required function and compatible with the lighting control system.
 - 1) Remote test switch / fire alarm override interface.
 - 2) The 15-minute time delay upon return of normal power or remote test/fire alarm override release.
4. Manufacturers:
 - a. Lighting control manufacturer

2.7 AUTOMATIC LOAD CONTROL RELAY (ALCR)

- A. ALCR20; Automatic Load Control Relay ALCR, 120/277 volt, dry/damp listed, 32F to 113F (0C to 45C) operating temperature, plenum NEMA 1 rated, test button with visual indicator, remote test and fire alarm control, UL924 listed latest edition, Electrical Code Article 700 compliant.
 1. Rating:
 - a. 20 amp (16 A permitted) LED driver and ballast.
 2. Lighting Control Coordination: Provide ALCR device compatible with designated lighting zone controls. Example: switched, 0-10 volt dimming, DALI control, 2 wire dimming, or DMX.
 3. Operation:

- a. ALCR device shall allow the same local lighting control devices to control both the normal lights and emergency designated lighting. Devices that require separate local lighting controls for the normal and designated emergency lighting are NOT allowed.
- b. ALCR device shall monitor the normal power circuit and shunt/bypass the local lighting controls upon loss of power, remote test switch, or fire alarm override to provide full lumen output for designated emergency lighting.
- c. ALCR device shall return designated emergency lighting to local lighting control after a 15-minute delay upon return of normal power or remote test/fire alarm override release.
- d. Equivalent Facilitation and Performance: A limitation of equivalent comparable products may require some of the required functions of the ALCR device to be provided by an alternative component of the lighting control system. The following functions may be performed by alternative components of the lighting control system when the device is listed for the required function and compatible with the lighting control system:
 - 1) Remote test switch / fire alarm override interface.
 - 2) The 15-minute time delay upon return of normal power or remote test/fire alarm override release.

4. Manufacturers:

- a. Lighting control manufacturer

2.8 TIME CLOCK SWITCHES (STANDALONE)

- A. SW-TC; Time Clock Switch, astronomical digital control, 7 day or 365/7 day schedule with holiday schedule, 2 channel, 120/277 Volt, 15 amp SPDT Contact, on/off override, indoor/outdoor enclosure, IECC / ASHRAE 90.1 battery backup compliance, UL Listed.

2.9 BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH (BCELTS)

- A. BCELTS; Branch Circuit Emergency Lighting Transfer Switch (BCELTS), 120/277 volt, dry/damp listed, 32F to 113F operating temperature, plenum NEMA 1 rated, test button with visual indicator, remote test and fire alarm control, UL1008 listed, UL924 listed latest edition, Electrical Code Article 700 compliant.
 1. Rating: 20 amp (16 A permitted) LED driver, ballast, incandescent.
 2. Lighting Control Coordination: Provide BCELTS device compatible with designated lighting zone controls. Example: Switched, 0-10 volt dimming, DALI control, 2 wire dimming, or DMX.
 3. Operation:
 - a. BCELTS device shall allow the same local lighting control devices to control both the normal lights and emergency designated lighting. Devices that require separate local lighting controls for the normal and designated emergency lighting are NOT allowed.

- b. BCELTS device shall monitor the normal power circuit, shunt/bypass the local lighting controls, and transfer the load from the normal circuit to the emergency circuit upon loss of power, remote test switch, or fire alarm override to provide full lumen output for designated emergency lighting.
- c. BCELTS device shall return designated emergency lighting to local lighting control after a 15-minute delay upon return of normal power or remote test/fire alarm override release.
- d. Equivalent Facilitation and Performance: A limitation of equivalent comparable products may require some of the required functions of the BCELTS device to be provided by an alternative component of the lighting control system. The following functions may be performed by alternative components of the lighting control system when the device is listed for the required function and compatible with the lighting control system.
 - 1) Remote test switch / fire alarm override interface.
 - 2) The 15-minute time delay upon return of normal power or remote test/fire alarm override release.

PART 3 - EXECUTION

3.1 PRE-CONSTRUCTION MEETING

- A. Schedule a pre-construction meeting with the controls representative, installing contractor, Architect/Engineer, and Owner to explain the proposed lighting control system and integration with other systems as when applicable per the design documents.

3.2 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify field dimensions and coordinate physical size of all equipment with the architectural requirements of the spaces into which they are to be installed. Allow space for adequate ventilation and circulation of air.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts existing conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings.
- B. All wiring shall be installed in conduit. Class II low voltage control wiring may be open wiring and shall maintain 6 inch spacing from electronic ballast and other RFI/EMI sources.

- C. Low Voltage Cabling (less than 100 volts): Low voltage lighting control cabling shall be plenum listed. Low voltage cables in non-accessible areas shall be installed in conduit. Low voltage lighting control cable may be installed without conduit in accessible areas using the following types of cable supports. Cable support types/systems shall comply with the warranty requirements of the low voltage cable manufacturer.
 - 1. J-hooks; batwing type.
 - 2. Bridle rings with saddle supports.
 - 3. Low voltage cable batwings supported by independent luminaire support systems (luminaire support cabling); use of batwings on ceiling support systems not allowed.
 - 4. Listed cable ties. Low voltage cabling secured to exterior of luminaire power raceway.
- D. All branch load circuits shall be live tested before connecting the loads to the lighting control panel.
- E. Lighting Control Station Wiring: Provide the grounded (neutral) conductor portion of the branch circuit with the line voltage phase conductors at each lighting control station.
- F. Lighting Control Panel Directories: Provide a typewritten directory for each lighting control panel indicating relay/dimmer and description of load controlled.

3.4 INTEGRATION WITH OTHER SYSTEMS

- A. The Network-Based lighting control system interacts, is controlled by, or controls the following other systems per the design documents and lighting sequence of operations descriptions. The contractor shall provide the necessary communication gateways, relays, cabling, and programming to interact with the following systems.
 - 1. Building Automation System
 - 2. Fire Alarm and Automatic Detection System
 - 3. Security and Intrusion Detection System
 - 4. Audio/Visual Systems
 - 5. Shade Raise/Lower Controls

3.5 BRANCH CIRCUIT POWER WIRING FOR CONTROLLERS

- A. Branch circuit power for the following lighting control system components shall be provided from the following branches. Lighting control power shall originate from the same branch circuits serving the controlled luminaires:
 - 1. Lighting Control System (Physical Server, Central Station, or Cloud-based Access): Emergency (Electrical Code Article 700) Life Safety Branch (Electrical Code Article 517)
 - 2. Room controllers, lighting control power supplies, devices, components, and accessories when an associated (ALCR) device is applicable to the lighting control sequence of operation: Emergency (Electrical Code Article 700) Life Safety Branch (Electrical Code Article 517)

3. Room controllers, lighting control power supplies, devices, components, and accessories when an associated (BCELTS) device is applicable to the lighting control sequence of operation: The load side of the BCELTS device normal and emergency/life safety pending the status of the BCELTS.
4. The contractor shall coordinate the branch circuit power source required with the Engineer when required for unique lighting control system devices, components, and accessories.

3.6 LOW VOLTAGE LIGHTING CONTROL CABLING

- A. Control Cable Raceway Routing: All wiring shall be installed in conduit. Class II low voltage control wiring may be open wiring, independently supported, and shall maintain 150 mm (6 inch) spacing from luminaire drivers and other RFI/EMI sources.
- B. Control Cabling Installed with Line Voltage Wiring: When low voltage control cabling is installed with line-voltage wiring, the control wiring shall be, copper conductors, minimum 16 AWG or per manufacturer, with cable insulation equal to the line-voltage rating (voltage, temp rating, etc.) and comply with Specification Section 260513 "Wire and Cable."
- C. Network Cabling: As required by manufacturer.
- D. Splices and Taps: Tapping or wire trap connectors shall be used to splice all Class 1 and Class 2 control wiring. Twist-on, wire-nut type connectors are not allowed.

3.7 Automatic Load Control Relays (ALCR20, ALCR3) and Branch circuit emergency lighting transfer switch (bcelts)

- A. Field install per manufacturer requirements.
- B. Fire Alarm Override: Provide connection to addressable fire alarm relay.

3.8 SUPPORT SERVICES

- A. System Startup:
 1. Manufacturer shall provide factory authorized technician to confirm proper installation and operation of all system components.
- B. Pre-Program, Testing, Training Coordination:
 1. The construction documents and sequence of operations define the original design intent of the lighting controls as coordinated between the owner and the design team. The definition of the scope is intended to identify the hardware and programming flexibility required prior to programming, system testing, and owner training.
 2. The final system programming, control station labels, scene presets, dimmer presets, dimmer range limits, fade times, etc. are subject to on site coordination between the design team, owner, contractor, and manufacturer. Contractor/manufacturer programming of the system prior to an onsite coordination with the owner and design team shall not be considered final programming nor commissioning.

3. The contractor and manufacturer shall provide on site representatives to provide final programming including preset, scene, switch labeling, and other programming adjustments based on owner and design team onsite observation and verbally requested adjustments as part of the based bid scope of work.
4. The contractor shall document onsite requested changes and update operation and maintenance manuals to match final programming.

C. Testing:

1. System shall be completely functional tested by a factory-authorized technician. All loads shall be tested live for continuity and freedom from defects, and all control wiring shall be tested for continuity and connections prior to energizing the system components.
2. Programming of initial zones, schedules, lighting levels, control station groups, and sensor settings shall be performed by a factory-authorized technician. Lighting Control Sequence of Operation shall serve as a basis for programming, However, all final decisions regarding groups and schedules shall be at the direction of the Owner. The following procedures shall be performed at a minimum:
 - a. Confirm automatic sensor placement, sensitivity, and time delay settings to meet specified performance criteria.
 - b. Confirm daylight sensor placement, sensitivity, deadband, and delay settings to meet specified performance criteria.
 - c. Confirm that schedules and time controls are configured to meet specified performance criteria and Owner's operating requirements.
 - d. Confirm control station labeling, presets, switch labels, and scenes.
3. Verify occupancy/vacancy and daylight sensor operation is correct after furniture and equipment is installed in each area. Make adjustments to sensor settings and time delays to allow proper operation.
4. Verify occupancy/vacancy sensors are located to provide complete coverage for the area served with no nuisance switching.
 - a. Relocate sensors or provide additional sensors as necessary to provide adequate coverage.
 - b. Mask occupancy/vacancy sensors where necessary to prevent nuisance switching from adjacent areas.

D. Training:

1. Manufacturer shall provide competent factory-authorized technician to train Owner personnel in the operation, maintenance and programming of the lighting control system. Submit training plan with notification seven (7) days prior to proposed training dates.
2. Training duration shall be no less than three (3) days, with one (1) day being scheduled at least two (2) weeks after initial training.

E. Documentation:

1. Manufacturer shall provide system documentation including:

- a. System one-line showing all panels, number and type of control stations and sensors, communication line, and network or building automation system BAS interface unit.
- b. Drawings for each panel showing hardware configuration and numbering.
- c. Panel wiring schedules.
- d. Typical diagrams for each component.

3.9 SYSTEM COMMISSIONING

- A. Contractors' tests shall be scheduled and documented in accordance with the commissioning requirements. Refer to Section 010900, General Commissioning, for further details.
- B. Mask sensors where necessary to prevent nuisance switching from adjacent areas.
- C. System verification testing is part of the commissioning process. Verification testing shall be performed by the Contractor and witnessed and documented by the Commissioning Agent. Refer to Section 010900, General Commissioning, for system verification tests and commissioning requirements.
- D. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans. Refer to Section 010900, General Commissioning, for Contractor training requirements.

END OF SECTION

SECTION 262000 - SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Arrangement with Utility Company for permanent electric service.
- B. Underground service entrance

1.2 RELATED SECTIONS AND WORK

- A. Refer to the One-Line Diagram for additional information.

1.3 SYSTEM DESCRIPTION

- A. System Voltage: 208Y/120 volts, three phase, four-wire, 60 Hertz.

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

- A. Meter: Furnished by the Utility Company.
- B. Meter Base: Furnished by the Contractor, as approved by the Utility Company. (Manufacturers: Milbank, Superior, Duncan, or Anchor).
- C. Metering Transformer Compartment: Furnished as part of the main switchboard to Utility Company's specifications.
- D. Meter Distribution Center:
 - 1. 208/120 volt, 3 phase, 4 wire,, 800A copper bus, 65 kAIC, 3 phase, 4 wire meter sockets each protected with a 100 amp, 3 pole circuit breaker. Meter sockets shall conform to electric utility company metering department requirements. UL listed.
 - 2. Manufacturers:
 - a. Square D EZ Meter-Pak
 - b. General Electric
 - c. Siemens
 - d. Cutler Hammer

2.2 IDENTIFICATION

- A. Provide a permanent plaque or sign denoting all services, feeders, and branch circuits supplying the building or structure and the area served by each. Install plaque or sign at each service disconnecting means.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Make arrangements with Utility Company to obtain permanent electric service to the Project.
- B. Primary distribution equipment and pad-mounted transformers shall be furnished and installed by the Utility Company.
- C. Primary conductors shall be furnished, installed, and terminated by the Utility Company. Primary conduit shall be furnished and installed by the Contractor, as shown on the drawings, to the Utility Company's requirements.
- D. Underground: Install service entrance conduits in concrete envelope from Utility Company's pad mounted transformer to meter cabinet and building service entrance equipment. Utility Company will connect service conductors to transformer secondary lugs.

END OF SECTION

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Main switchboard:MSB

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Electrical Distribution Diagram and Electrical Schedules for size, rating, and configuration.
- B. Section 260913 - Energy Metering and Management System
- C. Section 262811 - Arc Reduction Earthing System

1.3 REFERENCES

- A. ANSI C12 - Code for Electricity Metering
- B. ANSI C39.1 - Requirements for Electrical Analog Indicating Instruments
- C. ANSI C57.13 - Requirements for Instrument Transformers
- D. NEMA AB 1 - Molded Case Circuit Breakers
- E. NEMA KS 1 - Enclosed Switches
- F. NEMA PB 2 - Dead Front Distribution Switchboards
- G. NEMA PB 2.1 - Instructions for Safe Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or less

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 260500.
- B. Include front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; switchboard instrument details; instructions for handling and installation of switchboard; and electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.
- C. Arc Energy Reduction Documentation: Submit documentation to demonstrate the arc energy reduction system is set to operate at a value below the available arcing current.
- D. Submit manufacturer's instructions under provisions of Section 260500.

1.5 SPARE PARTS

- A. Keys: Furnish four each to the Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site under provisions of Section 260500.
- B. Deliver in 48-inch maximum width shipping splits, unless approved otherwise by both the Contractor and Architect/Engineer, individually wrapped for protection, and mounted on shipping skids.
- C. Store and protect products under provisions of Section 260500.
- D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- E. Handle in accordance with NEMA PB2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 260500.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Approved Manufacturers:
 - 1. Square D Class 2700 QED-2, I-Line, Powerstyle
 - 2. ABB ReliaGear SB
 - 3. Siemens
 - 4. Eaton

2.2 RATINGS

- A. Definitions:
 - 1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. Refer to Section 260553 for additional requirements.
 - 2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.

- B. The switchboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.3 SWITCHBOARD CONSTRUCTION AND RATINGS

- A. Factory-assembled, dead front, metal-enclosed, and self-supporting switchboard assembly conforming to NEMA PB2, and complete from incoming line terminals to load-side terminations.
- B. Switchboard electrical ratings and configurations as shown on the drawings.
- C. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials used.
- D. Main Section Devices: Individually mounted and compartmented.
- E. Distribution Section Devices: Group mounted.
- F. Auxiliary Section Devices: Individually mounted and compartmented.
- G. Bus Material: Aluminum with tin plating, sized in accordance with NEMA PB 2.
- H. Bus Connections: Bolted, accessible from front only for maintenance. Plug-on connections may be utilized with Architect/Engineer's pre-approval by addenda.
- I. Bus bars shall be fully isolated, braced for minimum ampere rms symmetrical rating as indicated on drawings.
- J. The bus shall extend the full height of the distribution sections to provide space for future breakers.
- K. Provide a 1 X 1/4-inch copper ground bus through the length of the switchboard.
- L. Maximum Dimensions: 8' 6"L
- M. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

2.4 SWITCHING, OVER-CURRENT PROTECTIVE DEVICES, AND ARC ENERGY REDUCTION

- A. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide breaker interrupting ratings as indicated on the plans. Where necessary to meet interrupting ratings, breakers shall be provided with automatically resetting current limiting elements in each pole.

- B. Solid State Molded Case Circuit Breakers: (All breakers identified on plans as solid-state with 2,500 ampere frame sizes and below.) Provide molded case switch with electronic sensing, timing, and tripping circuits for fully adjustable time current characteristic settings including ground fault trip, instantaneous trip, long time trip, long time delay, short time trip, and short time delay. Trip setting shall be field programmable with restricted access and a sealable clear cover. Provide stationary mounting. Provide breaker interrupting ratings as indicated on the plans.
- C. Arc Energy Reduction with Selective Coordination:
 - 1. Provide an arc energy reduction system to reduce the clearing time of an arc flash event. The arc energy reduction system shall be provided for overcurrent protection devices rated 1,200 amps or larger.

2.5 INSTRUMENTS AND SENSORS

- A. Current Transformers: ANSI C57.13; 5 ampere secondary, bar or window type, with single secondary winding, unless otherwise required for application, and secondary shorting device, primary/secondary ratio as required, burden and accuracy consistent with connected metering and relay devices, 60 Hertz.
- B. Energy Metering and Management System: Refer to Section 260913.
 - 1. Provide integral Digital Power Meters DPM with harmonic analysis and Digital Energy Meters DEM when scheduled and shown on the plans.
 - 2. Provide individual Circuit Breaker Metering CBM when scheduled and shown on the plans.
 - a. The scheduled circuit breaker shall be provided with integral metering. Provide a separately integrated meter when the scheduled circuit breaker is not integral meter functional.

2.6 ACCESSORIES

- A. Provide REQUIRED accessories as described below. Provide SCHEDULED accessories when listed with plan schedules. Refer to plan schedules for additional requirements.
- B. Barriers: Provide finger safe barriers for lineside uninsulated and ungrounded terminations and components which remain energized when the main disconnecting device is 'OPEN'. REQUIRED
- C. Barriers (Service Equipment): Provide solid barriers for lineside uninsulated and ungrounded terminations and components which remain energized when the main disconnecting device is 'OPEN'. REQUIRED
- D. Transformer Disconnect Lockable Hasp: Provide circuit breakers, fused switches, and disconnects serving transformers with a lockable padlock hasp capable of being locked in the open/closed position. REQUIRED

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install switchboard in locations shown on the drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Install fuses in each switch.

3.2 FIELD QUALITY CONTROL

- A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each. Test voltage shall be 1000 volts, and minimum acceptable value for insulation resistance is 2 megohms.
- C. Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.

3.3 ADJUSTING AND CLEANING

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Touch up scratched or marred surfaces to match original finish.
- C. Provide time/current trip curves for all adjustable protection devices that require setting. Also provide curves and equipment information for associated new and existing fixed devices that require coordination with new protection devices. Submit time/current curves in hard copy or electronic format.
- D. Adjust trip and time delay settings to values as scheduled, or as instructed by the Architect/Engineer.
- E. Where two levels of ground fault are provided, test ground fault circuit breakers to prove selective coordination in accordance with manufacturer's directions. Provide testing documentation with Operating & Maintenance Manual submittals.

END OF SECTION

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Lighting and appliance branch circuit panelboards: Panel '###'

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Electrical Distribution Diagram and Electrical Schedules for size, rating, and configuration.
- B. Section 260913 - Energy Metering and Management System
- C. Section 262811 - Arc Reduction Earthing System

1.3 REFERENCES

- A. NEMA AB 1 - Molded Case Circuit Breakers
- B. NEMA FU 1 - Low voltage cartridge fuses
- C. NEMA KS 1 - Enclosed Switches
- D. NEMA PB 1 - Panelboards
- E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
- F. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment
- G. UL 248 - Low-Voltage Fuses
- H. UL 67 - Panelboards

1.4 SUBMITTALS

- A. Submit shop drawings for equipment and component devices under provisions of Section 260500.
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Arc Energy Reduction Documentation: Submit documentation to demonstrate the arc energy reduction system is set to operate at a value below the available arcing current.
- D. Submit manufacturer's instructions under provisions of Section 260500.

1.5 SPARE PARTS

- A. Keys: Furnish four (4) each to the Owner.
- B. Fuses: Furnish 10% or a minimum of three (3) spare fuses of each type and rating installed to the Owner.
- C. Fuse Pullers: Furnish one (1) fuse puller to the Owner.

PART 2 - PRODUCTS

2.1 RATINGS

- A. Definitions:
 - 1. Series rated equipment shall be defined as equipment that can achieve a required UL AIC rating with an upstream device such as a main breaker or a combination of devices to meet or exceed a required UL AIC rating. All series rated equipment shall have a permanently attached nameplate indicating that device rating must be maintained. See Section 260553 for additional requirements.
 - 2. Fully rated equipment shall be defined as equipment where all devices in that equipment shall carry a minimum of the AIC rating that is specified.
- B. The panelboards for this project shall be fully rated unless otherwise specifically noted in the Drawings or Specifications.

2.2 MAIN AND DISTRIBUTION PANELBOARDS

- A. General
 - 1. Manufacturers:
 - a. Square D QMB, I-Line
 - b. ABB ReliaGear neXT
 - c. Siemens F2, P4
 - d. Eaton PRL4, PRL5
- B. Enclosure: NEMA PB 1; Type 1.
- C. Provide cabinet front with hinged trim on door to allow access to wiring gutters without removal of trim and flush lock. Door hardware shall provide swing clear operation (180-degree swing). Finish in manufacturer's standard gray enamel.
- D. Provide panelboards with aluminum copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.
- E. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

2.3 BRANCH CIRCUIT PANELBOARDS

A. General

1. Manufacturers:

- a. Square D NQ, NF
- b. ABB ReliaGear Series
- c. Siemens P1
- d. Eaton PRL1, PRL2

B. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type.

C. Enclosure: NEMA PB 1; Type 1.

D. Provide panelboards with copper bus, ratings as scheduled on the drawings. Provide copper ground bus in all panelboards.

E. All multiple-section panelboards shall have the same dimensional back box and cabinet front size.

F. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on the drawings. Do not use tandem circuit breakers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards plumb as indicated on the drawings in conformance with NEMA PB 1.1.

B. Height: 6 feet to handle of highest device.

C. Provide filler plates for unused spaces in panelboards.

D. Provide custom typed circuit directory for each branch circuit panelboard. Label shall include equipment name or final approved room name, room number, and load type for each circuit (examples: SUMP SP-1 or ROOM 101 RECEPT). Revise directory to reflect circuit changes required to balance phase loads. Printed copies of the bid document panel schedules are not acceptable as circuit directories.

E. Stub five (5) empty one-inch conduits to accessible location above ceiling out of each recessed panelboard and panelboards installed in electrical closets less than 36" deep.

F. Install fuses in fusible switch assemblies.

3.2 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 262716 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
- B. ANSI/NEMA ICS 1 - Industrial Control and Systems
- C. ANSI/NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems
- D. ANSI/NEMA ICS 6 - Enclosures for Industrial Control Equipment and Systems

1.2 SUBMITTALS

- A. Submit product data under provisions of Section 260500.
- B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in ANSI/NEMA ICS 1.
- C. Include cabinets and enclosures in composite electronic coordination files. Refer to Section 260500 for coordination drawing requirements.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250; Type 1 14 gauge steel.
- B. Finish: Manufacturer's standard polyester powder paint finish.
- C. Covers: Continuous hinge with stainless steel hinge pin. Covers longer than 24 inches shall have 3-point latching.
- D. Locks: Flush 1/4 turn cylinder key latch
- E. Provide interior white painted metal panel for mounting terminal blocks and electrical components.

2.2 CABINETS

- A. Cabinet Boxes: Galvanized steel with removable endwalls.
- B. Cabinet Fronts: Steel, surface type with screw cover front, concealed hinge and flush lock keyed to match branch circuit panelboard; finish in gray baked enamel.

2.3 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.
- B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

2.4 FABRICATION

- A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.
- B. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cabinets and enclosures plumb; anchor securely to wall and structural supports at each corner, minimum.
- B. Provide accessory feet for free-standing equipment enclosures.
- C. Install trim plumb.

END OF SECTION

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Device plates and box covers
- B. Receptacles (REC-#)
- C. Countertop and furniture receptacle assemblies (REC-#)

1.2 RELATED SECTIONS

- A. Section 260933 - Lighting Control Systems.

1.3 QUALITY ASSURANCE

- A. Provide similar devices from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the Electrical Code, by a testing agency to Authorities Having Jurisdiction and marked for intended use.
- C. Comply with the Electrical Code.

1.4 REFERENCES

- A. DSCC W-C-896F - General Specification for Electrical Power Connector
- B. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
- C. NEMA WD 1 - General Color Requirements for Wiring Devices
- D. NEMA WD 6 - Wiring Devices - Dimensional Requirements
- E. NFPA 70 - National Electrical Code (NEC) with 2020 Washington State Amendments
- F. UL 498 - Standard for Attachment Plugs and Receptacles
- G. UL 943 - Standard for Ground Fault Circuit Interrupters
- H. UL 1691 - Standard for Single Pole Locking-Type Separable Connectors

1.5 SUBMITTALS

- A. Submit product data under provisions of Section 260500.

- B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

1.6 EXTRA STOCK

- A. Base Stock: Provide one complete set of color-coded single pole locking-type separable cables with factory connectors for feeder application. Provide adequate parallel cables for each respective phase, neutral, and equipment ground.

1.7 COORDINATION

- A. Receptacles for Owner Furnished Equipment: Match plug configurations.
- B. Cord and Plug Sets: Match equipment requirements.
- C. Coordinate installation of receptacle assemblies in countertops with the Contractor providing the countertop. Contractor shall coordinate penetrations and conduit routing in countertops with drawings and other obstacles below the installation surface.

PART 2 - PRODUCTS

2.1 DEVICE COLOR

- A. All switch, receptacle, and outlet colors shall be verified with Architect, unless indicated otherwise.

2.2 COVERPLATES

- A. All switches, receptacles, and outlets shall be complete with the following:
 - 1. Unbreakable thermoplastic/thermoset plastic and match device color coverplates in finished spaces where walls are finished.
 - 2. Decorator Grade - Public: Decorator thermoset plastic and match device color wallplates in public finished spaces where walls are finished.
 - a. Manufacturer:
 - 1) Leviton Decora
 - 2) Hubbell Decorator
 - 3) Cooper Decorator
 - 4) or approved equal
 - 3. Decorator Grade - Screwless: Decorator snap-on nylon or polycarbonate wallplates with sub-base in public finished spaces; match device color.
 - a. Manufacturer:
 - 1) Leviton 803##
 - 2) Hubbell RCW
 - 3) Cooper PJS

- 4) Pass & Seymour SWP
- 5) or approved equal

- 4. #302 stainless steel coverplates in unfinished spaces for flush boxes.
- 5. Galvanized steel coverplates in unfinished spaces for surface mounted boxes.

- B. Where several devices are ganged together, the coverplate shall be of the ganged style for the number of devices used.
- C. Install nameplate identification as indicated in Section 260553.
- D. Plate securing screws shall be metal with head color matching the wall plate finish.

2.3 MODULAR CONNECTORS

- A. Devices listed below are traditional wired devices. Contractor option to provide equivalent modular connector-type devices (Hubbell Snap Connect, Pass & Seymour Plug Tail, Leviton Lev-Lock, Copper ArrowLink) where applicable.
- B. Wiring devices with modular wiring type quick connectors shall comply with the following in addition to the above:
 - 1. Wired with #12 THHN Cu, stranded or solid, 3 or 4 wire as required for device, minimum 6" lead length.
 - 2. Connector contacts shall be crimped or welded.

2.4 RECEPTACLES

- A. Refer to Electrical Symbols List for device type.
- B. REC-DUP: NEMA 5-20R Duplex Receptacle:
 - 1. Standard Grade: 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face and steel back strap.
 - a. Manufacturers:
 - 1) Hubbell 5352A
 - 2) Leviton, 5362-S
 - 3) Pass & Seymour 5362
 - 4) Cooper 5352
 - 2. Decorator Grade: Provide decorative style duplex receptacles in public spaces where walls are finished.
 - a. Manufacturers:
 - 1) Hubbell DR20
 - 2) Leviton 16362
 - 3) Pass & Seymour 26342
 - 4) Cooper 6352

3. Heavy Duty: 125-volt, 20 amp, 3-wire grounding type heavy duty industrial grade with impact resistant thermoplastic face and one-piece brass back strap with integral ground contacts.
 - a. Manufacturers:
 - 1) Hubbell 5362
 - 2) Leviton 5362
 - 3) Pass & Seymour 5362A
 - 4) Cooper AH5362
- C. REC-DUP-GFI: NEMA 5-20R Ground Fault Duplex Receptacle:
 1. Standard Grade: 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, listed.
 - a. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
 - b. Manufacturers:
 - 1) Hubbell GF20L
 - 2) Leviton GFNT2
 - 3) Pass & Seymour 2097
 - 4) Cooper SGF20
- D. REC-DUP-GFI-R: Remote Ground Fault Device:
 1. Ground fault device for remote downstream receptacles. 125-volt, 20 amp. Test and reset buttons in impact resistance thermoplastic face, listed.
 - a. Manufacturers:
 - 1) Hubbell GFBF20
 - 2) Leviton 6895
 - 3) Pass & Seymour 2085
 - 4) Cooper VGFD20
- E. REC-DUP-W: NEMA 5-20R Weatherproof While-In-Use Ground Fault Duplex Receptacle:
 1. 125-volt, 20 amp, 3-wire grounding type with test and reset buttons in impact resistant thermoplastic face, weather resistant WR listed. Provide extra-duty NEMA 3R rated while-in-use clear cast aluminum outlet box hood.
 2. Device shall perform self-test of GFCI circuitry in accordance with UL 943.
 - a. Manufacturers:
 - 1) Hubbell:
 - a) GFRTW20 with clear housing RW57300
 - 2) Leviton GFWT2 with clear housing 5977-CL
 - 3) Pass & Seymour 2097TRWR with clear housing WIUC10-C

- 4) Cooper WRS GF20 with clear housing WIU-1

F. REC-USB: NEMA 5-20R Receptacle with USB Charger:

1. Standard Grade Type A USB: 125-volt, 20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. Type A USB charging rated at 5VDC 3.0A minimum. Mounted in double gang backbox.
 - a. Manufacturers:
 - 1) Hubbell USB20X2
 - 2) Leviton #####
 - 3) Pass & Seymour TR5362USB
 - 4) Cooper TR7766
2. Standard Grade Type C USB: 125-volt, 20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face.
 - a. One Type A USB charging rated at 5VDC 3.0A minimum and one Type C USB charging rated at 5VDC 5.0A. Mounted in double gang backbox.
 - b. Two Type C USB charging rated at 5VDC 5.0A. Mounted in double gang backbox.
 - c. Manufacturers:
 - 1) Hubbell USB USB20C5
 - 2) Leviton #####
 - 3) Pass & Seymour TR5362USB
 - 4) Cooper TR7766

G. REC-USB-O: NEMA 5-20R Receptacle with USB Charger:

1. Standard Grade Type A USB: 125-volt, 20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. Type A USB charging rated at 5VDC 3.0A minimum. Top half of duplex shall be split circuit wired and controlled by remote relay. Controlled receptacle shall have permanent NEMA approved and Electrical Code compliant marking on face of device. Mounted in double gang backbox.
2. Label alternative (when factory label is not available). Provide custom field applied permanent controlled receptacle label, NEMA and Electrical Code compliant marking on device coverplate. Label shall be permanent adhesive, durable, weatherproof, removable only by vigorous scrapping and likely damage to coverplate.
 - a. Manufacturers:
 - 1) Hubbell USB20X2
 - 2) Leviton #####
 - 3) Pass & Seymour TR5362USBCD
 - 4) Cooper TR7766
3. Standard Grade Type C USB: 125-volt, 20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. Top half of duplex shall be split circuit wired and controlled by remote relay. Controlled receptacle shall have permanent NEMA approved and Electrical Code compliant marking on face of device.

4. Label alternative (when factory label is not available). Provide custom field applied permanent controlled receptacle label, NEMA and Electrical Code compliant marking on device coverplate. Label shall be permanent adhesive, durable, weatherproof, removable only by vigorous scrapping and likely damage to coverplate.
 - a. One Type A USB charging rated at 5VDC 3.0A minimum and one Type C USB charging rated at 5VDC 5.0A. Mounted in double gang backbox.
 - b. Manufacturers:
 - 1) Hubbell USB20C5
 - 2) Leviton #####
 - 3) Pass & Seymour TR5362USBCD
 - 4) Cooper TR7766

H. REC-SIM-520R: NEMA 5-20R Simplex Receptacle:

1. 125-volt, 20 amp, 3-wire grounding type with impact resistant thermoplastic face.
 - a. Manufacturers:
 - 1) Hubbell HBL5361
 - 2) Leviton 5361
 - 3) Pass & Seymour 5361
 - 4) Cooper 5361

I. REC-SIM-1450R: NEMA 14-50R Simplex Receptacle:

1. 125/250-volt, 50 amp, 3-pole, 4-wire grounding type with thermoplastic face. Flush mounted at +4" AFF.
 - a. Manufacturers:
 - 1) Hubbell HBL9450A
 - 2) Leviton 279
 - 3) Pass & Seymour 3894
 - 4) Cooper 5754N

2.5 COUNTERTOP RECEPTACLE ASSEMBLIES

A. REC-#: Pop-up Style Receptacle Assembly Listed for Countertop Applications.

1. 125-volt, 15/20-amp, tamper resistant, 3-wire grounding type with impact resistant thermoplastic face. Two (2) NEMA 5-15R/5-20R, with both simplex devices on same face or opposite face of assembly, gasketed countertop enclosure, UL 948 section 146 spill test. Architect to select finish from standard factory options. Device(s) installation, orientation, and finish shall be coordinated with Architect/Engineer prior to installation.
2. Product Specific Coordination:
 - a. The Contractor shall provide provisions as required to maintain the product listing. Refer to the manufacturer's instructions for a complete list of product specific installation requirements.

- b. Hubbell: Provide GFCI circuit breaker for overcurrent protection device serving branch circuit.
 - c. Low Electric: Provide a REC-DUP-GFI in the cabinet cavity below the countertop for the device to plug into. Coordinate installation of the duplex device with the space available in the below countertop cabinet.
 - d. Branch Circuit: Provide a 15A/1P circuit breaker for 15 amp rated devices served by a dedicated branch circuit.
3. Manufacturers:
- a. Hubbell RCT200
 - b. Low Electric PUR20

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install convenience receptacles at elevations indicated in the General Installation Notes on the contract drawings.
- B. Install specific-use receptacles at heights shown on the contract drawings. Install devices level, plumb, and square with building lines. Coordinate installation of adjacent devices of separate systems with common mounting heights, including lighting, power, systems, technology, and temperature control device rough-ins.
- C. Ground Fault Protection: Provide ground fault protection for all branch circuit breakers serving 120/208 receptacles and electrical outlets rated 50 amps or less single-phase and 100 amps or less three-phase in the following locations, as shown on drawings, or required by adopted code:
 - 1. Bathrooms, and laundry areas.
 - 2. Kitchens' all 120-volt through 250-volt receptacles.
 - 3. Interior/Exterior locations subject to damp/wet conditions.
 - 4. When located within 6 feet of sinks, bathtubs, and shower stalls.
 - 5. Plug-and-cord receptacles when the utilization appliance is located within 6 feet of a sink edge.
 - 6. Specific Appliances: sump pumps, dishwashers, electric ranges, ovens, clothes dryers, microwave ovens.
- D. Arc-Fault Protection: Provide arc-fault protection for all branch circuit breakers serving the following spaces, or required by adopted code.
 - 1. Dwelling unit living and occupied areas including but not limited to kitchens, family, dining, living, parlors, libraries, dens, bedrooms, sunrooms, recreation, closets, hallways, laundry, and similar spaces.
- E. Tamper Resistant Protection: Provide tamper resistant protection for all 15 / 20-amp 120/208 straight blade wiring devices in the following locations, as shown on the drawings, or required by adopted code.
 - 1. Dwelling units and accessory dwelling unit structures.

2. Public Spaces involving: Transportation waiting, gymnasiums, fitness centers, auditoriums, public use venue common areas.

F. Install devices and wall plates flush and level.

G. Test receptacles for proper polarity, ground continuity and compliance with requirements.

END OF SECTION

SECTION 262729 - ELECTRIC VEHICLE CHARGING STATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Electric vehicle charging stations: EVO

1.2 REFERENCES

- A. The equipment and components in this specification shall be designed and manufactured according to the latest revision of the following standards (unless otherwise noted):
 - 1. SAE J1772 Standard for Electric Vehicle Conductive Charge Coupler
 - 2. Electrical Code Article 625 Electric Vehicle Charging Systems
 - 3. UL 2202, Electric Vehicle (EV) Charging System Equipment
 - 4. UL 2231, Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits
 - 5. UL 2251, Plugs, Receptacles and Couplers for Electric Vehicles
 - 6. UL 2594, Electric Vehicle Supply Equipment
 - 7. UL and cUL listed
 - 8. ISO 15693
 - 9. ISO 15118
 - 10. OCPP Compliant
 - 11. ADA Compliant
 - 12. International Energy Conservation Code (IECC) with Local Amendments
 - 13. International Green Construction Code (IGCC) where Adopted by AHJ

1.3 SUBMITTALS

- A. Submit product data under provisions of Section 260500.
- B. Provide product data showing configurations, finishes, dimensions, cable, and coupling information.
- C. Provide manufacturer installation, operation, and maintenance instructions.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Contractor shall inspect and report for damage.
- B. Contractor shall store in a clean, dry space. Cover with heavy canvas or plastic to keep out dirt, water, construction debris, and traffic. Heat enclosures to prevent condensation.
- C. Contractor shall handle in accordance with manufacturer's recommendations to avoid damaging equipment, installed devices, and finish.
- D. Contractor shall store, protect, and handle products in accordance with recommended practices listed in manufacturer's installation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ELECTRIC VEHICLE CHARGING STATION

- A. Accessory and pedestal selections per manufacturer recommendations unless otherwise noted in the drawings or specifications.
- B. Plan Identification:
 - 1. EVO: Level 2 electric vehicle charging station, dual port type.
- C. Approved Manufacturers:
 - 1. Level 2 Dual Port Charging Station Pedestal Style:
 - a. Charge Point CT4000 Series
 - b. Blink Charging Series7
 - c. BTC Power L2 Series
 - d. Or approved equal
- D. Level 2 EVCS: Electric vehicle (EV) charging station, Level 2 charging, with LCD display, LED display for charging status, fault indication, power available, internal ground fault protection 20mA, anti-nuisance tripping, and re-closure feature, listed.
 - 1. Enclosure Construction: Minimum NEMA 3R
 - 2. System Supply: 40 amp, 208]-volt, single phase, 60Hz.
 - 3. Cable / Connector: Usable cable to not exceed 25ft, unless equipped with a cable management system. SAE J1772 compliant connector. Provide complete with cable/connector support while not in use bracket.
 - 4. Environment: Wet location, -22°F to 122°F

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation Quality Control. The installer of the electric vehicle charging system, associated feeder, and branch circuit shall be qualified.
 - 1. Torque Settings Report. Develop an installation summary report that includes the manufacturer's torque settings guidelines compared to actual torque settings measured during the installation.
 - 2. Provide a separate report entry for each EVCS station. Include the torque settings for each connection originating at the feeder or branch circuit overcurrent protection device, interim splices, wiring device receptacles and outlets, and the charger itself.
- B. Field Markings. Provide engraved plastic label.
 - 1. Product: Nameplates and signs. Refer to Section 260553 - Electrical Identification.
 - 2. Supply Voltage, phases, frequency, full load amps for each circuit, Short circuit current rating.

3. Example: 208 VOLT, 1 PHASE, 60 HZ, 2- 60 AMP, 10k SSCR.
- C. Provide concrete pad and mow apron for pedestal installation.
- D. Placement:
 1. Verify field measurements with architectural plans.
 2. Install pedestal 12 inches behind concrete curb / paving limits or as directed by the manufacturer.
 3. Center pedestal in site islands 24 inches or less in width.
 4. Center dual port pedestals between parking stalls. Align with vehicle parking lines.
- E. Wiring Devices, Outlets. Wiring devices and outlets associated with the EVCS shall be rated 125% of the application.
- F. Ground Fault Protection:
 1. Charger voltage 150 volts to ground or less, provide Class A Ground Fault Circuit Interrupter Protection GFCI at the Over Current Protection Device OCPD or receptacle wiring device.
 2. Charger voltage greater than 150 volts to ground, provide Special Purpose Ground Fault Circuit Interrupter Protection SPGFCI at the Over Current Protection Device OCPD, not to exceed 20mA trip threshold.
- G. Grounding Rod: Provide 5/8 x 10'-0" copper clad steel ground rod for each pedestal, installed 12 inches below finished grade. Provide bare #6 ground wire with exothermic weld for bonding to EVCS pedestal.
- H. Labeling: Provide panel and circuit label for all circuits serving the electric vehicle charging station. Locate circuit labels on the inside utility access cover for the charging station.
- I. Disconnecting Means (Disconnecting Means NEC 625.43, where applicable):
 1. Disconnecting Means. For electric vehicle supply equipment rated more than 60 amperes or more than 150 volts to ground, the disconnecting means shall be provided and installed in a readily accessible location. The disconnecting means shall be capable of being locked in the open position. The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker used as the disconnecting means and shall remain in place with or without the lock installed. Portable means for adding a lock to the switch or circuit breaker shall not be permitted.

END OF SECTION

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SECTION 262811 - ARC REDUCTION EARTHING SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Arc Reduction Earthing Device (ARED) integrated with switchboards, switchgear, and similar equipment.

1.2 RELATED SECTIONS AND WORK

- A. Section 260553 - Electrical Identification
- B. Section 262413 - Switchboards

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code (NEC) Article 240.87 Arc Energy Reduction
- B. UL 2748 - Standard For Arcing Fault Quenching Equipment
- C. ANSI/IEEE C37.20.7 - Guide for Testing Switchgear Rated up to 52KV for Internal Arcing Faults.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 260500.
- B. Arc Fault Reduction: Submit project specific documentation to demonstrate the maximum incident energy as a result of the ARED. Provide computer modeling results reported in cal / sq cm at 18 inches.
- C. Arc Energy Reduction Documentation: Submit documentation to demonstrate the arc energy reduction system is set to operate at a value below the available arcing current.
- D. Submit manufacturer's instructions under provisions of Section 260500.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site under provisions of Section 260500.
- B. Deliver in 48-inch maximum width shipping splits, unless approved otherwise by both the Contractor and Architect/Engineer, individually wrapped for protection, and mounted on shipping skids.
- C. Store and protect products under provisions of Section 260500.

- D. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data under provisions of Section 260500.
- B. Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Approved Manufacturers:
 - 1. Schneider Electric Square D Arcblok
 - 2. Eaton Arc Quenching Device AQD
 - 3. ABB Ultra-Fast Earthing Switch UFES / Arc Guard
 - 4. Siemens SI Quench (Medium Voltage Only)

2.2 ARC REDUCTION EARTHING DEVICE

- A. Provide Arc Reduction Earthing Device ARED. Factory-assembled integral with associated electrical distribution equipment (switchboard, switchgear, unit substation, other). Provide a dedicated compartment for the system.
- B. Arc Detection Systems:
 - 1. Provide inclusive automatic detection in each section, overcurrent protection compartment, and bus compartment associated with the protected equipment.
 - 2. System configured to provide protection without technician activation by maintenance switch or similar functionality.
 - 3. Configure system to avoid nuisance tripping from overcurrent tripping light emissions.
 - 4. Control power shall originate from the installed equipment or provided per manufacturer recommendations.
 - 5. Provide electrical interlock between the ARED and the main equipment disconnect to prevent re-energization of the equipment.
 - 6. Acceptable Detection Systems: Fiber optic arc flash monitoring or arc flash sensors.
- C. Nameplate:
 - 1. Provide custom engraved nameplate for the Arc Reduction Earthing Device compartment.
 - 2. Nameplate language. Arc Reduction Earthing Device. DO NOT RE-ENERGIZE EQUIPMENT prior to performing field evaluation, maintenance, removal of fault causing condition, and manufacturer re-commissioning or replacement.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install arc reduction ground system in location(s) shown on the drawings. Install system per manufacturer instructions and requirements.

3.2 FIELD QUALITY CONTROL

- A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

3.3 FACTORY TESTING, STARTUP, AND COMMISSIONING

- A. Factory test the Arc Reduction Earthing Device ARED per manufacturer guidelines prior to shipment. A certified factory test report shall be included with each shipped assembly.
- B. Provide provisions for factory startup, owner training, and commissioning of the arc reduction Earthing Device. The factory technician shall be factory-trained, qualified, manufacturer's representative. Submit electronic copies of the manufacturer's field startup report.

END OF SECTION

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SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 REFERENCES

- A. UL 198C - High-Interrupting Capacity Fuses; Current Limiting Types
- B. UL 198E - Class R Fuses
- C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses)
- D. NEMA FU 1 - Low Voltage Cartridge Fuses
- E. NFPA 70 - National Electrical Code (NEC) with 2020 Washington State Amendments]

1.2 SUBMITTALS

- A. Submit product data under provisions of Section 260500.

1.3 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40°F or more than 100°F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - FUSES

- A. Bussman, Division of Eaton
- B. Edison Fuse, Division of Cooper Industries
- C. Mersen
- D. Littelfuse Inc

2.2 FUSES

- A. Dimensions and Performance: NEMA FU 1, Class as specified or indicated.
- B. Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- C. Fuses with ratings larger than 600 amperes: Class L (time delay), unless otherwise noted on the drawings.
- D. Fuses with ratings larger than 200 amperes but equal to or less than 600 amperes: Class RK-1 (time delay), unless otherwise noted on the drawings.

- E. Fuses with ratings less than or equal to 200 amperes (not including control transformer fuses): Class RK-5, unless otherwise noted on the drawings.
- F. Fuses for packaged equipment: Size and type as recommended by equipment manufacturer.

2.3 SPARE FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch- thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch- high letters on exterior of door.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fuses where indicated on the drawings and specifications.
- B. Install fuses in accordance with manufacturer's instruction.
- C. Install fuses in packaged equipment as required by equipment manufacturer.
- D. Install fuse with label oriented such that manufacturer, type, and size are easily read.
- E. Install spare fuse cabinet in the Main Electrical Room.

END OF SECTION

SECTION 262816 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches
- B. Non-fusible switches
- C. Molded case circuit switches
- D. Molded case switches
- E. Motor disconnect switch
- F. Enclosures

1.2 RELATED SECTIONS AND WORK

- A. Refer to the Disconnect and Starter Schedule for rating and configuration.

1.3 REFERENCES

- A. NEMA KS 1 - Enclosed Switches

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 260500.
- B. Product Data: For each type of enclosed switch, circuit breakers, accessory and component indicated, include dimensions, weights, and manufacturer's technical data on features, performance, and ratings.
- C. Electrical Characteristics: For each type of enclosed switch, enclosure types, current and voltage ratings, short-circuit current ratings, UL listing for series rating of installed devices, features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.5 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NON-FUSIBLE SWITCHES

- A. Acceptable Manufacturers:
 - 1. Square D 3110 Series
 - 2. Eaton DH Series
 - 3. ABB TH Series
 - 4. Siemens HNF / HF Series
- B. FDS-#; Fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position. Fuse Clips: Class 'R' fuse clips only, unless indicated otherwise on the drawings.
- C. DS-#; Non-fusible Switch Assemblies: NEMA KS 1; Type heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position.
- D. Enclosures: Type as indicated on the disconnect schedule.
- E. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.
 - 1. Lockable
 - 2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.

2.2 MOLDED CASE CIRCUIT BREAKERS AND SWITCHES

- A. Acceptable Manufacturers:
 - 1. Square D
 - 2. Eaton
 - 3. ABB
 - 4. Siemens
- B. CB-#; Molded Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. Adjustable Instantaneous Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip settings.
 - 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.

- b. Long- and short-time pickup levels.
 - c. Long- and short-time adjustments.
 - d. Ground-fault pickup level, time delay, and I₂t responses.
 - 4. Current Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
 - C. CB-#; Molded Case Switches: Molded case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
 - D. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.
 - 1. Lockable
 - 2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.
- 2.3 MOTOR DISCONNECT SWITCH
- A. Acceptable Manufacturers:
 - 1. Square D 3110 Series
 - 2. Eaton r5 Series
 - 3. ABB ML Series
 - 4. Siemens LBR Series
 - B. MD-#; Rotary Switch Assemblies: Rated for making and breaking loads, rotary type enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position without a tool. Handle lockable in OFF position.
 - C. Enclosures: Type as indicated on the Disconnect Schedule.
 - D. Ground lug connection provided in enclosure.
 - E. Accessories: Provide the following accessories. Refer to Disconnect Schedule for additional requirements for each application.
 - 1. Lockable
 - 2. Provide finger safe barriers for exposed line-side terminations and energized components when the switch is in the open position.
 - F. Listed UL 508 suitable for motor control.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on the drawings.

- B. Install fuses in fusible disconnect switches.
- C. Field coordinate installation with other contractors and equipment to maintain code required working space requirements.
- D. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.2 ADJUSTING

- A. Set field-adjustable circuit breaker trip ranges.

END OF SECTION

SECTION 262821 - CONTACTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General-purpose contactors
- B. Lighting contactors
- C. Enclosures

1.2 RELATED SECTIONS AND WORK

- A. Refer to Lighting Contactor Schedule.

1.3 REFERENCES

- A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems
- B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies
- C. UL 508 - Industrial Control Equipment

1.4 SUBMITTALS

- A. Submit shop drawings under provisions of Section 260500.
- B. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, and poles.
- C. Submit manufacturer's instructions under provisions of Section 260500.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Schneider Electric 8903 Series
- B. Eaton Corporation C30CN / CN35 Series
- C. ABB
- D. Siemens LC / CLM / CM Series

2.2 GENERAL-PURPOSE CONTACTORS

- A. Contactors: NEMA ICS 2 and UL 508; electrically held, mechanically held, 2 3-wire control.

- B. Coil Operating Voltage: 24, 120, 208 volts, 60 Hertz.
- C. Size: NEMA ICS 2; size as indicated on the drawings.
- D. Poles: Field convertible NO and NC configurations.
- E. Enclosure: ANSI/NEMA ICS 6; Type 1.

2.3 LIGHTING CONTACTORS

- A. Contactors: NEMA ICS 2 and UL 508; electrically held, 2-wire control.
- B. Coil Operating Voltage: 24 120 208 volts, 60 Hertz.
- C. Poles: Field convertible NO and NC configurations.
- D. Enclosure: ANSI/NEMA ICS 6; Type 1 or 3R depending on installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction boxes: and equipment enclosures.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

END OF SECTION

SECTION 263100 - SOLAR PHOTOVOLTAIC SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Photovoltaic Panels and Arrays

1.2 QUALITY ASSURANCE

- A. Manufacturer(s) of System Components: Company specializing in photovoltaic panel or inverter systems with five years documented experience.
- B. System Installer(s): Equipment installer(s) shall be North American Board of Certified Energy Practitioners NABCEP certified or be certified by photovoltaic inverter and panel manufacturers. Licensed electrical contractors with electrical apprenticeship documentation shall also be acceptable.
- C. System Commissioning: Operate, commission, and demonstrate seven (7) days of complete photovoltaic system operation prior to turnover to the Owner. Refer to Part 3 for system commissioning requirements.

1.3 REFERENCES

- A. ANSI C62.41 - IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
- B. IEEE 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
- C. IEEE 929 - Recommended Practices for Utility Interface of Photovoltaic Systems.
- D. IEEE 1547 - Standard for Interconnecting Distributed Resources with Electronic Power Systems.
- E. IEEE 1547.1 - Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.
- F. NFPA 70 - National Electrical Code (NEC) Article 690 - Solar Photovoltaic (PV) Systems
- G. UL 1703 - Standard for Flat-Plate Photovoltaic Modules and Panels
- H. UL 1741 - Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
- I. UL 1998 - Standard for Software in Programmable Components

1.4 PRODUCT SUBMITTALS

- A. Submit product data under provision of Section 260500.
- B. Photovoltaic Panels: Include unit dimensions, weight, material construction, wattage, voltage, current, open circuit voltage, short circuit current, clamping requirements, installation and maintenance information, and manufacturer voltage correction factor in information.
- C. Photovoltaic Inverter: Include unit dimensions, weight, installation and maintenance information. Also include the following:
 - 1. Input: DC voltage range, max current input.
 - 2. Output: AC voltage range, total harmonic distortion, power factor, efficiency, maximum current output.
 - 3. Disconnects for AC and DC systems.
 - 4. General: Power consumption, enclosure type, compliance with references.
 - 5. Environment: Ambient temperature rating, cooling requirements.
- D. Array Mounting Frame:
 - 1. Design of photovoltaic panel racking, ballasting and similar support systems shall be performed for loading indicated in this specification and structural general notes.
 - 2. Design of support shall be performed for loading indicated in this specification and structural general notes.
 - 3. Coordination drawing drawn to scale and coordinating the photovoltaic array with other systems and equipment in the vicinity for use in the development and layout of the mounting frame.
 - 4. Coordination with building superstructure structural engineer. Provide clear indication of design forces and maximum potential component forces at attachment points to building structure for confirmation of acceptability by the Structural Engineer of Record.
 - 5. Plan drawings and details shall be cross-referenced. Details provided are to clearly indicate attachment to structure, correctly representing the fastening requirements.
- E. Roof mounted system certification letter, signed by contractor, that the roof adhesives, fasteners, hardware, and accessories are approved by manufacturers of both the roofing system and the photovoltaic system.
- F. Provide calculation of expected annual total kilowatt hours for proposed equipment and installation.
- G. Provide a list of manufacturer and model for photovoltaic panels, power optimizers, inverters and racking system for evaluation.

1.5 SPARE PARTS

- A. Provide spare parts under provisions of Section 260500.

1.6 DELIVERY, STORAGE, HANDLING

- A. Store and protect products under provisions of Section 260500.

- B. Store in warm and dry location or per manufacturer's requirements.
- C. Handle per manufacturer's requirements.

1.7 OPERATION AND MAINTENANCE DATA

- A. Submit data under provision of Section 260500.
- B. Include description of operation and servicing procedures, list of major components, recommended remedial and preventative maintenance procedures, and list of spare parts.

1.8 WARRANTY

- A. Provide warranty under provisions of Section 260500.

1.9 PRE-INSTALLATION CONFERENCE

- A. Roof Mounted System: Conduct a pre-installation conference a minimum of one week prior to commencing roof mounted system work. Minimum participants to include general contractor, roofing contractor, electrical contractor, and photovoltaic system installer. Minimum agenda items shall include:
 - 1. Installation schedule.
 - 2. Protocols to protect roof system and roof warranty.
 - 3. Adhesive, fastener, accessories, and hardware approved to maintain roof system and photovoltaic system warranties.

1.10 SYSTEM DESCRIPTION

- A. Complete photovoltaic system rated 10 kW 600V DC at Standard Test Conditions STC including photovoltaic panels, inverter system, combiner/disconnects, metering, and reporting equipment. Systems shall be configured to produce 208Y/120 3 phase 4 wire 60 Hz power.
- B. Grid-tie interconnection with utility, including island protection and net metering.
- C. The photovoltaic system shall include a metering system for total system power production and a reporting system to monitor individual components.
- D. The photovoltaic system and inverter shall be configured as a grid inter-tie solar photovoltaic system. The individual inverters shall automatically de-energize their output to the building electrical system upon loss of the utility electrical service. The photovoltaic inverter system shall remain de-energized until the electrical utility voltage has been restored.
- E. Equipment shall be identified for use in solar photovoltaic systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Hanwha Qcells series

- B. Canadian Solar
- C. Jinko Solar
- D. SEG Solar
- E. Risen Solar Technology
- F. SolarWorld
- G. VSun
- H. Kyocera series
- I. Mission Solar series
- J. Or pre-approved equals

2.2 PHOTOVOLTAIC PANELS AND ARRAYS

- A. Equipment Ratings:
 - 1. Maximum Rated Power (STC) P_{max} : 515 watts
 - 2. Operating Power Point Voltage V_{mpp} : 33.90 VDC
 - 3. Maximum Power Point Current I_{mpp} : 15.20 A
 - 4. Maximum Open Circuit Voltage V_{oc} : 40.70 VDC
 - 5. Maximum Short Circuit Current I_{sc} : 16.07 A
 - 6. Nominal Operating Cell Temperature Conditions (NOCT) P_{max} : 0.30 % /°C
- B. Operating Environment Conditions:
 - 1. Operating Temperature: -40 to 85°C
 - 2. Wet location listed
- C. Cell Material: Silicon-based solar cell construction with UV stabilized polymer. Provide with bypass diode technology for partial shading operation.
- D. Panel Construction: Mono-facial anodized aluminum frame with ground point and tempered glass cover.
- E. Physical Dimensions and Weights: 39.4" 45" wide x 1.8" deep x 78" long. Maximum 60lbs/each.
- F. Panel Connections and Terminations:
 - 1. Provide manufacturer's wiring or field wiring with quick-connect terminations for series creation of module-strings and module-arrays.
 - 2. Provide field wiring with quick-connects terminations to combine boxes when applicable.
 - 3. All exterior wire and terminations shall be listed sunlight resistant.

2.3 MODULE LEVEL POWER ELECTRONICS

A. Power Optimizers:

1. Provide power optimizer modules mounted to back of panels to track MPPT and minimize losses from shading and uneven string lengths. Power optimizer must have been tested with submitted photovoltaic panel.
2. Minimum Efficiency: 98%

B. Minimum Equipment Protection Rating: NEMA 6P, Ingress Protection IP68

C. Rapid Shutdown:

1. Provide integral rapid shutdown system. The system shall be activated by loss of AC power.
2. Provide an emergency rapid shutdown power off station with the system disconnect switch.
3. DC Arc-Fault Circuit Protection: Provide PVAFCI arc-fault circuit interruption protection for DC branch circuits.

2.4 COMBINER/DISCONNECT

A. Combination of combiner box and solar array disconnect in a single enclosure.

B. Load break switch rated 600 VDC maximum with lockout provisions.

C. Fuse holders rated 30 amp maximum. Terminal blocks for each PV string.

D. Provide fused surge protective device (SPD) with visual status indicator and remote contact signaling. BUSSMAN BSP series or approved equal.

E. Enclosure: NEMA 4X.

2.5 PHOTOVOLTAIC GRID TIE STRING INVERTERS

A. Inverter Manufacturers:

1. SMA America Model
2. Xantrex Technology Inc.
3. Fronius USA, LLC
4. Yaskawa - Solectria
5. Solar Edge
6. Or pre-approved equals

B. Equipment Ratings:

1. AC Output Power Rating for Inverter: 10,000 watt
2. Output Voltage: 208/120V 3 phase
3. Power Factor: 1.0
4. Minimum CEC Efficiency: 97.5%
5. MPPT Operating Voltage Range: 150 to 600 VDC

6. Minimum number of MPPT tracker inputs or equivalent propriety system: 2
7. Total Harmonic Distortion: Less than 5%
8. DC Voltage Ripple: Less than 5%

- C. Inverter Technology: Transformerless Full DC/AC rectification, real sine-wave output with high frequency pulse width modulation PWM.
- D. Internal Protection: Inverter shall measure utility voltage, current, and impedance. Loss of utility power shall cause inverter to rapidly shut down. Inverter shall automatically reconnect to AC output bus and DC input bus upon return of utility source.
- E. The inverter shall be constructed to not allow backfeeding from the electrical utility to the photovoltaic panels or DC input bus.

2.6 METERING AND REPORT

- A. Web-Based Metering Application: Provide manufacturer's software for metering and reporting on web-based interface. The Electrical Contractor shall install and provide provision for custom initialization of the photovoltaic system software package.
- B. Displayed and Recorded Data:
 1. The following data shall be provided for each photovoltaic inverter and updated every 10 seconds.
 - a. Power
 - b. kWh today
 - c. Total kWh
 - d. Date
 - e. Time
 2. The following data shall be provided for the entire photovoltaic system:
 - a. Power
 - b. kWh today
 - c. Total kWh
 - d. Date
 - e. Time
 - f. kWh to utility today
 - g. Total kWh to utility
 3. The above information shall be recorded, logged, and compiled by the personal computer software for production and performance evaluation purposes.
 4. Provide data reporting and recording of all manufacturers' standard reporting functions and data acquisition reporting.

2.7 ARRAY MOUNTING

- A. Basis of design is given so integrator can provide design and installation of an equivalent system that is compatible with the provided modules and structure. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. UNIRAC Large Array (U-LA)
2. DPW Direct Power and Water
3. PROSOLAR

B. Mounting system requirements Roof mounting system:

1. 35-degree tilt angle.
2. Wind Load Requirements: 120 mph and class for the application
3. Snow Load: 30 pounds per square foot snow load.
4. Total System Weight: 5 lbs/sf
5. Seismic Requirements: As indicated on structural general notes.
6. Provides four mounting supports for each panel in accordance with manufacturer's requirements.
7. Coordinate final dimensions with architectural drawings and existing conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Photovoltaic cabling shall be installed in raceways separate from other building system cabling. Photovoltaic cabling shall be installed in conduit when located interior to the building.
- B. The photovoltaic panels and arrays shall be configured in an open circuit, short circuit, or provided with an opaque covering to disable the array from producing electrical power during installation. Refer to the manufacturer's information for additional disabling requirements during installation.
- C. Install fuses in all fuse holders and disconnects. Provide a label on the inside of each disconnect identifying the size, type, and model of each fuse installed.
- D. Provide provisions to seal all exterior penetrations. All photovoltaic system roof penetrations shall be sealed by the roofing contractor at the expense of the photovoltaic system contractor.
- E. Roof Mounted Systems:
 1. Provide photograph and report documentation of the roof system condition prior to installing any roof mounted photovoltaic systems. Provide a copy of the report to the general contractor and roofing contractor.
 2. Provide protective roof mats during the fabrication and installation of roof mounted photovoltaic systems to protect the roofing system.
 3. Provide provisions for roofing contractor to seal roof penetrations, provide roof protection at ballasted rack and raceway supports, and other points of interface between the roof and photovoltaic system at the expense of the photovoltaic installer.
 4. Provide sacrificial solar slip sheets under all roof mounted photovoltaic equipment, supports, and raceways. The material shall be the same material, color as the roof membrane material. Installation shall comply with roof warranty requirements.
 5. Provide provisions for the roofing contractor to repair any penetrations, wear, or general damage caused by installation of the photovoltaic system at the expense of the photovoltaic system installer.

6. Staging Plan: Coordinate equipment staging on roofs and other structural components with structure limitations. Execute the Equipment Staging Plan previously submitted and approved by the superstructure structural engineer.

F. Wire and Cable Schedule:

1. These requirements are in addition to the requirements of Section 260513.
2. DC Distribution System:
 - a. Exterior: Photovoltaic panel manufacturer-supplied cabling with quick connects.
 - b. Interior: Copper, stranded conductor, minimum 2,000 volt insulation, XLPE or EPR.
 - c. Underground or Wet Locations: Copper, stranded conductor, minimum 2,000 volt insulation, XLPE or EPR.
 - d. Conductors shall be color coded as follows:
 - 1) PV-: Black
 - 2) PV+: Red
 - 3) Ground Bond: Green
3. AC Distribution System:
 - a. Refer to Section 260513.
4. Use no wire smaller than 10 AWG for DC wiring of the photovoltaic system. The wire AWG shall be selected based on derating factors and voltage drop.

G. Interconnect photovoltaic inverters and/or communications gateway to each other and to the facility's local area network patch panel using Category 6 cable or other cable as directed by the inverter manufacturer.

H. Provide provisions for programming and initializing the system metering and reporting software per the Owner's requirements. The Contractor shall organize a meeting with the Owner to finalize the programming and user interfaces of the program software.

I. Install equipment per the manufacturer's recommendations.

3.2 LABELING

A. Refer to Section 260553 for product requirements.

B. Label all photovoltaic system equipment as required by code. The following label descriptions shall be considered the minimum requirement in addition to the compliance with the adopted code.

C. Label ground fault indicators:

1. "IN THE EVENT OF A GROUND FAULT INDICATION - THE NORMALLY GROUNDED CONDUCTORS MAY BE ENERGIZED AND UNDERGROUNDED"

- D. Label all AC-alternating current and DC-direct current disconnects of the photovoltaic power system.
 - 1. "---PHOTOVOLTAIC SYSTEM DISCONNECT---WARNING. ELECTRIC SHOCK HAZARD. DO NOT TOUCH TERMINALS. TERMINALS ON BOTH THE LINE AND LOAD SIDES MAY BE ENERGIZED IN THE OPEN POSITION"
- E. The AC disconnecting means for each photovoltaic inverter shall be labeled with the following:
 - 1. Operating Current:
 - 2. Operating Voltage:
 - 3. Maximum System Voltage:
- F. Label DC raceways, cabling, junction boxes, and conduit bodies with adhesive markings and labels suitable for the environment:
 - 1. Color: White capital letters on red background.
 - 2. Label Text: PHOTOVOLTAIC POWER SOURCE.
 - 3. Label intervals: Maximum 10 intervals or as required by code to identify all conduits run exposed or located above accessible ceilings. Conduits located above non-accessible ceiling or in floors and walls shall be labeled within 3 feet of becoming accessible, or separated by enclosures, walls, partitions, ceilings, and floors. Labels for multiple conduits shall be aligned.
- G. Label DC system disconnect and power conversion equipment with the following:
 - 1. Equipment type and contract documents designation of equipment.
 - 2. Name of upstream equipment and location of the upstream equipment if it is not located within sight.
 - 3. Nominal equipment voltage and rating.
 - 4. Max DC Voltage.
 - 5. Available fault current (from batteries if applicable).
 - 6. Date of fault current study; refer to one-line diagram.
- H. Label each electrical service location with rapid shutdown feature:
 - 1. Label text: "SOLAR PV SYSTEM WITH RAPID SHUTDOWN. TURN RAPID SHUTDOWN SWITCH TO THE "OFF" POSITION TO SHUT DOWN PV SYSTEM AND REDUCE SHOCK HAZARD IN ARRAY."
- I. Short Circuit Current: The interactive system point of interconnection shall be labeled at the disconnecting means with the following:
 - 1. Maximum AC Output Operating Current:
 - 2. Operating AC Voltage:
- J. The building service entrance disconnect shall be clearly labeled to identify there is a photovoltaic system interconnection. The location of the interactive system disconnect shall be identified with a plaque reading: "WARNING - PHOTOVOLTAIC SYSTEM DISCONNECT LOCATED AT".

K. Conductor Identification:

1. PV System DC circuit conductors shall be identified at all termination connections.
2. Identification shall include color coded shrink tube tagging, conductor colored insulation, or marking tape. Include +, POSITIVE, or POS identification style labeling in addition to color identification.

3.3 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 260500.
- B. Check for damage and tight connections prior to allowing the photovoltaic panels to begin power generation.
- C. Check for damage and proper operation of the photovoltaic inverters.
- D. Verify operation of the metering and reporting system components. Adjust and update the graphical user interface for project specific conditions.

3.4 SYSTEM COMMISSIONING

- A. Provide system commissioning report under provisions of Section 260500.
- B. Notify Architect/Engineer seven days prior to beginning final witness testing of the photovoltaic system.
 1. The Electrical Contractor shall fully test the complete photovoltaic system prior to notifying the Architect/Engineer for final witness testing.
- C. Test, measure, and record the following system values:
 1. Date:
 2. Time of test:
 3. Testers:
 4. Sun overcast conditions (full sun) (scattered clouds) (full cloud coverage).
 5. Inverter:
 - a. DC input current:
 - b. DC input voltage:
 - c. AC output current:
 - d. AC output voltage:
 - e. Output power:
- D. Performance Test of Interactive Inverter System:
 1. Verify proper operation of the photovoltaic system. Verify the photovoltaic system is producing power and delivering it to the building electrical distribution system.
 2. Simulate power outage of electrical utility by switching the main electrical service disconnect from "closed" to "open".
 3. Verify that each individual photovoltaic inverter has stopped producing electrical energy.

4. Simulate return of utility electrical power by switching the main electrical service disconnect from "open" to "closed".
5. Verify each photovoltaic inverter has reconnected to the photovoltaic panels and building electrical distribution system. Verify power delivery from the photovoltaic inverters to the building electrical distribution system.
6. Document any test failure, including reason for failure and corrective actions. Retest the photovoltaic system to complete satisfactory operation.

E. Utility Company Commissioning:

1. Perform commissioning tests required by the utility company for photovoltaic onsite distributed energy resources.
2. Coordinate testing, documentation, and submission requirements with the utility company.

END OF SECTION

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SECTION 264300 - SURGE PROTECTION DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes materials and installation requirements for factory and field wired low voltage surge protection devices (SPD) for the protection of all AC electrical circuits. SPD equipment to be installed at designated service entrance equipment, distribution panels, and electronic equipment.

1.2 QUALITY ASSURANCE

- A. The specified unit shall be designed, manufactured, tested and installed in compliance with the above references. The unit shall be "Listed by Underwriters Laboratories" to UL 1449.
- B. Each unit shall be designed and manufactured by a qualified manufacturer of power conditioning equipment. The qualified manufacturer must have been engaged in the design and manufacturer of such products for a minimum of five years.

1.3 REFERENCES

- A. ANSI/IEEE C62.33 - IEEE Guide on Testing of MOV components
- B. ANSI/IEEE C62.35 - IEEE Guide on Testing of SAD components
- C. ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltage in Low Voltage AC Power Circuits
- D. ANSI/IEEE C62.45 - IEEE Guide on Surge Testing for Equipment Connected to Low Voltage AC Power Circuits
- E. ANSI/UL 1449 Latest Edition - UL Standard for Safety for Surge Protective Devices
- F. CBEMA - Computer Business Equipment Manufacturers Association
- G. IEC 664 - International Engineering Consortium, Standard for Clamping Voltage
- H. NFPA 70 - National Electrical Code (NEC) with 2020 Washington Amendments
- I. UL 67 - Listed for Internal Panelboard Transient Voltage Surge Suppressors
- J. UL 96A - Devices listed as approved for secondary surge arrestors (VZCA)
- K. UL 248-1 - Fusing
- L. UL 1283 - Electromagnetic Interference Filters, Fifth Edition

1.4 SUBMITTALS

- A. Shop Drawings: Should include device dimensions, mounting requirements including wire size and over-current protection device rating, nameplate nomenclature, electrical ratings, short circuit current rating, and test results as indicated below under "Testing, Warranty and Life Expectancy" as provided by an independent test lab or a UL certified test lab for the category(ies) of suppression device(s) specified using the appropriate IEEE test wave. Product data sheets with installation instructions for each size and type of device are required. Shop drawings submitted without the testing data as required by section this section will be rejected.
- B. Fuse information: Provide fuse information if required for operation. Include size, manufacturer, time-current chart responses to UL 1449 testing requirements, maximum surge protection capability per mode and phase as limited by the fuse, and verification of repetitive surge protection device operation without system degeneration greater than 10%.

1.5 TESTING, WARRANTY AND LIFE EXPECTANCY

- A. Manufacturer must provide independent testing on repetitive capability and maximum surge current rating of service entrance suppressor units. This shall be performed at a nationally recognized lab not affiliated with the manufacturer.
 - 1. Single pulse surge current capacity: Single pulse surge current tested in a mode at rated surge currents.
 - 2. Single pulse surge current capacity test: An initial UL 1449 defined 1.2 x 50 μ s, 6000V open circuit voltage waveform and an 8 x 20 μ s, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit's suppression voltage (VPR).
 - 3. A single 8 x 20 μ s waveform pulse of maximum rated surge current per mode shall then be applied. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival. Survival is achieved if the suppression voltage measured from the two UL1449 surges does not vary by more than 10%.
- B. Minimum Repetitive Surge Current Capacity:
 - 1. Service entrance suppressor units should be tested repetitively at an independent lab to verify repetitive capacity.
 - 2. Minimum Repetitive Surge Current Capacity Test:
 - a. An initial UL 1449 surge defined as 1.2 x 50 μ s, 6000V open circuit voltage waveform and an 8 x 20 μ s, 500A and 3kA short circuit current waveform shall be applied to benchmark the unit's suppression voltage.
 - b. A repetitive number of ANSI/IEEE C62.41.2-2002 (Category C3) surges, defined as a 1.2 x 50 μ s 10kV or 20kV open circuit voltage waveform and an 8 x 20 μ s 10,000A short circuit current waveform, shall then be applied at one-minute intervals.
 - c. To complete the test, another UL 1449 surge shall be applied to verify the unit's survival.
 - 3. Survival is achieved if the suppression voltage (VPR) does not vary by more than 10%.
 - 4. Proof of such testing shall be the test log generated by the surge generator.

- C. Provide UL 1449 classification white sheet pages indicating the VPR (voltage protection rating) for each SPD unit submitted for this product using the 6kV/3kA combination wave surge.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- A. General: The unit shall provide transient voltage suppression, surge current diversion and high-frequency noise attenuation, when connected in parallel to the facilities distribution system. The unit MCOV shall not be less than 115% of the nominal system voltage. Operating frequency shall be for a 60 Hz system. The unit shall provide protection in all normal modes for "wye" and "delta" systems.
- B. Short Circuit Current Rating: Provide factory label for SCCR rating. The short circuit current rating shall be the larger of the listed value on the drawings or as required by the equipment protected.
- C. Type Definitions - Permitted Installation Locations:
 - 1. Type 1. Supply-side or Load-side of service disconnect. Load-side of service disconnects when listed for application and approved.
 - 2. Type 2. Load-side of service disconnect or separately derived system.
 - 3. Type 3. Load-side of branch circuits.
 - 4. Type 4. Integral to Original Equipment Manufacturer OEM equipment, factory installed.

2.2 RATINGS

- A. Service Entrance Suppressors:
 - 1. For 120/208-volt, 3 phase, 4 wire, type 2 unit.
 - a. Surge current capacity: 80,000/160,000, 100,000/200,000 amps per protection mode/phase
 - b. Nominal Discharge Current: 20 kA.
 - c. Mounting: Refer to the drawings.
 - d. Voltage Protection Rating: Refer to requirements below.
 - e. Components: Minimum component size of 20mm thermally protected metal oxide varistors (MOV).
 - f. Disconnect: Surge-rated disconnect with 200,000 SCCR.
 - 2. Manufacturers:
 - a. Square D Surgellogic EM# Series
 - b. Siemens TPS4 or BSPD Series
 - c. Eaton SPD Series
 - d. ABB Current Technology Current Guard Plus
 - e. ASCO Power Technologies 5## Series
 - f. LEA International LSS Series

- B. Service Entrance Suppressors - Hybrid:

1. For 120/208-volt, 3 phase, 4 wire, type 2 unit.
 - a. Surge current capacity: 100,000/200,000, 120,000/240,000 amps per protection mode/phase
 - b. Nominal Discharge Current (IN): 20 kA.
 - c. Mounting: Refer to the drawings.
 - d. Voltage Protection Rating: Refer to requirements below.
 - e. Components: Minimum component size of modular 20mm thermally protected metal oxide varistors (MOV). Modular hybrid combination of 20mm MOV may be combined with silicon avalanche diodes (SAD) or selenium cells.
 2. Manufacturers:
 - a. ABB Current Technology SL3 Series
 - b. ASCO Power Technologies 570 Series
 - c. LEA International DS Series
- C. Secondary Distribution Suppressors:
1. For 120/208-volt, 3 phase, 4 wire, type 2 unit.
 - a. Surge current capacity: 60,000/120,000, 100,000/200,000 amps per protection mode/phase
 - b. Nominal Discharge Current (IN): 20 kA.
 - c. Mounting: Refer to the drawings.
 - d. Voltage Protection Rating: Refer to requirements below.
 - e. Components: Minimum component size of 20mm metal thermally protected oxide varistors (MOV).
 2. Manufacturers:
 - a. Square D Surgellogic EM# Series
 - b. Siemens TPS4 or BSPD Series
 - c. Eaton SPD Series
 - d. ABB Current Technology Current Guard Plus
 - e. ASCO Power Technologies 5## Series
 - f. LEA International CFS Series
- D. Secondary Distribution Suppressors - Hybrid:
1. For 120/208-volt, 3 phase, 4 wire, type 2 unit.
 - a. Surge current capacity: 60,000/120,000, 100,000/200,000 amps per protection mode/phase.
 - b. Nominal Discharge Current (IN): 20 kA.
 - c. Mounting: Refer to the drawings.
 - d. Voltage Protection Rating: Refer to requirements below.
 - e. Components: Minimum component size of modular 20mm thermally protected metal oxide varistors (MOV). Modular hybrid combination of 20mm MOV may be combined with silicon avalanche diodes (SAD) or selenium cells.

2. Manufacturers:
 - a. Square D Surgelocic EM# Series
 - b. Siemens TPS4 or BSPD Series
 - c. Eaton SPD Series
 - d. ABB Current Technology SL3 Series
 - e. ASCO Power Technologies 5## Series
 - f. LEA International DS Series

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine equipment for size and type of surge protection device to be used to ensure physical compatibility.
- B. Inspect surge protection device for any signs of physical damage due to shipping or handling before installing surge protection device.

3.2 INSTALLATION

- A. Mounting Location:
 1. The unit shall be installed as close as practical to the panel secondary lugs in accordance with applicable national/Local Electrical Codes and the manufacturer's recommended installation instructions. Connect the unit to the switchboard or panel using a conduit nipple. Flush mount the unit in the front of the switchboard. Mount unit directly across from the breaker or disconnect serving it.
 2. Integral surge protection devices mount between the main and branch circuit breakers.
 3. If internal surge protection device is specified, device shall be installed in a barrier compartment isolated from other components.
- B. Connections:
 1. Conductors from the protected bus to the unit shall not be any longer than necessary avoiding unnecessary bends. The conductor leads shall be twisted together and as short as possible. Connection shall be with mechanical lugs for each phase, neutral, and ground if applicable. Contractor shall provide wire and circuit breakers sized per the approved manufacturer's requirements. Maximum lead length from protected bus to surge protection device shall be per manufacturer's requirements, but no greater than 5'-0".
 2. The surge protection unit shall be isolatable from the electrical distribution system via 3 pole circuit breaker mounted in the switchboard/panelboard or be equipped with a factory supplied integral fused switch or circuit breaker. Single phase 120-volt units shall be hardwired without a disconnecting means.
 3. Neutral and ground shall not be bonded together at secondary panelboard locations.
- C. Additional Locations: Critical Load Protection - Fixed Equipment (120 Vac):
 1. Install Type 3 hard-wired or plug-in surge protection device between each of the following equipment items and its power supply conductors.

- a. Fire alarm master panel
- b. Phone switch
- c. Security system master

D. General:

- 1. Check unit for proper operation of protection and indication under start-up.
- 2. Check unit to ensure all MOVs for each mode of protection are operational. Verify integral fuse links are operational and have not melted.
- 3. Surge suppression devices shall not be installed ahead of the main service disconnect(s).
- 4. Install fuses in all fuse holders and fused disconnects internal to the surge protection unit. Use fuses recommended by the manufacturer to satisfy repetitive UL 1449 operation of the surge suppression unit. External fusing of the surge protection device is not allowed.
- 5. Coordinate location of surge protection device to allow adequate clearances for maintenance.
- 6. Manufacturer service phone number shall be posted on the front of the surge protection device.

END OF SECTION

SECTION 265119 - LED LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires and accessories
- B. Exterior luminaires and accessories
- C. Light-emitting diode (LED) luminaire systems
- D. Emergency exit signs
- E. Lighting poles

1.2 RELATED SECTIONS

- A. The lighting system design includes a combination of luminaire sources, lighting control components, programming sequences, and supplementary components for building and energy code compliance. The design uses performance-based specifications for portions of the lighting system to account for the limitation of comparable product solutions available by competitive manufacturers. The Contractor shall reference related specification sections, plans, schedules, and details prior to submitting pricing, submittals, and installation. The Contractor shall coordinate system component compatibility among various manufacturers and suppliers for a turnkey lighting system. Referenced sections include, but are not limited to, the following:

- 1. 26 09 33 Lighting Control Systems
 - a. Automatic load control relay (ALCR) (individual luminaire - integral) (ALCR3)
- 2. Electrical drawings: Plans, luminaire schedules, lighting control sequence of operations, diagrams, and details.

1.3 REFERENCES

- A. ANSI C78.377 - Specifications for the Chromaticity of Solid State Lighting Products
- B. ANSI C82.16 - Light-Emitting Diode Drivers - Method of Measurement
- C. ANSI C82.77 - Standard for Harmonic Emission Limits and Related Power Quality Requirements for Lighting Equipment
- D. NFPA 70E - National Electrical Safety Code
- E. NEMA SSL1 - Electronic Drivers for LED Devices, Arrays or System
- F. UL 8750 - Light Emitting Diode (LED) Equipment for use in Lighting Products

- G. LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products
- H. LM-80 - Measuring Luminous Flux and Color Maintenance of LED
- I. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary)
- J. UL 924 - Standard for Emergency Lighting and Power Equipment
- K. Project site classification as defined in IESNA RP-33 LZ2.

1.4 SUBMITTALS

- A. Submit product data under provisions of Section 260500.
- B. Basic Requirements of Submittal:
 - 1. Submit product data sheets for luminaires, LED light engines, drivers and poles. Include complete product model number with all options as specified. Submittal shall be arranged with luminaires listed in ascending order, and with each luminaire's, LED light engine, driver, or pole information following luminaire's product data. Failure to organize submittal in this manner will result in the submittal being rejected.
 - 2. Submit lens product data, dimensions and weights if not included in product data sheet submittal.
 - 3. Include outline drawings, support points, weights, and accessory information for each luminaire.
 - 4. Submit manufacturer origin of LED chipset and driver.
 - 5. Submittals to be furnished with digital bookmarks.
- C. LED Lighting - Performance Testing Submittal (when requested by Architect/Engineer):
 - 1. IESNA LM-79: Include photometric report for the latest generation system being furnished. Provide name of independent testing laboratory, report number, date of test, luminaire series/model number, input wattage, and light source specifications.
 - 2. IESNA LM-80: Measuring Lumen Maintenance of LED Light Sources.
- D. LED Lighting - Control Compatibility Submittal:
 - 1. Submit lighting control capability data for each LED luminaire. The submittal shall clearly identify device data proposed by the Contractor and approved by the luminaire manufacturer for dimming, switching, addressable, wireless, and similar control characteristics.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site. Store and protect under provisions of Section 260500.
- B. Protect luminaire finishes, lenses, and trims from damage during storage and installation. Do not remove protective films until construction cleanup within each area is complete.
- C. Handle site lighting poles carefully to prevent breakage and damage to finish.

1.6 WARRANTY

- A. The warranty period begins at the date of Substantial Completion.
- B. LED Light Engines and Drivers:
 - 1. LED Drivers and Dimming Drivers: Five (5) years
 - 2. Light Emitting Diode (LED) Light Engines: Five (5) years
- C. Emergency Lighting Units and Exit Signs:
 - 1. Emergency Lighting Units: Three (3) year, non-prorated
 - 2. Exit Signs: Three (3) year, non-prorated
 - 3. Emergency Unit and Exit Sign Battery: Sealed lead acid or lead calcium cell, requiring no maintenance or replacement for ten (10) years under normal conditions.
- D. Emergency Drivers:
 - 1. Emergency LED Driver: Five (5) years
- E. Automatic Load Control Relay (ALCR): Five (5) year
- F. Pole Finish: Three (3) year warranty of pole color and finish

1.7 REGULATORY REQUIREMENTS

- A. Conform to NFPA 101 for installation requirements.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Lensed Troffers: Provide hinged frames with latches and 0.125-inch thick virgin acrylic lenses. Prismatic lenses shall have depth of no less than 0.080", KSH12 or equal. Other lenses as scheduled.
- B. Recessed Luminaires: Confirm ceiling and wall type and furnish trim and accessories necessary to permit proper installation in each system. Where fire-rated ceiling or wall assemblies are specified, furnish and install listed enclosures around luminaires that maintain the system rating.
- C. Luminaires: Louvers shall be anodized low iridescent specular aluminum with mitered corners and interlocking construction.
- D. Painted reflector surfaces shall have a minimum reflectance of 90%.

2.2 EXTERIOR LUMINAIRES AND ACCESSORIES - GENERAL

- A. Listed for wet or damp location as scheduled. Provide ingress protection (IP) rating when scheduled.

- B. Provide low temperature LED drivers, with reliable starting to -20°F.
- C. Exterior LED luminaires shall contain separate, easily accessible and replaceable Category C surge protection device.

2.3 LIGHT EMITTING DIODE (LED) LUMINAIRE SYSTEMS

- A. Refer to the luminaire schedule for color temperature and minimum color rendering index CRI requirements. Provide light source color consistency by utilizing a binning tolerance within a maximum 3-step McAdam ellipse unless noted otherwise.
- B. LED chip arrays specified as color changing shall have chip colors as noted on the luminaire schedule.
- C. Rated life shall be minimum of 50,000 hours at L70.
- D. LED chips shall be wired so that failure of one chip does not prohibit operation of the remainder of the chip array.
- E. Luminaire delivered lumens is defined as the absolute lumens per the manufacturers LM-79-08 test report.
- F. LED light engine shall have a maximum LLD of 0.85 at 50,000 hours at 25°C ambient.
- G. LED Driver:
 - 1. Solid state driver with integral heat sink. Driver shall have over-heat, short-circuit and overload protection, power factor 0.90 or above and maximum total harmonic distortion of 20%. Driver shall have a voltage fluctuation tolerance of +/- 10%.
 - 2. Drivers shall have dimming capabilities as outlined in the luminaire schedule for each luminaire type. Dimming shall control light output in a continuous curve from 100% to 10% unless noted otherwise.
 - 3. Driver shall have a minimum of 50,000 hours rated life.
 - 4. Driver shall be tested to ANSI C82-16 for input current inrush, total harmonic distortion (THD), and power factor. Driver start time shall be less than 0.5 seconds to 98% of initial light output. Flicker should be less than 30% throughout the operating range.
 - 5. Driver shall be field replaceable without removal of the luminaire.
 - 6. Demonstrate no visible change in light output with a variation of plus or minus 10 percent change in line-voltage input.

2.4 LED EMERGENCY LIGHTING UNITS

- A. Self-Powered Emergency Lighting Units: One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, automatic charger and electronic circuitry. Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
- B. Battery: Maintenance free lead calcium type, with 90, 120 minute capacity to supply the connected lamp load.

- C. Charger: Dual-rate solid state current limiting charger, capable of maintaining the battery in a full-charge state during normal conditions, and capable of recharging discharged battery to full charged within 168 hours. Low voltage disconnect to prevent deep discharge of battery.
- D. LED Lamp Wattage: As scheduled on luminaire schedule.
- E. Remote Lamps: Match LED lamps on unit.
- F. Indicators: Provide lamps to indicate AC ON and RECHARGING. Provide voltmeter.
- G. Provide test switch to transfer unit from normal supply to battery supply.
- H. Electrical Connection: Knockout for conduit connection.
- I. Unit Voltage: Refer to luminaire schedule volts, AC.

2.5 EMERGENCY EXIT SIGNS

- A. Self-Powered Exit Signs: Stencil face, 6-inch high letters, directional arrows as indicated, universal mounting type as indicated on the drawings. One-piece, self-contained unit with sealed, maintenance-free nickel cadmium battery, test switch, AC ON pilot light, automatic charger, and electronic circuitry. Power failure relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

2.6 LIGHTING POLES

- A. Manufacturers:
 - 1. Manufacturer of luminaire (metallic pole)
 - 2. Valmont Poles (metallic pole)
 - 3. U.S. Pole Company (metallic pole)
 - 4. KW Industries (metallic pole)
- B. Metal Poles: Round lighting pole with anchor base.
 - 1. Painted steel poles shall have electrostatic applied polyester powder coated paint finish thermally cured with UV protection. Interior of pole shall be coated with same coating for a minimum of 12" from base plate.
- C. Wind Load: 110 MPH velocity, with 1.14 percent three-second gust factor with luminaires and brackets mounted.
- D. Pole Top: Provide mast arm(s) in array as indicated.
- E. Anchor Bolts: As recommended by pole manufacturer. Provide template, flat washers, lock washers, and hex nuts for each pole. Grout between anchor plate and concrete base with non-shrink grout after pole is plumbed.

- F. Vibration Damper: Canister or snake type second mode vibration damper internal to the metal pole as recommended by pole manufacturer. Provide additional pole top damper for first mode vibration on single-head metal poles where recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Securely fasten luminaires to the listed and labeled ceiling framing member by mechanical means such as bolts, screws, rivets or listed clips identified for use with the type of ceiling framing members. The architectural ceiling framing system may be used in lieu of independent support with prior written approval by the ceiling system manufacturer and Authority Having Jurisdiction (AHJ). Luminaires and wiring installed in fire-rated ceiling assemblies shall be independently supported for all applications.
 - 1. Install recessed flanged luminaires to permit removal from below. Use manufacturer-supplied plaster frames and swing gate supports. Provide independent support as follows:
 - a. Luminaires less than 56 lbs: Provide a minimum of two (2) #12 gauge suspended ceiling support wires located on diagonal corners of the luminaires.
- B. Do not fasten luminaire supports to piping, ductwork, mechanical equipment, or conduit, unless otherwise noted. Support wires shall be tightly wrapped (minimum of three turns within 3 inches of the connection) and sharply bend to prevent vertical movement.
- C. Support suspended or pendant mounted luminaires independent of ceiling grid with adjustable stainless steel aircraft cables or per luminaire schedule mounting requirements. Suspension assembly and anchors shall be capable of supporting 300 pounds dead load at each suspension point.
- D. Support wire used to independently support luminaires, raceways, and wiring systems shall be distinguishable from ceiling support systems by color (field paint), tagging or equivalent means.
- E. Provide seismic bracing of luminaires per IBC Chapter 16. Design pendant luminaires on a component seismic coefficient (C_c) of 0.67. Design vertical supports with a factor of safety of 4.0. Contractor shall verify the Seismic Hazard Exposure Group and Performance Criteria Factor.
- F. Install lamps in lamp holders of luminaires.
- G. Adjust aimable luminaires to obtain lighting levels on objects and areas as directed to obtain desired lighting levels.
- H. Recessed luminaires and other optical accessories shall remain in protective wraps or films until construction in area is complete and area has been cleaned.
- I. Luminaire Pole Bases: Sized and constructed as indicated on the drawings. Project anchor bolts 2 inches minimum above base. Install poles plumb with double nuts for adjustment. Grout around pole anchor base.

- J. Use belt slings or non-chafing ropes to raise and set pre-finished luminaire poles.

3.2 CONSTRUCTION USE OF PROJECT LUMINAIRES

- A. The Contractor shall provide temporary construction lighting per the requirements of Division 1.
- B. The project luminaires shown on the construction documents shall not be used for temporary construction purposes without providing a plan for Owner approval that addresses energy and luminaire operating hours.

3.3 AUTOMATIC LOAD CONTROL RELAYS

- A. Factory or field installation per manufacturer requirements.
- B. Remote Test Switch: Provide connection to remote test switch.
- C. Fire Alarm Override: Provide connection to addressable fire alarm relay.

3.4 EMERGENCY LIGHTING UNITS AND EXIT SIGNS

- A. Install units plumb and level.
- B. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to Substantial Completion. Provide electronic copy of periodic test log form to Owner's Representative. Explain and instruct Owner's Representative of requirements for testing and maintenance. Refer to latest adopted NFPA 101 for testing and logging requirements.

3.5 RELAMPING

- A. Replace failed LED light engine modules or arrays at completion of work.

3.6 ADJUSTING AND CLEANING

- A. Align luminaires and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaires.
- B. Touch up luminaire and pole finish at completion of work.

3.7 OWNER TRAINING

- A. Test emergency lighting equipment for 60 minutes to determine proper operation, prior to Substantial Completion, with the Owner's Representative.
- B. Provide electronic copy of periodic test log form to Owner's Representative. Explain and instruct Owner's Representative of requirements for testing and maintenance. Refer to latest adopted NFPA 101 for testing and logging requirements.

3.8 LUMINAIRE SCHEDULE

- A. As shown on the drawings.

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Permit Set
Jul-10-2026

END OF SECTION

SECTION 270500 - BASIC COMMUNICATIONS SYSTEMS REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Communications Systems Requirements specifically applicable to Division 27 sections, in addition to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the associated drawings govern furnishing, installing, testing and placing into satisfactory operation the Communications Systems.
- B. The Contractor shall furnish and install all new materials as indicated on the drawings, and/or in these specifications, and all items required to make the portion of the Communications Work a finished and working system.
- C. All work will be awarded under a single General Contract. The division of work listed below is for the Contractor's convenience and lists normal breakdown of the work.
- D. Description of Systems include, but are not limited to, the following:
 - 1. Complete Structured Cabling System including, but not limited to:
 - a. Backbone cabling and terminations.
 - b. Horizontal cabling and terminations.
 - c. Information outlets (IOes) including faceplates, jacks and labeling.
 - d. Equipment racks, cable management, and equipment.
 - e. Cabling pathways.
 - f. Grounding and bonding
 - g. Testing
 - 2. Complete Voice Communications Equipment Systems.
 - 3. Complete Audio/Visual Systems.
 - 4. Audio/Visual Systems.
 - 5. Complete Clock Systems.
 - 6. Low Voltage Communications Wiring (less than +120VAC) as specified and required for proper system control and communications.
 - 7. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".

1.3 DIVISION OF WORK BETWEEN ELECTRICAL AND COMMUNICATIONS
CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.
 2. "Electrical Contractor" shall also refer to the Contractor listed in Division 27 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
 3. "Technology Contractor" as referred to herein refers to the Contractors listed in Division 27 of this Specification.
 4. Low Voltage Technology Wiring: The wiring (less than 120VAC) associated with the Technology Systems, used for analog and/or digital signals between equipment.
 5. Telecommunications/Technology Rough-in: Relates specifically to the backboxes, necessary plaster rings and other miscellaneous hardware required for the installation and mounting of the telecommunications/technology outlet. Rough-in shall include conduit from the information outlet backbox to above the lay-in ceiling. Where surface mounted backboxes are required, conduit shall be routed to above the lay-in ceiling.
- C. General:
1. The purpose of these specifications is to outline typical Electrical and Technology Contractor's work responsibilities as related to technology systems including telecommunications rough-in, conduit, power wiring, and low voltage communications and technology wiring. The prime contractor is responsible for all divisions of work.
 2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the technology drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the technology drawings but required for the successful operation of the systems shall be the responsibility of the Technology Contractor and included in the Contractor's bid.
 3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of technology systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Technology Contractor has convened to determine the exact location and requirements of the installation.

4. This Contractor shall establish electrical and technology utility elevations prior to fabrication and installation. The Technology Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Lighting Fixtures
 - b. Gravity Flow Piping, including Steam and Condensate
 - c. Sheet Metal
 - d. Sprinkler Piping and other Piping
 - e. Conduit and Wireway
 - f. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.

E. Technology Contractor's Responsibility:

1. Assumes all responsibility for the low voltage technology wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."
3. Assumes all responsibility for providing and installing all ladder rack and other cable management hardware (as defined herein).
4. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of technology equipment which is required to be bonded to the technology bonding system.
5. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

A. Definitions:

1. Coordination Drawings: A compilation of the pertinent layout and system drawings that show the sizes and locations, including elevations, of system components and required access areas to ensure that no two objects will occupy the same space.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.

- b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.
 - e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
 2. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

B. Participation:

1. The contractors and subcontractors responsible for work defined above shall participate in the coordination drawing process.
 2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
 3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

C. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:
 - 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).

2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

D. General:

1. Coordination drawing files shall be made available to the Architect/Engineer and Owner's Representative. The Architect/Engineer will only review identified conflicts and give an opinion, but will not perform as a coordinator.
2. A plotted set of coordination drawings shall be available at the project site.
3. Coordination drawings are not shop drawings and shall not be submitted as such.
4. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in his/her bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
5. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
6. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
7. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
8. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
9. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.
 - a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
10. Complete the coordination drawing process and obtain signoff of the drawings by all contractors prior to installing any of the components.
11. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination.

12. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Telecommunications Structured Cabling System Standards:

1. All work and equipment shall conform to the most current ratified version of the following published standards unless otherwise indicated that draft standards are to be followed:
 - a. ANSI/NECA/BICSI 568 - Standard for Installing Commercial Building Telecommunications Cabling
 - b. ANSI/TIA-568-0-D - Generic Telecommunications Cabling for Customer Premises
 - 1) 1-D - Commercial Building Telecommunications Standard
 - 2) 2-D - Balanced Twisted-Pair Telecommunications Cabling and Components Standard
 - 3) 3-D - Optical Fiber Cabling Components Standard
 - 4) 4-D - Broadband Coaxial Cabling and Components Standard
 - c. ANSI/TIA-569-E - Telecommunications Pathways and Spaces
 - d. ANSI/TIA-606-C - Administration Standard for Commercial Telecommunications Infrastructure
 - e. ANSI/TIA-607-D - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

B. Compliance with Codes, Laws, Ordinances:

1. Conform to all requirements of the City of Port Angeles Codes, Laws, Ordinances and other regulations having jurisdiction.
2. Conform to all published standards of The Peninsula Housing Authority.
3. In the event there are no local codes having jurisdiction over this job, the 2020 National Electrical Code shall be followed.
4. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.
5. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accordance with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with the proposal, a separate price required to make the system shown on the drawings comply with the codes and regulations.
6. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.

C. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
3. Pay all applicable charges for such permits or licenses that may be required.
4. All equipment and materials shall be as approved or listed by the following (unless approval or listing is not applicable to an item by all acceptable manufacturers):
 - a. Factory Mutual
 - b. Underwriters' Laboratories, Inc.

D. Service Provider Requirements:

1. Secure from the telecommunications service provider all applicable requirements.
2. Comply with all service provider requirements.

E. Examination of Drawings:

1. The drawings for the technology systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and the exact routing of cabling to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.
3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.
5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

F. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

1.6 WEB-BASED PROJECT SOFTWARE

- A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.

- B. The web-based project software shall include, at a minimum, the following features:
construction schedule, submittals, RFIs, ASIs, construction change directives, change orders,
drawing management, specification management, payment applications, contract modifications,
meeting minutes, construction progress photos.
- C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will
be provided from the start of the project through the completion of the warranty phase.
- D. At project completion, provide digital archive of entire project in format that is readable by
common desktop software applications in format acceptable to Architect/Engineer. Provide
data in locked format to prevent further changes.

1.7 SUBMITTALS

Referenced Specification Section	Submittal Item	Coordination Drawings
27 05 03	Through Penetration Firestopping	
27 05 26	Communications Bonding	
27 05 28	Interior Communications Pathways	Yes
27 05 43	Exterior Communications Pathways	Yes
27 05 53	Identification for Communication Systems	
27 11 00	Communication Equipment Rooms	Yes
27 13 00	Backbone Cabling Requirements	
27 13 43.53	Television Distribution System	
27 15 00	Horizontal Cabling Requirements	
27 17 10	Testing	
27 41 00	Professional Audio Video System	Yes
27 51 13	Paging Systems	Yes
27 51 19	Sound Masking System	Yes
27 51 23.50	Integrated Communication System	
27 52 23	Nurse Call	Yes
27 52 23.01	Wireless Nurse Call	Yes
27 53 13	Central Clock System	
27 53 13.13	Wireless Clock System	
27 52 23.01	Wireless Nurse Call	Yes
27 53 19	Distributed Antenna System (DAS)	

- A. General Submittal Procedures: In addition to the provisions of Division 1, the following are
required:
 - 1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Description of items submitted and relevant specification number

- e. Notations of deviations from the contract documents
 - f. Other pertinent data
- 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Description of item submitted (using project nomenclature) and relevant specification number
 - g. Notations of deviations from the contract documents
 - h. Other pertinent data
 - i. Provide space for Contractor's review stamps
- 3. Composition:
 - a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
- 4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
- 5. Contractor's Approval Stamp:
 - a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Only approved manufacturers are used.
 - 2) Addenda items have been incorporated.
 - 3) Catalog numbers and options match those specified.
 - 4) Performance data matches that specified.
 - 5) Electrical characteristics and loads match those specified.

- 6) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 7) Dimensions and service clearances are suitable for the intended location.
 - 8) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 9) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
 8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
 9. Reproduction of contract documents alone is not acceptable for submittals.
 10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
 11. Submittals not required by the contract documents may be returned without review.
 12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
 13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
 14. Contractor's responsibility for errors, omissions, or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
 15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
 - a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
 16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

B. Electronic Submittal Procedures:

1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.
2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 27 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 27 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.8 CHANGE ORDERS

- A. Change order work shall not proceed until authorized.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.
- B. Store materials on the site to prevent damage.
- C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.

1.10 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.11 WARRANTY

- A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 27 may require additional warranty requirements for specific equipment or systems.

- B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.
- C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.12 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 1 of these specifications.

1.13 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.
- B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.
- D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

- 2.1 Refer to individual sections.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or his or her employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and his or her personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 260533. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.
- B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.
- C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.
- D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

- A. General:

1. Refer to specific Division 27 sections for further requirements.
2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.
5. All communications cable tests that fail, including those due to excessive cabling lengths, shall be remedied by the Contractor without cost to the project.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that their representative can be present if desirable.
- C. Operating Instructions:
 1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the Communications Systems.

3.5 SYSTEM STARTING AND ADJUSTING

- A. The Communications Systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.
- B. All operating conditions and control sequences shall be simulated and tested during the start-up period.
- C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of troubleshooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.6 RECORD DOCUMENTS

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.
- C. Record actual routing of all conduits sized 2" or larger.
- D. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.
- E. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc.) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All telecommunications jacks are installed in the faceplates.
4. All telecommunications cabling is pulled and at least 90% of all jacks have been terminated at the jack and at the telecom room.
5. Telecommunications testing is in progress and at least 50% of testing has been completed.
6. Telecommunications labeling has been provided on at least 50% of each type of component requiring a label.
7. All telecommunications related grounding is complete.
8. All Audio/Visual components, cabling and control systems are installed, programmed and operational.
9. All overhead or integrated paging systems, including speakers, back boxes, cabling, and power supplies, and all headend equipment is installed, programmed and operational.
11. All access control system equipment, including card readers, conduits, cabling, electronic locks, controllers and all headend equipment, is installed, programmed and operational.

Prime Contractor: _____

By: _____

Requested Observation Date _____

Today's Date: _____

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

TELECOMMUNICATIONS - PROOF OF CERTIFICATION

There are specific Contractor qualification requirements for this project as defined in Section 270500, which may include Manufacturer Certification and RCDD or CNIDP credentials. This Proof of Certification document, and the supporting documentation require herein, is required to be submitted at the time of bid to show compliance with the requirements of 27 05 00.

Statement of Compliance:

The named Contractor's base bid is a structured cabling solution from the connectivity manufacturer: _____. Named Contractor is trained and certified, under the named manufacturer's formal certification program to provide and install all materials and work required by this project. Further, said Contractor is authorized, by the named manufacturer, to offer all product, labor and system assurance warranties required for this project by these contract documents.

The certification of this named manufacturer is valid, current and in effect as of the bid day of this project, the _____ day of _____, 20____.

The named Contractor is not employing any other sub-contractor on the telecommunications portion of this project that does not also meet this certification requirement.

Contractor Company Name: _____

Authorized Representative: (print) _____

Date: _____

Manufacturer Certification Number (if any): _____

If this project requires RCDD certification, complete the following:

RCDD or CNIDP Name: _____

RCDD #: _____ Expiration: _____

Submit the following with the bid:

This form.

Proof of Manufacturer Certification indicated above.

Proof of RCDD or CNIDP status.

END OF SECTION

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SECTION 270526 - COMMUNICATIONS BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Bonding Conductors
- B. Bonding Connectors
- C. Grounding Busbar (PBB and SBB)

1.2 RELATED WORK

- A. Section 260533 - Conduit and Boxes
- B. Section 260536 - Cable Trays
- C. Section 260513 - Wire and Cable
- D. Section 260526 - Grounding and Bonding
- E. Section 270500 - Basic Communications Systems Requirements
- F. Section 270528 - Interior Communication Pathways
- G. Section 270553 - Identification for Communication Systems

1.3 QUALITY ASSURANCE

- A. Refer to Section 270500 for relevant standards.

1.4 REFERENCES

- A. ANSI/TIA-607-D - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- B. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- C. NFPA 70 - National Electrical Code with 2020 Washington Amendments
- D. UL 467 - Grounding and Bonding Equipment

1.5 SUBMITTALS

- A. Submit product data and shop drawings under provisions of Section 270500 and Division 1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site under the provisions of Section 270500.
- B. Store and protect products under the provisions of Section 270500.
- C. Contractor shall exercise care to prevent corrosion of any products prior to installation. Corroded products shall not be acceptable for use on this project.

1.7 SYSTEM DESCRIPTION

- A. This section describes the requirements for the furnishing, installation, adjusting, and testing of a complete turnkey communications bonding system, including connection to the electrical ground grid.
- B. Performance Statement: This specification section and the accompanying drawings are performance based, describing the minimum material quality, required features, operational requirements, and performance of the system. These documents do not convey every wire that must be installed, every equipment connection that must be made, or every feature and function that must be configured. Based on the equipment constraints described and the performance required of the system as presented in these documents, the Contractor is solely responsible for determining all components, devices, equipment, wiring, connections, and terminations required for a complete and operational system that provides the required performance.
- C. This document describes the major components of the system. All additional hardware, subassemblies, supporting equipment, and other miscellaneous equipment required for complete, proper system installation and operation shall be provided by the Contractor.
- D. Basic System Requirements:
 - 1. The bonding system shall include, but not be limited to, the following major components:
 - a. Telecommunications Bonding Conductor (TBC)
 - b. Primary Bonding Busbar (PBB)
 - c. Telecommunications Bonding Backbone (TBB)
 - d. Bonding Conductor(s) (BC)
 - e. Bonding Connectors
 - f. Bonding system labeling and administration as defined in Section 270553.

1.8 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 270500.
- B. Provide final system block diagram showing any deviations from approved shop drawing submittal.
- C. Provide floor plans that document the following:
 - 1. Actual locations of system components, devices, and equipment.

2. Actual conductor routing.
 3. Actual system component, device, equipment, and conductor labels.
- D. Provide statement that system checkout test, as outlined in the approved shop drawing submittal, is complete and test results were satisfactory.

PART 2 - PRODUCTS

2.1 BONDING CONDUCTORS

A. Bare Copper:

1. Annealed uncoated stranded conductor.
2. Minimum size 6 AWG.

B. Insulated Copper:

1. Annealed uncoated stranded conductor.
2. Insulation:
 - a. PVC insulation with nylon outer jacket.
 - b. Rated at 600 volts.
 - c. Green.
3. Minimum size 6 AWG.

C. All bonding conductors shall be listed and recognized by a nationally recognized testing laboratory as being suitable for the intended purpose and for installation in the space in which they are installed.

D. Bonding Conductor Sizing:

1. All communications bonding system conductors shall be sized by length as follows:

Length Linear ft (m)	Size (AWG)
Less than 13 (4)	6
14 - 20 (4 - 6)	4
21 - 26 (6 - 8)	3
27 - 33 (8 - 10)	2
34 - 41 (10 - 13)	1
42 - 52 (13 - 16)	1/0
53 - 66 (16 - 20)	2/0
67 - 84 (20 - 26)	3/0
85 - 105 (26 - 32)	4/0
106 - 125 (32 - 38)	250 kcmil
126 - 150 (38 - 46)	300 kcmil
151 - 175 (46 - 53)	350 kcmil

Length Linear ft (m)	Size (AWG)
176 - 250 (53 - 76)	500 kcmil
251 - 300 (76 - 91)	600 kcmil
Greater than 301 (91)	750 kcmil

2.2 BONDING CONNECTORS

A. Acceptable Types:

1. Two-hole compression lug
2. Irreversible compression

B. Connectors shall comply with and UL 467 and be listed for use for specific types, sizes, and combinations of conductors and connected items.

2.3 GROUNDING BUSBAR (PBB AND SBB)

A. Features:

1. Wall-mount configuration.
2. Listed and recognized by a nationally recognized testing laboratory as being suitable for intended purpose.
3. Hole patterns compliant with BICSI recommendations and ANSI-J-STD-607-D standards.

B. Specifications:

1. Material: Electrolytic tough pitch copper bar with tin plating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Bonding Requirements:

1. The communications bonding system shall be a complete system. Contractor shall furnish and install all necessary miscellaneous components, devices, equipment, material, and hardware, including, but not limited to, lock washers, paint-piercing washers, hex nuts, compression lugs, insulators, mounting screws, lugs, etc., to provide a complete system.
2. A licensed electrician shall perform all bonding.
3. Comply with the manufacturer's instructions and recommendations for installation of all products.

B. Main Cross Connect and Service Entrance Room Bonding Requirements:

1. Locate the PBB in the service entrance room unless otherwise noted on the drawings.

- C. Where the service entrance cable contains a shield, the shield(s) shall be bonded to the PBB using manufacturer-approved hardware.
- D. Primary Bonding Busbar (PBB) Requirements:
 - 1. Install PBB such that it is insulated from its support with a minimum 2" standoff.
 - 2. Bond the PBB to the electrical service ground via the TBC.
 - a. A minimum of 1 foot separation shall be maintained between the TBC and any DC power cables, switchboard cable, or high frequency cables.
 - 3. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays, ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the PBB, shall be bonded to the PBB.
- E. Secondary Bonding Busbar (SBB) Requirements:
 - 1. Install SBB such that it is insulated from its support with a minimum 2" standoff.
 - 2. Bond each SBB to the PBB via the TBB.
 - a. A minimum of 1 foot separation shall be maintained between the TBB and any DC power cables, switchboard cable, or high frequency cables.
 - b. The TBB may be routed from PBB to SBB or as a radial feed to each SBB as the layout requires.
 - 3. If more than one (1) SBB is provided within the same room or space, they shall all be bonded together via a BC the same size as the TBB.
 - 4. All metallic continuous cable pathways, including, but not limited to, cable trays, basket trays, ladder racks, raceways, conduits, conduit sleeves, and fire-rated cable pathway devices, located within the same room or space as the SBB, shall be bonded to the SBB.
- F. Metallic Interior Communication Pathway Bonding Requirements:
 - 1. All metallic interior continuous communication cable pathways, including, but not limited to, conduit, conduit sleeves, fire-rated cable pathway devices, cable tray, basket tray, and ladder rack, shall be bonded to the communications bonding system.
- G. Bonding Conductor Requirements:
 - 1. Bonding conductors shall be green or marked with a distinctive green color.
 - 2. Bonding conductors shall be routed parallel and perpendicular to building structure along shortest and straightest paths possible. Number of bends and changes in direction should be minimized. Install and secure conductors in a manner that protects the conductors from impact and from physical or mechanical strain or damage.
 - 3. All bonding conductors shall be labeled in accordance with the requirements of Section 270553. In addition to the requirements of Section 270553:
 - a. Labels shall be nonmetallic.
 - b. Labels shall be printer-generated.

- c. Labels shall be located on conductors as close as is practical to their point of termination in a readable position.
 - 4. Interior water piping is not acceptable for use as a communications bonding system bonding conductor.
 - 5. Metallic cable shields are not acceptable for use as communications bonding system bonding conductors.
- H. Bonding Connection Requirements:
- 1. Make all connections in accessible locations to facilitate future inspection and maintenance.
 - 2. Communications bonding system connections shall be made using exothermic welding, two-hole compression lugs, or other irreversible compression-type connections. The use of 1-hole lugs is prohibited, except for connections to a rack-mount telecommunications ground bar. Connection hardware shall be listed for grounding and bonding. Sheet metal screws shall not be used to make communications bonding system connections.
 - 3. Thoroughly clean conductors before installing lugs and connectors.
 - 4. Install and tighten all connectors in accordance with manufacturer's instructions, using the appropriate purpose-designed tool(s) recommended by the manufacturer for that purpose. Exercise care not to tighten connectors beyond manufacturer's recommendations.
 - 5. Where necessary, remove paint and/or use paint-piercing washers to provide proper electrical bond at all connections.
 - 6. All bonding connections shall be coated in anti-oxidant joint compound that is purpose-designed and purpose-manufactured for that use. Anti-oxidant joint compound shall be applied in accordance with manufacturer's recommendations and instructions.
 - 7. All installed connectors on conductors installed in damp locations shall be sealed with dielectric grease and then covered with heat shrink tubing to protect against moisture ingress. Applied heat shrink tubing shall overlap conductor's outer jacket a minimum of four (4) inches past connector and be installed in accordance with manufacturer's recommendations and instructions.

3.2 FIELD QUALITY CONTROL

- A. Field inspection shall be performed under provisions of Section 270500.
- B. Where these specifications require a product or assembly without the use of a brand or trade name, provide a product from a reputable manufacturer that meets the requirements of the specifications.

3.3 ADJUSTING

- A. Adjust work under provisions of Section 270500.
- B. Contractor shall make any and all adjustments to the communications bonding system necessary to ensure that the installed system meets all requirements listed herein. Modifications necessary to comply with listed requirements or to provide specified performance shall be completed by the Contractor at no additional cost to the Owner.

3.4 TESTING

- A. Measure and document resistance to ground at PBB, each SBB, each RBB, and each electrical distribution panel bonded to the PBB or a SBB.
 - 1. Measurements shall be made not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage, and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by the fall-of-potential method according to IEEE 81.
 - 2. The preferred measured resistance to ground for the grounding electrode system is 5 ohms or less. Refer to Division 26 for exact project requirements.
 - 3. Under no circumstances shall any point in the communications bonding system have a lower resistance to ground than that of nearby electrical distribution system components that it is bonded to.
- B. Measure and document voltage between screen of installed and terminated ScTP, FTP, and/or SSTP horizontal cables and electrical ground of electrical outlet(s) serving the information outlet location area.
- C. Include measurement documentation in test data submitted at completion of project under provisions of Section 271710.

END OF SECTION

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SECTION 270528 - INTERIOR COMMUNICATION PATHWAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, tests and services to install complete wire mesh support systems, conduits, sleeves, innerduct, etc. for an interior cabling plant as shown on the drawings.
- B. Wire mesh support systems are defined to include, but are not limited to straight sections of continuous wire mesh, field formed horizontal and vertical bends, tees, drop outs, supports and accessories.

1.2 RELATED WORK

- A. Section 260533 - Conduit and Boxes
- B. Section 260527 - Supporting Devices
- C. Section 270500 - Basic Communications Systems Requirements
- D. Section 270526 - Communications Bonding

1.3 QUALITY ASSURANCE

- A. Refer to Section 270500 for requirements.

1.4 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. NEMA VE 2-2000 - Cable Tray Installation Guidelines

1.5 SUBMITTALS

- A. Under the provisions of Section 270500 and Division 1, prior to the start of work the Contractor shall submit:
 - 1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
 - 2. Manufacturer's installation instructions.
- B. Coordination Drawings:
 - 1. Include cable tray and conduit sleeve layout in composite electronic coordination files. Refer to Section 270500 for coordination drawing requirements.

1.6 DRAWINGS

- A. The drawings, which constitute a part of these specifications, indicate the general route of the wire mesh support systems, conduit, sleeves, etc. Data presented on these drawings is as accurate as preliminary surveys and planning can determine until final equipment selection is made. Accuracy is not guaranteed and field verification of all dimensions, routing, etc., is required.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Refer to Section 26 05 33 for conduit requirements for this project.

2.2 WIRE MESH CABLE TRAY - OVERHEAD

- A. General: Provide wire mesh of types and sizes indicated on drawings; with connector assemblies, clamp assemblies, connector plates, splice plates and splice bars. Provide drop-out fittings where cable tray is installed over equipment racks. Two drop-out fittings shall be installed over each rack so that a controlled radius is maintained into each side of every equipment rack that cable tray passes over. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features.
- B. Wire mesh shall be made of high strength steel wires and formed into a standard 2 inch by 4-inch wire mesh pattern with intersecting wires welded together. All wire ends along wire mesh sides (flanges) shall be rounded during manufacturing for safety of cables and installers.
- C. Materials and Finishes: Material and finish specifications for each wire mesh type are as follows:
 - 1. Electro-Galvanized Zinc: Straight sections shall be made from steel meeting the minimum mechanical properties of ASTM A510 and shall be electro-plated zinc in accordance with ASTM B633 SC2.
- D. Type of Overhead Wire Mesh Support System:
 - 1. All straight section longitudinal wires shall be straight (with no bends).
 - 2. Wire mesh supports shall be trapeze hangers or wall brackets. Center hung supports will not be allowed.
 - 3. Trapeze hangers are to be supported by 1/4 inch or 3/8-inch diameter rods.
 - 4. Provide manufacturer approved grounding clips as necessary for continuous grounding of tray.
 - 5. Basis of Design
 - a. nVent Caddy WBTray "Shaped" WBT#x# S Series
 - 6. Additional acceptable manufacturers:

- a. Cooper B-Line "Flextray"
- b. Cablofil, Inc,
- c. Wiremold "Fieldmate"

2.3 CABLE HANGERS AND SUPPORTS

- A. Provide a non-continuous cable support system suitable for use with open cable.
- B. Cable Hooks:
 - 1. Construction: Flat bottom design with a minimum cable bearing surface of 1-5/8". Hooks shall have 90-degree radius edges.
 - 2. All cable hook mounting hardware shall be recessed to prevent damage to cable during installation. Installed cabling shall be secured using a cable latch retainer that shall be removable and reusable.
 - 3. Finish: Pre-galvanized steel, ASTM A653 suitable for general duty use.
- C. Cable Hangers:
 - 1. Adjustable, non-continuous cable support slings for use with low voltage cabling.
 - 2. Steel and woven laminate construction, rated for indoor non-corrosive use. Laminate material shall be suitable for use in plenum environments.
 - 3. Sling length shall be adjustable to a capacity of 425 4-pair UTP cables.
 - 4. Cabling hanger load limit shall be 100 lbs per foot.
 - 5. Manufacturer:
 - a. Erico Caddy
 - b. CableCat CAT425
 - c. Arlington Fittings T1 Series
 - d. Or approved equal.

PART 3 - EXECUTION

3.1 CABLE HOOK SUPPORT SYSTEM

- A. In areas where cabling is not supported by cable tray, ladder rack, enclosed wireway or installed in conduit, such cabling shall be supported by an approved cable hook support system.
- B. Refer to manufacturer's requirements for allowable fill capacity for selected cable hook. In no case shall a 40% fill capacity be exceeded.
- C. Cable hooks shall be securely mounted per manufacturer's instructions. In no case shall the side-to-side travel of any cable hook exceed 6".
- D. Cable hooks shall be selected based on the contractor's cable routing. Hooks shall be capable of supporting a minimum of 30 pounds with a safety factor of 3.
- E. J-hook support spans shall be based on the smaller of the manufacturer's load ratings and code requirements. In no case shall horizontal spans exceed 5 feet and vertical spans exceed 4 feet.

- F. The resting and supporting of cabling on structural members shall not meet the requirements for cabling support specified herein.
- G. The use of tie-wraps or hook and loop type fasteners is specifically prohibited as a substitute for cable hooks specified herein.

3.2 CONDUIT AND CABLE ROUTING

- A. Refer to Section 260533 for additional requirements.
- B. All conduits shall be reamed and shall be installed with a nylon bushing.
- C. Maintain appropriate conduit bend radius at all times. For conduits with an internal diameter of less than 2", maintain a bend radius of at least 6 times the internal diameter. For conduits with an internal diameter 2" or greater, maintain a bend radius of at least 10 times the internal diameter.
- D. No conduit or sleeve containing more than two (2) cables shall exceed 40% fill ratio, regardless of length.
- E. Any conduit exceeding 90' in length or containing more than two (2) 90-degree bends shall contain a pull box sized per ANSI/TIA/EIA 569 requirements.
 - 1. A separate pull box is required for each 90' (or greater) length section.
 - 2. A separate pull box is required after any two (2) consecutive 90-degree bends.
 - 3. Pull box shall be located in an area that maintains accessibility of box, including the ability to remove box lid without removal or relocation of any other materials.
- F. Any conduit with bends totaling 90 degrees or more shall have the fill capacity derated by 15% for each 90 degrees of cumulative bend.
- G. Cables installed in any conduits that do not meet the above requirements shall be replaced at the Contractor's expense, after the conduit condition has been remedied.

3.3 WIRE MESH TRAY INSTALLATION

- A. Install wire mesh as indicated; in accordance with recognized industry practices (NEMA VE-2 2000), to ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70B and NECA's "Standards of Installation" pertaining to general electrical installation practices.
- B. Cable tray sections shall be grounded in accordance with manufacturer's recommendations using manufacturer approved hardware. Painted sections shall have paint removed at each grounding attachment point.
- C. Test wire mesh support systems to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. Refer to NFPA 70B, Chapter 18, for testing and test methods.

- D. A minimum of 12" of working clearance shall be maintained above the wire mesh support system to allow installation and maintenance of the cables within the tray. This minimum access may be reduced only where equipment crosses the tray at an angle.
- E. Provide sufficient space encompassing wire mesh to permit access for installing and maintaining cables.
- F. Tray shall be continuous from source to termination and shall not change elevation, direction or otherwise expose cables to travel without 2" x 4" mesh support.
- G. Overhead Tray shall be field cut using only manufacturer approved cutting device and methods. Cutting device shall be an offset blade bolt cutter; standard bolt cutters are specifically not permitted.
- H. Bends in overhead tray shall be accomplished by utilizing manufacturer's cutting guides.
- I. All splices of tray shall be provided with splice washers, bars or springs as recommended by the manufacturer.

3.4 ATTACHMENT TO METAL DECKING

- A. Where supports for cable trays and cable hook systems attach to metal roof decking, excluding concrete on metal decking, do not exceed 25 lbs. per hanger and a minimum spacing of 2'-0" on center. This 25-lb. load and 2'-0" spacing include adjacent electrical and mechanical items hanging from deck. If the hanger restrictions cannot be achieved, supplemental framing off steel framing will need to be added.

END OF SECTION

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SECTION 270553 - IDENTIFICATION FOR COMMUNICATION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the identification requirements relating to the structured cabling system and its termination components and related subsystems.
- B. Identification and labeling.

1.2 RELATED WORK

- A. Section 270500 - Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

- A. Refer to Section 270500 for relevant standards.

1.4 SUBMITTALS

- A. Under the provisions of Section 270500 and Division 1, prior to the start of work the Contractor shall submit:
 - 1. Documentation of labeling scheme.

PART 2 - PRODUCTS

2.1 LABELING

- A. Adhesive labels shall meet the requirements of UL 969 (Ref D-16) for legibility, defacement and adhesion. Exposure requirements of UL 969 for indoor and outdoor (as applicable) use shall be met.
- B. Insert labels shall meet the requirements of UL 969 for legibility, defacement and general exposure.
- C. Labeling shall be consistent for all common elements in the project. This consistency shall include label size, color, typeface and attachment method.
- D. Labels incorporating bar codes shall be either Code 39 conforming to USS-39 or Code 128 conforming to USS-128.
 - 1. All Code 39 bar codes shall have a ratio between 2.5:1 and 3.0:1. Provide a minimum "quiet zone" of 0.25" on each side of the bar code.
 - 2. A descriptive label for reading by personnel shall be provided with any bar code. Bar codes by themselves are not acceptable.

- E. Tag all CAT 3, CAT 5E, CAT 6, and optical fiber cables at both the Communications Equipment Room and the information outlets using the following alphanumeric labeling system:
1. (Room Number) - (Outlet Number) - (Jack Number) - (Use).
 2. "Outlet Number" shall start with 1 in each room, with additional outlets in each room numbered sequentially.
 3. "Jack Number" shall start with 1 for the upper left jack in each outlet, increasing sequentially from left to right and top to bottom across the outlet face.
 4. "Use" shall be designated by the following:
 - a. "V" for voice (RJ-45)
 - b. "D" for data (RJ-45)
 - c. "C" for video (coax)
 - d. "M" for multimedia retrieval (coax)
 - e. "S" for speaker (RCA)
 5. Example #1: "106-1-1-V" indicates the top left voice jack in outlet #1 in Room 106.
 6. Example #2: "109-3-4-D" indicates the bottom right data jack (assuming a 4-port faceplate) in outlet #3 in Room 109.

2.2 DOCUMENTATION/AS-BUILTS/RECORDS

A. General:

1. Upon completion of the installation, the Contractor shall submit as-builts per the requirements of Section 270500 and Division 1. Documentation shall include the items detailed in the subsections below.
2. All documentation, including hard copy and electronic forms shall become the property of the Owner.

B. Record Drawings:

1. The drawings are to include cable routes and outlet locations. Outlet locations shall be identified by their sequential number as defined elsewhere in this document. Numbering, icons and drawing conventions used shall be consistent throughout all documentation provided.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND LABELING

A. Cable Labeling:

1. Horizontal cables shall be labeled at each end.

- a. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color may include blue with a white stripe to indicate the higher performance class station cabling.
2. Backbone cables shall be labeled at each end.
 - a. Provide additional cable labeling at each manhole and pull box.
 - b. Cables that are routed through multiple pathway segments shall contain reference to all pathway segments in the pathway linkage field.
 - c. Cables that differ only by performance class shall have a suitable marking or label to indicate the higher performance class. For example, station cabling utilizing the blue color, may include blue with a white stripe to indicate the higher performance class station cabling.
- B. Information Outlet Labeling: Tag all voice and data jacks as defined herein.
- C. Grounding/Bonding Labeling:
 1. The PBB shall be labeled "PBB." There shall be only one PBB in the facility.
 2. Label all TBB conductors connecting to the PBB with a unique label, located at both ends of the TBB.
 3. Each SBB shall be labeled with a unique label.
 4. All TBB conductors connecting to the SBB shall be labeled uniquely at each end of the cable.

END OF SECTION

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SECTION 270800 - COMMISSIONING OF COMMUNICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Description
- B. Responsibilities
- C. Related Work
- D. Test Equipment

1.2 DESCRIPTION

- A. The purpose of this section is to specify Division 27 responsibilities in the commissioning process.
- B. The systems to be commissioned are listed in Section 019100.
- C. Commissioning requires the participation of the Division 27 Contractor to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 019100. Division 27 Contractor shall be familiar with all parts of Section 019100 and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.3 RESPONSIBILITIES

- A. Refer to Section 019100.

1.4 RELATED WORK

- A. Specific commissioning requirements are given in the following sections of these specifications. All the following sections apply to the Work of this section.
 - 1. Section 017823 - Operations and Maintenance
 - 2. Section 017900 - Demonstration and Training
 - 3. Section 019100 - Commissioning
 - 4. Section 210800 - Commissioning of Fire Suppression
 - 5. Section 220800 - Commissioning of Plumbing
 - 6. Section 230800 - Commissioning of HVAC
 - 7. Section 260800 - Commissioning of Electrical
 - 8. Section 280800 - Commissioning of Electronic Safety and Security

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The Contractor shall provide all test equipment necessary to fulfill the testing requirements of this Division. This equipment includes, but is not limited to, the following:
 - 1. Digital multimeter capable of measuring voltage (AC/DC), current, and resistance.
 - 2. Power quality and energy analyzer capable of capturing waveform (3 phase) and data recording.
- B. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the related specifications. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.
- C. Refer to Section 019100 for additional Division 27 requirements.

PART 3 - EXECUTION

- A. Refer to Section 019100.

END OF SECTION

SECTION 271300 - BACKBONE CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the products and execution requirements relating to furnishing and installing backbone communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of both optical fiber and/or copper cabling.

1.2 RELATED WORK

- A. Section 270500 - Basic Technology Systems Requirements.
- B. Section 271500 - Horizontal Cabling Requirements.
- C. Section 271720 - Structured Cabling System Warranty.

1.3 QUALITY ASSURANCE

- A. Refer to Section 270500 for relevant standards.

1.4 SUBMITTALS

- A. Under the provisions of Section 270500 and Division 1, prior to the start of work the Contractor shall submit:
 - 1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
 - 2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The basis of design is listed herein. Refer to Section 271720 for additional acceptable manufacturers.

2.2 OPTICAL FIBER BACKBONE - INSIDE PLANT

- A. Multimode (MM)/Singlemode (SM):
 - 1. This optical fiber backbone cable shall be suitable for installation in building riser systems, in conduit, in cable tray and/or in innerduct.
 - 2. Optical fiber cable materials shall be all dielectric (no conductive material).

3. Optical fiber cable shall carry an OFNR (optical fiber non-conductive riser) or OFNP (optical fiber non-conductive plenum) rating. Refer to Section 270500 for project requirements.
 4. Outer Sheath: The outer sheath shall be marked with the manufacturer's name, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet.
 5. Temperature Range:
 - a. Storage: -40C to +70C (no irreversible change in attenuation).
 - b. Operating: -40C to +70C.
 6. Humidity Range: 0% to 100%.
 7. Maximum Tensile Strength (greater than or equal to 12 fibers):
 - a. During Installation: 1332 N (300 lb. force) (no irreversible change in attenuation).
 - b. Long-Term: 600 N (135 lb. force).
 8. Maximum Tensile Strength (less than or equal to 6 fibers):
 - a. During Installation: 1000 N (225 lb. force) (no irreversible change in attenuation).
 - b. Long-Term: 100 N (67 lb. force).
 9. Bending Radius:
 - a. During Installation: 20 times cable diameter.
 - b. No Load: 10 times cable diameter.
- B. Optical fiber cables suitable for installation in multiple environments (e.g., underground duct and building risers) may be used at the Contractor's option. Such optical fiber cables shall meet all specifications noted above for cables designated for each environment through which the optical fiber cable shall pass.
- C. Basis of Design (OM3 Multimode):
1. Hubbell OM3 (HFCD15xxx series).
 2. Additional acceptable manufacturers.
 - a. Corning
- 2.3 COPPER BACKBONE - INSIDE PLANT
- A. CAT 6 Backbone Cable:
1. CAT 6 backbone cables shall meet all the specifications detailed in Section 271500.
 2. Color-coding of the pairs shall be per industry standards for 25-pair cables.
 3. This CAT 6 backbone cable shall be suitable for installation in free-air, in building risers, in conduit and/or in cable tray and carry a riser CMR or plenum CMP rating. Refer to Section 270500 for project requirements.

Test Procedure	Maximum Attenuation Change
Cable Retention (FOTP-6)	0.2dB
Durability (FOTP-21)	0.2dB
Impact (FOTP-2)	0.2dB
Thermal Shock (FOTP-3)	0.2dB
Humidity (FOTP-5)	0.2dB

Test Procedure	Maximum Attenuation Change
Cable Retention (FOTP-6)	0.2dB
Durability (FOTP-21)	0.2dB
Impact (FOTP-2)	0.2dB
Thermal Shock (FOTP-3)	0.2dB
Humidity (FOTP-5)	0.2dB

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

- A. Cable slack shall be provided in each backbone fiber optic cable. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage and be secured in the termination enclosure or a separate enclosure designed for this purpose. Multiple cables may share a common enclosure.
- B. A minimum of 5 meters (approximately 15 feet) of slack cable (each cable if applicable) shall be coiled and secured at both ends located in the entrance room, telecommunications room or main equipment room, for backbone and intra-building cable.
- C. Where exposed, all backbone fiber optic cable shall be installed in protective inner duct. This includes areas where the cable is routed in cable tray and where making a transition between paths (e.g., between conduit and cable tray or into equipment racks). The inner duct should extend into the termination and/or storage enclosure(s) at system endpoints.

3.2 CROSS-CONNECTS

- A. The Contractor will be responsible for all cross-connects between the data backbone cabling and network electronics and between the data network electronics and horizontal cabling.
- B. The Contractor shall be responsible for the cross-connect wiring between the horizontal and backbone voice cabling.
 - 1. All four (4) pairs of the horizontal cable shall be terminated on modular patch panels. Two (2) pairs of the horizontal cable shall be cross-connected to the backbone cable. Refer to the drawings for requirements of the 110 to RJ-45 cross connect cable.

2. All four (4) pairs in each horizontal cable shall be terminated on 110-type termination blocks in a field dedicated for horizontal cabling. Two (2) pairs of the horizontal cable shall be cross-connected to the backbone cable. 2-pair cross-connect wire, color-coded to identify each pair, shall be used. The 25TH pair position (50th, 75th, etc.) of each riser voice block shall remain vacant.
 3. Fastening cables directly to support brackets with wire or plastic ties will not be accepted. All cabling shall be neatly laced, dressed and supported. Avaya 88A retainer clips (or equivalent) shall be used on each 110-type termination block to secure jumper wires on the wiring block(s).
- C. This Contractor shall be responsible for cross-connects between the cabling terminations at the entrance room and the telephone utility network point-of-presence. It shall be the responsibility of the Contractor, to work with the Owner and provide the necessary assistance to allow Owner and/or telephone company personnel to make the necessary connections to establish service on the new cable system. These activities include, but are not limited to cross-connect documentation, general wiring overview and cable pair identification.

END OF SECTION

SECTION 271500 - HORIZONTAL CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the products and execution requirements relating to furnishing and installing horizontal communications cabling and termination components and related subsystems as part of a cabling plant. The cabling plant consists of copper cabling.

1.2 RELATED WORK

- A. Section 270500 - Basic Communications Systems Requirements
- B. Section 271720 - Structured Cabling System Warranty

1.3 QUALITY ASSURANCE

- A. Refer to Section 270500 for relevant standards and plenum or non-plenum cable requirements.

1.4 SUBMITTALS

- A. Under the provisions of Section 270500 and Division 1, prior to the start of work the Contractor shall submit:
 - 1. Manufacturer's data covering all products proposed, including construction, materials, ratings and all other parameters identified in Part 2 - Products, below.
 - 2. Manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLE

- A. CAT 6 Cable:
 - 1. The horizontal cable requirements must be met, as well as the following channel requirements.
 - 2. Performance tests shall be conducted using swept frequency testing through 250 MHz for the channel. All numbers given are for a 4-connection channel. Discrete frequency testing results at 250 MHz is not acceptable.
 - 3. Performance data shall be characterized as "Guaranteed Headroom" and shall be guaranteed by the manufacturer to perform at guaranteed margins over ANSI/TIA/EIA-568-C.2. Performance data that is not warranted by the manufacturer will not be considered.

4. The structured cabling and connectivity must be provided by the same company. For the purpose of this specification that shall mean that the cabling and connectivity must be marketed, branded, supported, warranted, and distributed by the same company. Specifically, ally or partnerships between cabling manufacturers and connectivity manufacturers do not meet this requirement unless otherwise listed below. Specifically, products made by others through an OEM relationship are acceptable if the products are marketed, branded, supported, warranted, and distributed by the same company.
5. The 4-connector channel performance margins listed in the below criteria shall be guaranteed minimum margins above ANSI/TIA/EIA-568-C.2 with electrical parameters between 1-250 MHz.
 - a. Insertion Loss: 5%
 - b. NEXT: 3.0 dB
 - c. PS NEXT: 5.0 dB
 - d. ACR-F (ELFEXT): 4.0 dB
 - e. PS ACR-F (PS ELFEXT): 5.0 dB
 - f. Return Loss: 2 dB
6. The jacket color for CAT 6 cable shall be white for voice applications and blue for data applications.

2.2 CONNECTORS/COUPLERS/ADAPTERS

A. Coax (F-Connector):

1. RG-6 and RG-11 coax cable shall be terminated at the work area and at communication equipment rooms in a male F-type connector.
2. The male F-type connector shall:
 - a. Be matched to the RG-6 and RG-11 coax cable type proposed by the Contractor.
 - b. Be a single-piece F-type connector.
 - c. Incorporate a 1/2" crimp ring which uses hex crimp.
3. The male F-type connectors shall be mated to female/female feed-thru couplings at both the information outlet and modular patch panel locations. These couplings shall be matched to the male F-type connector. Couplings shall be of sufficient length as to allow for the male F-type connector to fully seat (both sides).

2.3 FACEPLATES/JACKS

A. CAT 6 Jacks:

1. CAT 6 horizontal cable shall each be terminated at their designated work area location on RJ-45 modular jacks. These modular jack assemblies shall snap into a modular mounting frame. The combined modular jack assembly is referred to as an information outlet.
2. The same orientation and positioning of modular jacks shall be utilized throughout the installation. Prior to installation, the Contractor shall submit the proposed configuration for each information outlet type for review by the Architect/Engineer.

3. Information outlet faceplates shall incorporate recessed designation strips at the top and bottom of the frame for identifying labels. Designation strips shall be fitted with clear plastic covers.
4. Where standalone CAT 6 only modular jacks are identified, the information outlet faceplate shall be configured as to allow for the addition of one (1) additional modular jack (CAT 3, CAT 5E, or CAT 6) to be installed to supplement each such modular jack as defined by this project. The installation of these supplemental modular jacks is NOT part of this project.
5. Any unused modular jack positions on an information outlet faceplate shall be fitted with a removable blank inserted into the opening.
6. The information outlet faceplate shall be constructed of high impact plastic (except where noted otherwise). The information outlet faceplate color shall:
 - a. Match the receptacle color used for other utilities in the building, or
 - b. When installed in surface raceway (if applicable), match the color of that raceway.
7. Different faceplate and frame designs for locations, which include optical fiber cabling relative to those, that terminate only copper cabling are acceptable. Information outlets that incorporate optical fiber shall be compliant with the above requirements plus:
 - a. Be a low-profile assembly.
 - b. Incorporate a mechanism for storage of cable and fiber slack needed for termination.
 - c. Position the optical fiber couplings to face downward or at a downward angle to prevent contamination.
 - d. Incorporate a shroud that protects the optical fiber couplings from impact damage.
8. All information outlets and the associated modular jacks shall be of the same manufacturer throughout the project.
9. The CAT 6 modular jacks shall be non-keyed 8-pin modular jacks.
10. The interface between the modular jack and the horizontal cable shall be a 110-type termination block or insulation displacement type contact. Termination components shall be designed to maintain the horizontal cable's pair twists as closely as possible to the point of mechanical termination.
11. CAT 6 modular jacks shall be pinned per TIA-568A, TIA-568B.
12. CAT 6 termination hardware shall, as a minimum, meet all the mechanical and electrical performance requirements of the following standards:
 - a. ANSI/TIA/EIA-568-A-5
 - b. ANSI/TIA/EIA-568A
 - c. ISO/IEC 11801
 - d. IEC 603-7
 - e. FCC PART 68 SUBPART F
13. The color for CAT 6 jacks shall be white for voice applications and blue for data applications. Alternately, a color-coded bezel or icon may be used to identify the CAT 6 modular jack.

2.4 HORIZONTAL FIBER CABLE

A. Multimode (MM)/Singlemode (SM):

1. Horizontal optical fiber cable shall be suitable for installation in building riser systems, in conduit, in cable tray and/or in innerduct.
2. Horizontal optical fiber cable shall carry an OFNR (optical fiber non-conductive riser) or OFNP (optical fiber non-conductive plenum) rating. Refer to Section 270500 for project requirements.
3. Outer Sheath: The outer sheath shall be marked with the manufacturer's name, date of manufacture, fiber type, flame rating, UL symbol, and sequential length markings every two feet.
4. Temperature Range:
 - a. Storage: -40C to +70C (no irreversible change in attenuation).
 - b. Operating: -40C to +70C.
5. Humidity Range: 0% to 100%.
6. Maximum Tensile Strength (greater than or equal to 12 fibers):
 - a. During Installation: 1332 Newton (300 lb. force) (no irreversible change in attenuation).
 - b. Long Term: 600 N (135-lb. force).
7. Maximum Tensile Strength (less than or equal to 6 fibers).
 - a. During Installation: 1000 Newton (225 lb. force) (no irreversible change in attenuation).
 - b. Long Term: 100 N (67 lb. force).
8. Bending Radius:
 - a. During Installation: 20 times cable diameter.
 - b. No Load: 10 times cable diameter.

- B. The horizontal optical fiber cable plant is based on the installation of low strand-count optical fiber cables "fiber to the desk" to be installed from the work area to the communication equipment room serving that area. Refer to the floor plan drawings that identify the location of communication equipment rooms and information outlets. Note that the optical fiber cable count to each information outlet location may vary by location.

C. Multimode (MM)/Singlemode (SM):

1. Refer to "Horizontal Fiber Performance" in Section 271500 for optical fiber performance parameters.

2.5 HORIZONTAL FIBER PERFORMANCE

A. Multimode (MM):

1. Fiber Type: Multimode; doped silica core surrounded by a concentric glass cladding.
2. Index Profile: Graded Index.
3. Transmission Windows: 850-nm and 1300-nm.
4. Core Diameter (nom): 50-um (microns) $\pm$ 3.
5. Cladding Diameter: 125-um $\pm$ 2.
6. Core-clad Concentricity: Less than or equal to 3-um.
7. Cladding Non-circularity: Less than or equal to 2.0%.
8. Fiber Coating Diameter:
9. 250-um $\pm$ 15 (primary coating)
 - a. 900-um (nominal) secondary coating (tight buffer)
 - b. All coatings shall be mechanically strippable without damaging the optical fiber.
10. Attenuation (maximum @ 23 $\pm$ 5C; backbone):
 - a. @ 850-nm: 3.0 dB/km
 - b. @ 1300-nm: 1.0 dB/km
 - c. When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the average change in attenuation over the rated temperature range of the cable shall not exceed 0.50 dB/km with 80% of the measured optical fibers not exceeding 0.25 dB/km.
11. Bandwidth (minimum):
 - a. @ 850-nm: 500 MHz*km
 - b. @ 1300-nm: 500 MHz*km
12. No optical fiber shall show a point discontinuity greater than 0.2 dB at the specified wavelengths. Such a discontinuity or any discontinuity showing a reflection at that point shall be cause for rejection of that optical fiber by the Owner.

2.6 RG-6 BROADBAND RF COAXIAL CABLE

A. Basic Construction:

1. Center conductor: 18 AWG bare copper covered steel; 0.040" OD (nominal); foamed polyethylene dielectric.
2. Four Layer Shield:
 - a. Inner shield: aluminum-polypropylene-aluminum laminated tape with overlap bonded to dielectric.
 - b. Second shield: 60% 34 AWG bare aluminum braid wire.
 - c. Third shield: non-bonded aluminum foil tape.
 - d. Outer shield: 40% 34 AWG bare aluminum braid wire.

B. Electrical Performance Characteristics:

1. Impedance: 75 ohms.

2. Velocity of propagation: Greater than or equal to 82%.
3. Maximum attenuation (per 100 feet) for non-plenum rated cable:
 - a. at 55-MHz: 1.60 dB
 - b. at 450-MHz: 4.26 dB
 - c. at 750-MHz: 5.59 dB
 - d. at 1000-MHz: 6.54 dB
4. Maximum attenuation (per 100 feet) for plenum-rated cable:
 - a. at 50-MHz: 1.60 dB
 - b. at 400-MHz: 4.60 dB
 - c. at 700-MHz: 6.60 dB
 - d. at 1000-MHz: 8.20 dB

A. RJ-45:

1. Provide the same quantity of Category 6 copper work area cords as copper patch panel cords specified in Section 271100. Copper work area cords shall be equipped with an 8-pin modular RJ-45 connector on each end.
2. Manufacturer of copper patch cable shall be the same as the manufacturer of the horizontal copper cable.

2.8 FIBER WORK AREA CORDS

A. Optical Fiber Work Area Cords (Multimode):

1. The optical fiber work area cord shall be 62.5/125 μ m or 50 μ m multimode (MM) optical fiber, utilizing tight buffer construction. Coordinate fiber type with owner prior to purchase and installation.
2. Provide the same quantity of optical fiber work area cords as optical fiber patch cords specified in Section 271100.
3. The optical fiber work area cords shall be a 6 feet in length.
4. Optical fiber work area cords shall incorporate ceramic tipped ST, SC, LC, MT-RJ type connectors. Connector body shall be of materials similar to that used in the proposed couplings.
5. Channels shall be of equal length.
6. Refer to Section 271500 for cable and connector performance requirements.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

A. Horizontal Cabling:

1. The maximum horizontal cable drop length for Data UTP shall not exceed 295 feet in order to meet data communications performance specifications. This length is measured from the termination panel in the wiring closet to the outlet and must include any slack required for the installation and termination. The Contractor is responsible for installing horizontal cabling in a fashion so as to avoid unnecessarily long runs. Any area that cannot be reached within the above constraints should be identified and reported to the Architect/Engineer prior to installation. Changes to the contract documents shall be approved by the Architect/Engineer.
 2. All cable shall be free of tension at both ends. In cases where the cable must bear some stress, Kellum grips may be used to spread the strain over a longer length of cable.
 3. Manufacturer's minimum bend radius specifications shall be observed in all instances.
 4. Horizontal cabling installed as open cabling shall be supported at a maximum of 5' between supports. Refer to the specifications for required cable supports.
 5. Horizontal cabling installed as open cable or in cable tray shall be bundled at not less than 10' intervals with hook-and-loop tie wraps. The use of plastic cable ties is strictly prohibited.
 6. The maximum conduit fill for horizontal cabling shall not exceed 40% regardless of conduit length.
 7. Cable sheaths shall be protected from damage from sharp edges. Where a cable passes over a sharp edge, a bushing or grommet shall be used to protect the cable.
 8. Cabling shall not be routed through wall(s) without a pathway. Provide conduit sleeve pathways through wall(s) for proper installation of horizontal cabling.
- B. A coil of 3 feet in each cable shall be placed in the ceiling at the last support (e.g., J-hook, bridle ring, etc.) before the cables enter a fishable wall, conduit, surface raceway or box. At any location where cables are installed into movable partition walls or modular furniture via a service pole, approximately 15-feet of slack shall be left in each horizontal cable under 250 feet in length to allow for change in the office layout without re-cabling. These "service loops" shall be secured at the last cable support before the cable leaves the ceiling and shall be coiled from 100% to 200% of the cable recommended minimum bend radius.
1. To reduce or eliminate EMI, the following minimum separation distances from 480V power lines shall be adhered to:
 - a. Twelve (12) inches from power lines of less than 5-kVa.
 - b. Eighteen (18) inches from high-voltage lighting (including fluorescent).
 - c. Thirty-nine (39) inches from power lines of 5-kVa or greater.
 - d. Thirty-nine (39) inches from transformers and motors.
 2. Information outlets shown on floor plans with the subscript "W" are intended to be used for wall mounted telephones. Back boxes for wall mounted telephones shall not be located within 12" vertically, or horizontally, from any light switches, power receptacles, nurse call devices, thermostats, or any other architectural element that would otherwise prevent the installation of a wall mounted telephone on the mating lugs.

3.2 CABLE TERMINATION REQUIREMENTS

- A. Cable Termination - CAT 3 Voice Horizontal Cabling:

1. Voice pairs shall terminate on wall-mounted 110-type termination blocks at the entrance room, main equipment room and/or telecommunications rooms.
2. If the "last" Horizontal termination block is greater than 50% utilized, one additional block shall be provided for future use. Provide additional horizontal termination blocks to accommodate a minimum of additional drops.
3. The Contractor shall furnish and install cable management hardware (e.g., D-rings and cable guides) to neatly and securely route the cable from the nearest cable tray to the cable termination hardware.
4. The height of the voice termination field shall not exceed 6 feet (72 inches) above floor level to facilitate cable maintenance.
5. Termination blocks on which the backbone and horizontal cabling are terminated shall be positioned in separate columns. Backbone cabling should be positioned to the left; horizontal cabling to the right and be in close proximity to simplify installation and subsequent tracing of cross-connect wiring. Where new cabling is to be integrated with existing cabling at the building entrance, it will be the responsibility of the Contractor, in cooperation with the Owner, to coordinate placement of voice termination hardware of the local exchange carrier(s) serving the site.
6. Cables shall be fed from below the termination hardware in a manner that will facilitate growth.
7. Horizontal troughs incorporating split plastic distribution rings shall be provided by the Contractor to accommodate routing of jumpers. Troughs shall be positioned at the top of and between each column of termination blocks. Rings shall be positioned between the backbone and horizontal blocks for vertical routing of jumpers and/or cross-connect wiring.
8. Termination of horizontal voice cabling shall be accomplished by using 4-pair (e.g., C4-type) clips. The 25th of each row on the 110-type termination block located in the telecommunication room shall not be used for termination of horizontal voice cable.
9. Termination of backbone voice cabling shall be accomplished by using 5-pair (e.g., C5-type) clips.
10. The Contractor shall ensure that the twists in each cable pair are preserved to within 1.0 inch of the termination for all voice UTP cables. The cable jacket shall be removed only to the extent required to make the termination.
11. A jumper wire spool holder shall be installed at the main equipment room. Two full 1000-foot spools of 24 AWG one-pair jumper wire, one spool each of white-blue/blue and white-green/green, shall be supplied with the holder. The spool holders shall be assemblies designed for that purpose.

B. Cable Terminations - Data UTP:

1. Modular patch panels shall be designed and installed in a fashion as to allow future horizontal cabling to be terminated on the panel without disruption to existing connections.
2. If the "last" patch (per rack) is greater than 50% utilized, one additional patch panel shall be provided for future use.
3. At information outlets and modular patch panels, the Contractor shall ensure that the twists in each cable pair are preserved to within 0.5-inch of the termination for data cables. The cable jacket shall be removed only to the extent required to make the termination.

C. Cable Terminations - Fiber Optic:

1. All fibers shall be terminated using the specified connector type.
2. All terminated fibers at the telecommunications rooms shall be mated to couplings mounted on panels. Couplings shall be mounted on a panel that, in turn, snaps into the housing assembly. Any unused panel positions shall be fitted with a blank panel inhibiting access to the fiber optic cable from the front of the housing.
3. All couplings shall be fitted with a dust cap.
4. Fibers from multiple locations may share a common enclosure, however, they must be segregated on the connector panels and clearly identified. Fibers from multiple destinations may be secured in a common enclosure provided that they are clearly identified as such. Fibers from different locations shall NOT share a common connector panel (e.g., "insert").
5. Slack in each fiber shall be provided to allow for future re-termination in the event of connector or fiber end-face damage. Adequate slack shall be retained to allow termination at a 30" high workbench positioned adjacent to the termination enclosure(s). A minimum of 1 meter (approximately 39") of slack shall be retained regardless of panel position relative to the potential work area.

D. Cable Terminations - Shielded (T1):

1. Shielded cabling shall be terminated on 110-type termination blocks. The blocks shall be wall-mounted at all locations.
2. Blocks shall be sized to provide for a minimum 20% growth in capacity relative to the initial installation.
3. Consistency shall be maintained throughout the installation relative to conductor sequence on the blocks. Building ground and cable shield drain wire shall be terminated immediately to the left of each two data pairs on the cross-connect fields.
4. Designation labels shall be color-coded YELLOW to identify the cabling as a Network Connection. Pairs shall be identified on the labels numerically. Ground and shield shall be identified for each pair.

END OF SECTION

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SECTION 271710 - TESTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This section describes the testing requirements relating to the structured cabling system and its termination components and related subsystems.

1.2 RELATED WORK

- A. Section 270500 - Basic Communications Systems Requirements

1.3 QUALITY ASSURANCE

- A. Refer to Section 270500 for relevant standards.

1.4 SUBMITTALS

- A. Under the provisions of Section 270500 and Division 1, prior to the start of work, the Contractor shall submit:
 - 1. Complete information on testing procedure as described herein.
 - 2. Test plan summary for each cable type to be tested including equipment to be used, setup, test frequencies or wavelengths, results format, etc.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING COPPER

- A. General Requirements:
 - 1. Perform acceptance tests as indicated below for each sub-system (e.g., backbone, horizontal, etc.) as it is completed.
 - 2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.
 - 3. Visually inspect all cabling and termination points to ensure that they are complete and conform to the wiring pattern defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.

4. Conduct acceptance testing according to a schedule coordinated with the Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove the wiring connections are correct.
6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used, and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results in their native format.
7. All cabling shall be 100% fault-free unless noted otherwise. If any cable is found to be outside the specification defined herein, that cable and the associated termination(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.
8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

a. CAT 6 Cable:

- 1) Testing shall be from the modular jack at the information outlet to the modular patch panel in the communication equipment room.
- 2) Horizontal cable shall be free of shorts within the pairs, and be verified for continuity, pair validity and polarity, and conductor position on the modular jack (e.g., wire map). Any defective, split, or mis-positioned pairs must be identified and corrected.
- 3) CAT 6 horizontal cable shall be tested to 250 MHz as defined by TIA/EIA-568-C.2. Measurements shall be of the "Permanent Link", "Channel Link", including patch cords, cabling and modular jacks at the information outlet and modular patch panel. Parameters to be tested must include:
 - a) Wire Map
 - b) Length
 - c) NEXT Loss (Pair-to-Pair)
 - d) NEXT (Power Sum)
 - e) ELFEXT (Pair-to-Pair)
 - f) ELFEXT (Power Sum)
 - g) Return Loss
 - h) Attenuation
 - i) Propagation Delay
 - j) Delay Skew
- 4) The maximum length of horizontal cable shall not exceed 295 feet, which allows 33 feet for technology equipment and modular patch cords.

- 5) To establish testing baselines, cable samples of known length and of the cable type and lot installed shall be tested. The cable may be terminated with an eight-position CAT 6 modular connector (8-pin) to facilitate testing. Nominal Velocity of Propagation (NVP) and nominal attenuation values shall be calculated based on this test and be utilized during the testing of the installed cable plant. This requirement can be waived if NVP and nominal attenuation data is available from the cable manufacturer for the exact cable type under test.
- 6) CAT 6 horizontal cable testing shall be performed using a test instrument designed for testing to 250 MHz or higher. Test records shall verify, "PASS" on each cable and display the specified parameters, comparing test values with standards based "templates" integral to the unit. Test records that report a PASS*, FAIL*, or FAIL result for any of the parameters will not be accepted.
- 7) In the event results of the tests are not satisfactory, the Contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests that disclosed faulty or defective material, equipment, or installation methods, and shall make additional tests as the Architect/Engineer deems necessary at no additional expense to the project or user agency.

3.2 TESTING FIBER

A. General Requirements:

1. Perform acceptance tests as indicated below for each optical fiber sub-system (e.g., backbone, horizontal, etc.) as it is completed.
2. Supply all equipment and personnel necessary to conduct the acceptance tests. The method of testing shall be approved by the Architect/Engineer.
3. Visually inspect all optical fiber cabling and termination points to ensure that they are complete and conform to the standards defined herein. Provide the Architect/Engineer with a written certification that this inspection has been made.
4. Conduct acceptance testing according to a schedule coordinated with the Owner/Architect/Engineer. Representatives of the Owner may be in attendance to witness the test procedures. Provide a minimum of one (1) week's advance notice to the Architect/Engineer to allow for such participation. The notification shall include a written description of the proposed conduct of the tests, including copies of blank test result sheets to be used.
5. Tests related to connected equipment of others shall only be done with the permission and presence of the Contractor involved. The Contractor shall ascertain that testing only is required to prove that the optical fiber connections are correct.
6. Provide test results and describe the conduct of the tests including the date of the tests, the equipment used and the procedures followed. At the request of the Architect/Engineer, provide copies of the original test results.
7. All optical fiber cabling shall be 100% fault-free unless noted otherwise. If any optical fiber cable is found to be outside the specification defined herein, that optical fiber cable and the associated connector(s) shall be replaced at the expense of the Contractor. The applicable tests shall then be repeated.

8. Should it be found by the Architect/Engineer that the materials or any portion thereof furnished and installed under this Contract fail to comply with the specifications and drawings with respect or regard to the quality, amount, or value of materials, appliances, or labor used in the work, it shall be rejected and replaced by the Contractor and all work disturbed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.
 9. The optical fibers utilized in the installed cable shall be traceable to the manufacturer. Upon request by the Owner, provide cable manufacturer's test report for each reel of cable provided. These test reports shall include manufacturer's on-reel attenuation test results at 850-nm and 1300-nm for each optical fiber of each reel prior to shipment from the manufacturer.
 - a. On-the-reel bandwidth performance as tested at the factory. Factory data shall be provided upon request.
 - b. The testing noted for optical fiber cabling utilizes an Optical Time Domain Reflectometer (OTDR). However, the Contractor may submit to the Architect/Engineer for pre-approval of alternate fiber optic testing equipment.
- B. Tests Prior to Installation: The Contractor, at their discretion and at no cost to the Owner, may perform an attenuation test with an OTDR at 850-nm or 1300-nm on each optical fiber of each cable reel prior to installation. Supply this test data to the Architect/Engineer prior to installation.
- C. Tests After Installation: Upon completion of cable installation and termination, the optical fiber cabling shall be tested to include:
1. Optical Attenuation ("Insertion Loss" Method):
 - a. Optical Attenuation shall be measured on all terminated optical fibers in one direction of transmission using the "Insertion Loss" method measurement in accordance with the TIA/EIA 526-14, Method B, and be inclusive of the optical connectors and couplings installed at the system endpoints. Access jumpers shall be used at both the transmit and receive ends to ensure that an accurate measurement of connector losses is made. Multimode optical fibers shall be tested at 850 ± 30 nm. Singlemode optical fibers (if applicable) shall be tested at 1300 ± 20 nm.
 - b. Attenuation of optical fibers shall not exceed the values calculated as follows:
 - 1) Attenuation (max.) = $2 * C + L * F + S$ dB.
 - 2) Where C is the maximum allowable Connector Loss (in dB), L is the length of the run (in kilometers), and F is the maximum allowable optical fiber loss (in dB/km). S is the total splice loss (# of splices * maximum attenuation per splice).
 2. Verification of Link Integrity (OTDR):

- a. All optical fibers shall be documented in one direction of transmission using an Optical Time Domain Reflectometer (OTDR). Multimode optical fibers shall be tested at 850-nm and 1300-nm (nominal). Singlemode optical fibers (if applicable) shall be tested at 1310-nm and 1550-nm (nominal). The OTDR(s) shall incorporate high-resolution optics optimized for viewing of short cable sections. Access jumpers of adequate length to allow viewing of the entire length of the cable, including the connectors at the launch and receive end, shall be used. Access jumpers used for testing shall match the type and core diameter of the fiber optic strand under test.
- b. Set OTDR's test variables to the manufacturer's published backscatter coefficient and velocity of propagation figure for the specific strand of fiber under test. OTDR's range should be set to approximately 1.5 times the length of the strand under test, pulse width should be optimized for the length of the fiber optic strand under test, and number of averages should be adjusted to approximately 120 seconds per wavelength.
- c. OTDR traces revealing a point discontinuity greater than 0.2 dB in a multimode optical fiber or 0.1 dB in a singlemode optical fiber (if applicable) at any of the tested wavelengths or any discontinuity showing a reflection at that point shall be a valid basis for rejection of that optical fiber by the Owner. The installation of that optical fiber cable shall be reviewed in an effort to remove any external stress that may be causing the fault. If such efforts do not remove the fault, that optical fiber cable and the associated terminations shall be replaced at the expense of the Contractor.

3.3 TESTING COAX

- A. A Time Domain Reflectometer (TDR) shall be used to verify cable length and to test for cable faults and breaks. A step-function high resolution Time Domain Reflectometer shall be employed for this test. The results shall be automatically plotted on an X-Y plotter with a Y axis voltage reflection coefficient resolution of .001 per division. The X axis will resolve down to 1" of cable. The TDR will sweep the cable at a rate no greater than 50' per second, or such lower rate as necessary to resolve cable faults to the 1" and .001 VRC level.
- B. The cable shall be terminated with its characteristic impedance, and an appropriate impedance matching pad shall be used to match the analyzer to the cable where necessary. Cable shall be rejected if any single fault is observed of amplitude greater than .003 voltage reflection coefficient. Characteristic impedance shall also be measured at 5% of nominal value.
- C. Cyclic faults (such as cable reel stress and die drawdown) shall be limited to a voltage reflection coefficient of 0.005.

3.4 DOCUMENTATION/AS-BUILTS/RECORDS

- A. General:
 1. Upon completion of the installation, submit as-builts per the requirements of Section 270500 and Division 1. Documentation shall include the items detailed in the subsections below.
 2. All documentation, including hard copy and electronic forms, shall become the property of the Owner.

3. The Architect/Engineer may request that a 10% random field retest be conducted on the cable system at no additional cost to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the Contractor, additional testing can be requested to the extent determined necessary by the Architect/Engineer, including a 100% retest. This retest shall be at no additional cost to the Owner.

END OF SECTION

SECTION 280500 - BASIC ELECTRONIC SAFETY AND SECURITY SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Basic Safety and Security System Requirements (herein referred to Security) specifically applicable to Division 28 sections, in addition to Division 1 - General Requirements.
- B. All materials and installation methods shall conform to the applicable standards, guidelines and codes referenced herein and within each specification section.

1.2 SCOPE OF WORK

- A. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the security systems as shown on the drawings and specified herein.
- B. Each Contractor shall provide all new materials as indicated in the schedules on the drawings, and/or in these specifications, and all items required to make the portion of the security systems a finished and working system.
- C. Separate contracts will be awarded for the following work.
- D. Description of systems include but are not limited to the following:
 - 1. Fire detection and alarm.
 - 2. All associated electrical backboxes, conduit, miscellaneous cabling, and power supplies required for proper system installation and operation as defined in the "Suggested Matrix of Scope Responsibility".

1.3 DIVISION OF WORK BETWEEN ELECTRICAL AND SECURITY CONTRACTORS

- A. Division of work is the responsibility of the Prime Contractor. Any scope of work described in the contract document shall be sufficient for including said requirement in the project. The Prime Contractor shall be solely responsible for determining the appropriate subcontractor for the described scope. In no case shall the project be assessed an additional cost for scope that is described in the contract documents. The following division of responsibility is a guideline based on typical industry practice.
- B. Definitions:
 - 1. "Electrical Contractor" as referred to herein refers to the Contractors listed in Division 26 of this Specification.

2. "Electrical Contractor" shall also refer to the Contractor listed in Division 28 of this specification when the "Suggested Matrix of Scope Responsibility" indicates the work shall be provided by the EC. Refer to the Contract Documents for the "Suggested Matrix of Scope Responsibility".
3. "Security Contractor" as referred to herein refers to the Contractors listed in Division 28 of this Specification.
4. Low Voltage Security Wiring: The wiring (less than 120VAC) associated with the Security Systems, used for analog and/or digital signals between equipment.

C. General:

1. The purpose of these Specifications is to outline typical Electrical and Security Contractor's work responsibilities as related to security systems including back boxes, conduit, cable tray, power wiring and low voltage security wiring. The prime contractor is responsible for all divisions of work.
2. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals are approved. Therefore, only known wiring, conduits, raceways, and electrical power as related to such items, is shown on the Security Drawings. Other wiring, conduits, raceways, junction boxes, and electrical power not shown on the Security Drawings but required for the successful operation of the systems shall be the responsibility of the Security Contractor and included in the Contractor's bid.
3. Where the Electrical Contractor is required to install conduit, conduit sleeves and/or power connections in support of Security systems, the final installation shall not begin until a coordination meeting between the Electrical Contractor and the Security Contractor has convened to determine the exact location and requirements of the installation.
4. Where the Electrical Contractor is required to install cable tray that will contain Low Voltage Security Wiring, the installation shall not begin until the Security Contractor has completed a coordination review of the cable tray shop drawing.
5. This Contractor shall establish Electrical and Security utility elevations prior to fabrication and installation. The Security Contractor shall cooperate with the Electrical Contractor and the determined elevations in accordance with the guidelines below. This Contractor shall coordinate utility elevations with other trades. When a conflict arises, priority shall be as follows:
 - a. Lighting Fixtures
 - b. Gravity Flow Piping, including Steam and Condensate
 - c. Sheet Metal
 - d. Cable Trays, including 12" access space
 - e. Sprinkler Piping and other Piping
 - f. Conduit and Wireway
 - g. Open Cabling

D. Electrical Contractor's Responsibility:

1. Assumes all responsibility for all required conduit and power connections when shown on the "Suggested Matrix of Scope Responsibility" to be provided by the Electrical Contractor.
2. Assumes all responsibility for providing and installing cable tray.
3. Responsible for Security Systems grounding and bonding.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other Contractors to determine a viable layout.

E. Security Contractor's Responsibility:

1. Assumes all responsibility for the low voltage security wiring of all systems, including cable support where open cable is specified.
2. Assumes all responsibility for all required backboxes, conduit and power connections not specifically shown as being provided by the Electrical Contractor on the "Suggested Matrix of Scope Responsibility."
3. Responsible for providing the Electrical Contractor with the required grounding lugs or other hardware for each piece of security equipment which is required to be bonded to the telecommunications bonding system.
4. This Contractor is responsible for coordination of utilities with all other Contractors. If any field coordination conflicts are found, the Contractor shall coordinate with other contractors to determine a viable layout.

1.4 COORDINATION DRAWINGS

- A. Provide coordination drawings showing the complete, coordinated installation of mechanical, electrical, plumbing, fire protection, and other systems within available building spaces.

B. Definitions:

1. Coordination Drawings: Coordination drawings are defined as composite drawings or models that incorporate work of multiple trades and demonstrate coordinated routing, elevations, and clearances.
 - a. Mechanical trades shall include, but are not limited to, mechanical equipment, ductwork, fire protection systems, plumbing piping, medical gas systems, hydronic piping, steam and steam condensate piping, and any item that may impact coordination with other disciplines.
 - b. Electrical trades shall include, but are not limited to, electrical equipment, conduit 1.5" and larger, conduit racks, cable trays, pull boxes, transformers, raceway, busway, lighting, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - c. Technology trades shall include, but are not limited to, technology equipment, racks, conduit 1.5" and larger, conduit racks, cable trays, ladder rack, pull boxes, raceway, ceiling-mounted devices, and any item that may impact coordination with other disciplines.
 - d. Maintenance clearances and code-required dedicated space shall be included.

- e. The coordination drawings shall include all underground, underfloor, in-floor, in chase, and vertical trade items.
2. Provide one complete, composite coordination drawing package for each building area, system, or phase demonstrating fully coordinated conditions.
3. The composite coordination drawing package may be created from multiple trade-specific electronic files; however, the final deliverable shall clearly represent a single coordinated installation.
4. Spaces with open/cloud ceiling architecture shall indicate the overhead utilities and locate equipment as required to maintain clearance above lights. The intent for the installation is to maintain a maximum allowable vertical clearance and an organized/clean manner in the horizontal. Notify Architect/Engineer of the maximum clearance which can be maintained. Failure to comply will result in modifications with no cost to Owner.
 - a. In cloud ceiling architecture, when open cabling/wire and/or cable tray crosses gaps between ceiling clouds and/or walls, cabling is to transition to conduits to span the gaps in order to conceal cabling from below.
5. The contractors shall use the coordination process to identify the proper sequence of installation of all utilities above ceilings and in other congested areas, to ensure an orderly and coordinated end result, and to provide adequate access for service and maintenance.

C. Participation:

1. The Contractor shall be responsible for coordinating all trades and preparing coordination drawings.
2. One contractor shall be designated as the Coordinating Contractor for purposes of preparing a complete set of composite electronic CAD coordination drawings that include all applicable trades, and for coordinating the activities related to this process.
 - a. The Coordinating Contractor shall utilize personnel familiar with requirements of this project and skilled as draftspersons/CAD operators, competent to prepare the required coordination drawings.
3. Electronic CAD drawings shall be submitted to the Coordinating Contractor for addition of work by other trades. IMEG will provide electronic file copies of applicable drawings for contractor's use if the contractor signs and returns an "Electronic File Transfer" waiver provided by IMEG. IMEG will not consider blatant reproductions of original file copies an acceptable alternative for coordination drawings.

D. Drawing Requirements:

1. The file format and file naming convention shall be coordinated with and agreed to by all contractors participating in the coordination process and the Owner.
 - a. Scale of drawings:

- 1) General plans: 1/4 Inch = 1'-0" (minimum).
 - 2) Mechanical, electrical, communication rooms, and including the surrounding areas within 10 feet: 1/2 Inch = 1'-0" (minimum).
 - 3) Shafts and risers: 1/2 Inch = 1'-0" (minimum).
 - 4) Sections of shafts and mechanical and electrical equipment rooms: 1/4 Inch = 1'-0" (minimum).
 - 5) Sections of congested areas: 1/2 Inch = 1'-0" (minimum).
2. Ductwork layout drawings shall be the baseline system for other components. Ductwork layout drawings shall be modified to accommodate other components as the coordination process progresses.
 3. There may be more drawings required for risers, top and bottom levels of mechanical rooms, and shafts.
 4. The minimum quantity of drawings will be established at the first coordination meeting and sent to the Architect/Engineer for review. Additional drawings may be required if other areas of congestion are discovered during the coordination process.

E. General:

1. Provide coordination drawings files to the Architect/Engineer for review of identified conflicts. The Architect/Engineer will not act as the project coordinator and is not responsible for coordination of the work. The Architect/Engineer will review only clearly identified conflicts submitted by the Contractor and will not perform clash detection or coordination. The Architect/Engineer will not compile or reconcile multiple trade files and will rely on the Contractor's composite coordination drawing package.
2. The Contractor remains solely responsible for coordination regardless of any review or comment provided by the Architect/Engineer.
3. A plotted set of coordination drawings shall be available at the project site.
4. Coordination drawings are not shop drawings and are not subject to approval. Receipt or review of coordination drawings does not constitute approval of routing, layout, means, methods, sequencing, or constructability.
5. The contract drawings are schematic in nature and do not show every fitting and appurtenance for each utility. Each contractor is expected to have included in the bid sufficient fittings, material, and labor to allow for adjustments in routing of utilities made necessary by the coordination process and to provide a complete and functional system.
6. The contractors will not be allowed additional costs or time extensions due to participation in the coordination process.
7. The contractors will not be allowed additional costs or time extensions for additional fittings, reroutings or changes of duct size, that are essentially equivalent sizes to those shown on the drawings and determined necessary through the coordination process.
8. The Architect/Engineer reserves the right to determine space priority of equipment in the event of spatial conflicts or interference between equipment, piping, conduit, ducts, and equipment provided by the trades.
9. Changes to the contract documents that are necessary for systems installation and coordination shall be brought to the attention of the Architect/Engineer.
10. Access panels shall preferably occur only in gypsum board walls or plaster ceilings where indicated on the drawings.

- a. Access to mechanical, electrical, technology, and other items located above the ceiling shall be through accessible lay-in ceiling tile areas.
 - b. Potential layout changes shall be made to avoid additional access panels.
 - c. Additional access panels shall not be allowed without written approval from the Architect/Engineer at the coordination drawing stage.
 - d. Providing additional access panels shall be considered after other alternatives are reviewed and discarded by the Architect/Engineer and the Owner's Representative.
 - e. When additional access panels are required, they shall be provided without additional cost to the Owner.
11. Complete the coordination drawing process and obtain documented sign-off from all participating trades confirming that coordination drawings have been reviewed and coordinated prior to installation. Sign-off shall consist of signatures on the composite coordination drawing package or a coordination log identifying participating trades and acceptance of the coordinated layout.
 12. Do not begin installation of work in an area until coordination drawings for that area are complete and trade sign-offs have been obtained.
 13. Submit unresolved coordination conflicts to the Architect/Engineer for direction prior to installation. Conflicts that result after the coordination drawings are signed off shall be the responsibility of the contractor or subcontractor who did not properly identify their work requirements, or installed their work without proper coordination. Conflicts identified after installation due to incomplete coordination shall be corrected at no additional cost to the Owner.
 14. Updated coordination drawings that reflect as-built conditions may be used as record documents.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Only products of reputable manufacturers as determined by the Architect/Engineer will be acceptable.
2. Conform to all requirements of the City of Port Angeles and the State of Washington Codes, Laws, Ordinances and other regulations having jurisdiction.
3. Conform to all published standards of The Peninsula Housing Authority.
4. In the event there are no local codes having jurisdiction over this job, the 2020 National Electrical Code shall be followed.
5. If there is a discrepancy between the codes and regulations having jurisdiction over this installation, and these specifications, Architect/Engineer shall determine the method or equipment used.
6. If the Contractor notes, at the time of bidding, that any parts of the drawings or specifications do not comply with the codes or regulations, Contractor shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, Contractor shall submit with the proposal a separate price to make the system comply with the codes and regulations.

7. Verify the installation environment prior to purchasing or installing any cable. Cable installed in a plenum environment shall be appropriately rated. Bring all discrepancies between the contract documents and installation conditions to the attention of the Architect/Engineer prior to purchase or installation.
8. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

B. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
3. Pay all applicable charges for such permits or licenses that may be required.
4. All equipment, and materials shall be as approved or listed by the following: (Unless approval or listing is not applicable to an item by all acceptable manufacturers.)
 - a. Factory Mutual
 - b. Underwriters' Laboratories, Inc.

C. Examination of Drawings:

1. The drawings for the Security Systems work are diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and the exact routing of cabling to best fit the layout of the job. Scaling of the drawings will not be sufficient or accurate for determining this layout. Where a specific route is required, such route will be indicated on the drawings.
3. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
4. If an item is either shown on the drawings, called for in the specifications or required for proper operation of the system, it shall be considered sufficient for including same in this contract.
5. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.
6. Where words "provide", "install", or "furnish" are used on the drawings or in the specifications, it shall be taken to mean, to furnish, install and terminate completely ready for operation, the items mentioned.

D. Electronic Media/Files:

1. Construction drawings for this project have been prepared utilizing Revit.

1.6 WEB-BASED PROJECT SOFTWARE

- A. The General Contractor shall provide a web-based project software site for the purpose of hosting and managing project communication and documentation until completion of the warranty phase.
- B. The web-based project software shall include, at a minimum, the following features: construction schedule, submittals, RFIs, ASIs, construction change directives, change orders, drawing management, specification management, payment applications, contract modifications, meeting minutes, construction progress photos.
- C. Provide web-based project software user licenses for use by the Architect/Engineer. Access will be provided from the start of the project through the completion of the warranty phase.
- D. At project completion, provide digital archive of entire project in format that is readable by common desktop software applications in format acceptable to Architect/Engineer. Provide data in locked format to prevent further changes.

1.7 SUBMITTALS

- A. Submittals shall be required for the following items, and for additional items where required elsewhere in the specifications or on the drawings.
- B. General Submittal Procedures: In addition to the provisions of Division 1, the following are required:
 - 1. Transmittal: Each transmittal shall include the following:
 - a. Date
 - b. Project title and number
 - c. Contractor's name and address
 - d. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - e. Description of items submitted and relevant specification number
 - f. Notations of deviations from the contract documents
 - g. Other pertinent data
 - 2. Submittal Cover Sheet: Each submittal shall include a cover sheet containing:
 - a. Date
 - b. Project title and number
 - c. Architect/Engineer
 - d. Contractor and subcontractors' names and addresses
 - e. Supplier and manufacturer's names and addresses
 - f. Division of work (e.g., plumbing, heating, ventilating, etc.)
 - g. Description of item submitted (using project nomenclature) and relevant specification number
 - h. Notations of deviations from the contract documents
 - i. Other pertinent data

- j. Provide space for Contractor's review stamps
3. Composition:
- a. Submittals shall be submitted using specification sections and the project nomenclature for each item.
 - b. Individual submittal packages shall be prepared for items in each specification section. All items within a single specification section shall be packaged together where possible. An individual submittal may contain items from multiple specifications sections if the items are intimately linked (e.g., pumps and motors).
 - c. All sets shall contain an index of the items enclosed with a general topic description on the cover.
4. Content: Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; dimensions; shipping and operating weights; shipping splits; service clearances; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
5. Contractor's Approval Stamp:
- a. The Contractor shall thoroughly review and approve all shop drawings before submitting them to the Architect/Engineer. The Contractor shall stamp, date and sign each submittal certifying it has been reviewed.
 - b. Unstamped submittals will be rejected.
 - c. The Contractor's review shall include, but not be limited to, verification of the following:
 - 1) Addenda items have been incorporated.
 - 2) Catalog numbers and options match those specified.
 - 3) Performance data matches that specified.
 - 4) Electrical characteristics and loads match those specified.
 - 5) Equipment connection locations, sizes, capacities, etc. have been coordinated with other affected trades.
 - 6) Dimensions and service clearances are suitable for the intended location.
 - 7) Equipment dimensions are coordinated with support steel, housekeeping pads, openings, etc.
 - 8) Constructability issues are resolved (e.g., weights and dimensions are suitable for getting the item into the building and into place, sinks fit into countertops, etc.).
 - d. The Contractor shall review, stamp and approve all subcontractors' submittals as described above.

- e. The Contractor's approval stamp is required on all submittals. Approval will indicate the Contractor's review of all material and a complete understanding of exactly what is to be furnished. Contractor shall clearly mark all deviations from the contract documents on all submittals. If deviations are not marked by the Contractor, then the item shall be required to meet all drawing and specification requirements.
6. Submittal Identification and Markings:
- a. The Contractor shall clearly mark each item with the same nomenclature applied on the drawings or in the specifications.
 - b. The Contractor shall clearly indicate the size, finish, material, etc.
 - c. Where more than one model is shown on a manufacturer's sheet, the Contractor shall clearly indicate exactly which item and which data is intended.
 - d. All marks and identifications on the submittals shall be unambiguous.
7. Schedule submittals to expedite the project. Coordinate submission of related items.
8. Identify variations from the contract documents and product or system limitations that may be detrimental to the successful performance of the completed work.
9. Reproduction of contract documents alone is not acceptable for submittals.
10. Incomplete submittals will be rejected without review. Partial submittals will only be reviewed with prior approval from the Architect/Engineer.
11. Submittals not required by the contract documents may be returned without review.
12. The Architect/Engineer's responsibility shall be to review one set of shop drawing submittals for each product. If the first submittal is incomplete or does not comply with the drawings and/or specifications, the Contractor shall be responsible to bear the cost for the Architect/Engineer to recheck and handle the additional shop drawing submittals.
13. Submittals shall be reviewed and approved by the Architect/Engineer before releasing any equipment for manufacture or shipment.
14. Contractor's responsibility for errors, omissions, or deviation from the contract documents in submittals is not relieved by the Architect/Engineer's approval.
15. Schedule shall allow for adequate time to perform orderly and proper review of submittals, including time for consultants and Owner if required, and resubmittals by Contractor if necessary, and to cause no delay in Work or in activities of Owner or other contractors.
- a. Allow at least two weeks for Architect's/Engineer's review and processing of each submittal.
16. Architect/Engineer reserves the right to withhold action on a submittal which, in the Architect/Engineer's opinion, requires coordination with other submittals until related submittals are received. The Architect/Engineer will notify the Contractor, in writing, when they exercise this right.

C. Electronic Submittal Procedures:

- 1. Distribution: Email submittals as attachments to all parties designated by the Architect/Engineer, unless a web-based submittal program is used.

2. Transmittals: Each submittal shall include an individual electronic letter of transmittal.
3. Format: Electronic submittals shall be in PDF format only. Scanned copies, in PDF format, of paper originals are acceptable. Submittals that are not legible will be rejected. Do not set any permission restrictions on files; protected, locked, or secured documents will be rejected.
4. File Names: Electronic submittal file names shall include the relevant specification section number followed by a description of the item submitted, as follows. Where possible, include the transmittal as the first page of the PDF instead of using multiple electronic files.
 - a. Submittal file name: 28 XX XX.description.YYYYMMDD
 - b. Transmittal file name: 28 XX XX.description.YYYYMMDD
5. File Size: Files shall be transmitted via a pre-approved method. Larger files may require an alternative transfer method, which shall also be pre-approved.

1.8 CHANGE ORDERS

- A. Change order work shall not proceed until authorized.

1.9 PRODUCT DELIVERY, STORAGE, HANDLING & MAINTENANCE

- A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.
- B. Store materials on the site to prevent damage.
- C. Keep fixtures, equipment and materials clean, dry and free from harmful conditions.

1.10 NETWORK / INTERNET CONNECTED EQUIPMENT

- A. These specifications may require certain equipment or systems to have network, Internet and/or remote access capability ("Network Capability"). Any requirement for Network Capability shall be interpreted only as a functional capability and is not to be construed as authority to connect or enable any Network Capability. Network Capability may only be connected or enabled with the express written consent of the Owner.

1.11 WARRANTY

- A. At a minimum, provide a one (1) year warranty for all equipment, materials, and workmanship. Individual specifications sections within Division 28 may require additional warranty requirements for specific equipment or systems.

- B. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of substantial completion unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or their representative.
- C. Warranty requirements shall extend to correction, without cost to the final user, of all work and/or equipment found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

1.12 INSURANCE

- A. Contractor shall maintain insurance coverage as set forth in Division 0 of these specifications.

1.13 MATERIAL SUBSTITUTION

- A. Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required.
- B. Equivalent equipment manufactured by the other named manufacturers may be used. Contractor shall ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. When using other listed manufacturers, the Contractor shall assume responsibility for any and all modifications necessary (including, but not limited to structural supports, electrical connections and rough-in, and regulatory agency approval, etc.) and coordinate such with other contractors. The Architect/Engineer shall make the final determination of whether a product is equivalent.
- C. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer via addendum. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of design. The Architect/Engineer may reject manufacturer at time of shop drawing submittal. The Contractor assumes all costs incurred by other trades on the project as a result of changes necessary to accommodate the offered material, equipment or installation method.
- D. Should this Contractor be unable to secure approval from the Architect/Engineer for other unnamed manufacturers as outlined above, this Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article or equipment necessitating extra expense on This Contractor or on the part of other Contractors whose work is affected.

PART 2 - PRODUCTS

2.1 PLENUM RATING REQUIREMENTS

- A. This project requires all cable jackets, hook and loop cable ties, fasteners, and any other product installed in plenum space to carry a plenum rating.

PART 3 - EXECUTION

3.1 JOBSITE SAFETY

- A. Neither the professional activities of the Architect/Engineer, nor the presence of the Architect/Engineer or the employees and subconsultants at a construction site, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the contract documents and any health or safety precautions required by any regulatory agencies. The Architect/Engineer and personnel have no authority to exercise any control over any construction contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor is solely responsible for jobsite safety. The Architect/Engineer and the Architect/Engineer's consultants shall be indemnified and shall be made additional insureds under the Contractor's general liability insurance policy.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Installation of all conduit and cabling shall comply with Sections 26 05 33 and 26 05 13. Additional conduit requirements described within this Division shall be supplemental to the requirement described in Section 260533. Should conflicts exist between the two Divisions the more stringent (more expensive material and labor) condition shall prevail until bidding addendum or construction clarification or RFI can be submitted and responded to. In no case shall the Contractor carry the least stringent condition in the pricing.
- B. It is the Contractor's responsibility to survey the site and include all necessary costs to perform the installation as specified.
- C. The Contractor shall be responsible for identifying and reporting to the Architect/Engineer any existing conditions including but not limited to damage to walls, flooring, ceiling and furnishings prior to start of work. All damage to interior spaces caused by this Contractor shall be repaired at this Contractor's expense to pre-existing conditions, including final colors and finishes.
- D. All cables and devices installed in damp or wet locations, including any underground or underslab location, shall be listed as suitable for use in such environments. Follow manufacturer's recommended installation practices for installing cables and devices in damp or wet locations. Any cable or device that fails as a result of being installed in a damp or wet location shall be replaced at the Contractor's expense.

3.3 FIELD QUALITY CONTROL

A. General:

1. Refer to specific Division 28 sections for further requirements.
2. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
3. The necessary instruments and materials required to conduct or make the tests shall be supplied by the Contractor who shall also supply competent personnel for making the tests who has been schooled in the proper testing techniques.
4. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

B. Protection of cable from foreign materials:

1. It is the Contractor's responsibility to provide adequate physical protection to prevent foreign material application or contact with any cable type. Foreign material is defined as any material that would negatively impact the validity of the manufacturer's performance warranty. This includes, but is not limited, to overspray of paint (accidental or otherwise), drywall compound, or any other surface chemical, liquid or compound that could come in contact with the cable, cable jacket or cable termination components.
2. Application of foreign materials of any kind on any cable, cable jacket or cable termination component will not be accepted. It shall be the Contractor's responsibility to replace any component containing overspray, in its entirety, at no additional cost to the project. Cleaning of the cables with harsh chemicals is not allowed. This requirement is regardless of the PASS/FAIL test results of the cable containing overspray. Should the manufacturer and warrantor of the structured cabling system desire to physically inspect the installed condition and certify the validity of the structured cabling system (via a signed and dated statement by an authorized representative of the structured cabling manufacturer), the Owner may, at their sole discretion, agree to accept said warranty in lieu of having the affected cables replaced. In the case of plenum cabling, in addition to the statement from the manufacturer, the Contractor shall also present to the Owner a letter from the local Authority Having Jurisdiction stating that they consider the plenum rating of the cable to be intact and acceptable.

3.4 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representative or representatives in the maintenance, care, and operation of the complete systems installed under this contract.
- B. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems.

- C. The Owner has the option to make a video recording of all instructions. Coordinate schedule of instructions to facilitate this recording.
- D. Notify the Architect/Engineer of the time and place for the verbal instructions to be given to the Owner's representative so a representative can be present if desired.
- E. Refer to the individual specification sections for minimum hours of instruction time for each system.
- F. Operating Instructions:
 - 1. The Contractor is responsible for all instructions to the Owner and/or Owner's operating staff on the security systems.
 - 2. If the Contractor does not have Engineers and/or Technicians on staff that can adequately provide the required instructions on system operation, performance, troubleshooting, care and maintenance, the Contractor shall include in the bid an adequate amount to reimburse the Owner for the Architect/Engineer to perform these services.

3.5 SYSTEM STARTING AND ADJUSTING

- A. The security systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, configuration, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, equipment settings, software configuration, troubleshooting and verification of software, and final adjustments that may be required.
- B. All operating conditions and control sequences shall be simulated and tested during the start-up period.
- C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of troubleshooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Owner on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.6 RECORD DOCUMENTS

- A. Refer to the Division 1 Section: PROJECT CLOSEOUT for requirements. The following paragraphs supplement the requirements of Division 1.
- B. Mark specifications to indicate approved substitutions, change orders, and actual equipment and materials used.

- C. This Contractor shall maintain at the job site, a separate and complete set of Security Drawings which shall be clearly and permanently marked and noted in complete detail any changes made to the location and arrangement of equipment or made to the Technology Systems and wiring as a result of building construction conditions or as a result of instructions from the Architect or Engineer. All Change Orders, RFI responses, Clarifications and other supplemental instructions shall be marked on the documents. Record documents that merely reference the existence of the above items are not acceptable. Should This Contractor fail to complete Record Documents as required by this contract, This Contractor shall reimburse Architect/Engineer for all costs to develop record documents that comply with this requirement. Reimbursement shall be made at the Architect/Engineer's hourly rates in effect at the time of work.
- D. Record actual routing of all conduits sized 2" or larger.
- E. The above record of changes shall be made available for the Architect and Engineer's examination during any regular work time.
- F. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.7 ADJUST AND CLEAN

- A. Contractor shall thoroughly clean all equipment and systems prior to the Owner's final acceptance of the project.
- B. Contractor shall clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment.
- C. Contractor shall remove all rubbish, debris, etc., accumulated during the Contractor's operations from the premises.

STATEMENT INDICATING READINESS FOR FINAL JOBSITE OBSERVATION

To assist the contractor in a timely close-out of the project, it is crucial that the final jobsite observation is not conducted prior to the project being ready. The contractor is required to review the completion status of the project at the time the observation is scheduled. This review, and the subsequent submittal of this form to the Architect/Engineer, shall indicate the contractor's agreement that the area of the project being requested for final observation is ready as defined below. The following list represents the degree of completeness required prior to requesting a final observation:

1. All cabling pathways (cable tray, ladder rack, conduit sleeves, etc.) are installed and all cabling has been pulled through them.
2. All mechanical firestop products are installed and all other penetrations have been sealed.
3. All CCTV cameras, mounts, cabling and all headend equipment are installed, programmed and operational.
4. All access control system equipment, including card readers, conduits, cabling, electronic locks, controllers and all headend equipment, is installed, programmed and operational.

Prime Contractor: _____ By: _____

Requested Observation Date _____ Today's Date: _____

Contractor shall sign this readiness statement and transmit to Architect/Engineer at least 10 days prior to the requested date of observation.

It is understood that if the Architect/Engineer finds that the project is not complete as defined above and that the final jobsite observation cannot be completed on the requested date, the Architect/Engineer will return to the site at a later date. All additional visits to the site for the purposes of completing the final observation will be billed T&M to the Contractor at our standard hourly rates, including travel expenses or the contractor's retainage may be deducted for the same amount.

END OF SECTION

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SECTION 281500.30
MULTI-FAMILY ACCESS CONTROL DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. System operation and credential encoding system.
 - 2. Online door controller system.
 - 3. Mobile configuration application.
 - 4. Electromechanical resident room locks.
 - 5. Electromechanical common area locks.
 - 6. Credential enrollment station.
 - 7. Cloud based access control system application software.
 - 8. Access credentials.
- B. Related Sections:
 - 1. Division 01 "General Requirements".
 - 2. Division 06 Section "Rough Carpentry".
 - 3. Division 06 Section "Finish Carpentry".
 - 4. Division 08 Section "Hollow Metal Doors and Frames".
 - 5. Division 08 Section "Pre-Hung Wood Doors".
 - 6. Division 08 Section "Fiberglass Doors",
 - 7. Division 08 Section "Automatic Door Operators".
 - 8. Division 26 "Electrical".

9. Division 28 Section "Intercom Entry Systems".
 10. Division 32 Section "Decorative Metal Fences and Gates".
- C. Codes and References: Comply with the version adopted by the Authority Having Jurisdiction.
1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
 2. IBC - International Building Code.
 3. NFPA 80 - Fire Doors and Windows.
 4. NFPA 101 - Life Safety Code.
 5. NFPA 105 - Installation of Smoke Door Assemblies.
 6. FCC Part 15 Subpart C.
 7. State Building Codes, Local Amendments.
- D. Standards: All hardware specified herein shall comply with the following industry standards:
1. ANSI/BHMA Certified Product Standards - A156 Series
 2. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

1.03 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. System Operational Descriptions: Complete system operational narratives for the integrated access-controlled openings defining the owner's prescribed requirements for the opening functionality. Narratives include, but are not limited to, the following situations: normal secured/unsecured state of door; authorized access; authorized egress; unauthorized access; unauthorized egress; fire alarm and loss of power conditions, and interfaces with other building control systems.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access-controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary access control components.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware and site management installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.
- F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Inventory components upon receipt and provide secure lock-up and shelving. Do not store electronic locks, software or accessories at Project site without prior authorization.
- B. Tag each lockset or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service.

1.05 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing electrified door hardware and access control system components.
- B. System Survey: Prior to ordering the system, review the construction documents to determine the correct number and locations of stand-alone locks and wired devices if possible.
 - 1. Data-on-Credential applications that require physical credentials are supported by online updaters.
- C. Electrical Connections: Coordinate the layout and installation of scheduled electrified door and related access control equipment with required connections to source power junction boxes, low voltage power supplies and Power over Ethernet switches as applicable.

1.06 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
 - 1. Structural failures including excessive deflection, cracking, or breakage.
 - 2. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 3. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:

1. nexTouch NTB600 Series Cylindrical Lock: 3-year electrical, 3-year mechanical, 1-year finish.
2. nexTouch NTM600 Series Mortise Lock: 3-year electrical, 3-year mechanical, 1-year finish.
3. nexTouch NTT600 Series Electrified Trim for Rim Exit Device: 3-year electrical, 3-year mechanical, 1-year finish.
4. NTD600 Series Deadbolt Lock: 1-year electrical, 3-year mechanical, 1-year finish.
5. NTD600 Series Interconnected Lock: 1-year electrical, 3-year mechanical, 1-year finish.
6. NTX-600-KIT Updater/Controller: 1-year electrical.
 - a. NTX600-CTRL: 1-year electrical.
 - b. HID R10BLE, R40BLE, SE SEOS BLE Readers: limited lifetime electrical.

1.07 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed by certified integrator for continued adjustment, maintenance, and removal and replacement of system components.

1.08 SCOPE OF WORK

- A. Access Control Site Management System: Furnish and install at the indicated locations the specified integrated access control door hardware and access control system firmware and software for a completely operational access control. System includes, but is not necessarily limited, to the following:
 1. Electrified integrated access control locks, network switches, updaters, door position switches, remote credential updaters, keypads, access credentials, system application software and mobile configuration device application, special tools, operating manuals, and required cabling and accessories as detailed below and listed in the Access Control Hardware Sets at the end of Part 3.
 - a. Provide manufacturer approved integrated access control locks, exit hardware, and remote mounted credential updaters and keypads that are functionally compatible with the specified access control equipment interfaces.
- B. Owner to provide the following:

1. Internet accessible devices that support current browser software.
 2. Compatible mobile devices that run an Android OS and offer NFC (Near Field Communication) capabilities, thus capable of accepting the mobile configuration application.
 - a. For offline lock and online updater configuration: Mobile device to run an Android OS and offer NFC (Near Field Communication) capabilities, thus capable of accepting the mobile configuration application.
 - b. For mobile access to offline lock and online updaters: Bluetooth Low Energy (BLE) capable IOS or Android mobile device with internet connection to download the ASSA ABLOY ACCENTRA Access mobile application.
 3. Power Sourcing, Network Switches, Power over Ethernet: Quantity as required to accommodate installed access control devices.
 4. Network Control Connections: LAN/Ethernet communication ports (jacks) and network interface cards as needed, CAT5e (CAT6) cabling from network router/switch to networked updater, outlet and cover plates and/or patch cables required for network connection.
 5. Power Supplies, including battery or uninterrupted backup power supply (UPS) and separately fused surge protection, required for the electrified door hardware, access control equipment, and PoE switches or wireless routers driving the integrated credential reader locking devices.
 6. Installation, final configuration and commissioning of electrified door and access control system hardware, power supplies and related accessories.
 7. System application and cloud services and mobile application including installation, programming, and end user training of the access control system and mobile access applications demonstrating operating, repair, and maintenance procedures.
- C. Electrical contractor, Division 26, to provide the following:
1. Source power wiring (120VAC) as required for the integrated locking and access control hardware, equipment, accessories and power supplies. This includes quad outlets as required on a dedicated circuit and the related conduit, stub-in, junction boxes and connectors required for the source power delivery and connections.

2. Provide required conduit, stub-in, junction and back boxes for both the electrified locking hardware and access control equipment at each of the access controlled or monitored openings per plan drawings and specs. Supply and install conduit between each of the aforementioned devices and between the electrical junction boxes, power supplies and access control equipment located on or above the door opening.
 - a. At wall mounted updaters, provide conduit on the secured side of the door, 36" from the finish floor and 6" from the edge of the frame, to the related power supplies and access control equipment.
 - b. At electrical hardware power transfers provide conduit on the secured side of the opening from the power transfer, thru-wire hinge, or serviceable panel location on the frame jamb to the related power supplies and access control equipment.
 3. Electrical Contractor to provide all 120VAC cabling connections and terminations from the electrical junction boxes to these electrical devices.
- D. Access Control System Integrator to provide the following:
1. Low voltage wiring (12/24VDC) and communication cabling (RS-485) to support controllers, relays, and electrified locking devices and door operators to updaters and power supplies. Work includes related connectors, final terminations, and hook-ups required for a complete and functional access controlled opening in accordance with applicable codes and specified system operational narratives.
 - a. Provide size appropriate spacers for updaters mounted against metal surfaces.
- E. Elevator Contractor to provide the following:
1. Interface or landing of interface cable onto the elevator call button will be performed by a certified elevator contractor.
 2. Coordinate with certified integrator provisions for a credential reader with output allowing the elevator call button to be activated. A validated credential reader and updater will be required for activation.
- F. Final connections to fire alarm system, if required, by electrical and fire alarm system contractors.
1. Provide permits, submittals and approvals required by the authority having jurisdiction, prior to commencing with work.

PART 2 PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
- C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.02 EQUIPMENT AND SYSTEM FEATURES

- A. System: System is cloud based and supports all major browsers.
 - 1. Client Requirements:
 - a. Internet Browser: Firefox, Chrome, Internet Explorer, Edge or similar.
 - b. Internet access.
 - 2. System Features:
 - a. 5,000 unique user credentials.
 - b. Ability to grant residents limited administrative rights to manage visitors/guests themselves via their mobile application and/or web interface.
 - c. Unlimited credential updaters (with door control).
 - d. User-definable schedules and revalidation periods.
 - e. Unlimited user-definable access for authorized users to system services.

- f. Unlimited provisioning of mobile credentials for system users.
 - g. Remote and schedule unlock for online door controllers.
 - h. Remote reboot and remote firmware upgrade of online controllers.
 - i. Access permissions with start and end dates and times for credential holders.
 - j. User definable emergency one-time-PIN code issuance for offline locks.
 - k. Unlimited cloud accessible audit history.
 - l. Visibility of online status of online openings.
 - m. System export capabilities to .CSV file format.
- B. Mobile Configuration Application: Provide a configuration application which is compatible with Android 5.0 or later and offers NFC (Near Field Communication) capabilities.
- 1. Configures time, date and system association for both offline locks and online updaters.
 - 2. Assigns unique identities to all devices within the system.
 - 3. Communicates lock information- lock type and firmware version to the cloud service.
 - 4. Displays locally retrieved audit trail from offline locks.
 - 5. Controls local lock settings and master code.
 - 6. Resets offline locks to factory default.
 - 7. Offline lock firmware upgrade over the air via NFC or BLE.
- C. Mobile Access Application: For residents and staff who desire to use a mobile device to access offline locks and/or online updaters- must have internet connectivity to receive the mobile credential and the device must be either Android 5.0 or IOS 13.
- 1. Stores SEOS credential in secure element of the mobile device.
 - 2. Revalidates mobile credential when an internet connection is established.
 - 3. Communicates access privileges to both offline locks and online openings.
 - 4. Provides positive visual, and optional audible, and vibratory feedback about the status of credential transaction in real time.

5. Ability to grant residents limited administrative rights to manage visitors/guests themselves via their mobile application and/or web interface.
 6. Communicates transaction information to the cloud when an internet connection is established.
- D. The facility will operate with the control of online updaters if physical credential access is required. If only mobile access is required, the facility may optionally operate without the control of online updaters.
- E. Manufacturers:
1. ASSA ABLOY ACCENTRA (YA) - Data-on-Credential compatible with the ASSA ABLOY Multi-Family Access Management Software System.

2.03 SYSTEM COMPONENTS AND TECHNOLOGY

- A. The system shall provide the ability for online operators to operate as online doors for the purposes of both access control and encoding/updating credentials. Provide the necessary network and lock components to create an online lock control system at the perimeter of the building. Utilize standard Ethernet and Power over Ethernet (PoE) as the communication backbone between the system server and the wired (on-line) doors and updaters.
- B. Functionality:
1. Online updaters must function as an offline locking system by continuing to grant access to authorized users if online communication is interrupted but continuous power is still applied.
 2. Must provide real-time control of online updaters and access privileges of individual users from a central or remote location.
 3. Must allow resident and staff credentials to be changed, extended, or revoked from cloud system. Resident credentials are automatically revoked upon move-out or expiration of a lease and allowable access timeframe.
 4. Credential holders shall be able to obtain a one-time PIN code from the systems software with proper authorization by the site administrator for emergency access to offline locks.

5. Must be possible to display access audit trails, low battery events, and system access in the cloud system. Additionally, audit trails from offline locks must be visible from the mobile configuration application via local lock retrieval.
 6. Must be possible to issue multiple mobile and physical credentials per user.
- C. Lock Communication: Provide locks with RFID and BLE read/write capabilities to provide the communication link between the system server and the lockset over data-on-credential transport mechanism.
- D. Credential Updaters/Controller combination: Provide R10/40 OSDP SE BLE Updaters compatible with: ISO 14443A. Provide system capable of supporting an unlimited number of online updaters acting as single door controllers and/or credential enrollment stations. Controller directly connects into the LAN/WAN network, using DHCP, DNS and TCP/IP addressing. Controller can be powered by PoE switches (specified in the electrical section), or by a 24VDC power supply. Controller shall offer a manual configuration lock option to prevent unauthorized configuration of the online updater.

2.04 ACCESS CONTROL LOCKS

- A. Cylindrical Locks: ANSI/BHMS S156.2, Series 4000, Grade 1 cylindrical lockset with integrated keypad for access and programming. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide locksets with functions and features as follows:
 - a. Fully encrypted AES 128 NFC and BLE wireless communication between lock and SEOS® credentials.
 - b. Pushbutton keypad or capacitive touchscreen.
 - c. Voice guided (English, French or Spanish) programming and master PIN code for security.
 - d. Motorized locking and unlocking.
 - e. Unlockable via key, one time PIN code and/or card, fob or mobile credential with optional deadbolt.
 - f. Firmware upgradable over the air via configuration application.
 - g. Audit trail with 200 locally retrievable and unlimited cloud management events.
 - h. Optional modes: privacy, wrong-try shutdown, escape return, passage.

- i. Powered via 4AA batteries, external 9VDC regulated power supply, or 9VDC transistor battery backup terminal at keypad (emergency).
 - 2. Manufacturers:
 - a. ASSA ABLOY ACCENTRA (YA) - nexTouch NTB600-ACC Series.
- B. Interconnected Locks: ANSI/BHMA A156.2, Series 4000, Grade 2 interconnected lock with integrated keypad for access and programming. Listed manufacturers shall meet all functions and features as specified herein.
- 1. Provide locksets with functions and features as follows:
 - a. Fully encrypted AES 128 NFC and BLE wireless communication between lock and SEOS® credentials.
 - b. Capacitive touchscreen.
 - c. Voice guided (English, French or Spanish) programming and master PIN code for security.
 - d. Motorized locking and unlocking.
 - e. Unlockable via key, one time PIN code and/or card, fob or mobile credential with optional deadbolt.
 - f. Firmware upgradable over the air via configuration application.
 - g. Audit trail with 200 locally retrievable and unlimited cloud management events.
 - h. Optional modes: privacy, wrong-try shutdown, escape return, passage.
 - i. Powered via 4AA batteries, external 9VDC regulated power supply, or 9VDC transistor battery backup terminal at keypad (emergency).
 - 2. Manufacturers:
 - a. ASSA ABLOY ACCENTRA (YA) - NTC600-ACC Series.

2.05 CREDENTIAL UPDATERS/DOOR CONTROLLERS

- A. Contactless smart credential updaters to securely read information from and write access control data to 13.56 MHz contactless RFID smart credentials. The contactless smart credential updater is designed for use in the Accentra Access Control system by providing:

1. Secure access control data exchange between the credential and the updater utilizing key diversification and mutual authentication routines.
2. Contactless smart credential updater to be designed for low current operation to enable migration from most legacy proximity applications without the need to replace existing electrified door hardware, wiring and/or power supplies.
3. Updater product construction suitable for both indoor and outdoor applications.
4. Updater available with either pig tail or terminal block wiring options.
5. Updater available in either mini-mullion or wall switch form factor.
6. Manufacturers (13.56 MHz iCLASS):
 - a. ASSA ABLOY ACCENTRA (YA) - NXT 610BLE/640BLE (as specified).

2.06 CREDENTIALS

- A. Contactless Smart Card Credentials: Card credentials incorporating an access control identification technology that utilizes 13.56 MHz radio frequency (RF) circuits in microchip form. The microchips are encoded and securely transmit the encoded information when activated.
 1. Technology features:
 - a. Available in 8K-Bytes.
 - b. AES-128 bits cryptographic algorithms for data protection.
 - c. Hardware chip integrating co-processor with high performance for cryptographic calculations with symmetric keys.
 2. Security features:
 - a. Programmable with one or several Secure Identity Objects® (SIOs®) for each application.
 3. Interoperability:
 - a. Fully supported by iCLASS SE® and multiclass SE® readers that can process SIO-enabled data formats. PACS online only supported by iCLASS SE readers with firmware Revision E or later.

4. Quantity: Include three per resident room. Coordinate additional credential quantities with the facility manager.
5. Manufacturers (13.56 MHz iCLASS SEOS):
 - a. ASSA ABLOY ACCENTRA (YA) - NTX600-YALPRX-8K.
- B. Key Fobs: Fobs incorporating an access control identification technology that utilizes 13.56 MHz radio frequency (RF) circuits in microchip form. The microchips are encoded and securely transmit the encoded information when activated.
 1. Technology features:
 - a. Available in 8K-Bytes.
 - b. AES-128 bits cryptographic algorithms for data protection.
 - c. Hardware chip integrating co-processor with high performance for cryptographic calculations with symmetric keys.
 2. Security features:
 - a. Programmable with one or several Secure Identity Objects® (SIOs) for each application.
 3. Fob technology features:
 - a. 13.56MHz FOB supports Accentra offline iCLASS SEOS and PACS online iCLASS SEOS technologies with 8K.
 4. Memory interoperability:
 - a. Fully supported by iCLASS SE® and multiCLASS SE® readers that can process SIO-enabled data formats. PACS only supported by iCLASS SE readers with firmware Revision E or later.
 5. Quantity: Include three per resident room. Coordinate additional fob credential quantities with the facility manager.
 6. Manufacturers (13.56 MHz iCLASS SEOS offline and online):
 - a. ASSA ABLOY ACCENTRA (YA) - NTX600-YALFOB-8K.
- C. Mobile Credentials:

1. Technology features:
 - a. 2.4 GHz mobile credential supports Accentra offline iCLASS SEOS and PACS online iCLASS SEOS technologies.
 - b. AES-128 bits cryptographic algorithms for data protection.
2. Security features:
 - a. Authenticated with secure, automatically expiring registration code.
 - b. Revocable over the air with active internet connection or via lapsed revalidation period
3. Quantity: Include up to three per resident or staff member identity
4. Manufacturers:
 - a. ASSA ABLOY ACCENTRA (YA) - 2.4 GHz iCLASS SEOS offline.

2.07 FABRICATION

- A. Fasteners: Provide system components manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.08 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions for compliance with requirements for installation tolerances, labeled fire door assembly construction, and other conditions affecting performance.

- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.02 PREPARATION

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.03 INSTALLATION

- A. Install each item to comply with manufacturer's written instructions and according to specifications.
 - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of products including but limited to: front desk equipment and software, remote controllers, electromechanical exit devices, and unit room locks.
- B. Storage: Provide a secure lock up for materials delivered to the project but not yet installed. Control the handling and installation of items so that the completion of the work will not be delayed by material losses before and after installation.

3.04 FIELD QUALITY CONTROL

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.
 - 1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.05 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating unit and each door lock to ensure proper operation. Replace units that cannot be adjusted to operate as intended.

3.06 CLEANING AND PROTECTION

- A. Protect all components stored on construction site in a covered and dry place. Protect installed components during the construction phase. Install components at the latest possible time frame.
- B. Clean components as necessary to restore proper finish. Provide final protection and maintain conditions that ensure components are without damage or deterioration at time of owner occupancy.

3.07 DEMONSTRATION

- A. Instruct Owner's managerial personnel on the correct use of the online updater, configuration application for the purpose of lock updates for time after battery changes, and cloud service components.
- B. Instruct Owner's managerial personnel on the location and navigation of the cloud service and configuration application user manuals in the cloud service.
- C. Instruct Owner's maintenance personnel to adjust, operate, and maintain electromechanical door hardware.

3.08 DOOR HARDWARE SCHEDULE

- A. Refer to Section 087100, Door Hardware Schedule, for hardware sets.

END OF SECTION

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**SECTION 281523
INTERCOM ENTRY SYSTEMS**

PART 1 GENERAL

1.01 REFERENCE STANDARDS

- A. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 SUMMARY

- A. This Section includes multi-tenant video intercom entry systems and related products.
- B. Related Sections:
 - 1. Division 01 "General Requirements".
 - 2. Division 06 Section "Rough Carpentry".
 - 3. Division 06 Section "Finish Carpentry".
 - 4. Division 08 Section "Hollow Metal Doors and Frames".
 - 5. Division 08 Section "Pre-Hung Wood Doors".
 - 6. Division 08 Section "Fiberglass Doors",
 - 7. Division 08 Section "Automatic Door Operators".
 - 8. Division 26 Section "Electrical"
 - 9. Division 28 Section "Multi-Family Access Control Hardware Devices".
 - 10. Division 32 Section "Decorative Metal Fences and Gates".
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- D. Codes, References and Standards:
 - 1. American National Standards Institute (ANSI/TIA/EIA) 568 - Commercial Building Telecommunications Cabling Standard.

2. International Organization for Standards (ISO) 9001:2000 - Quality Management Systems - Requirements.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including Preparation instructions and recommendations, storage and handling requirements and recommendations and installation methods.
- B. Shop Drawings: Submittals to include wiring diagrams indicating wiring for each item of equipment and interconnections between items of equipment. Include manufacturer's names, model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
- C. Installation and Operation Manuals: Submit manufacturer's installation and operation manual, including operation instructions and component wiring diagrams. Provide detailed information required for Owner to properly operate equipment.
- D. Warranty: Submit manufacturer's standard warranty.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Engage a qualified manufacturer that is an ISO 9001 (2008) certified company.
- B. Installer Qualifications: Factory trained and experienced with system installations of scope and size required for the Project.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in clean, dry area indoors in accordance with manufacturer's instructions.
- C. Protect materials during handling and installation to prevent damage.

1.07 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 INTERCOM ENTRY STATIONS

- A. Door Stations (Multi-Tenant, Large Occupancy): Modern, rectangular surface or flush mounted IP video door stations for multi-tenant residences and buildings with up to 500 units.
 - 1. Manufacturers:
 - a. DoorBird (DR) - D21 Series.
- B. Indoor Stations: Single-family or multi-tenant door communication IP video stations.
 - 1. Provide door stations with the following functions and features:
 - a. Scratch-resistant tempered Gorilla glass 4" true color touch display.
 - b. Visitor history with cloud recording.
 - c. Three relays for door release.
 - d. Two-way HD audio up to 102 dB.
 - e. Room-to-room communication with multiple indoor stations.
 - f. Home and building automation control.
 - 2. Manufacturers:
 - a. DoorBird (DR) - A1100 Series.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive integrated security and communication system and notify architect of conditions that would adversely affect installation or subsequent use. Do not begin installation until unacceptable conditions are corrected.

3.02 PREPARATION

- A. Verify the following compliance before starting installation.
 - 1. All units, except for the entrance station and tenant station, are designed for indoor use only.

2. The unit turns inoperative during power failure.
3. In areas where broadcasting station antennas are close by, intercom system may be affected by radio frequency interference.
4. Keep the intercom wires at least 1 foot away from strong electrical wiring including wiring for inverter electrical appliances; noise and malfunction could result.
5. Keep the unit more than 3.3 feet away from radio or TV set.
6. If a strong light shines on the main unit screen, the picture will turn white or only silhouettes will be visible.
7. Other manufacturer's devices (such as sensor, detectors, door releases) used with this system, comply with the manufacturer's installation requirements.

3.03 INSTALLATION

- A. Install integrated security and communication system in accordance with manufacturer's instructions at locations indicated on the Drawings.
- B. Mount equipment plumb, level, square, and secure. For video entrance stations and video door stations, comply with manufacturer's design requirements to provide optimum picture quality of station monitoring.

3.04 SETUP AND ADJUSTING

- A. Adjust integrated security and communication system for proper operation in accordance with manufacturer's instructions.

3.05 DEMONSTRATION AND TRAINING

- A. Demonstrate that integrated security and communication systems function properly.
 1. Perform demonstration at final system inspection by qualified representative of manufacturer.
- B. Provide instruction and training of Owner's personnel as required for operation of integrated security and communication system.
- C. Provide hands-on demonstration of operation of system components and complete system, including user-level program changes and functions.
- D. Provide instruction and training by qualified representative of manufacturer.

3.06 PROTECTION

- A. Protect installed integrated security and communication system from damage during construction.

END OF SECTION

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SECTION 283101 - FIRE ALARM AND DETECTION SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fire alarm and detection systems.

1.2 RELATED WORK

- A. Section 260553 - Electrical Identification: Refer to electrical identification for color and identification labeling requirements.

1.3 REFERENCES

- A. 2020 NFPA 70 - National Electrical Code (NEC) with Washington State amendments.
- B. NFPA 72 - National Fire Alarm and Signaling Code
- C. NFPA 101 - Life Safety Code
- D. UL 2017 - General Purpose Signaling Devices and Systems
- E. UL 217 / 268 - Standard for Smoke Alarms / Smoke Detectors for Fire Alarm Systems
- F. 2021 Washington State Fire Code

1.4 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 260500 and as noted below.
 - 1. Failure to comply with all the following and all the provisions in 26 05 00 will result in the shop drawing submittal being rejected without review.
 - 2. Failure to submit the fire alarm without all requirements fulfilled in a single comprehensive submittal will be grounds to require a complete resubmittal.

1.5 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Provide quantity equal to 2 percent (2%) of amount of each type installed, but no less than two (2) units of each type.
 - a. Smoke and heat detectors, manual pull stations, duct smoke detectors, monitor modules, control modules and relays.
 - b. Notification Appliances: Speakers, speaker strobes, and strobes.

2. Keys: The installing contractor shall collect all equipment spare keys provided with each lockable or resettable device/cabinet minimum of one (1) set each and shall turn over to the Owner upon completion.
3. All spare parts shall be housed in metal cabinet labeled "Fire Alarm Spare Parts."
4. Portable Firefighter Emergency Handset Phones: Provide 10. Locate in the room with the main fire alarm panel.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of Section 260500.
- B. Store and protect products under provisions of Section 260500.

1.7 REGULATORY REQUIREMENTS

- A. System: UL or FM Global listed.
- B. Conform to requirements of NFPA 101.
- C. Conform to requirements of Americans with Disabilities Act (ADA).
- D. Conform to UL 864 Fire Alarm, UL 1076 Security, UL2017 General Signaling, and UL 2572 Mass Notification Communications.

1.8 SYSTEM DESCRIPTION

- A. Performance Statement: This specification section and the accompanying fire alarm specific design documents describe the minimum material quality, required features, and operational requirements of the system. These documents do not convey every wire that must be installed and every equipment connection that must be made. Based on the equipment described and the performance required of the system, as presented in these documents, the Vendor and the Contractor are solely responsible for determining all wiring, programming and miscellaneous equipment required for a complete and operational system.
- B. This section of the specifications includes the furnishing, installation and connection of the microprocessor controlled, intelligent reporting, fire alarm equipment required to form a complete coordinated system that is ready for operation. It shall include, but is not limited to, alarm initiating devices, control panels, auxiliary control devices, annunciators, power supplies, and wiring as indicated on the drawings and specified herein.
- C. Fire Alarm System: NFPA 72; Automatic and manual fire alarm system, non-coded, analog-addressable with automatic sensitivity control of certain detectors, multiplexed signal transmission.
- D. System Supervision: Provide electrically supervised system, with supervised Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC). Occurrence of single ground or open condition in initiating or signaling circuit places circuit in TROUBLE mode. Component or power supply failure places system in TROUBLE mode.

- E. Alarm Reset: Key-accessible RESET function resets alarm system out of ALARM if alarm initiating circuits have cleared.
- F. Lamp Test: Manual LAMP TEST function causes alarm indication at each zone at fire alarm control panel and at annunciator panels.
- G. Drawings: Only device layouts and some equipment have been shown on the contract drawings. Wiring and additional equipment to make a complete and functioning system has not been shown, but shall be submitted on the shop drawings.

1.9 PROJECT RECORD DOCUMENTS

- A. Submit documents under the provisions of Section 260500.
- B. Include location of end-of-line devices.
- C. Provide a CAD drawing of each area of the building (minimum scale of 1/16" = 1'-0") showing each device on the project and its address. The devices shall be shown in their installed location and shall be labeled with the same nomenclature as is used in the fire alarm panel programming.
- D. Submit test results of sound pressure level (dBA) and intelligibility (STI) with the rooms tested designated on the floor plan. Notification devices shall have the tap wattage designated.

1.10 OPERATION AND MAINTENANCE DATA

- A. Submit data under provisions of Section 260500.
- B. Include operating instructions, and maintenance and repair procedures.
- C. Include results of testing of all devices and functions.
- D. Include manufacturer's representative's letter stating that system is operational.
- E. Include the CAD floor plan drawings.
- F. Include shop drawings as reviewed by the Architect/Engineer and the local Authority Having Jurisdiction.

1.11 WARRANTY

- A. Provide one (1) year warranty on all materials and labor from Date of Substantial Completion.
- B. Warranty requirements shall include furnishing and installing all software upgrades issued by the manufacturer during the one (1) year warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Johnson Controls - Simplex
- B. Notifier by Honeywell
- C. Edwards - EST
- D. Siemens Fire Safety
- E. Gamewell - FCI

2.2 FIRE ALARM CONTROL PANEL (FAP)

- A. Control Panel: Modular, power-limited electronic design. Provide flush surface wall-mounted enclosure as shown on plans. Enclosure shall be minimum 0.060 steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.
- B. Each Signaling Line Circuit (SLC loop) shall not be loaded over 80% of the maximum device capacity. For example, in the minimum system capacity column listed below, if the fire alarm manufacturer's system capacity of analog sensors per loop is 99 devices, then no more than 79 devices shall be wired on that loop. The minimum system capacity shall be as follows:
 - 1. Minimum Total Addressable Points: 250
 - 2. Minimum Total SLC Loops (including board, ready for field connections): 1
- C. Signal Line Circuit (SLC) and Notification Appliance Circuit (NAC) Boards:
 - 1. Each board shall communicate directly with each addressable analog sensor and binary input to determine normal, alarm, or trouble conditions. Analog signals would be used for automatic test and determination of maintenance requirements.
 - 2. Each board shall contain its own microprocessor and shall be provided to monitor addressable inputs and to control addressable outputs (addressable relays). The board shall communicate and provide power to all devices on its loop over a single pair of wires, except where 4-wire devices require a separate power circuit.
- D. Central Processing Unit:
 - 1. The central processing unit (CPU) shall communicate with the monitor and control all other modules in the panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the CPU.
 - 2. The CPU shall execute all control-by-event programs for specific action to be taken if a designated situation is detected in the system. A real-time system clock for time annotations on the display and printer shall be included.
 - 3. All power for the unit shall be supervised and supplied by the FAP.

E. Display:

1. The board shall provide all controls and indicators used by the system operator and may also be used to program all control panel parameters.
2. The board shall provide an alphanumeric array for display of custom alphanumeric labels for all addressable points. It shall also provide indicators for AC Power, System Alarm, System Trouble, Display Trouble and Signal Silence.
3. Displayed descriptions of addressable points shall include actual room names/numbers selected by the Owner. This information shall be obtained prior to programming. Room names/numbers shown on floor plans shall not be used.
4. The board shall provide a touch key-pad with control capability to command all system functions and entry of any alphanumeric information. Twenty different passwords with four levels of security shall be supported to prevent unauthorized manual control or programming.

F. Memory: The CPU and display interface board shall be augmented by non-volatile field programmable memory. EPROM memory will also be allowed provided the memory is burned in with minimum expansion capability equal to the total system capacity of the panel. Memory shall not be lost upon primary and secondary power failure.

G. Power Supply:

1. Input power shall be 120 VAC, 60 Hertz. Output power shall be as noted on the device specifications and drawings. Each component of the fire alarm system requiring 120 VAC input power shall be served from a dedicated emergency life safety branch circuit. Provide two #12 conductors and one #12 ground in 3/4" conduit to a dedicated 20A/1P circuit breaker with a red handle and a manufacturer's standard handle lock-on device. Identify/label breaker and branch circuit in accordance with NFPA requirements and Specification Section 260553.
2. Adequate to supply 125% of all control panel and peripheral power needs as well as 125% of power required for all external audio-visual devices. The power supply may be increased as needed by adding additional modular expansion power supplies. Over-current protections shall be provided on all power outputs.
3. All power supplies shall be designed and installed to meet UL and NFPA requirements for power-limited operation on all external initiating and indicating circuits.
4. The power supply shall provide integral charger for use with internal batteries. Battery capacity shall be sufficient for operation of the entire system for 24 hours in a non-alarm state followed by alarm mode for 15 minutes, plus 25% spare capacity for future devices.

H. Surge Protection:

1. All fire alarm control panels, NAC panels, etc. shall be provided with a surge protection device (SPD). The SPD shall be UL listed to Standard 1449 Rev 3. The unit should be clearly labeled in accordance with Identification Section 260553. The SPD shall have thermal fuses to protect against fire in short circuit conditions. The unit shall provide visual indication that the unit is protecting and functioning.
2. Any communications or signaling circuits associated with the fire alarm system, which leave or enter a facility, shall be provided with a surge protection device. The devices shall be as recommended by the fire alarm system manufacturer.

I. Digital Communicator:

1. Provide phone line interface capable of fire alarm notification to the local fire department, fire protection agency, or monitoring service. Communicator shall report in SIA and most major communication formats, with the capability of transmitting each device address point in a format compatible with the central station receiver.

2.3 Fire Alarm Pathway Class and Survivability Level

A. Pathway Class:

1. Pathway Class B: Circuits NOT capable of transmitting an alarm beyond the location of the fault condition. Wiring of outgoing and return conductors is permitted to be run in the same conduit or cable.

2.4 SIGNALING LINE CIRCUIT DEVICES

- A. Combination Devices: Subscripts identify combination type devices when applicable. Contractor shall provide the combination device or provide multiple device(s) to meet the functionality when the manufacturer does not offer the required functionality with a single device.

B. Signal Line Device(s):

1. Subscripts: Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - a. Device type as follows:
 - 1) W = Weather Proof
 - 2) WG = Wire guard is required
 - 3) Candela Ratings:
 - a) ## = 15 Candela, 30 Candela; 75 Candela; 110 Candela; 177 Candela
 - b) CD = NICET designer shall select Candela rating as required to provide full coverage of the space.

C. FA-120; Smoke Detectors:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - a. Device types as follows:
 - 1) Blank = Photoelectric
 - 2) BR = Beam Receiver
 - 3) BT = Beam Transmitter
 - 4) CO = Combination Smoke / Carbon Monoxide
 - 5) COH = Combination Smoke / Carbon Monoxide / Heat

- 6) COS = Combination Smoke / Carbon Monoxide / Strobe
 - 7) H = Combination Smoke / Heat Detectors
 - 8) ID = In-Duct Detector
 - 9) SA = Stand Alone with Sounder
 - 10) SB = Sounder Base
 - 11) SV = Stand Alone with Sounder and 177 Candela Strobe
2. (BLANK) Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.
3. (BR) and (BT) Projected Beam Type Detectors: This device shall utilize photoelectric analog smoke sensor technology. Provide with transmitter and associated receiver. Microprocessor-based detector shall provide a minimum of eight sensitivity levels, temperature and dirt compensation, and automatic gain control. Sensor to contain beam alignment adjustments and receiver calibration.
- a. Detector shall connect directly to an SLC loop or shall be provided with multiple monitor modules, as required, to connect to the SLC loop and for monitoring alarm and trouble output contacts. The detector shall be provided complete with all mounting hardware provided and installed where indicated on the drawings.
 - b. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided.
 - c. Provide with remote indicator panel providing LED indications of alarm and trouble.
4. (CO) Combination Smoke / Carbon Monoxide:
- a. Multi-criteria sensor for photoelectrical smoke sensing and carbon monoxide (CO) detection. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.
 - b. The combined photoelectric smoke detection CO module shall have separate sensors that adjust the detection profile in response to the input from the sensors.
 - c. The combined photoelectric smoke detection / CO module shall have selectable modes of operation for OSHA compliant toxic gas sensing, enhanced fire sensing, and nuisance alarm reduction mode.
 - d. The detector shall use only one address on the SLC.
 - e. CO sensor cartridge element shall be field replaceable.
5. (COH) Combination Smoke / Carbon Monoxide/Heat Detector:
- a. Multi-criteria sensor for photoelectrical smoke sensing, heat and carbon monoxide (CO) detection. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.
 - b. The combined photoelectric smoke detection / heat / CO module shall have separate sensors that adjust the detection profile in response to the input from the sensors.

- c. The combined photoelectric smoke detection / CO module shall have selectable modes of operation for OSHA compliant toxic gas sensing, enhanced fire sensing, and nuisance alarm reduction mode.
 - d. The detector shall use only one address on the SLC.
 - e. CO sensor cartridge element shall be field replaceable.
- 6. (COS) Combination Smoke / Carbon Monoxide/ Strobe Detector:
 - a. Multi-criteria sensor for photoelectrical smoke sensing, carbon monoxide (CO) detection, and 177 Candela strobe. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.
 - b. The combined photoelectric smoke detection / heat / CO module shall have separate sensors that adjust the detection profile in response to the input from the sensors.
 - c. The combined photoelectric smoke detection / CO module shall have selectable modes of operation for OSHA compliant toxic gas sensing, enhanced fire sensing, and nuisance alarm reduction mode.
 - d. The detector shall use only one address on the SLC.
 - e. CO sensor cartridge element shall be field replaceable.
- 7. (H) Combination Smoke / Heat Detector:
 - a. Multi-criteria sensor for photoelectrical smoke sensing and rate of rise heat detection. Carbon monoxide electrolytic sensing module shall provide toxic gas sensing to UL2034 and UL2075 standards.
 - b. The detector shall use only one address on the SLC
- 8. (IN) In-Duct Smoke Detectors:
 - a. Analog Photoelectric Type Sensor: Shall use the photoelectric principle to measure smoke density and send data to the control panel representing the analog level of smoke density measured.
 - b. Low Flow Type: Listed for use in duct with 0-2000 feet per minute velocity.
 - c. Each smoke detector shall connect directly to an SLC loop.
 - d. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided to match the duct application. Provide a two-piece head/base design.
 - e. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
 - f. Provide a remote LED indicator device (FA-240/241), mounted in ceiling directly below detector with a single-gang faceplate labeled: Duct Smoke Detector.
- 9. (SA) Stand Alone with Horn:
 - a. 120 VAC with 9V battery backup (batteries supplied by Contractor), photoelectric type, integral test switch, Form A/Form C contacts, 90 dB piezo solid-state horn, low/missing battery alarm, pulsing LED sensing chamber, insect screen, LED condition indicator, UL 217 listed.

- b. Approved Manufacturers:
 - 1) Gentex 9120 Series
 - 2) System Sensor
 - 3) Fenwall
 - 4) Gamewell
 - 5) Kidde
- 10. |
- 11. (SV) Stand Alone with Sounder and 177 Candela Strobe:
 - a. 120 VAC with 9V battery backup (batteries supplied by Contractor), photoelectric type, integral 177 Candela strobe, integral test switch, Form A/Form C contacts, 90 dB piezo solid-state horn, low/missing battery alarm, pulsing LED sensing chamber, insect screen, LED condition indicator, UL 217 listed.
 - b. Approved Manufacturers:
 - 1) Gentex 9120 Series
 - 2) System Sensor
 - 3) Fenwall
 - 4) Gamewell
 - 5) Kidde
- 12. Each smoke detector shall connect directly to an SLC loop, unless listed as stand alone.
- 13. Each detector shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided. Provide a two-piece head/base design.
- 14. Each detector shall have a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
- 15. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. Remote indicator terminals shall be provided. Provide a remote LED indicator device if detector is not visible from a floor standing position.
- 16. A test means shall be provided to simulate an alarm condition.
- 17. Where operation is noted as required below 32F and/or above 120F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32F and 120F.
- D. FA-130; Manual Pull Stations:
 - 1. Manual pull station, addressable, single action, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering. Provided with all necessary mounting hardware.
 - 2. Manual stations shall connect directly to an SLC loop. Stations shall provide address setting means using rotary decimal or DIP switches.
 - 3. Where operation is noted as required below 32F and/or above 120F, a conventional device shall be installed with a unique monitor module located in the nearest available location, with maintained temperatures between 32F and 120F.

E. FA-131; Manual Pull Stations with Cover:

1. Manual pull station, addressable, single action, reset key lock, semi-flush mount, red high abuse plastic or cast metal construction with white lettering. Provide device with clear Lexan tamper resistant cover with integral 9V battery powered alarm that sounds when shield is lifted. Provided with all necessary mounting hardware.
2. Manual stations shall connect directly to an SLC loop. Stations shall provide address setting means using rotary decimal or DIP switches.
3. Where operation is noted as required below 32F and/or above 120F, a conventional device shall be installed with a unique monitor module located in the nearest available location, with maintained temperatures between 32F and 120F.

F. FA-140; Heat Detectors:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
 - a. Device types as follows:
 - 1) Blank = Combination Rate of Rise / Fixed Temp
 - 2) F = Fixed Temp
 - 3) RC = Rate Compensated
2. (BLANK) Combination rate of rise and 135F fixed temperature analog thermal type sensor. Factory programmed to alarm at 135F and at 15F per minute rate-of-rise. Sensor shall measure heat level and send data to the control panel representing the analog level of thermal measurement and rate-of-rise.
3. (F) 200F fixed temperature. Provide a remote addressable monitor module to interface with addressable system as shown on the plans.
4. (RC) Rate Compensated
5. Provide a two-piece head/base design, with a manual switching means to set the internal identifying code (address) of that detector, which the control panel shall use to identify its address with the type of sensor connected.
6. Heat detectors shall connect directly to SLC loops. Where fixed temperature is used, one monitor module may be used to monitor all detectors in one room/area as shown on the drawings.
7. Detectors shall be mounted, where shown on the drawings, on a twist-lock base with all mounting hardware provided.
8. Provide a remote LED indicator device if detector is not visible from a floor-standing position.
9. Dual alarm and power indicators shall be provided that flash under normal conditions and remain continuous under alarm or trouble conditions. A connection for attachment of a remote indicator shall be provided.
10. A test means shall be provided to simulate an alarm condition.
11. Where operation is noted as required below 32F and/or above 120F, a conventional device shall be installed with a unique monitor module located in the nearest available location with maintained temperatures between 32F and 120F.

2.5 NOTIFICATION APPLIANCE DEVICES

A. FA-200; Visual Alarm Devices:

1. Wall or ceiling mounted, refer to plans.
2. High intensity (Candela rating as scheduled on the drawings) xenon strobe or equivalent under a lens. Candela rating shall be visible from exterior of the device.
3. The maximum pulse duration shall be 0.2 seconds with a maximum duty cycle of 40%. The flash rate shall be 1 Hz. Where more than two strobes are visible from any one location, the fire alarm visual devices shall be synchronized.
4. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.
5. (W) Weatherproof Visual Notification Device: High intensity strobe, square housing, 75 Candela rating, suitable for wet locations. Provide with weatherproof back box.
 - a. Mounting: Semi-flush wall.
 - b. Conduit shall not be exposed.

B. FA-210; Audio Alarm Devices:

1. Subscripts are used to define the device type, installation, and identify the device with a specific sequence of operation.
2. Device types as follows:
 - a. M = Mini-Horn
3. Sound Rating: 85 dB at 10 feet. Sound levels for alarm signals shall not exceed 120 dBA in the occupied area.
4. Device shall be capable of a high and low dB level setting. Unless noted otherwise, the device shall be set to the high setting at building completion.
5. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.
6. (M) Mini-Horn Audio Notification Device: Electronic Horn.
7. Mounting: Single gang flush wall.
8. Sound Rating: 85 dB at 10 feet. Sound levels for alarm signals shall not exceed 120 dBA in the occupied area.
9. Device shall be capable of a high and low dB level setting. Unless noted otherwise, the device shall be set to the high setting at building completion.
10. Device, housing, and backbox shall be UL listed for fire alarm/emergency applications.
11. (M) Mini-Horn Audio Notification Device: Electronic Horn.
 - a. Mounting: Single-gang flush wall.

C. FA-211; Combination Audio and Visual Alarm Device:

1. Combine audio and visual components into a single device. Refer to the corresponding paragraphs above for requirements of each component.
2. (W) Weatherproof Audio/Visual Notification Device: Electronic horn with high intensity strobe, square housing, 75 Candela, suitable for wet locations. Provide with weatherproof back box.

- a. Mounting: Semi-flush wall.
- b. Conduit shall not be exposed.

2.6 WIRE GUARDS

- A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, or other device requiring protection.
 - 1. Factory fabricated and furnished by device manufacturer.
 - 2. Finish: Paint of color to match the protected device.

2.7 WIRING

- A. Fire alarm wiring/cabling shall be furnished and installed by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes. Cabling shall be UL listed and labeled as complying with the Electrical Code for power-limited fire alarm signal service.
- B. Fire Alarm Cable:
 - 1. Manufacturers:
 - a. Comtran Corp.
 - b. Helix/HiTemp Cables, Inc.
 - c. Rockbestos-Suprenant Cable Corp.
 - d. West Penn Wire/CDT.
 - e. Radix.

PART 3 - EXECUTION

3.1 SEQUENCES OF FIRE ALARM OPERATION

- A. General:
 - 1. Refer to the Fire Alarm Operation Matrix on the drawings for basic requirements and system operation.

3.2 INSTALLATION

- A. Install system in accordance with manufacturer's instructions and referenced codes.
- B. Fire Alarm Control Panel:
 - 1. Install the control panel where shown on the drawings.
 - 2. All expansion compartments, if required, shall be located at the control panel.
- C. Devices:
 - 1. General:

- a. All ceiling-mounted devices shall be located where shown on the reflected ceiling and floor plans. If not shown on the reflected ceiling or reflected floor drawings, the devices shall be installed in the relative locations shown on the floor drawings in a neat and uniform pattern.
 - b. All devices shall be coordinated with luminaires, diffusers, sprinkler heads, piping and other obstructions to maintain a neat and operable installation. Mounting locations and spacing shall not exceed the requirements of NFPA 72.
 - c. Where the devices are to be installed in a grid type ceiling system, the detectors shall be centered in the ceiling tile.
 - d. The location of all fire alarm devices shall be coordinated with other devices mounted in the proximity. Where a conflict arises with other items or with architectural elements that will not allow the device to be mounted at the location or height shown, the Contractor shall adjust location of device so that new location meets all requirements in NFPA 72 and all applicable building codes.
2. Per the requirements of NFPA, detector heads shall not be installed until after the final construction cleaning unless required by the local Authority Having Jurisdiction (AHJ). If detector heads must be installed prior to final cleaning (for partial occupancy, to monitor finished areas or as otherwise required by the AHJ), they shall not be installed until after the fire alarm panel is installed, with wires terminated, ready for operation. Any detector head installed prior to the final construction cleaning shall be removed and cleaned prior to closeout.
3. Protection of Fire Alarm System:
 - a. A smoke detector shall be installed within the vicinity of the main fire alarm panel and every NAC extender panel per NFPA 72. A heat detector may be substituted when a smoke detector is not appropriate for the environment of installation.
4. In-Duct Analog Smoke Detectors:
 - a. In-duct analog smoke detectors shall be installed in the duct where shown on the drawings and details. The devices shall be installed in the respective duct at the approximate location where shown on the electrical drawings to meet the operation requirements of the system.
 - b. All detectors shall be accessible.
5. Heat Detector, Linear Wire Type:
 - a. Install detection wire within 20 inches of the underside of building roof, floor, or as recommended by the manufacturer.
 - b. The protected area shall not exceed 4,000 square feet per zone. Provide a separate zone for areas divided by fire/smoke rated walls.
6. Manual Pull Stations:
 - a. Stations shall be located where shown and at the height noted on the drawings.
7. Addressable Relays and Monitor Modules:

- a. Modules shall be located as near to the respective monitor or control devices as possible, unless otherwise indicated on the drawings.
 - b. All modules shall be mounted in or on a junction box in an accessible location.
 - c. Where not visible from a floor standing position, a remote indicator shall be installed to allow inspection of the device status from a local floor standing location.
8. Notification Appliance Devices:
- a. Devices shall be located where shown on the drawings.
 - b. Wall-mounted audio, visual and audio/visual alarm devices shall be mounted as denoted on the drawings.

D. Wiring:

1. Fire alarm wiring/cabling shall be provided by the Contractor in accordance with the manufacturer's recommendations and pursuant to National Fire Codes.
2. All junction boxes with SLC and NAC circuits shall be identified on cover. Refer to Identification Section 260513 for color and identification requirements.
3. Fire Alarm Power Branch Circuits: Building wiring as specified in Section 260513.
4. Notification Appliance Circuits shall provide the features listed below. These requirements may require separate circuits for visual and audible devices.
 - a. Fire alarm temporal audible notification for all audio appliances.
 - b. Synchronization of all visual devices where two or more devices are visible from the same location.
 - c. Ability to silence audible alarm while maintaining visual device operation.
5. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary fire protection functions shall be in fire alarm conduits. Wiring splices shall be avoided to the extent possible, and if needed, they shall be made only in junction boxes, and enclosed by plastic wire nut type connectors. Transposing or changing color coding of wires shall not be permitted. All conductors in conduit containing more than one wire shall be labeled on each end, in all junction boxes, and at each device with "E-Z Markers" or equivalent. Conductors in cabinets shall be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals shall be numbered and coded, and no unterminated conductors are permitted in cabinets or control panels. All controls, function switches, etc. shall be clearly labeled on all equipment panels.

E. Fire Alarm Cabling Color Code: Provide circuit conductors with insulation color coding as follows, or using colored tape at each conductor termination and in each junction box.

1. Power Branch Circuit Conductors: In accordance with Section 260553.
2. Signaling Line Circuit: Overall red jacket with black and red conductors.
3. DC Power Supply Circuit: Overall red jacket with violet and brown conductors.
4. Notification Appliance Circuit: Overall red jacket with blue and white conductors.

- F. Devices surface mounted in finished areas shall be mounted on surface backboxes furnished by fire alarm equipment supplier. Backboxes shall be painted to match device and shall not have visible knockouts.
- G. Make conduit and wiring connections to door release devices, sprinkler flow and pressure switches, sprinkler valve monitor switches, fire suppression system control panels, duct analog smoke detectors and all other system devices shown or noted on the Contract Documents or required in the manufacturer's product data and shop drawings.

3.3 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 260500.
- B. Test in accordance with NFPA 72, Chapter 14 and local fire department requirements. Submit documentation with O & M manuals in accordance with Section 14.6 of the Code.

END OF SECTION

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SECTION 310000

EARTHWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work includes but is not limited to the following:
 - 1. Layout of project per plans.
 - 2. Accomplishing indicated and required stripping, excavation, filling, compaction, subgrade preparation, rough and finish grading, and the like.
 - 3. Removing materials from the site which are either:
 - a. Not approved for use or are in excess of that required.

1.02 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including and Supplementary Conditions and Division 01 Specification Sections, apply to this section. Coordinate related work specified in other parts of the Project Manual, including but not limited to the following:
 - 1. Section 012200 – Unit Prices: Description of unit prices affecting the work of this Section.
 - 2. Section 311000 – Site Clearing
 - 3. Section 331000 – Water Utilities
 - 4. Section 333000 – Sanitary Sewer Utilities
 - 5. Section 334000 – Storm Drainage Utilities
 - 6. Section 321200 – Flexible Paving
 - 7. Section 321200 – Rigid Paving

1.03 REFERENCES

- A. Ecology 2019 Stormwater Management Manual of Western Washington
- B. Clallam County Engineering Design Standards (current edition)

C.	Port Angeles	Urban Services Standards & Guidelines
D.	WSDOT/APWA	Standard Specifications for Road, Bridge, and Municipal Construction, Current Edition
E.	Standard Details	WSDOT APWA Standard Plans for Road, Bridge and Municipal Construction
F.	ASTM C136	Standard Method for Sieve Analysis of Fine and Coarse Aggregate
G.	ASTM D1557	Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/cu ft.)
H.	ASTM D2922	Standard Test methods for Density of Soil and Soil- Aggregate in Place by Nuclear Methods (Shallow Depth).
I.	ASTM D3017	Standard Test methods for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
J.	ASTM	2023 Annual Book of Standards
K.	Geotechnical Report	Lot 24 Eklund Heights – Soils Investigation, Zenovic & Associates Inc. June 9, 2026

1.04 SUBMITTALS

- A. General: Comply with Section 013300. Samples: Submit a minimum 50-pound sample for each material 4 business days prior to placing material.
- B. Quality Assurance/Control Submittals.
- C. Test Reports: Sieve analysis for each material.
- D. Certificates: WSDOT pit certification for each pit.

1.05 QUALITY ASSURANCE

- A. Comply with applicable provisions of the following specifications and documents:
 - 1. WSDOT Standard Specifications. Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction, Current Edition
 - 2. ASTM D1556-90 Test Method for Density of Soil in Place by the Sand-Cone Method.
 - 3. ASTM C136 Standard Method for Sieve Analysis of Fine and Coarse Aggregate.

4. ASTM D-422 -90 Method for Particle Size Analysis of Soils.
5. ASTM D1557-91 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Ef-fort (56,000 ft-lb/cu ft).
6. ASTM D2922-91 Standard Test methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
7. ASTM D3017-88 Standard Test methods for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
8. ASTM D698-91 Standard Test method for Moisture-Density relations of soils and soil-aggregate mixture using 5.5-lb. Rammer and 12-inch Drop.
9. ANSI/ASTM D1557-78 Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-pound Rammer and 1 18-inch Drop.
10. AASHTO T176 Plastic Fines in Graded Aggregates and Soils by use of the Sand Equivalent Test.
11. ASTM D3017-78 Test Methods for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

PART 2 PRODUCTS

2.01 GENERAL

- A. All imported fill materials shall be from a Washington State Department of Transportation (WSDOT) approved source.

2.02 UTILITY TRENCH BACKFILL

- A. On-site material should not be used for trench backfill. The Contractor shall import material for trench backfill. Utility Trench Back-fill shall be imported Gravel Borrow in accordance with WSDOT 9-03.14(1).

2.03 PIPE BEDDING

- A. Bedding shall conform to Section 9-03.12(3) of WSDOT-APWA.

2.04 CRUSHED SURFACING

- A. Base course and top course shall conform to section 9-03.9(3) of WSDOT-APWA.

2.05 WASHED DRAIN ROCK

- A. Shall conform to Section 9-03.12(4) of WSDOT-APWA, Gravel Backfill for Drains. It shall be free of roots, organic matter, and other unsuitable materials.

2.06 IMPORTED STRUCTURAL FILL

- A. All fill placed under buildings, footings, slab-on-grade floor, utility trenches, roadways, sidewalks, walkways, and all other paved areas shall be "structural fill" as defined herein, unless specified otherwise for particular applications. Structural fill shall be imported materials that conform to the grading requirements of Gravel Borrow, Section 9-03.14(1) of the Standard Specifications, except the material passing the #200 sieve shall be less than 5% and the maximum material size is 3". The contractor is to assume that all structural fill is to be imported structural fill.

2.07 COMMON FILL

- A. All fill placed under landscaped and vegetated areas to specified subgrade elevations shall be "common fill" as defined herein, unless specified otherwise for particular applications.
 - 1. Common Fill shall be granular material, either naturally occurring or processed. It shall be essentially free from various types of wood waste, concrete debris or other extraneous or objectionable materials. It shall have such characteristics of size and shape that it will compact readily. The maximum particle size shall not exceed 3 inches. On-site Common fill shall conform to Section 9-03.14(3) of the Standard Specifications except that the percent by weight passing the U.S. No. 200 sieve shall be based on the portion passing the ¾ inch sieve.
 - 2. On-site material used for common fill shall have an organic matter content of less than 20%.

2.08 APPROVAL OF FILL MATERIAL

- A. All fill placed under footings, slab-on-grade floor, asphalt paving, sidewalks, walkways, and other paved areas shall be "Imported Structural Fill" as defined herein, unless specified otherwise for particular applications.
- B. Approvals of fill material: All material that is proposed to be used as fill and backfill shall be graded and tested for moisture content. Gradation and test results shall be submitted for review and approved by the Geotechnical Engineer or Testing Agency prior to placement. The encountered fill exhibits a wide range of soil densities and appears to consist of materials derived on-site and moved or disturbed during earlier site work. Below the existing fill is medium dense to dense silty sand with gravel. Reuse of the on-site soils for structural fill is not allowed.

- C. It is the sole responsibility of the Contractor to protect existing ground, prepared subgrade, and any stockpiled material from inclement weather, surface runoff, construction traffic and other conditions that may preclude the re-use of the material.
- D. The on-site material is not suitable for fill or backfill, the Contractor shall import an acceptable fill material conforming to these specifications at no additional cost to the owner.

2.09 CAPILLARY BREAK

- A. Capillary break shall be AASHTO Grading No. 67 per Section 9.03.1(4)C of the Standard Specifications.

2.10 QUARRY SPALLS

- A. Quarry Spalls shall be Permeable Ballast per Section 9-03.9(2) of the Standard Specifications.

2.11 FILTER FABRIC

- A. Filter fabric for silt fences shall be Mirafi 140N or approved equivalent.

2.12 TRACER TYPE

- A. Utility pipe tracer tape shall be detectable below ground surface, color coded, with utility name printed on tape. Conductive warning tape required over all sewer, drainage, water and irrigation pipe. Tape shall be manufacturer's standard permanent, bright-colored, continuous printed plastic tape, aluminum backed, intended for direct-burial service. The tape shall be not less than 6" wide x 4 mils thick.

- 1. Tape Schedule:

Piping	Color	Wording
a. Domestic Water Water	Blue	Caution Domestic
b. Fire Water	Blue	Caution Fire Water
c. Irrigation Water Water	Blue	Caution Irrigation
d. Storm Sewer	Green	Caution Storm Sewer
e. Sanitary Sewer	Green	Caution Sanitary Sewer

2.13 SEEDING

- A. Not included. See Section 311000 – Site Clearing.

PART 3 EXECUTION

3.01 PERMITS

- A. Obtain all required permits and inspections. Pay any and all fees or costs for permits and inspections.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL (TESC)

- A. All work shall conform to the Contract Documents and Clallam County requirements.
- B. The TESC facilities indicated by the project plans are the minimum requirements for the anticipated site conditions. During the construction period, these facilities shall be upgraded as needed for unexpected storm events and modified to account for changing site conditions.
- C. Adequate temporary and permanent control of surface water runoff and subsurface seepage will be re-quired in order to allow site access, grading, and construction of underground utilities to proceed. Site preparation and initial construction activities should be planned to minimize disturbance to the existing ground surface particularly during extended wet weather periods when the presence of excess moisture may render the site soils more prone to disturbance. During wet site conditions, equipment traffic should not be allowed on exposed subgrade areas. The Contractor shall be responsible for protecting prepared surfaces from surface ponding, storm water runoff, and construction traffic. The Contractor will be solely responsible for any repairs required to these surfaces at no additional cost to the owner.

3.03 PROTECTION OF EXISTING FACILITIES

- A. Utilities: The Contractor shall protect from damage private and public utilities in accordance with 1-07.17 of WSDOT-APWA.
- B. Pavement: The Contractor shall protect all pavements or paved areas intended to remain.
- C. Access Streets and Roadways: Maintain wheel cleaning stations to clean wheels and undercarriage of trucks before leaving site, as necessary to prevent dirt from being carried onto public streets. Provide new wheel cleaning stations prior to driving on paved surfaces. If the streets are fouled, they must be cleaned immediately in conformance with the Clallam County and all governing requirements and regulations.

- D. Repair and/or replacement of damaged facilities will be accomplished at the Contractor's expense.
- E. Dust Control: Contractor shall sprinkle water as necessary to control dust during dry weather conditions. Do not use water to extent cause flooding, contaminated runoff, or icing.

3.04 STABILIZATION OF EXCAVATIONS AND TRENCHES

- A. The Contractor shall exercise sound engineering and construction practices for excavations and trenches and maintain them so that no damage will occur to any foundation, structure, pole line, pipeline, or other facility because of sloughs or slopes, or from any other cause. If, as a result of the excavation or trenching, there is disturbance of the ground that may endanger other property or require repair, the Contractor shall take remedial action at no additional cost to the Owner.
- B. The Contractor shall anticipate and provide dewatering, shoring or other types of stabilization, in addition to the shoring required for safety by State codes, as required to maintain the integrity of the trench or excavation and to protect nearby existing utilities and structures. Caving the site soils should be anticipated in excavations through loose surficial on-site soils. All earthwork shall conform to the Washington Administrative Code (WAC) 296-155 requirements for Excavation, Trenching, and Shoring. Cuts should meet the requirements of federal, state, local ordinances, such as OSHA and WISHA. The use of temporary bracing and/or sloped cuts should be anticipated. If the Contractor elects to provide stabilization by open pit excavation or flatter side slopes, no additional compensation will be made for the work including excavation, select backfill material, backfilling, and protection of existing facilities.

3.05 SITE GRADING

- A. General: Required contours and elevations are indicated and noted on Drawings; should indicated figures conflict with actual conditions, notify Owners Representative and obtain direction before proceeding with grading of area in conflict. Stripping:
 - 1. Strip and remove topsoil, roots, organic debris, and unsuitable material from areas to be developed. The Contractor shall exercise care to completely avoid mixing topsoil and other organic matter with the underlying soil.
 - 2. The Testing Agency or Geotechnical Engineer shall approve final stripping depth. The Contractor assume that at least 6 inches of in-place thickness or more topsoil shall be removed. However, additional material may need to be removed beneath the

proposed buildings as noted. Haul and dispose of materials off-site in a legal manner. See Section 31 10 00, Site Clearing for recycling of material.

B. Grading:

1. Shape surface of site to grades and contours as noted.
2. Remove debris, rocks over 4-inch in size, vegetation, and other organic matter from material to be re-used.
3. Control grading around building areas and building excavations at all times to prevent flow of water into excavated areas and ponding adjacent to building.
4. For paving and other site improvements, shape subgrades to lines, grades, and cross sections indicated. After design grade is reached, exposed soils shall be scarified to a depth of at least 6 inches; moisture conditioned if necessary and then compacted to the required relative minimum. Any soft soils encountered shall be moisture conditioned and recompact or excavated and replaced with compacted fill, whichever is necessary to reach the required compaction at no additional cost to the Owner. Bring low areas up to required elevations with approved fill materials.
5. Subgrade: Grading shall conform to Section 2-06 of WSDOT-APWA.

3.06 EXCAVATION

A. General

1. Provide excavation of whatever nature required for construction of the work; verify character, quality, and disposition of material to be excavated prior to commencing. Blasting is not permitted.
2. Cuts should meet the requirements of federal, state, and local ordinances, such as OSHA and WISHA. The Contractor shall anticipate the use of temporary bracing, "trench boxes," and or sloped cuts per geotechnical recommendations as needed at no additional cost to the Owner.
3. Contractor shall keep excavations free from water while construction is in progress. Per the Geotechnical Analysis for ground water conditions, the Contractor shall anticipate the use of sump pumps and other methods for de-watering at no additional cost to the Owner.
4. All earthwork for utilities shall conform to the Washington Administrative Code (WAC) 296-155 requirements for Excavation, Trenching, and Shoring.

5. All excavated excess soil shall be exported from the site and disposed of at an approved location at no additional cost to the Owner.
- B. Excavation for Utilities
1. Trench excavation shall conform to Section 7-08 of WSDOT-APWA. Grade and smooth bottoms of trenches to provide uniform bearing and support for each length of utility pipe. All trenches shall be excavated to true and smooth bottom grades and in accordance with the lines given by the engineer. Remove rocks and similar material to provide a minimum 6-inch clearance under and around all portions of the pipe. Placement of bedding material shall precede installation of pipe. This shall include the necessary leveling of the native trench bottom or top of foundation material as well as placement and compaction of required bedding material to a uniform grade so the entire length of pipe will be supported on a uniformly dense and unyielding foundation.
 2. Catch basins, manholes and similar structures (as indicated): Excavate to furnish a minimum of 12 inches between sides and bottom of excavation and outer surfaces of structure. Take care to excavate to exact depths required; fill over-excavation with compacted gravel for trench backfill.
- C. Excavation for Structures: Extend excavation to depth as required for footings to bear on suitable material for structural bearing. Fill to planned grades with structural fill.
1. Proof-roll exposed native sediments and fill soils with heavy equipment or hand probe with a steel bar to identify soft or unstable areas requiring further over-excavation.
 2. Extend over-excavation of unsuitable material as determined by the Geotechnical Engineer, to width equal to depth of excavation below footing grade, except where width of excavation is restricted by adjacent existing foundation. Do not disturb support soils for existing foundations. Support soils are considered to be those soils within a prism projected downward and outward from existing footings at inclinations of 1 foot horizontal to 1 foot vertical (1H:1V).
 3. Following the over-excavation, backfill with imported structural fill to planned foundation grade and to planned subgrade for slabs-on-grade. Existing on-site fill soils are shall not be re-used as structural fill.

3.07 BACKFILL AND COMPACTION

A. General

1. All areas that are to receive compacted fill shall be field reviewed by the Testing Agency and the Geotechnical Engineer prior to the placement of new fill.
2. Soil surfaces that will receive compacted fill shall be scarified to a depth of at least six inches. The scarified soil shall be moisture-conditioned to obtain soil moisture near optimum moisture content. The scarified soil shall be compacted to a minimum relative compaction as listed in this Section. Relative compaction is defined as the ratio of the in-place soil dry density to the maximum dry density as determined by the ASTM D1557 test method.
3. Place fill in controlled layers the thickness of which is compatible with the type of compaction equipment used. The loose thickness of each fill layer shall not exceed eight inches. Compact each layer to a mini-mum relative compaction as listed in this Section. Determine the field density of compacted soils by the ASTM D2922 and D3017 test method or equivalent.
4. Fill soils shall consist of imported soils approved by the Testing Agency. All imported fills shall be granular and shall meet the gradation requirements stated herein. The Testing Agency shall evaluate and/or test imported material for its conformance with specifications before delivery to the site. The Contractor shall notify the Testing Agency 72 hours prior to importing fill to the site. Rocks larger than six inches shall be segregated from fill material and removed from site.
 - a. The Testing Agency shall observe the placement of compacted fills and conduct in-place field density tests on the compacted fill to check for adequate moisture content and the required relative compaction. Where less than the required relative compaction is indicated, remove and replace the substandard soil or apply additional compactive effort and moisture-condition the soil as necessary until the relative compaction as specified in this Section is attained. Provide level testing pads for the conducting of field density test by the Testing Agency.
5. Compaction Requirements: Compact all fill and backfill to prevent subsequent settlement. Water settling or jetting is not permitted as a means of compaction. Furnish heavy rollers or compactors except as follows:
 - a. Use pneumatic hand tampers for trenches and areas not accessible to heavy equipment.
 - b. Compact areas within 5' of footings, foundations and walls with hand vibrators.

6. Required compaction: Compact fill and backfill to the following minimum relative compaction (per-centage of maximum dry density determined in accordance with ASTM D1557):

a. Locations Relative Compaction	Required Minimum
b. Under slabs on grade & footings	95%
c. Under walks and paving	95%
d. Under gravel roadways	95%
e. Beddings for utility lines	95%
f. Against walls	90%
g. Against footings and foundations	90%
h. Planting and landscape areas	90%
i. Other	90%

B. BACKFILLING FOR UTILITIES

1. Bedding for utility pipes: Properly place material in trenches in accordance with the depths shown on the plans. Do not disturb the sides of trenches. Compact and shape material to conform to the barrel of the pipe to ensure continuous firm bedding for full length of pipe.
2. Pipe zone backfills shall be placed in loose layers and compacted to 95 percent maximum density. Back-fill shall be brought up simultaneously on each side of the pipe to the top of the pipe zone. In backfilling the pipe zone bedding Contractor shall use compactive measures such as vibratory plate compactor or hand implements to protect the pipe from any damage or shifting. Backfill above the pipe zone shall be accomplished in such a manner that the pipe shall not be shifted out of position nor damaged by im-pact or overloading.
3. Backfilling of trenches near structures shall not take place until the cement in the masonry has become thoroughly hardened. Walking on the pipe shall not be allowed until at least one foot of earth has been placed upon it.
4. Trench backfills shall be spread in uniform layers and be compacted by mechanical tampers. The back-fill material shall be placed in successive layers not exceeding 6

inches in loose thickness, with each layer being compacted in accordance with this section.

5. Compaction control tests shall be performed as specified in this Section.
6. If the required compaction density has not been obtained, the Contractor shall remove the backfill from the excavation, and recompact using heavier compaction equipment or more passes, until the required density is achieved.

C. Backfilling for Structures:

1. Footings: Fill over-excavated volume under new footings with compacted imported structural fill in accordance with over-excavation and compaction requirements, as specified in this Section.
2. Areas under New Slabs on Grade: Place imported structural fill to bring to grade and compact as specified in this Section.

3.08 FINISH GRADING

- A. General: Remove all concrete, rocks, rubble and debris larger than 2-1/2 inches from surface. Finish grades flush with adjacent surfaces unless indicated otherwise. Finish grades for landscaped areas adjacent to sidewalks shall be 1 inch below elevation of sidewalk unless noted otherwise. Execute any fine grading as may be necessary or incidental to all subsequent work.
- B. Grading Tolerance: Finish grades shall match contours and elevations shown within 1/10 foot.
- C. Approval of Finish Grading: Finish grades will be inspected and subject to approval by Owner's Representative. Contractor shall correct work not approved by Owner's Representative at no additional cost or time.
- D. Protection of Finished Surfaces: Allow no heavy objects to be moved over finished grade surfaces. At no additional cost to Owner, repair any ruts or holes in finished surfaces, and any obstructions to positive drainage. The contractor shall repair all areas showing settlement.

3.09 FIELD QUALITY CONTROL

- A. Special Inspections: Testing Agency or Geotechnical Engineer will approve fill materials, observe placement of compacted fill, and conduct in-place field density tests on compacted fill, checking moisture content and relative compaction. Where less than required relative compaction is indicated, remove and replace substandard soil, or further

compact and moisture-condition soil until specified relative compaction is attained.
Furnish level testing pads for conducting field density test by Testing Agency or
Geotechnical Engineer.

3.10 ADJUSTMENTS

- A. Repair ruts and holes in finished graded surfaces.
- B. Correct slopes and obstructions to positive drainage.
- C. Repair areas showing settlement.
- D. Make corrections and adjustments to finish grading, as directed by the Owner's Representative.

3.11 PROTECTION

- A. Do not permit heavy objects or construction traffic to be moved over graded surfaces.
- B. Protect graded and disturbed areas from run-off, ponding water, and other conditions which may alter finish grades and that may preclude a suitable surface for the next phase of construction. Subgrades shall be sealed with a smooth drum roller before wet weather leads to their deterioration. Protect existing soils with BMP's outlined in the King County Surface Water Design Manual. BMPs shall be updated as needed to maintain soil protection. Accumulated water and any unstable soils shall be immediately re-moved and replaced with an equivalent amount of Imported Structural Fill at no additional cost to the Owner. Contractor shall repair all areas showing settlement at no additional cost to the Owner.
- C. Private and Public Utilities: Protect from damage in accordance with 1-07.17 of WSDOT-APWA.
- D. Paved Areas Intended to Remain: Protect from damage.

END OF SECTION

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SITE CLEARING

1.01 SECTION INCLUDES

1. Construct and maintain temporary erosion and sedimentation control.
2. Remove site landscaping, vegetation, and unwanted materials.
3. Grubbing work consists of removing and disposing of unwanted materials from below the ground surface.
4. Remove and dispose of materials from site according to regulatory requirements.
5. Removal or plugging and abandoning of existing utilities as shown on the Plans or as required to construct improvements.
6. Protect from harm any trees, vegetation, existing sidewalks, curbs, or other objects selected to remain, refer to Landscape Plans in the contract documents for protection notes and details.

A. Drawings and general provisions of Contract, including and Supplementary Conditions and Division 01 Specification Sections, apply to this section. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:

1. Section 310000 "Earthwork."
2. Section 312500 "Erosion and Sedimentation Controls."

A.	Clallam County	Engineering Design Standards
B.	Ecology Washington	2019 Stormwater Management Manual for Western
C.	WSDOT-APWA	Standard Specifications for Road, Bridge, and Municipal Construction, Current Edition

- ## 1.04 SUBMITTALS

- ### 1.05 DESCRIPTION

- ## 1.06 EXISTING CONDITIONS

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2. Do not close or obstruct streets, fire lanes, sidewalks, or passageways without permission from owner or authorities having jurisdiction.
3. If required by Owner or governing authorities, provide alternate routes around closed or obstructed traffic ways.
4. Obtain all permits required for work within the public right of way. Coordinate all improvements within public right of way with governing authority.
5. Provide safe access around buildings to remain in service during construction per architectural plans and specifications.

1.07 DIMENSIONS AND LAYOUTS

- A. The Contractor will be responsible for furnishing, setting and marking all line and location stakes, including offsets and general construction staking. When work requiring control is being performed, all necessary related equipment, supplies and instruments shall be on site. A qualified layout engineer, surveyor, or technical specialist must be assigned to the Contractor's crew for this work. This equipment and personnel must be available, at no additional cost to the Owner for the purpose of verifying layout and certifying the accuracy of work on the site.
- B. The Contractor is responsible for preserving all benchmarks and stakes and the replacement of any that are displaced or missing.
- C. The Contractor is responsible for review of all utility purveyor, project survey, and City or State records relative to the existing underground utilities. The Contractor is responsible for avoiding damage to these facilities and shall restore all utilities at no additional cost to the Owner.
- D. The Contractor is to notify the Owner's Representative immediately if underground utilities not shown on the Agency's record are encountered.

1.08 LIABILITY

- A. The Contractor is an independent contractor and not an employee of the owner. The owner shall have no liability to the Contractor or any third persons for Contractor's failure to faithfully perform and follow the provisions of these Specifications and the requirements of the governing agencies. Notwithstanding the failure of the owner to discover a violation by the Contractor of any of the provisions of these Specifications, or to require the Contractor to fully perform and follow any of them, such failure shall not constitute a waiver of any of the requirements of these Specifications which shall remain fully binding upon the Contractor.

- B. Subcontractors employed by the Contractor shall be bound to all the work and safety standards specified. Subcontractor's personnel shall meet the requirements as specified and shall be supervised by the Contractor during performance of this work.

PART 2 PRODUCTS

2.01 TEMPORARY FENCING

- A. Temporary chain link fencing: minimum 6' height, line posts at 8' o.c. maximum. 2" chain link mesh fence.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify clearing and grubbing and site improvement removal may safely and appropriately begin.
- B. Obtain required permits and permission from local governing authorities and Owner prior to commencing work.
- C. Prior to beginning site removals and clearing, meet with Owner's Representative and review all pro-posed utility layouts on site. Indicate all existing trees, shrubs, and landscaping as well as site improvements that will be affected by construction. Coordinate removals of landscape materials with Owner.
- D. Provide appropriate fencing and/or barricades for safety and protection in the vicinity of the work area.

3.02 EROSION CONTROL

- A. The implementation of the Erosion Control system and the maintenance, replacement and upgrading of these facilities is the responsibility of the Contractor until all construction is approved. The Temporary Erosion and Sediment Control (TESC) facilities must be maintained in conjunction with all clearing and grading activities, and in such a manner as to ensure that sediment laden water does not enter the drainage system or violate applicable water standards.
- B. The TESC facilities shown on the plans are the minimum requirements for anticipated site conditions. During the construction period, the erosion control facilities installed may require maintenance or upgrading (e.g. additional sumps, relocation of ditches and silt fences, etc.) as shown on the plans or as needed. All work associated with the construction, maintenance, upgrading and removal of the erosion control system throughout project duration shall be at no additional cost to the Owner.

- C. The Contractor is responsible to provide temporary and permanent control of surface water and subsurface seepage to allow for site access, grading, construction of underground utilities, and paving. The contractor is solely responsible for protecting disturbed areas from inclement weather and surface runoff during construction process to provide a suitable working platform for all phases of the construction. Ground water from up gradient sources shall be intercepted and routed around work area per geotechnical recommendations. The Contractor shall be familiar with and shall follow the geotechnical recommendations concerning subgrade protection.
- D. All pumped construction de-watering shall be drained through a pump discharge mat or other approved or specified method to remove sediment.
- E. Access Streets and Roadways: Provide wheel cleaning stations to clean wheels and undercarriage of trucks before leaving site, as necessary to prevent dirt from being carried onto public streets and other areas of the site not currently under construction. If streets are fouled, clean immediately in conformance with the Clallam County and all governing requirements and regulations.

3.03 CLEARING

- A. Remove growth and underbrush within the clearing limits as required for new construction and as indicated. Perform removal operations in a manner to protect existing property to remain, refer to Land-scape Plans.
- B. Remove all stumps and associated roots.
- C. Save and protect trees indicated on plans to remain, refer to Landscape Plans for notes and details.
- D. Protect all off-site trees along adjacent roadways and on surrounding properties, refer to Landscape Plans for notes and details.
- E. Provide and maintain tree protection per Landscape Plans.

3.04 STRIPPING OF ON-SITE MATERIALS

- A. General: Grub or otherwise prepare areas where clearing has occurred to receive construction or other improvements.
- B. Excavate and remove all stumps to a minimum depth of 2'-0" below finished grade. Replace void with Structural Fill.

- C. Excavate and remove roots larger than ½ inch in diameter, rocks, and boulders greater than 4 inches, and any remaining paving, and the like, as well as other unsuitable materials. Replace void with Structural Fill.
- D. Strip and remove and stockpile, if necessary, cut material to be exported offsite:
 - 1. Contractor shall exercise extreme caution not to mix on-site stockpiled materials during construction
- E. Areas to be occupied by proposed building: Contractor shall assume for bidding that the existing soils shall be excavated, removed and replaced in accordance with Section 310000 Earthwork. The Owner will provide on-site testing and Geotechnical recommendations to determine the actual depth of stripping required.
- F. Stripping depths:
 - 1. Strip not less than 1'-0" min. below existing grade, contractor to confirm with project geotechnical engineer when adequate stripping is achieved.
- G. Use only hand methods for grubbing inside the greater of a 10-foot radius or the drip line of trees indicated to remain

3.05 REMOVAL OF UNDERGROUND UTILITIES

- A. Remove underground utilities as shown on the project plans and as necessary to construct improvements. Remove and dispose of material from the site according to regulatory requirements. Contact Engineer immediately if conflicting information appears on plans of existing utilities to be re-moved/abandoned prior to proceeding.
- B. Plug and abandon in accordance with WSDOT/APWA Section 7-08.3(4) all pipe to be taken out of service but to remain in place. Note locations of all utilities to be abandoned in place on Project Record Documents.
- C. See irrigation demolition plan for portions of the existing irrigation system that are to be removed and disposed of.

3.06 TREE PROTECTION

- A. Refer to Landscape Plans in the contract documents for details and notes on tree and vegetation protection.

3.07 DUST CONTROL

- A. Sprinkle excavated material and access roads as necessary to limit dust to lowest practicable level. Do not use water to extent causing flooding, contaminated runoff, and exposed pipe.

3.08 SEEDING

- A. Seeding between July 1 and September 1 may require additional irrigation to grow adequate cover. Contractor is responsible for ensuring adequate growth for cover and to prevent erosion no matter when areas are seeded. Mulch is required for slopes greater than 3:1 and shall be provided for all areas seeded between October 15 and April 1. Any seeded areas that fail to establish at least 80 percent cover with-in one month shall be re-seeded at no additional cost to the Owner. If reseeded is ineffective, an alternate method, such as sodding, or nets/blankets shall be used at no additional cost to the Owner. Any area that experiences erosion shall be re-seeded and protected by mulch. Seeded areas shall be supplied with adequate moisture, but not to the extent to cause runoff, to establish planting.
- B. Fertilization for Temporary Erosion and Sediment Control and final grading plan shall be landscape architects' recommendations. The seed bed should be firm but not compacted such that the seeds will not vegetate quickly. Slopes steeper than 3H:1V shall be roughened surface.
- C. Temporary Erosion and Sediment Control seeding shall be provided for all disturbed areas to limits of disturbance and not developed with landscape covering.
- D. In planting areas and lawns as indicated on the plans. Screened, sandy loam, weed-free, min. 6% organic material, free of sticks and rocks over 2-inches in diameter, weeds, sod clumps, and other deleterious materials as approved. Contractor shall have import topsoil tested for pH, trace minerals, N, P and K at a minimum.

3.09 DRAINAGE

- A. Always keep designated drainage ways open for drainage. Maintain and/or adjust erosion control facilities as required to prevent sediment from entering the on-site system or off-site. At no time shall more than one foot of sediment be allowed to accumulate within catch basins, ditches or swales.
- B. All catch basins and conveyance lines shall be mechanically cleaned prior to project completion. Mud/sediment build-up shall be mechanically removed, and the cleaning operation shall not flush sediment-laden water into the downstream system.
- C. Keep open pits and holes caused because of demolition work free of standing water.

3.10 DISPOSAL OF MATERIALS

- A. Refuse from clearing, grubbing and stripping shall be disposed of by the Contractor in a manner consistent with government regulations. In no case shall refuse material be left on the project site, shoved onto abutting private properties, or buried in embankments or trenches on the project site. Debris shall not be deposited in a stream or body of water, any public right of way or upon private property except by written consent of the private property owner. On-site burning is not allowed. Maintain hauling routes clean and free of debris resulting from work of this Section.

END OF SECTION

SECTION 312500

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This section includes but is not limited to the implementation and maintenance of a comprehensive erosion control plan that complies with the Clallam County regulations. The contractor is responsible for implementing Best Management Practices (BMP's) in accordance with the Clallam County requirements. The information provided on the contract plans should be considered a minimum for the anticipated construction and conditions. The contractor shall be responsible for adding additional BMP's as conditions change at no additional cost to the Owner. The Contractor shall coordinate installation and inspections of the BMP's with the Clallam County Inspector. Additional BMP's shall be stockpiled on site as requested by the Inspector.
- B. This Section includes the following:
 - 1. Silt Control Measures.
 - 2. Temporary Stormwater Runoff Control.
 - 3. Measures to keep streets clean.
 - 4. P.E. sheeting cover for exposed soil.
 - 5. Maintaining, monitoring, and supplementing silt control, storm water runoff control measures and additional BMP's as required by the Clallam County and other local jurisdictions.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 310000 "Earthwork."
 - 2. Section 334000 "Storm Drainage Utilities."

1.03 REFERENCES

A. Clallam County
Erosion and Sediment Control
Coughlin Porter Lundeen Project: C23658

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B. Ecology	2019 Stormwater Management Manual of Western Washington
C. Ecology	NPDES
D. WSDOT-APWA	Standard Specifications for Road, Bridge, and Municipal Construction, current edition
E. Standard Details	WSDOT APWA Standard Plans for Road, Bridge and Municipal Construction, Current Edition
F. Geotechnical Report	Lot 24 Eklund Heights – Soils Investigation, Zenovic & Associates Inc. June 9, 2026

1.04 SUBMITTALS

- A. Product Submittals: Product catalog cuts for silt fence, and silt sack inserts. Aggregate Materials: Coarse aggregate for gravel construction entrance.

1.05 REGULATORY REQUIREMENTS

- A. Work to comply with Clallam County standards. The Contractor shall coordinate with the Clallam County Inspector.
- B. The Contractor shall apply for and maintain the Ecology Construction General Stormwater Permit (NPDES Permit) and operate in accordance with the requirements of the permit.

1.06 SEQUENCING AND SCHEDULING

- A. Install erosion control measures in work areas prior to any clearing, grubbing, demolition, general site grading, or other construction in the area. Erosion control items shall be installed and removed at various times throughout the duration of the project.

1.07 MAINTENANCE

- A. Maintain erosion control through the duration of the project.
- B. Maintain erosion control after substantial completion per this section.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Filter Fabric Fence: In accordance with WSDOT Standard Specifications Section 9-33, Permanent Erosion Control, High Serviceability, Class B.

- B. Straw Mulching: In accordance with WSDOT Standard Specifications Section 9-14.4(1).
- C. Filter Fabric: Mirafi 140N or equal.
- D. Filter Bag Inserts: Commercially manufactured filter bags specifically manufactured for silt filtering, and which will provide filtering performance required. Contractor to verify current standards with the Clallam County Inspector.
- E. Polyethylene (PE) Sheeting: In accordance with WSDOT Standard Specifications Section 9 14.5(3).
- F. Quarry spalls: Per Section 9-03.9(2), WSDOT Standard Specifications.
- G. Storm Drain Pipe: Per Section 334000.

PART 3 EXECUTION

3.01 TESC FACILITIES

- A. The implementation of the Erosion Control system and the maintenance, replacement and upgrading of these facilities is the responsibility of the Contractor until all construction is approved. The Temporary Erosion and Sediment Control (TESC) facilities must be maintained in conjunction with all clearing and grading activities, and in such a manner as to ensure that sediment laden water does not enter the drainage system or violate applicable water standards in accordance with the Clallam County requirements and the contract documents.
- B. The TESC facilities shown on the plans are the minimum requirements for anticipated site conditions. During the construction period, the erosion control facilities installed may require maintenance, relocation or upgrading (e.g. additional sumps, relocation of ditches and silt fences, etc.) as shown on the plans or as needed. All costs associated with the construction, maintenance, upgrading and removal of the erosion control system throughout project duration shall be at no additional cost to the Owner.
- C. Adequate temporary and permanent control of surface water runoff and subsurface seepage will be re-quired to allow site access, grading, and construction of underground utilities to proceed. Site preparation and initial construction activities should be planned to minimize disturbance to the existing ground surface particularly during extended wet weather periods when the presence of excess moisture will render the site soils more prone to disturbance. During wet site conditions, equipment traffic should not be allowed on exposed subgrade areas. Erosion of the soil will occur as exposed surfaces are disturbed due to construction activity and exposure to climatic conditions. The Contractor shall be re-sponsible for protecting disturbed or prepared surfaces by some form of

weather cover if left exposed for more than 2 days. Contractor shall also protect disturbed or prepared surfaces from surface ponding, storm water runoff, and construction traffic. The Contractor will be solely responsible for any repairs required to these surfaces at no additional cost to the owner.

- D. Access Streets and Roadways: Provide wheel cleaning stations to clean wheels and undercarriage of trucks before leaving site, as necessary to prevent dirt from being carried onto public streets. If streets are fouled, clean immediately in conformance with Clallam County and all governing requirements and regulations.

3.02 TURBIDITY MONITORING

- A. The contractor shall be responsible for meeting turbidity requirements as required by the Clallam County. Additional TESC measures may be required to achieve discharge requirements. The contractor shall be responsible for providing additional measures as work progresses to meet turbidity requirements. All required provisions of the Department of Ecology Construction General Stormwater Permit shall be performed.

3.03 EXAMINATION

- A. Verify locations of existing catch basins and related storm drainage features that may be impacted by construction activities.

3.04 PREPARATION

- A. Locate existing utilities, avoid damage or disturbance. For aid in utility location call "Dial Dig 1 800 424 5555," 48 hours (two working days) prior to beginning construction. Provide and pay for additional marking as required.
- B. Survey limits of work to install silt fence.
- C. Perform clearing or other work required to installing erosion control.

3.05 CONSTRUCTION

- A. Filter Fabric Fence:
 - 1. Field adjusts location to perimeter of clearing and stripping. Location shown on drawings is schematic. Cast all trench excavation soils from fence installation to the Construction side of fence. Overlap filter fabric fence joints minimum 1 foot prior to backfilling trench.
- B. Polyethylene Sheeting:

1. Overlap joints minimum 28 inches. Overlap in direction of drainage and prevent water from draining onto material being protected. Secure in place to prevent movement and damage. Provide sandbags at 2.5 feet spacing and tie the sandbags together with rope on slopes greater than 3:1. Minimize driving stakes through plastic.
- C. Diversion Swales and Berms:
1. Construct in a manner to intercept, divert, and channel runoff to sediment ponds. Plan locations are schematic. Field adjust, move, and reconstruct as necessary during construction to maintain drainage to sediment ponds and allow construction to proceed. Provide Straw bale check dams at minimum 100 feet spacing.
- D. Straw Bale Check Dams:
1. Construct such that drainage flows through bales. Bevel bale edges or fill gaps to ensure drainage passes through straw filter. Larger flows may flow over top on occasion. Key bales into ground to prevent drainage under bales. Raise elevations of ends of check dams to prevent drainage around ends. Provide splash pad on downstream side to prevent scouring from high flows or overtopping.

3.06 ADJUSTMENTS AND REVISIONS

- A. Adjust or move swales, berms, pipes, culverts, bales, and silt fences as necessary during construction to direct site runoff to temporary ponds, silt filters, and grass swales.

3.07 PROTECTION AND MAINTENANCE

- A. Protection:
1. Where possible, maintain natural vegetation for silt control.
 2. Prevent silt-laden water from leaving site or from entering off-site storm sewer systems.
 3. All slopes, cut, or fill areas where Work has stopped for more than 30 days shall be stabilized by mulching, polyethylene sheeting or other method to prevent erosion and sediment transport.
 4. Paved surfaces shall be kept clean by the use of mechanical sweeping equipment, hand shovels and brooms or other accepted methods suitable of removing dirt, rock, silt and sand. No street washing will be allowed.
- B. Supplementary measures

1. Provide additional silt control and temporary erosion control measures as required to protect soils and prevent silt laden runoff from leaving project site at no additional cost to the Owner.

C. Maintenance

1. Monitor and maintain silt control measures. Remove accumulations of sediment when more than 50 per-cent of silt storage capacity is filled. Maintain all temporary erosion control facilities until need for each facility has been superseded by other stabilization methods or until Architect authorizes removal.
2. Inspect and repair temporary erosion control facilities. Inspect the entire system to ensure proper operation a minimum of once per week, during and after storms, and prior to weekends and holidays.

END OF SECTION

SECTION 321200

FLEXIBLE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work includes but is not limited to the following:
 - 1. Crushed surfacing for asphalt concrete paving.
 - 2. Crushed surfacing for gravel roadway
 - 3. Asphalt concrete paving.
 - 4. Asphalt patching for Utilities.
 - 5. Products furnished but not installed.

1.02 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including and Supplementary Conditions and Division 01 Specification Sections, apply to this section. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:
 - 1. Section 310000 "Earthwork".
 - 2. Section 321600 "Rigid Paving".

1.03 REFERENCES

- A. Ecology 2019 Stormwater Management Manual for Western Washington
- B. Clallam County Engineering Design Standards
- C. WSDOT-APWA Standard Specifications for Road, Bridge, and Municipal Construction, Current Edition
- D. Standard Details WSDOT/APWA Standard Plans for Road, Bridge and Municipal Construction, Current Edition
- E. ASTM D1557 Methods of Test for Moisture-Density Relations of Soils, Using 10 lb. (4.5 kg) Rammer and 18 In. (457 mm) Drop.

- F. APWA Designs and Specifications for Asphalt Concrete Pavements and Bases, 1990 Edition
- G. Geotechnical Report Lot 24 Eklund Heights – Soils Investigation, Zenovic & Associates Inc. June 9, 2026
- H. This work shall consist of one or more courses of plant mixed asphalt concrete placed on a prepared foundation or base in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross-sections shown in the plans or established by the Owner's Representative.
- I. Asphalt concrete shall be composed of asphalt and aggregate which, with or without the addition of mineral filler and blending sand as may be required, shall be mixed in the proportions specified to provide a homogenous, stable and workable mixture.

1.04 PROJECT SITE CONDITIONS

- A. Environmental Requirements:
 - 1. In accordance with referenced standard specifications and the following:
 - a. Do not pave in rain or when subgrade or base is wet or frozen.
 - b. Do not apply tack coats when the temperature is below 50 degrees F. or when base is wet.
 - c. Apply asphalt concrete paving only when the temperature is above 40 degrees and when base is dry.

1.05 DIMENSIONS AND LAYOUTS

- A. See Section 311000.
- B. The Contractor is to notify the Owner's Representative immediately if underground utilities not shown on the Agency's record are encountered.

1.06 QUALITY ASSURANCE

- A. Contractor shall correct any work that exhibits aggregate separation, soft spots, and excess porosity at no additional cost to the Owner.
- B. Repair cracks and unsatisfactory elevation irregularities immediately upon notification.
- C. Replace any paving not draining properly.

1.07 WORK WITHIN THE RIGHT-OF-WAY

- A. All work within the public Right-of-Way shall meet Clallam County Road Standards.
- B. Contractor is responsible for obtaining all permits for work within the Right of Way and coordinating with the Clallam County inspectors.

1.08 SUBMITTALS

- A. Submit under provisions of Division 013300.
- B. Submit product data for all materials specified.

PART 2 PRODUCTS

2.01 GENERAL

- A. Comply with "Quality Control" provisions, "References," Specifications, and Manufacturer's data. Where these may be in conflict, the more stringent requirements govern.
 - 1. Conform to APWA - Section II, "Specifications for Asphalt Paving" of above referenced manual. Provide bases, type and thickness of asphalt concrete as required by type of soils for indicated use.

2.02 HEADERS, BENDERS & STAKES

- A. Construction Grade Douglas fir; preservative treated.

2.03 CRUSHED ROCK BASE COURSE

- A. Shall be per 31 20 00 – Earth Moving.

2.04 TACK COAT

- A. Cationic Emulsified Asphalt CSS-1 in accordance with Section 9-02.1(6) of the Standard Specifications. Apply to all vertical surfaces to which "HMA" abuts.

2.05 ASPHALT BINDER

- A. Asphalt binder shall be viscosity grade PG 58-22.

2.06 ASPHALT CONCRETE

- A. All onsite paving shall be Class ½" Hot Mix Asphalt in accordance with Section 9-03.8 of the Standard Specifications.
- B. Asphalt concrete mixing and proportioning shall comply with Section 9-03.8 of the WSDOT-APWA.

2.07 CRACK FILLER

- A. Flex-a-fill rubberized asphalt, or equal

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify installation conditions as satisfactory to receive work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes your acceptance of conditions as satisfactory.
 - 1. Construction shall conform to the details, dimensions and grades specified. Maximum variations in finished grade of paving shall be +/- 0.05 feet.
 - 2. Grade and compact all areas to be paved in accordance with Section 31 10 00.

3.02 PREPARATION

- A. Protect surrounding areas and surfaces to preclude damage from work of this Section.
 - 1. Protect work of other trades. Take exceptional care in work adjacent to buildings.
 - 2. Should any defacement or damage occur, repair or replace as directed
- B. Preparation of Asphalt Patches
 - 1. Where existing asphalt concrete pavement upon a granular base is required to be removed due to deterioration, settlement, concrete curb construction or trenching, uniformly define the area in size and shape. Remove the existing asphalt by cutting pavement vertically at a sufficient distance of at least 6" over the undisturbed base surface and then break up and remove the affected pavement.
 - 2. Replace the granular base under the removed pavement as shown on the plans.
- C. Preparation of Parking Lot for Paving: Prepare parking lot subgrade in accordance with Section 31 10 00. Place crushed surfacing in accordance with WSDOT-APWA Section 4-04, to the thicknesses shown on the drawings.
- D. Traffic Control: Traffic Control shall be provided as required in accordance with the Clallam County requirements, the Manual on Uniform Traffic Control Devices, and WSDOT requirements

3.03 SOIL STERILANT

- A. Sterilize all areas to be paved with a relative application of material at a minimum of twenty (20) pounds of polyborchlorate per 1,000 sq. ft. of surface, mixed with water and applied with power spraying after grading is completed, or as recommended by the manufacturer. Apply soil sterilant in accordance with Section 8-02.3(2) of WSDOT-APWA

3.04 CRUSHED SURFACING BASE AND TOP COURSE

- A. Place aggregate base and top course in accordance with Section 4-04 of the WSDOT-APWA. Relative dry compaction shall be a minimum of 95 percent of modified proctor maximum dry density as determined in accordance with ASTM D1557
- B. Prior to asphalt concrete placement, treat the prepared surface in accordance with Section 5-04.3 of WSDOT-APWA

3.05 TACK COAT

- A. Apply a tack coat to all existing pavement surfaces to be overlaid or abutted with new asphaltic pavement. Apply tack coat at a rate of 0.05 to 0.15 gal/sy. Allow enough time for complete breaking to occur before the overlay is placed. Place no more tack coat than can be covered the same day. Place no tack coat when the surface temperature of the pavement is below 50 degrees F or when rain is imminent.

3.06 ASPHALT CONCRETE

- A. Place asphalt in accordance with Section 5-04 of WSDOT-APWA. Spread, finish and compact in accordance with Sections 5-04.3(9) and 5-04.3(10).
- B. Construct joints in accordance with Section 5-04.3(11).
- C. Provide surface smoothness and grading in accordance with Section 5-04.3(13). Accomplish paving in accordance with the weather limitations outlined in Section 5-04.3(16).
- D. Sample and test asphalt concrete in accordance with Sections 5-04.3(10)B and 5-04.3(12).
- E. Contractor shall completely flood by fire line or tank truck paved area in the presence of the owner's representative to verify that no ponding is occurring. Any areas of bird baths or ponding must be re-paired or replaced in accordance with the Asphalt Institute's "Asphalt in paving Maintenance" Manual Series No. 16.

3.07 CLEANING

- A. After completion of paving operations, clean surfaces of excess or spilled asphaltic materials.

- B. Contractor shall phase the final lift of pavement in a manner to limit Construction traffic within this area after completion.
- C. Do not permit vehicular traffic on asphaltic paving until it has cooled and hardened, and in no case sooner than twelve (12) hours after placing.

3.08 RECYCLING OF ASPHALT MATERIALS

- A. Recycling some waste asphalt paving materials may be possible at some off-site locations.
- B. No waste materials can be recycled on-site. All waste paving materials must be disposed of off-site.

END OF SECTION

SECTION 321300

RIGID PAVING

PART 1 GENERAL

1.01 THIS SECTION INCLUDES THE FOLLOWING:

- A. Provide cement concrete sidewalks, concrete paving, and curb ramps as shown on the Contract Documents.
- B. Coordinate and provide miscellaneous concrete for footings for site furnishings, equipment, and signs.
- C. Aggregate and soil materials.
- D. Protection and conditioning of onsite materials.
- E. Exporting and disposing of unsuitable and excess soil material.
- F. Recycling and processing concrete rubble for aggregate (Contractor Option).
- G. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. Section 310000 "Earthwork."
 - 2. Section 321200 "Flexible Paving."

1.02 REFERENCES

- 1. WSDOT Standard Specifications Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction, Current Edition
- 2. Current Clallam County Engineering Design Standards
- 3. WSDOT/APWA Standard Plans for Road, Bridge and Municipal Construction, Current Edition
- 4. City of Port Angeles Urban Services Standards & Guidelines
- 5. Site Geotechnical Report Lot 24 Eklund Heights – Soils Investigation, Zenovic & Associates Inc. June 9, 2026

1.03 SUBMITTALS

- A. General: Comply with Section 013300. Samples: Submit minimum 50-pound sample for each material-al 4 business days prior to placing material.

- B. Quality Assurance/Control Submittals.
- C. Test Reports: Sieve analysis for each material.
- D. Certificates: WSDOT pit certification for each pit.
- E. Samples: Joint filler material.

PART 2 PRODUCTS

2.01 CEMENT CONCRETE PAVING, SIDEWALKS, ADA RAMPS, CEMENT CONCRETE EXTRUDED AND VERTICAL CURB

- A. Construct cement concrete sidewalks and integral curb and sidewalks and ADA ramps in conformance with Standard Specification 8-14, Class 4000 PSI Portland Cement Concrete with air entrainment in accordance with Standard Specification 5-05.3(1). Calcium Chloride is not allowed as an admixture.
- B. Pavement, sidewalks, and ADA ramps located in the Right-of-Way shall be constructed in accordance with the City of Port Angeles Urban Services Standards & Guidelines
- C. Construct cement concrete extruded vertical curb with air entrained concrete Class 4000 conforming to the requirements of WSDOT-APWA Section 8-04.3. Portland cement and aggregates shall conform to Section 8-04.2 of WSDOT-APWA. Calcium Chloride is not allowed as an admixture.

2.02 PREFORMED JOINT FILLERS.

- A. Conform to Standard Specification Section 9-04.1(2)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify installation conditions as satisfactory to receive work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes your acceptance of conditions.
 - 1. Verify proper compaction of subgrade, Section 310000, for on-grade work.

3.02 PREPARATION

- A. Field Measurements.

1. Carefully verify and coordinate with all Clallam County and WSDOT/APWA requirements Identify existing structural foundations near excavations. Verify excavation will not undermine footings or supports and cause damage to structures.
2. Verify existing dimensions and shapes. Conform to existing where applicable.

3.03 INSTALLATION

- A. Install cement concrete vertical curbs and curb and gutter in accordance with Contract Documents and WSDOT/APWA Section 8-04.3(1). Provide expansion joints at maximum 15-foot maximum spacing. Coordinate expansion joints with the Architects scoring pattern. Perform the work in a manner that results in a curb constructed to specified line and grade, uniform in appearance and structurally sound. Re-move curbs found with unsightly bulges, ridges or other defects and replaced at no additional cost to the Owner if Owner's representative considers them irreparable. When checked with a 10-foot straight-edge, grade shall not deviate more than 1/8 inch, and alignment shall not vary more than 1/4 inch. Curb repairs shall match existing grades.
- B. Cement concrete sidewalks and walkways shall be installed in accordance with the plan drawings and WSDOT-APWA Section 8-14. Expansion joints shall be provided at a maximum 15-foot spacing and shall be coordinated with the Architectural scoring pattern. Sidewalks paving shall be divided to match existing scoring pattern, by scoring 1/4 inch deep. Sidewalks and walkways shall be installed flush with adjacent walks. Sidewalks shall be sloped away from adjacent buildings or crowned in the middle if landscaping on either side.
- C. Concrete sidewalks and paving shall be finished as specified in Section 321320 – Site Concrete Finishes.
- D. Form expansion joints with preformed joint filler. Install strippable joint at joints to receive sealant specified in Section 079200.

3.04 DEFECTIVE WORK

- A. Remove and replace defective work not conforming to the plans and specifications to specified tolerance at no additional cost to the Owner.
- B. Remove and replace, as directed, any sidewalks or walkways that show excessive cracking, and which do not freely drain, at no additional cost to the Owner.

3.05 CLEANING

- A. Leave premises clean and free of residue of work of this Section.

END OF SECTION

PAVEMENT MARKINGS AND SIGNAGE

1.01 SECTION INCLUDES

- ## 1.02 RELATED SECTIONS

- ### 1.03 REFERENCES

- ## 1.04 SAMPLING AND TESTING

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1. A test report showing that the proposed batch meets all specified requirements.

1.05 TEMPORARY TRAFFIC CONTROLS

- A. Place suitable warning signs for alerting approaching traffic. Place traffic cones or markers along newly painted lines to control traffic and prevent damage to newly painted surfaces.
- B. The contractor is responsible for obtaining all permits and coordinating with the Clallam County for installation of signs and striping within public Right of Way.

PART 2 PRODUCTS

2.01 TRAFFIC PAINT

- A. Paint shall be lead free, Low VOC Solvent Based or Waterborne paint per Section 9-34.2 of the Standard Specifications.
- B. Paint shall be delivered and stored in sealed containers that plainly show the designated name, formulation, or specification number, batch number, color, date of manufacture, manufacturer's name, formulation number and directions, all of which shall be printed legibly at time of use. The paint shall be homogeneous, easily stirred to a smooth consistency, and shall show no hard settlement or other objectionable characteristics.
- C. Color shall conform to Section 9-34.2(2) of the Standard Specifications.

2.02 SITE SIGNS

- A. Fire Lane Signs shall read "NO PARKING – FIRE LANE".
 1. Signs shall be located at the entrance to each fire lane and at 150-foot intervals along the route.
 2. Signs shall measure 12" x 18" and have red letters on a white background.
- B. Site signs shall be 80-millimeter anodized aluminum with engineer grade reflective sheeting and graffiti film.
- C. Sign mounting hardware and fasteners shall be stainless steel or hot-dipped galvanized.
- D. Signposts shall be a minimum 2" diameter Schedule 40 galvanized pipe with top caps or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify installation conditions as satisfactory to receive work of this Section. Do not install until unsatisfactory conditions are corrected. Beginning work constitutes your acceptance of conditions as satisfactory.
 - 1. Pavement markings shall conform to WSDOT/APWA Section 8-22.
 - 2. All permanent signs shall conform to WSDOT/APWA Section 8-21.

3.02 PREPARATION

- A. All surfaces to be marked shall be thoroughly cleaned before the application of the paint. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of the methods as required. Large areas of tar, grease, rubber deposits, or foreign material shall be completely removed with scrapers, wire brushes, sandblasting, steam cleaning, power brooming or approved chemicals or mechanical abrasion.

3.03 APPLICATION

- A. Pavement Markings shall be per Section 8.22.3 of the Standard Specifications.
- B. Application thickness shall be per Section 8.22.3(3)F of the Standard Specifications.
- C. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking letters and symbols. Sharply outline edges of marking. The maximum drying time requirement of the paint specifications shall be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. Discontinue painting operations if there is a deficiency in drying of the marking, until cause of the slow drying is determined and corrected.

3.04 SIGN INSTALLATION

- A. Install signs at locations as shown on plans and in accordance with Section 8-21.3(2) of WSDOT/APWA and MUTCD.

3.05 CLEANING

- A. Leave premises clean and free of residue of work of this Section.

END OF SECTION

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SECTION 323113
CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Posts, rails, and frames.
- B. Wire fabric.
- C. Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a (Reapproved 2022).
- B. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2025.
- C. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.
- D. ASTM F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework; 2018 (Reapproved 2022).
- E. ASTM F1083 - Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2018 (Reapproved 2022).
- F. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric); 1990.

1.03 SUBMITTALS

- A. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components. See CLFMI CLF-SFR0111 for planning and design recommendations.

PART 2 PRODUCTS

2.01 COMPONENTS

- A. Line Posts: 1.9 inch diameter.

- B. Corner and Terminal Posts: 2.38 inch diameter.
- C. Gate Posts: 3-1/2 inch diameter.
- D. Top and Brace Rail: 1.66 inch diameter, plain end, sleeve coupled.
- E. Bottom Rail: 1.66 inch diameter, plain end, sleeve coupled.
- F. Fabric with Pre-Inserted Slats: 2 inch diamond mesh interwoven wire, 9 gauge, 0.1483 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.
 - 1. Privacy Slats: High-density polyethylene (HDPE), woven into fabric.
 - a. Visual Barrier: 95 percent.
 - b. Slat Color: As selected from manufacturer's full range of colors.
- G. Tension Wire: 6 gauge, 0.1920 inch thick steel, single strand.
- H. Tie Wire: Aluminum alloy steel wire.

2.02 MATERIALS

- A. Posts, Rails, and Frames:
 - 1. ASTM A1011/A1011M, Designation SS; hot-rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi; zinc coating complying with ASTM F1043 and ASTM F1083.
 - 2. Line Posts: Type I round in accordance with FS RR-F-191/1D.
 - 3. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.
- B. Wire Fabric:
 - 1. ASTM A392 zinc coated steel chain link fabric.

2.03 ACCESSORIES

- A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size[or dry, packaged, normal-weight concrete mix complying with ASTM C387/C387M mixed with potable water according to manufacturer's written instructions
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

2.04 FINISHES

- A. Components and Fabric: Vinyl coated over coating of 1.8 ounces per square foot galvanizing.
- B. Accessories: Same finish as framing.
- C. Color(s): To be selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install framework, fabric, accessories and gates in accordance with ASTM F567.
- B. Place fabric on outside of posts and rails.
- C. Set intermediate posts plumb , in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff. Depth: Minimum footing frost depth per code.
- D. Brace each gate and corner post to adjacent line post with horizontal center brace rail. Install brace rail one bay from end and gate posts.
- E. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.
- F. Install hardware and gate with fabric to match fence.
- G. Repair finish at all field welded locations with cold applied galvanizing, primer, and vinyl coating to match factory finish.

3.02 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.

END OF SECTION

SECTION 323119
DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative steel fences.
- B. Manual Pedestrian Gates
- C. Powered Vehicle Gates
- D. Automatic gate operators.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- B. ASTM F2200 - Standard Specification for Automated Vehicular Gate Construction; 2024.
- C. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016 (Reapproved 2023).
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. Product Data: Submit manufacturer's data sheets on each product to be used.

- B. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
- C. Wiring Diagrams: Include diagrams for power, signal, and control wiring.
- D. Shop Drawings:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
 - 2. Foundation details.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. For gate operators to include in maintenance manuals.

PART 2 PRODUCTS

2.01 FENCES

- A. Fences: Complete factory-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with electrodeposition coating, and having the following performance characteristics:
 - 1. Capable of resisting vertical load, horizontal load and infill performance requirements for fence categories defined in ASTM F2408.
- B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
 - 1. Total Coating Thickness: 2 mils, minimum.
 - 2. Color: As selected by Architect from manufacturer's standard range.
- C. Steel: ASTM A653/A653M; tensile strength 45,000 psi, minimum.
 - 1. Hot-dip galvanized; ASTM A653/A653M, G60.
- D. Hinges: Finished to match fence components.

2.02 MECHANICALLY FASTENED STEEL FENCE

- A. Provide fence meeting requirements for Residential class as defined by ASTM F2408.

- B. Fence Panels: Mechanically fastened with internal reinforcement and tamperproof fasteners; 6 feet high by minimum 6 feet long panels.
 - 1. Panel Style: Two rail.
 - 2. Panel Strength: Capable of supporting 600 pound load applied at midspan without deflection.
 - 3. Attach panels to posts with manufacturer's standard panel brackets.
- C. Posts: Steel tube.
 - 1. Size: 2 inches square by 16 gauge with manufacturer's standard cap.
 - 2. Post Cap: Ball.
- D. Rails: Manufacturer's standard, double-wall steel channel; 1 inch square by 18 gauge with pre-punched picket holes.
 - 1. Picket Retaining Rods: 1/8 inch galvanized steel.
 - 2. Picket-to-Rail Intersection Seals: PVC grommets.
- E. Pickets: Steel tube. 5/8 inch square, 18 gauge.
 - 1. Spacing: 4.175 inch on center.
 - 2. Size: 1 inch square by 14 gauge, 0.0747 inch
 - 3. Style: Square top pickets extend above top rail.
- F. Flexibility: Capable of following variable slope of up to 1:4.
- G. Swing Gates
 - 1. Gate Configuration: Single Leaf.
 - 2. Gate Frame Height: Match adjoining fence height.
 - 3. Gate Opening Width: 36 Inches with clear opening width with 32 inches clear minimum to meet accessibility standards.
 - 4. Steel Frames and Bracing: Match materials and finish of adjoining decorative metal fencing.
 - 5. Frame Corner Construction: Welded.

6. Infill: Comply with requirements for adjacent fence.
7. Picket Size, Configuration, and Spacing: Comply with requirements for adjacent fence.
8. Hardware:
 - a. Gates without Access Control: Latches permitting operation from both sides of gate with padlock hasp. See Specialty Hardware for hinges.
 - b. Gates with Access Control: See Specialty Hardware for hinges, access control housing, and gate boxes. See Division 08 Hardware for balance of gate hardware.

H. Horizontal Slide Gates.

1. Gate Configuraton: Bi-parting Cantilever slide gates with external roller assemblies.
2. Height: Match fence height.
3. Automated vehicular gates shall comply with ASTM F2200 Class II.
4. Galvanized-Steel Frames and Bracing: Fabricate members from square tubing.
5. Frame and Bracing Members: Square tubes 2 inches x 2 inches minimum formed from 0.108-inch nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch nominal-thickness steel sheet and hot-dip galvanized after fabrication.
6. Welded frame with 5/16-inch diameter, adjustable truss rods for panels 5 feet wide or wider
7. Infill and Pickets: Comply with requirements for adjacent decorative metal fence.
8. Finish: To match adjacent decorative metal fence.

2.03 SPECIALTY HARDWARE

- A. Hinges: Finished to match fence components.
1. Closing: Self.
 2. Mechanism: Spring, adjustable tension and pitch.
 3. Material: Steel.
- B. Access Control Housing

1. Steel box, 14 gauge, with black powdercoat finish and 18 gauge stainless steel faceplate for mounting two single gang devices, with tubular key lock, for welding to fencepost or mounting to remote pedestal, to house Knox key switch and access control card reader as scheduled.
2. Manufacturer: Keedex.com. Model: # iCan.
3. Provide one adjacent to jamb fencepost of each pedestrian gate with access control, welded to fencepost on non-secure side, and one for each remote pedestal. Where only one device is scheduled, provide 18 gauge stainless steel blank cover plate over unused opening.

C. Panic Device Gate Box

1. Weldable steel gate box to for panic device mounting, 12 gauge steel.
2. Manufacturer: Keedex.com. Model: As required for scheduled panic device.
3. Provide one each pedestrian gate, welded to gate.

D. Electric Strike Device Gate Box

1. Weldable steel gate box to for electric strike mounting, 12 gauge steel.
2. Manufacturer: Keedex.com. Model: As required for scheduled device.
3. Provide one for each pedestrian gate with access control, welded to fencepost on latch side of gate.

E. Remote Pedestal

1. Gooseneck pedestal, 42 inches tall, with 5 x 5 x 1/4" inch baseplate and two 4 x 4 inch 14 gauge universal face plates. 2 x 2 inch 12 gauge steel tube, powdercoated. Face plate for mounting access control housing and mounting intercom. With concealed wireway and removable pull covers for wiring.
2. Provide one for each sliding vehicle gate.

2.04 AUTOMATIC GATE OPERATORS

- A. Sliding Gates: Prewired, pedestal-mounted gate operators for bi-parting horizontal sliding gates, per ASTM F2200 and UL 325.
 1. Class: Class I.

2. Operating type: Roller chain.
3. Control Functions: Open, Pause, Close. Provide contacts for gate operation by Knox key switch, access control system, vehicle presence detector, and all safeties.
4. Maximum Open/Close Time: 10 seconds.
5. Access: Access control system and Knox key switch on remote pedestal .
6. Maximum gate weight: 800 pounds.
7. Horsepower Rating: Suitable for connected load, 110 VAC, single phase.
8. Provide one point of contact for 110 v power for gate operator and all controls. Provide transformer for all low voltage controls.
9. Frequency of Use: 25 cycles per hour.
10. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide NEMA 4X photo eye sensors as required with momentary-contact control device.
 - b. Secondary Device: Provide electric sensing edge with wireless edge kit
11. Vehicle Presence Detector for "Free Exit": System includes automatic closing timer with adjustable time delay and timer cutoff switch, and presence detector designed to open and close gate. System includes emitter/receiver detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway when infrared beam in zone pattern is interrupted, and to emit a signal activating the gate operator.
12. Warning Module: Audio and visual alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving; compliant with the United States Access Board's ADA-ABA Accessibility Guidelines.
13. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type, permitting manual operation if operator fails. Design system so control-circuit power is disconnected during manual operation
 - a. Type: Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge.

14. Instructional, Safety, and Warning Labels and Signs: According to UL 325 and Manufacturer's standard for components and features specified.
15. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - a. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - 1) Outdoor Locations: Type 3R.

2.05 ACCESSORIES

- A. Electrical: Low voltage wiring and raceways UL listed for exterior exposure.
- B. Equipment Bases/Pads: Precast concrete, depth not less than 12 inches, size and reinforced to support gate motor and operator.
- C. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size[or dry, packaged, normal-weight concrete mix complying with ASTM C387/C387M mixed with potable water according to manufacturer's written instructions.
- D. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.
- E. Welded wire security mesh, finished to match fence, 1/2 inch x 1/2 inch, 16 gauge minimum.
 1. Provide on full width pedestrian gates x 3 feet tall, centered on panic device, and in 18 inch radius half-moon area of fence directly adjacent to latch side of pedestrian gates, aligned to prevent outside access to panic device.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Set fence posts in concrete, in accordance with the manufacturer recommended size spacing.

- C. Set intermediate posts plumb , in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff. Depth: Minimum footing frost depth per code.
- D. Repair finish at all field welded locations with cold applied galvanizing, primer, and painted finish to match factory finish.
- E. Install operator in accordance with manufacturer's instructions and in accordance with NFPA 70. Adjust and verify proper operation of all devices which operate motor operated gates, including access control, intercome, all safety devices, safety resets, alarms, and manual over-ride.
- F. Provide low voltage wiring and terminations from gate operator to all activation devices: access control switch, intercom, knox key switch, vehicle presence detector, and safety devices, in weathertight raceways.

3.02 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum Distance from Property Line: 6 inches.

3.03 CLEANING

- A. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- B. Clean fence with mild household detergent and clean water rinse well.

3.04 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Training: Train Owner's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.05 PROTECTION

- A. Protect installed products until completion of project.

- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

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**SECTION 323313
SITE BICYCLE RACKS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior bicycle racks.

1.02 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Installation methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Exterior Bicycle Racks:
 - 1. Basis of Design: The Wagner Companies Pre-Galvanized Bike Rack Kit, Single Loop, SR1LW.

2.02 BICYCLE RACKS

- A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
 - 1. Style: Round loop.
 - 2. Capacity: As shown on drawings.
 - 3. Mounting, Ground: In-ground anchor.
 - 4. Finish: Hot-dipped galvanized, maintenance-free and weather-resistant.
 - 5. Accessories: In-ground grout cover.
- B. Materials:
 - 1. Pipe: Carbon steel, ASTM A53/A53M, Schedule 40.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Install level, plumb, square, and correctly located as indicated on drawings.
- C. In-Ground Anchor Installation:
 - 1. Prepare holes in size according to manufacturer's instructions.
 - 2. Place anchoring bolts through the holes in pipe.
 - 3. Lower rack into holes, ensuring the bottom of lower bends are at least 1-1/2 inch from the ground.
 - 4. Place concrete.
 - 5. Level rack before concrete sets.
 - 6. Support until dry.

END OF SECTION

SECTION 323500 SCREENING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal screening devices.
- B. Concrete footings.

1.02 REFERENCE STANDARDS

- A. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- B. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- D. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2023.

1.03 SUBMITTALS

- A. Product Data: Provide data on panels, accessories, fittings, and hardware.
- B. Shop Drawings: Indicate plan layout, hardware anchorage, relationship to steel support framing, and spacing and schedule of components.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel posts, plates, and angles per Division 05 and as indicated on drawings.
- B. Metal Screening Devices:
 - 1. Basis of Design: Longboard Architectural Products, Inc., www.longboardproducts.com/#sle.
 - 2. Privacy Beams, nominal 1 inch x 5 inches, 6063 T-5 extruded aluminum with factory finish.
 - 3. Provide optional beam caps all open ends.

C. Concrete Footings:

1. Normal Weight Concrete:
 - a. Compressive Strength: 2,500 psi when tested in accordance with ASTM C39/C39M at 28 days.
 - b. Water-Cement Ratio: Maximum 40 percent by weight.
 - c. Maximum Slump: 3 inches.
 - d. Maximum Aggregate Size: 5/8 inch.

D. Hardware

1. Galvanized or stainless steel hardware for exterior exposed use.

PART 3 EXECUTION

3.01 INSTALLATION

A. Concrete Footings:

1. Excavation:
 - a. Excavate to accommodate new screening devices and construction operations.
 - b. Excavate to specified elevations.
 - c. Excavate to dimensions required to safely install, adjust, and remove bracing or supports necessary for installation of work.
2. Concrete:
 - a. Comply with requirements of ACI SPEC-301.
 - b. Place concrete in accordance with ACI PRC-304.

B. Metal Screening Devices:

1. Install according to manufacturer's written instructions.
2. Post Framing:
 - a. Embed posts as indicated in concrete footings.
 - b. Set posts level and plumb in position indicated on drawings.

- c. Make provisions for erection loads and sufficient temporary bracing to maintain structure plumb and in true alignment until completion of erection and installation of permanent bracing.
- 3. Panel Sheathing:
 - a. Securely fasten to posts plumb and level. Install factory end caps.

3.02 TOLERANCES

- A. Maximum Variation from Plumb and Level: 1/4 inch.
- B. Maximum Offset from True Alignment: 1/4 inch.

3.03 PROTECTION

- A. Protect installed screening device from subsequent construction operations.
- B. Touch up, repair, or replace damaged products.

END OF SECTION

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SECTION 321540

CRUSHED ROCK PAVING

PART 1 - GENERAL

1.1 Description: Provide all labor, materials, and equipment to perform the following work of the Contract, including incidentals related to that work and other work specified elsewhere in the Contract Documents:

- A. Survey for horizontal and vertical control of all work of the Contract.
- B. Protection of Existing Features and Work in Progress.
- C. Construction of crushed rock pathways.
- D. Removing materials from the site which are in excess of that required.

1.2 Related Sections: Coordinate related work specified in other parts of the Project Manual, including but not limited to the following:

Section 31 00 00 - Earthwork
Section 32 11 23 - Mineral Aggregates

1.3 QUALITY ASSURANCE:

- A. The Contractor is responsible for verifying the quality of the work and shall perform compaction and density tests on request of the Engineer to check compliance with these specifications. A copy of the test reports shall be furnished to the Engineer.
- B. The Engineer's Testing Agency may perform compaction and density tests to check compliance with these specifications.
- C. The Engineer may require that an independent testing laboratory test imported materials at any time. If the material is found to be non-compliant with the Contract, the Contractor shall bear the cost of testing, removal of all non-compliant materials from the Project Site, and replacement of the materials with materials meeting the requirements of the Contract. If the materials tested are found to be compliant with the requirements of the Contract, the Owner will reimburse the Contractor for costs incurred for testing plus mark-ups as allowed for elsewhere in the Contract.
- D. It is the responsibility of the Contractor to verify the accuracy of all survey information provided by the Owner prior to commencing excavations or filling operations. Commencement of these operations constitutes acceptance of the survey information as appropriate to meet the intent of the Contract.

- E. Submittals: The Engineer shall approve in principle all products used in the execution of this section prior to their importation to the Project Site. Submit a particle gradation analysis in graph and table form for each product specified.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. Prior to the importation of any materials, the Contractor shall provide the Engineer with a certified test lab report of the sieve analysis of the product. The Engineer shall be the final determining factor in establishing compliance with sieve requirements. No material shall be brought onto the job site until the initial sieve analysis has been approved in writing.
- B. During the course of importation of materials, the Contractor shall be responsible for continually checking the materials to insure that they continue to meet the Specifications.

2.2 CRUSHED ROCK BASE AND TOP COURSE AGGREGATES:

- A. Use as Base Course for ADA Accessible pathways: 5/8" Minus Crushed Rock (Mineral Aggregate Type 1 - "Ledge Rock" Top Course Keystone), bearing no naturally occurring or worn surfaces per Section 02060 - Mineral Aggregates. Gradation of the base course shall be:

<u>Sieve Size</u>	<u>Percent Passing</u>
5/8" square sieve	100%
1/4" square sieve	55 - 75%
U.S. No. 40 sieve	8 - 24%
U.S. No. 200 sieve (wet)	10% Max. (wet)

- A. Use as Top Course for ADA Accessible (less than 5% grades) pathways, with Optional Stabilizer/Binder: 1/4" Minus Crushed Rock (#4 to Dust) shall consist of crushed ledge rock or talus bearing no naturally occurring or worn surfaces as produced by Glacier Northwest, or approved equal.

<u>Sieve Size</u>	<u>Percent Passing</u>
1/2" square sieve	100%
3/8" square sieve	96-100%
U.S. No. 10 sieve	45-65%
U.S. No.40 sieve	15-25%
U.S. No.80 sieve	10-20%
U.S. No. 100 sieve	10-18%
U.S. No. 200 sieve (wet)	12% Min. (wet)
% Fracture	75% Min.
Sand Equivalent	40% Min.

2.3 STABILIZER/BINDER:

- A. Stabilizer/Binder shall be used in conjunction with pathway construction where grades are steeper than 2% and shall be one of the following products:
1. Organic-Lock, as supplied by Olympic Organics, 7890 NE Ecology Rd, Kingston, WA 98346. 360-689-8127
 2. Organic-Lock, as supplied by Applied Organics 19835 Woodinville Snohomish Rd NE, Woodinville, WA 98072. 425-485-9813
 3. "Generic-CPX 2900 Series Generic Copolymer Resin Soil-Stabilizer Solution", as supplied by A.R. Smith Distributing Co., LLC, 303 33rd Avenue, Seattle, WA 98122, Ph. 206-650-0832, FAX: 206 219-4149, or arsmith30333@comcast.net or alex@arsmithcompany.com.
 4. "Stabilizer", as supplied by Stabilizer Solutions, Inc., 33 South 28th Street, Phoenix, AZ 85034, Ph 800-336-2468, or www.stabilizersolutions.com.
 5. Or, approved equal.

PART 3 - EXECUTION

3.1 PROTECTION OF EXISTING FACILITIES

- A. Utilities: The Contractor shall protect from damage private and public utilities. Verify the locations of underground utilities minimum 48 hours prior to excavation.
- B. Pavement: The Contractor shall protect from damage all pavement or paved areas including curbs and walks intended to remain. The Contractor shall be responsible for replacement if damage occurs to pavement or curbs.
- C. It is the responsibility of the Contractor to protect all work in progress from damage due to extremes of cold, moisture, or drying, or mechanical damage from equipment traffic or foot traffic. Alert the Engineer to the presence or likelihood of conditions that may adversely affect the quality of the work, the physical structure of soils, or transport of site soils off-site.

3.2 PREPARATION:

- A. Establish sub-grades to a neat, smooth surface of uniform slope according to the plans.
- B. Protect soils from excessive moisture.
- C. Apply supplemental moisture to overly dry soils.
- D. Do not work frozen soils.

3.3 GRADING:

- A. Removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Engineer is not authorized. Unauthorized excavation, as well as remedial work directed by the Engineer shall be at the Contractor's expense.
- B. Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified areas. Compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades. Finish surfaces free from irregular surface changes.
- C. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place the material, then grade and shape stockpiles to allow for proper drainage.
- D. Locate and retain soil materials away from edge of excavations and drip lines of trees to remain.
- E. Dispose of excess soil material and waste materials as herein specified.

3.4 COMPACTION:

- A. General: Control soil compaction during construction providing minimum percentage of density specified for area classification. Do not allow equipment traffic to overly compact areas beyond specified percentages. Remediate over compaction as directed by the Engineer including ripping, regrading and re-compaction or over-excavation and in-kind replacement per plan.
- B. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages for maximum density for soils which exhibit a well-defined moisture density relationship (cohesive soils) determined in accordance with ASTM D1557; and not less than the following percentages of relative density; determined in accordance with ASTM 2049, for soils which will not exhibit a well defined moisture density relationship (cohesionless soils).
 - 1. Import aggregate base material for Crushed Rock Path - 95%.
 - 2. Crushed Rock Path Top Course - 95%
- C. Moisture Control:
 - 1. Where sub-grade or lift of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.

2. Before compaction, moisten or aerate each layer as necessary to provide optimum content. Compact each layer to required percentages of maximum dry density or relative dry density for each area classification.
3. Do not perform compaction operations on excessively wetted soils.

3.5 CRUSHED ROCK BASE COURSE:

- A. Provide a minimum 4" compacted lift of specified Crushed Rock Base Aggregate true to the elevations either described or implied in the Contract Drawings or as required to match adjacent existing pavements, and a minimum of 4" beyond the horizontal layout lines of pavement as indicated on the Contract Drawings.

3.7 CRUSHED ROCK TOP COURSE:

- A. Provide a 2" compacted lift of specified Crushed Rock Top Course **Stabilized** Crushed Rock true to the elevations either described or implied by the Contract Drawings or as required by the Engineer.
- B. Shape the pathway to the desired width and grades **and shape before applying the stabilizer product**. For both base and surfacing courses, slightly crown or pitch the surface (2% max. cross-slope) so as to provide natural runoff and drainage. Compact until surface is hard and dense. Repair or replace soft spots, ruts or other damage that may occur prior to the final acceptance by the Engineer at no additional cost to the Owner. Depth as shown on the plans and details is always compacted depth.
- C. For $\frac{1}{4}$ " top course, after placement, water in the surface, then compact by rolling or using plate compacter. Repeat as needed to provide uniform thickness, compacted surface to meet ADA requirements.
- D. *Apply stabilizer product mixture and compact for a semi-permeable but stabilized pathway or trail with loose top material per manufacturer's recommendations.*

- 3.8 Disposal of Excess and Waste Materials: Remove from the Owner's property all waste materials, including unacceptable excavated material, trash and debris, and dispose of it off site in a legal manner. Provide dump receipts from an approved dumpsite.

END OF SECTION

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SECTION 328000
IRRIGATION COMPONENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials equipment and related items necessary to complete the work identified in these Specifications. Provide a complete and operable, automatic irrigation system with complete and uniform water coverage for all new landscape areas identified on the Landscape Plan. The items of work to be performed include, but are not limited to:
 - 1. Provide trenching and backfilling for piping/wiring.
 - 2. Provide and install irrigation sleeving.
 - 3. Provide and install pipe, sprinkler heads, fittings, valves and valve boxes.
 - 4. Provide and install valve control wire and controller.
 - 5. Guarantee, maintenance, protection and system testing.
 - 6. All other related items required to complete the work in the best-accepted trade practices.

1.2 SYSTEM COVERAGE CRITERIA

- A. Coverage: The irrigation system shall provide 100% coverage of all and tree planting areas and shrub/groundcover planting areas as directed. Irrigation heads shall be located and adjusted to avoid over-spray on paved surfaces.
- B. Zoning: Number of zones shall be determined by designer and shall be based on available water pressure at the site. Contractor shall inform Landscape Architect of any and all problems with pressure and/or flow to site.

1.3 PROTECTION OF WORK, PROPERTY, UTILITIES AND PERSONS

- A. Provide protection of all property, persons, work in progress, structures, utilities, walls, walks, curbs and paved surfaces from damages incurred arising from this Contract. The Contractor shall pay for any repair of such damage at no additional cost to the Owner. Verify locations of all underground utilities prior to commencement of work. Existing known utilities have been shown on the Architectural/Engineering or Survey Drawings. The Contractor shall be responsible for the protection of said utilities. Promptly notify the General Contractor and Owner of any conflict between proposed work and obstruction(s).

- B. Notify local utility companies a minimum of 48 hours prior to beginning work.

1.4 SUBMITTALS

- A. At least 30 days prior to beginning work described in this section submit the following data for products submitted for review.
 - 1. Manufacturer's descriptive data including operating materials used in products, test certificates, special features, guarantees and other data required to completely describe the product.
 - 2. Samples of the proposed substitution when requested. Samples will be returned to Contractor whether or not approval is given.
- B. Product Data: Material and equipment composite data sheets shall be submitted for the following:
 - 1. Galvanized pipe
 - 2. PVC pipe
 - 3. Gate valves
 - 4. Double check assembly
 - 5. Pressure gauges
 - 6. Manual drain valve
 - 7. Quick coupling valves (inc. key and hose swivel)
 - 8. Master valve
 - 9. Flow sensor
 - 10. Control valves
 - 11. Communication, control, and trace wire
 - 12. Wire splices (all types)
 - 13. Swing joints
 - 14. Sprinkler heads/nozzles
 - 15. Landscape Drip system
 - 16. Valve boxes
 - 17. Controller

18. ET Water HermitCrab Smart Controller

19. Frost Free Yard Hydrant

- C. Submit the number of copies required by the Contract Documents. Clearly index, label, and highlight products to be utilized.

1.5 VERIFICATION OF SITE CONDITIONS

- A. Before proceeding with any work, the Contractor shall verify all dimensions pertaining to the location of irrigation equipment. Contractor shall verify location and depth of service lines, existing irrigation mainline and available static water pressure. Should any error or conflicts in the Drawings and/or Specification be found, the Contractor shall immediately notify the Owner's Representatives.
- B. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
1. Notify Owner no fewer than (2) working days in advance of any proposed interruption of water service. Do not proceed with interruption of water service without Owner's written permission.
- C. Utilities and Existing Structures: The exact location of existing structures and overhead or underground utilities, shall be determined by the Contractor and he shall conduct his work so as to prevent interruption of service or damage to them. Protect existing structures and utility services and repair damages.
- D. Finish Grades: Verify the correctness of all finish grades within the work area to insure the proper soil-coverage depth over pipe lines.

1.6 CLEANUP

- A. All paved surfaces shall be kept clean of soil and debris on a daily basis.
- B. Contractor shall be responsible for cleaning all paved surfaces affected by irrigation work prior to final acceptance.

1.7 GUARANTEE AND REPLACEMENT

- A. All materials and workmanship shall be guaranteed for a period of one year. Guarantee period shall commence when written Final Acceptance is granted. This guarantee does not apply to work or damage done to the system by others after Final Acceptance. Guarantee shall also cover repair of damage to any part of the premises (including planting) resulting from leaks, settlement or other defects in materials, equipment and workmanship to the satisfaction of the Owner.

1.8 SYSTEM PROTECTION

- A. During the one-year guarantee period, the Contractor shall be responsible for deactivating and draining the system prior to freezing weather. A compressor shall be used to blow the system dry. Contractor shall reactivate the system at the onset of the Spring growing season. Both operations shall be performed once during the guarantee period.
- B. Contractor shall notify the Owner in writing of the dates the system was winterized and reactivated, and shall be held responsible for any damages resulting from the failure to comply with the above procedure.
- C. When using compressed air to winterize the system, do so in two (2) short cycles at no more than 75-psi pressure. Do not allow pipe to compressor to get hot to the touch. The Contractor shall winterize the system prior to irrigation system substantial completion approval and acceptance if freezing weather occurs or is forecast. In such an event, the Contractor shall, as directed by the Landscape Architect, reactivate the system for final inspection and acceptance.
- D. Winterization and reactivation prior to final acceptance will not satisfy the warranty period requirement to deactivate (winterize) and reactivate the irrigation system.
- E. Fill and repair depressions and replace construction materials damaged from settlement or repair of irrigation trenches, throughout the warranty period.
- F. Adjust sprinkler heads as necessary to maintain complete, 100% overlap coverage, and to keep spray off structures, out of roadways, and off pavements throughout the warranty period.
- G. Replace defective parts throughout the warranty period.

1.9 SYSTEM MAINTENANCE

- A. Provide maintenance of the irrigation system until Final Acceptance including head and nozzle adjustment, setting and adjusting controller times, and replacing defective materials.
- B. Operations and Maintenance Manual:
 - 1. At, or before, Substantial Completion review of irrigation system, submit for review one (1) manual, bound in hardback, 3-ring notebook, to Owner's Representative. At a minimum, the following information/items are required to be in the manual:
 - a. List of authorized distributors and service representatives for each item of irrigation equipment, including names, addresses and telephone numbers.
 - b. Guarantee/warranty certificates for all equipment used and Contractor's written warranty for entire system one (1) year guarantee.
 - c. Instruction manuals for all equipment used. Including ET Water HermitCrab.
 - d. Parts lists for each item with exploded views of each item showing part numbers.
 - e. A pocket for one (1) blue-line print of the reviewed mylar record drawings laminated in clear plastic. This print shall be added at time of Final Inspection.

- f. Controller cabinet keys.

1.10 PERMITS, CODES AND ORDINANCES

- A. Obtain and pay for all necessary permits and fees as required by applicable codes and ordinances for this work.
- B. Comply with all applicable codes, regulations and ordinances.
- C. City of Tumwater shall inspect and approve the backflow prevention device.

1.11 SUBSTITUTIONS

- A. Specific reference to manufacturer's' names and products specified in the Section are used as standards, but this implies no right to substitute other material or methods without written approval of the Owner's Representative.
- B. Installation of any approved substitution is Contractor's responsibility. Any changes required for installation of any approved substitution must be made to the satisfaction of the Owner's Representative and without additional cost to Owner.
- C. No substitutions will be permitted which the Owner's Representative has not submitted for prior review and comment.
- D. Review by Owner's Representative of substituted equipment and/or dimensional drawings do not waive these requirements.

1.12 REVIEWS

- A. Contractor shall coordinate all review processes and dates with Owner's Representative. Contractor shall give the Owner's Representative 48 hours notice prior to any inspection. Contractor is responsible for uncovering/unearthing any sections of installation upon request from Owner's Representative. Contractor is responsible for providing inspections of trench depths, head layout, pressure tests and performance tests.
- B. Contractor shall provide a written Irrigation Installation plan summarizing proposed sequences of installation, methods of installation and estimated dates of completion. This work plan shall accompany requested Submittals and will be approved prior to installation of Irrigation System.
- C. Mainline trench depth, component placement and pressure tests may be accomplished concurrently. Mainline may be installed and tested in sequences, three (3) sequences maximum. Each section shall remain uncovered at all connections and valve assemblies. Each subsequent section shall be tested in conjunction with preceding section (not isolated).

1.13 OWNER TRAINING

- A. Prior to Final Acceptance of work, Contractor shall provide the Owner with all keys, tools and maintenance manuals necessary to operate/deactivate the irrigation system. The Contractor shall train and instruct the Owner's Representative as to the operation and maintenance of the irrigation system.

1.14 RECORD DRAWINGS

- A. Furnish Record Drawings of the complete irrigation system in accordance with the following conditions:
 - 1. Contractor will be provided with CD/USB drive with PDF showing irrigation work as designed under this contract.
 - 2. Maintain the blue-line prints on site at all times during construction. Make a daily record of all work installed on the prints.
 - 3. On the prints, show actual locations of valves, master valves, gate valves, risers, piping and sleeving. Dimension from easily identified permanent features such as buildings, curbs, fences, walks or property lines.
 - 4. Show approved manufacturer's name and catalog number on prints.
 - 5. Make drawings to scale with all notations neat in appearance.
 - 6. After testing and review of mainlines and laterals for backfill, transfer all information noted on blue-line prints to the mylar in a neat, orderly way.
 - 7. Turn the Record Drawings over to the Owner's Representative in PDF format on CD/USB for review after Final Inspection of the Project. Record Drawings must be submitted, reviewed and corrected if required prior to final payment.

1.15 EXTRA MATERIALS

- A. Prior to final acceptance, the Contractor shall provide to the Owner (at no additional cost to the Owner), the keys and/or other tools necessary to activate, operate, and drain the system, including:
 - 1. Two (2) quick coupling valve keys w/ hose swivels.
 - 2. Two (2) quick coupling valve cover keys.
 - 3. Two (2) manual gate valve keys.
 - 4. Two (2) of each type of rotor head installed.
 - 5. Five (5) of each type of spray head installed.
 - 6. All extra nozzle sets not utilized during the installation.

7. Two (2) valve box cover keys.

PART 2 - PRODUCTS

2.1 PLASTIC PIPE

A. Polyvinyl Chloride Pipe (PVC):

1. Pressure Mains, Laterals and Sleeving - All Sizes: Polyvinyl chloride (PVC) 1120, 1220, Schedule 40, solvent weld and shall conform to ASTM D1785.
2. Threaded Pipe, Adapters and Nipples: PVC 1120 or 1220, Schedule 80, conforming to ASTM D1785.

B. Pipe shall be marked with manufacturer's name, class of pipe, NSF seal and date and shift of manufacturing run. Pipe shall bear no evidence of interior or exterior extrusion marks.

C. Pipe walls shall be uniform, smooth and glossy. Pipe may be pre-belled or with individual solvent-weld couplings.

D. Fittings shall be PVC Schedule 40, full size unless otherwise noted. Fittings shall be of brand(s) recommended by manufacturer of pipe.

2.2 DUCTILE IRON PIPE

A. Ductile iron pipe shall comply with WDOTSS 9-30.1(1).

2.3 GALVANIZED PIPE AND FITTINGS

A. Galvanized Pipe shall be Schedule 40, domestic manufacture, and shall conform to ASTM A 53. Fittings shall be malleable galvanized.

1. All galvanized pipe and fittings installed below grade shall be painted with Fields A470 "Rainstop", nonfibered, asphalt coating.
2. All galvanized pipe fittings installed above grade shall be painted with one coat of galvanized metal primer followed by one coat matte black alkyd oil enamel.

2.4 PIPE THREAD TAPE / COMPOUND

A. All galvanized pipe threads shall be wrapped at least three (3) times, but no more than four (4), with Teflon tape. A thin coat of Rector Seat T+2, Teflon paste shall be applied on top of the Teflon tape prior to assembly

2.5 PIPE AND WIRE SLEEVES

- A. Pipe sleeves shall be twice the diameter of the pipe passing through it, but no smaller than 4 inches (4") in diameter. No more than one pipe shall be installed in each sleeve.
- B. Control and communication wire shall be installed in separate 2 inches (2") diameter CL-200 PVC sleeves.
- C. Sleeve under all paved surfaces and where indicated on Drawings.
- D. Extend sleeves minimum 24 inches (24") past both sides of pavement edge.
- E. Mark sleeve ends with a 2x4 wooden stake driven 18 inches (18") into grade with 24 inch (24") exposed. "IR Sleeve" shall be imprinted in on each stake in black, waterproof ink. The top of each stake shall be painted with fluorescent pink marking paint and shall be further marked with three wraps of fluorescent pink flagging tape. Remove stakes after irrigation lines are installed.
- F. No additional payment shall be made under any circumstances for locating sleeves.
- G. Mainline and lateral piping shall be sleeved using Ductile Iron Pipe.

2.6 SOLVENT WELD COMPOUND

- A. Two-step application using Weld-on P-70 purple primer and Weld-on 727 Clear, fast setting PVC glue or as recommended by pipe manufacturer to meet site conditions encountered. Submit product information for approval.

2.7 REMOTE CONTROL VALVES

- A. Valves shall be Rainbird 100-PEB-Series: size as shown on the Drawings. Supply each valve with PRS pressure-regulating valve and adjust pressure as shown on plan.
- B. Each Remote Control Valve shall be supplied with an identification tag . Each valve shall be numbered as shown on Plan.
- C. Master Control Valve shall be Hunter IBV-201G-FS-As-R brass body, 24 Volt solenoid mechanism, normally closed.

2.8 QUICK COUPLER VALVE

- A. Quick coupler valves located on Pressure Mainline shall be Rainbird 44 LRC with locking rubber cover. Provide with valve key and hose swivel for each quick coupler valve.

2.9 MANUAL DRAIN AND CONTROL VALVE

- A. Manual On/Off Valves shall be Kennedy-Ken Seal II #8561ASS. Size to match mainline size.

2.10 AUTOMATIC CONTROLLERS

- A. Refer to Irrigation Plan for controller location and specifications. Coordinate exact location with Building Electrician and Construction Manager.
- B. Web-based smart controller by ET Water, model HermitCrab, 1-888-685-5505.

2.11 COMPATIBLE SENSORS & VALVES

- A. Flow Meter: Hunter Flow-Click FCT-200.
- B. Solar Sensor: Hunter WSS-SEN Wireless Solar Sensor. Not shown on plans. Provide at Location Determined by Owner.

2.12 IRRIGATION HEADS

- A. Spray heads for landscape areas shall be Rainbird 1800 Series with 6" pop-up heights. Nozzles as indicated on Plan.

2.13 CONTROL WIRE

- A. Control Wire shall be Hunter Two-Wire. Valve wire shall be direct burial wire, Copper, insulated. Wire to be twisted red/blue pair.
- B. Splice: Watertight electrical splices shall a dry splice 3M-DBYconnector or approved equal. Submit sample for approval.
- C. Electrical Tape: Black plastic, 3/4" wide, spec. grade, minimum .007" thick, all weather type.
- D. Duct Tape: All weather cloth tape.
- E. Plastic Ties: Clear plastic locking ties. Size to allow for pipe diameters.
- F. Locator wires for below-grade piping shall be #14 bare copper, U.L. approved as UF, ASTM B-3 rated.

2.14 BACKFLOW PREVENTION DEVICE

- A. Double Check Valve Assembly: Febco #850U, bronze valve body with flanged end gate valves or approved equal.

2.15 METER

- A. Irrigation Meter per the City of Tumwater. See Civil Drawing Utility Plan for additional information.

2.16 VALVE BOXES AND VAULTS

- A. Valve Boxes shall be a combination of polyolefin and fibrous material. Extensions may be required to bring the valve box to the proper level. Utilize drop in style covers unless specified otherwise. Boxes shall be as follows:

1. Double Check Valve Assembly: Carson 17"x30" Super Jumbo Rectangular Box, model #1730-24 HDPE w/1730-24 Purple "RCWDNDES" label reading Reclaimed Water-Do Not Drink (English and Spanish) with Locking Bolt.
2. Manual Drain Valve, Quick Coupler Valve, Master Control Valve, and Flow Meter : Carson 10" Diameter Valve Box, model #0910-18 HDPE w/6" extension #910T Cover Purple, "RCWDNDES" label reading Reclaimed Water-Do Not Drink (English and Spanish) with Hex Bolt.
3. Automatic Control Valve: Carson 14"x19" Standard Rectangular Box, model #1419-12 HDPE Purple wit 12" extension w/ #1419T Purple "RCWDNDES" label reading Reclaimed Water-Do Not Drink (English and Spanish) with Hex. Bolt.
4. All Valve Boxes on Green Roof: Carson 6" Round Valve Box 6" Extension, model #38005610 w/Purple Lid.
5. Concrete pavers for Valve Box support shall be Contractor's choice; confirm with OWNER'S REPRESENTATIVE

2.17 YARD HYDRANT

A. Woodford Y34 Freeze less Iowa Yard Hydrant

1. Manufacturer: Woodford, or approved equal
2. Model: Woodford Y34, or approved equal/ 2 – 3 ft model
3. Size: ¾" inch inlet with ¾ inch hose thread outlet
4. Bury Depth: Per local frost depth (12 inches for Port Townsend)
5. Flow: Full port design suitable for hose filling and irrigation
6. Finish: Factory Finish
7. Install on a 12" minimum washed drain rock sump beneath the drain port
8. Separate Shut-off Valve in an accessible valve box upstream
9. 4 inch concrete collar around the hydrant
10. Hose hanger and hose
11. All materials and connections should comply with local code requirements
12. All work shall be done per Plumbing requirements. See Plumbing drawings for additional information

2.18 MISCELLANEOUS KEYS

- B. Provide three (3) of each of the following keys: Manual drain key, valve box cover lock key, controller cabinet key.

2.19 DRAIN ROCK

- A. Gravel Backfill for Drains.

2.20 ELECTRICAL CONDUIT

- A. This specification pertains only to low voltage wiring. All 120-volt power specifications are referred to Section 16000 – Electrical.
- B. Conduit above finish grade shall be rigid galvanized steel with zinc-protected threads. Fittings shall be of the same material with hot dipped galvanized finish.
- C. Conduit within a building shall be EMT where permitted by Code. Fittings shall be suitable for this product.
- D. Conduit within the ground shall be Schedule 40 Rigid PVC. Fittings shall be suitable for this product.
- E. Conduit for underground communication cable for centrally-controlled systems, when not buried with irrigation piping, shall be Schedule 40 gray PVC, 1-1/2" diameter, with pre-manufactured sweeps. Above grade conduit for PE89 shall be rigid steel as described above.
- F. All equipment furnished and installed shall be in accordance with National, State, and City Electrical Codes, established safety codes and applicable local codes and ordinances.
- G. Conduit runs shall be a maximum 400 feet without a pull box. Pull boxes shall be located every 400 feet.
- H. Pull boxes shall be as noted in herein with "ELECTRICAL" permanently branded on the lid.
- I. Flow sensor cable (PE-89) shall be enclosed in a separate 1-1/2" Schedule 40 conduit.

2.21 MAINTENANCE EQUIPMENT

- A. Provide two (2) manufacturer's service wrenches for each head type requiring wrenches for servicing or adjustment.

PART 3 - EXECUTION

3.1 VERIFICATION

- A. Prior to installation, verify that adequate gallonage and pressure is available to properly operate the irrigation system. Immediately notify Owner's Representative of inadequate conditions.

3.2 LAYOUT

- A. Layout work as accurately as possible to Drawings. Contractor will be provided with electronic drawing to accurately place Turf Rotors. Drawings are diagrammatic to the extent that swing joints, offsets and all fittings are not shown. No changes to irrigation system will be made by the Contractor without approval of the Landscape Architect.
- B. Accurately stake head locations, following the design shown on the Drawings. Do not exceed manufacturer's recommended spacing. Alterations and changes to the layout may be expected in order to conform to ground conditions and to obtain full and adequate coverage of water. No changes or alterations in the Irrigation Plan shall be made without the prior authorization of the Owner's Representative.
- C. Adjust layout as necessary to install around existing work. Where piping is shown to be under paved areas, but running parallel and adjacent to planted areas, intention is to install piping in planted areas. Do not install piping directly over another line in common trench. Offset piping to opposite sides of the trench.
- D. Install irrigation to avoid proposed and existing tree and root locations. Plant locations will be field adjusted to avoid irrigation equipment, at direction of Owner's Representative.

3.3 TRENCHING

- A. Provide all excavations as required for installation of work included in this Section, including shoring of earth banks, if necessary. Restore all surfaces, existing underground installations, etc., damaged or cut as a result of the excavation, to their original condition.
- B. Contractor shall submit a written schedule of Trenching and Irrigation Pipe installation for approval by Owner's Representative prior to beginning trenching. This schedule shall include, at the very least the proposed dates of beginning of mainline trenching, completion of mainline pipe installation, beginning of lateral pipe trenching and completion of lateral pipe installation. Trenching and installation may be phased to facilitate Pressure Testing, 2 phases only permitted.
- C. Dig trenches wide enough to allow a minimum of 4" between parallel pipe lines. Trenches shall be of sufficient depth to provide minimum cover from finish grades as follows:
 - 1. Over PVC mainline pipe and control wires: 18" minimum cover.
 - 2. Over pipe on non-pressure side of irrigation control valve (lateral lines): 18" minimum cover.
 - 3. Over all sleeving: 24" minimum cover.

4. Excavate to depth required in any material encountered with no extra compensation. Backfill all irrigation trenches with clean sand.
 5. Install pipe with manufacturer's markings facing up (12 o'clock).
 6. Where multiple irrigation pipes share a common trench, trench shall be sufficiently wide (or piping shall be arranged) to allow four inches (4") minimum of horizontal separation and six inches (6") minimum of vertical separation between piping, while maintaining specified minimum and maximum cover over piping. Irrigation pipes shall be located in a separate trench from any domestic water piping.
- D. Dispose of all surplus suitable excavation from trenches off-site.

3.4 SLEEVEING

- A. Install sleeves under all paved surfaces as required to facilitate installation of the irrigation work.
- B. Irrigation mainline and lateral sleeves shall have one sleeve per irrigation pipe. Wire chase sleeves are not shown on the drawing but shall be installed adjacent to all mainline sleeves. Wire chase sleeves shall be a minimum of 2" in diameter.
- C. Extend sleeves a minimum of 24" beyond the edge of curbs, walks, walls and/or other paved surfaces. Cap and identify sleeve ends.
- D. Plug ends of sleeves around insert piping with fiberglass insulation material to prevent soil from entering ends. Complete this prior to backfilling of trenches.
- E. Compact backfill to a minimum of 92% per ASTM D1557.
- F. Bore underneath existing pavements to install sleeves for wiring and mainline. Minimum depth of top of sleeve to pavement elevation is twenty four inches (24").

3.5 QUICK COUPLERS

- A. Install on triple swing joints as detailed and specified. Set top of all quick coupler valve boxes flush with final finish grade. Set all quick coupler valves perpendicular to finish grade. Valve box shall be no closer than 12" to pavement except as noted.
- B. Quick Coupling Valve shall be installed a minimum of twelve inches (12"), and maximum of thirty-six inches (36") from pavement or lawn edge (except at point of connection). The maximum distance from the top of the quick coupler to the top of the valve box shall be three inches (3"). Make sure quick coupler key easily passes the top of the valve box when fully engaged. The valve shall be installed inside a ten inch (10") round valve box. Care must be taken to prevent excessive water backup within the valve box.
- C. A six-inch (6") layer of washed gravel backfill for drains shall be placed in the bottom of the valve box, encased in a layer of geotextile fabric.

- D. Thoroughly flush mainline before installing Quick Coupling Valves.

3.6 DRAIN VALVES

- A. Install manual drain valve per detail and as described herein.
- B. All valves to be installed at locations shown on plans, verify with OWNER'S REPRESENTATIVE prior to installation.

3.7 CONTROL WIRING

- A. Wiring between automatic controller and automatic control valve shall comply with National Electric Code, latest edition.
- B. Splices will be permitted only at junction boxes, valve boxes, or at control equipment. A minimum of 2' of excess conductor is to be left at all splices, terminal and control valves. Encapsulate all splices with approved connectors.
- C. All control wire that is not installed within mainline trench shall be buried at 24" depth minimum and sleeved with appropriately sized Schedule 40 PVC conduit (or better). Sleeve shall be continuous from mainline trench to mainline trench and from mainline trench to controller. All control wire installed above ground shall be encased (sleeved) within intermediate metal conduit and fittings (or better). All such sleeves shall be marked on "as-built" drawing.

3.8 AUTOMATIC CONTROLLERS

- A. Coordinate location of Controller with Owner. Contractor shall determine that w-fi connection is available in Administration Building. If not connection is available Contractor shall coordinate with Owner's Representative an alternate location for controllers.
- B. Contractor is responsible for providing 120/230 VAC power to Controller if necessary. All electrical modifications shall be approved by Owner's Representative prior to installation.
- C. Mount Controller per manufacturer's specifications. Final installation shall be plumb, secure and with finished appearance. All conduit shall be secured to wall or framing with galvanized pipe clamps. Provide material descriptions and shop drawings for all mounting procedures.
- D. Mount Solar Sensor at location determined by Owner's Representative.

3.9 COMPATIBLE SENSORS AND VALVES

- A. Flow Meter
 - 1. Connect Flow Meter to Mainline with as detailed.
 - 2. Provide individual control and common wires to Controller with spare common. Splice wires as detailed.

3. Control wires from Flow Meter to controller shall be sized and colored as specified by Flow Meter manufacturer. There shall be no other buried splices allowed between controller and Flow Meter.
- B. Master Valve
 1. Install Master Valve similar to typical Electric Control Valve. Provide spare common wire continuous from Controller to Master Valve and signal wire.
- 3.10 DOUBLE CHECK VALVE ASSEMBLY
 - A. Install Double Check Valve Assembly securely and level. Provide adequate clearance as detailed or per manufacturer's specifications (whichever is greater).
 - B. Shall be certified by State of Washington Backflow Assembly Tester, after installation.
- 3.11 REMOTE CONTROL VALVES
 - A. Install in approximate locations shown on plan, outside of paved areas and grouped together where possible.
 - B. Where valves occur adjacent to paved areas, install so that the valve box will be no closer than 12" to paving and perpendicular or parallel to it. Grouped valves shall be spaced evenly to present a neat appearance. Valve boxes shall be installed 1/2 inch above finish grade.
 - C. Enclose all valves in individual valve boxes. Use valve box extensions as required. Install as per detail and locate precisely by dimensions from two (2) fixed objects on Record Drawings.
 - D. Valve bonnet packing and bolts shall be checked and tightened.
 - E. Provide sufficient room within valve box to service or replace all equipment. Place Valve Boxes on concrete pavers on all four corners. Valve Boxes shall be level and exhibit zero movement. Backfill around boxes and compact to 95%.
- 3.12 PIPE AND FITTINGS
 - A. Transport and store pipe on a flat and even surface.
 - B. Seal all threaded joints with 3 wraps minimum of Teflon tape. No PVC pipe shall be threaded or connected to a threaded fitting without an adapter.
 - C. Prior to construction of this project, Contractor shall provide the Owner's Representative with written evidence that all Contractor staff assigned to solvent welding duties of PVC pipe or fittings are in possession of an up-to-date certification card issued by manufacturer representative of specified solvent cement. If Contractor's staff are not in possession of current certification cards, the Contractor shall schedule and complete a training seminar (conducted by solvent cement manufacturer representative) and provide written evidence

of training completion for each staff member, to the Owner's Representative prior to construction. Only staff that are certified shall be permitted to solvent weld pipe and fittings.

- D. All gasketed and solvent weld plastic pipe shall be installed in accordance with manufacturer's installation instructions. Great care shall be taken to ensure that the inside of the pipe is absolutely clean. Pipe ends (not being worked) shall be protected and not left open. Cleaning of cutting burrs is mandatory.
- E. For solvent weld pipe, PVC pipe ends shall be cut at a 90-degree angle to the pipe length and shall be cleaned (use approved reaming tool) of all burrs prior to cementing. Pipe ends shall be wiped clean with a rag that has been lightly wetted with PVC thinner. Joints shall be completely free of moisture or condensation.
- F. Cement shall be applied with a light coat on the inside of the fitting and a heavier coat on the outside of the pipe (no further back from the end of pipe than the fitting would slip). Application of cement on the interior of the fittings shall be quantified to ensure no cement shall be pushed into the flow stream of the pipe. Pipe shall be inserted into the fitting and given a quarter turn to seat the cement. Excess cement shall be wiped from the outside of the pipe. Cement that becomes unduly thick or heavy shall not be thinned and re-used. CONTRACTOR SHALL DISPOSE OF SAME. Pipe shall be tested as indicated elsewhere in these specifications.
- G. Allow 15 minutes (minimum) set-up time for solvent weld joints before moving or handling. Pipe shall be partially center-loaded to prevent arching or slipping. No water shall be permitted in the pipe for at least 10 hours to permit solvent weld set and cure. Backfilling shall be done when the pipe is not in an expanded condition due to heat or pressure. Cooling of the pipe can be accomplished by operating the system for a short period of time before backfilling, or by backfilling in the early part of the morning before the heat of the day. Before pressure testing, allow 24 hours cure time for solvent weld joints.
- H. Lateral line pipe may be longitudinally bent at a ratio of 200 times the outside diameter (o.d.) of the pipe over the length of one (1) full stick of pipe [i.e.: 1-1/2" pipe (1.9" o.d.) can be bent to a minimum radius of 1.9 x 200 or 380 inches (31.7') over 20'].

3.13 FLUSHING

- A. Flush all mainlines once prior to the installation of valves, and again after the installation of valves and prior to pressure testing.
- B. Flush all lateral lines prior to the installation of sprinkler nozzles.

3.14 PRESSURE TEST

- A. General:

1. To be valid, all tests must be observed by the Owner's Representative.

2. Submit verbal requests for review to Owner's Representative at least 48 hours prior to anticipated testing. Do not request testing until satisfied that work will pass test.
- B. Preparation:
1. Prior to request for preliminary testing, accomplish the following:
 - a. Install all piping, valves and other equipment except sprinkler heads.
 - b. (Cap all risers except first riser downstream from valve on each lateral.
 - c. Purge all air from mainlines.
- C. All joints and connections shall be left exposed until after completion and acceptance of pressure test.
- D. Entire mainline shall be capped and pressurized to 100 PSI for a period of 30 minutes without introduction of additional service or pumping pressure. Lines that show loss of pressure exceeding 5 PSI at the end of specified test period shall be rejected.
- E. Test of Laterals:
1. Purge all air from laterals and cap all risers. Open valves and bring system to available static line pressure. Lateral lines will be visually reviewed. Lines that exhibit visible leakage shall be rejected.
 2. Rejected systems or portions of system shall be repaired and retested until testing requirements are met. Do not request retest until satisfied that system will pass testing requirements.
 3. Plug all test cocks on double-check valves after testing by Water Department. Plugs shall be brass and threads shall be sealed with Teflon tape.
- 3.15 SPRINKLER HEADS
- A. Install pop-up sprinklers flush with finish grade in landscape areas. Adjust radii of sprinklers to obtain optimum coverage.
 - B. Backfill around heads shall be approved native or import topsoil, well compacted. Sprinklers shall be installed flush with sidewalks and curbs and no closer than three inches (3") from any paved edge. All heads shall be set perpendicular to finish grade unless otherwise specified on the plans. Refer to details.
 - C. Thoroughly flush lines before installing sprinkler heads.
 - D. Refer to installation details on Drawings for all sprinkler heads.
- 3.16 SPRINKLER AND QUICK COUPLING VALVE SWING JOINTS (RISERS)

- A. On spray and quick coupling valve flexible swing joints, apply two wraps of Teflon tape around threaded outlet connection (to sprinkler or quick coupling valve). Threaded connections shall be watertight. Do not over tighten.

3.17 VALVE BOXES

- A. Install valve boxes plumb and flush with finish grade, so that a reel type mover may pass over without interference. Box shall be supported on continuous brick foundation per detail. Valve box archway shall not rest on piping – provide a minimum of one-inch (1") clearance around any piping.
- B. Provide filter fabric cover over all below grade openings to prevent debris from contaminating the drain rock.
- C. If construction debris washes into the automatic valve or quick coupling valve boxes prior to project completion, remove existing gravel and replace with new gravel.

3.18 BACKFILLING

- A. Backfill:
 - 1. After system is operating and the required tests and review have been made, backfill excavations and trenches with the specified backfill.
 - 2. Backfill when PVC pipe is not in an expanded condition due to heat or pressure. Cooling the pipe can be accomplished by operating the system a short time or by backfilling in the early part of the morning.
- B. Compaction:
 - 1. Trenches shall be thoroughly water-settled. No sluicing will be permitted. Trenches shall be backfilled uniform flush with the surrounding grade, raked and rolled with a roller weighing minimum 90 lbs. per linear foot.
 - 2. Trenches or tunnels under roads or paved areas shall be backfilled and tamped with a mechanical tamper in successive 6" lifts.
 - 3. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to minimum 95% density under pavements, 85% under planted and lawn areas.
 - 4. Dress all areas to surrounding finish grades.

3.19 RESTORATION AND CLEANUP

- A. All roots, rocks and debris shall be removed from site.
- B. Sweep and wash all walks, pavement and steps.

3.20 PERFORMANCE TESTS

- A. Notification: Submit verbal request for reviews to Owner's Representative at least 48 hours prior to anticipated review.
- B. All Performance Tests shall be accomplished prior to installation of any landscape material. Exceptions to this shall be Trees and landscape boulders with approval of Owner's Representative.
- C. Prior to request for preliminary review and Coverage Check, accomplish the following:
 - 1. Complete all work including balancing, adjusting the system (pressure-reducing valves, flow-adjustment keys, nozzles, etc.) to provide optimum coverage without fogging.
 - 2. Adjust sprinkler heads to finish grade as specified.
 - 3. Clean out all sediment from valve boxes so that drain rock is exposed below bottom of valve, and all wiring (including spare wires) is visible.
 - 4. Complete the Operations and Maintenance Manual for review by Owner's Representative.
 - 5. Present Owner's Representative with a preliminary Record Drawing (on paper with pencil) showing location of all changes to Irrigation Plan to facilitate Review and Coverage tests.
 - 6. Obtain all miscellaneous keys, spare parts and tools required under this contract for review by Owner's Representative and delivery to Owner.
- D. Preliminary Review: Owner's Representative shall review Irrigation system for accuracy of layout to Plan and finish height of sprinkler heads in relation to finish grade and clearance of sprinkler heads from curbs, walks, walls and buildings. In addition all other aspects of finish presentation shall be reviewed prior to placement of landscape material.
- E. Coverage Check: Remove all valve box covers and operate each zone of the system at direction of Owner's Representative. Owner's Representative shall mark with flagging any sprinkler heads not spaced correctly. Large areas not receiving proper coverage shall be identified through similar means. Corrections to layout shall be made accordingly and/or by recommendation of Owner's Representative.

3.21 FINAL INSPECTION

- A. Prior to final inspection of work, Contractor shall have completed all punch list items and shall submit signed and approved sprinkler/plumbing/health/electrical permits as applicable to the work.
- B. At the time of, and as part of, the Final Inspection, conduct a training and orientation session for the Owner covering the operation, adjustment and maintenance of the irrigation system. The Record Drawings and Operations and Maintenance Manual shall be reviewed and all features explained. Notify the Owner in writing two (2) weeks prior to the

training and orientation session. The date and time of the session shall be subject to approval of the Owner.

- C. Operations Test: Test is acceptable if system operates through at least one (1) complete cycle in a satisfactory manner, with uniform coverage of areas to be irrigated, and automatic controls functioning properly.
- D. Provide Owner's Representative with complete Mylar Record Drawing for review and approval. Upon approval Contractor shall supply copy of Record Drawing to be attached to Controller cabinet (inside if possible)
- E. Acceptance of work establishes beginning of one (1) year warranty period for irrigation system.

END OF SECTION

**SECTION 329000
PLANTING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

Note: Prior to bidding the work of this Section, Contractors shall visit the site to generally familiarize themselves with existing conditions, soils, slope, access, and other readily apparent site conditions.

1.2 DESCRIPTION OF WORK

- A. Work includes all materials, equipment and labor necessary for: decompaction, placing topsoil, finish grading, rock and gravel placement, planting of trees, shrubs and ground covers; seeding, invasive plant removal, protection, maintenance, guarantee and replacement; extended maintenance and related items necessary to complete the work indicated on the drawings and/or specified.

1.3 QUALITY ASSURANCE

- A. Plant Material: All plant material, Washington Grade No. 1 as per State of Washington Department of Agriculture Order Numbers 1229, 1230 and 1322. Quality, size and condition as determined by standards set forth in the aforementioned Standards and the American Association of Nurserymen Standard ANSI 260.1- 1973. Plant names shall conform to latest edition of "Standardized Plant Names" as adopted by American Joint Committee of Horticulture Nomenclature.
 - 1. Fertilizer: Conform to Washington State Department of Agriculture Laws and Federal Specification O-F- 241D pertaining to commercial fertilizers.
 - 2. Soil: Conform to USDA soil textural class.
 - 3. Seed: Conform to Washington State Department of Agriculture Rules for Seed Certification.
 - 4. Compost: Compost to be certified in accordance with U.S. Compost Council Seal of Testing Assurance (STA) program.

1.4 SUBMITTALS

- A. All Plant Materials: All plant material shall be ordered immediately following the award of contract. Contractor responsible for ensuring that plants of specified sizes and quantities

will, in fact, be as specified at the time of planting. Provide the Owner's Representative with copies of purchase orders for all plants delivered to the site.

1.5 PROTECTION OF EXISTING CONDITIONS

- A. Protect work, adjacent property, public, and be responsible for any damage or injury arising from this contract due to actions or neglect.

1.6 SCHEDULING

- A. Upon commencing work, the General Contractor shall examine the site and protect all trees, shrubs and other areas designated to remain in a manner substantial enough to resist the forces of construction equipment that will be on site.
- B. Confine work to areas designated. Do not disturb existing vegetation outside of project limit lines. Protect all trees within project limits not designated to be removed. Repair or replace vegetation damaged as a result of Contractor's operation to satisfaction of Owner's Representative at Contractor's expense.

- 1. Contractor shall install temporary fencing at dripline of trees to remain prior to grading.

- C. Contractor shall be cognizant of all utility lines and underground obstructions. He shall familiarize himself with all utility, irrigation, mechanical, and electrical plans so that his digging/drilling operations do not damage lines. Repair or replacement by original installer shall be made at Contractor's expense for all existing buildings, equipment, underground utilities, irrigation equipment, paving, surfacing, stairs, and/or forms damaged as a result of Contractor's operations in a manner satisfactory to the Owner's Representative before final payment is made.
- D. Protect plants, roots, balls and tips at all times from injury in handling, from sun or drying winds from beginning of digging operations, during transportation and on site until final planting.
- E. Provide all necessary safeguards, as approved and/or required by the Owner's Representative, for the protection of all planted areas until provisional inspection/acceptance is accomplished, or for such time as it requires to ensure vigorous establishment of the plant material.

1.6 FIELD QUALITY CONTROL AND REVIEW

- A. Notification: The Contractor shall give 48 hours' notice to the Owner's Representative when an inspection is desired.
- B. Inspections:

1. Plant Material: Owner's Representative will review and approve all plant material at the site prior to installation. Remove unsatisfactory material from site immediately.
2. Plant Locations: Owner's Representative will review, adjust, and approve plant locations prior to installation.

1.7 SUBSTANTIAL COMPLETION

- A. All plant material to be installed prior to project date of substantial completion.
- B. All lawns to be seeded prior to project date of substantial completion.

1.8 SUBSTANTIAL COMPLETION REVIEW (Punch List)

- A. Upon completion of all planting, seeding, and all other work (if any) required under the contract, the Contractor shall request a provisional inspection. No partial approvals will be given. Included in this requirement is that all lawn areas are fully established, being full and vigorous with no bare spots whatsoever. A minimum of two mowings shall have taken place prior to request for substantial completion review. Final review and acceptance of the work shall establish the beginning of the guarantee period.

1.9 FINAL REVIEW

- A. The Contractor shall request a final inspection upon satisfactory completion of all work required under this contract, including all punch list items.

1.10 GUARANTEE REPLACEMENT

- A. Plant Material: Guarantee in a healthy, thriving condition all trees, shrubs and groundcovers for two years from date of substantial completion. Plant containers and root balls shall be free of all weeds. Any plants requiring replacement or missing must be installed prior to final acceptance and start of guarantee period. During the guarantee period, all dead diseased, dying, broken or disappeared plant materials from any cause except those noted below shall be replaced immediately by the Contractor at no additional expense to the Owner's Representative. Use specified plants and plant as specified; guarantee until active, healthy growth is evident.

The Owner's Representative shall determine if a tree or shrub is dead based on the following;

A tree shall be considered dying or dead when the main leader has died back, or a minimum of 25 percent of the crown has died or been damaged. A shrub or groundcover shall be considered dying or dead when a minimum of 25 percent of the plant has died or been damaged.

- B. Seeded Areas: Guarantee a uniform stand of grass with no bare spots whatsoever in seeded areas at time of substantial completion review (Punch List). Reseed with the seed and in the

manner originally specified any area which fails to vigorously establish a uniform stand for any reason whatsoever. Fill to finish grade with approved topsoil and seed as specified all seeded areas with evidence of settlement or erosion. Repeat all such reseeding until final acceptance at Contractor's expense.

- C. Contractor's Responsibility: During guarantee period, Contractor shall not be responsible for replacing plants destroyed or damaged by vandalism or accidents caused by vehicles other than the Contractor's, or Acts of God, or severe cold as substantiated by 25-year low temperature records (exceeding 25 year low), provided that Contractor has exercised due care to protect work. Should replacement fall due during non-planting season, contractor may request Owner's Representative's permission to defer planting until proper season. If permission is granted, immediately remove and dispose of dead plants, including all roots. Holes shall be backfilled properly with planting mix and finish graded until the proper planting season. Plants used for replacement shall be of same kind and size originally planted and planted as originally specified.

PART 2 - PRODUCTS

2.1 PLANTS

- A. Quantities, species and varieties, size and condition as shown on planting plan and schedule. Plants to be Washington Grade No. 1, fresh, well foliated, in prime condition when in leaf, exhibiting normal habit of growth, having all buds intact and free of disease, injury, insects, insect eggs, larva, indication of strawberry root weevil, all seeds and weed roots.
- B. All plants shall be from stock which has been acclimated to conditions prevailing at the project and which has been consistently cultivated and grown in these conditions. No cold storage plants; all grafted trees to be grafted at ground level.
- C. Ball and burlapped (B&B) stock to have a natural ball sufficient to ensure survival and healthy growth; bare root (BR) materials to have sufficient root system to ensure survival and healthy growth. Containerized stock must be free of large circling roots.
- D. Substitutions are strongly discouraged. No substitutions shall be made without the written approval of the Owner's Representative. Requests for substitutions must be made at the time that documentation of ordered plant material is provided. The substitution request must be accompanied by written proof from at least five major plant suppliers that the plant is not available.
- E. Plants must be installed no more than 30 days after delivery to site. Provide adequate water by temporary means to keep plants in top condition. Store plants in protected location away from hot sun and strong, drying wind.

2.2 FERTILIZERS AND SOIL AMENDMENTS

- A. General: Approved brands conforming to applicable State fertilizer laws. Uniform in composition, dry, free- flowing, delivered to the site in original unopened containers, each bearing the manufacturer's guaranteed analysis. All fertilizers must be EPA approved. Fertilizer needs to be based on results of soil test.
- B. Trees, Shrubs and Ground Cover:
 - 1. Formula 4.2.2 "Transplanter" as manufactured by Pacific Agro Co., with Hercules Nitroform and W.R. Grace's "Magamp" and trace elements. Apply at rate of:
 - a. Trees: 8 oz.
 - b. Shrubs: 4 oz.
 - c. Ground Cover: 2 oz.
- C. Agriform Tablets: Planting tablets, 21-gram size, as manufactured by Agriform International Chemicals, Inc., 20-10-5 analysis. Apply at the rate of:
 - 1. Trees: 4 tablets
 - 2. Shrubs: 2 tablets
 - 3. Ground Cover: 1 tablet
- D. Seeded Lawn Areas:
 - 1. Installation Fertilizer (Fertilizer 'A'):
 - a. Total available Nitrogen: 16% by weight (of which 50% is derived from controlled release sources including Nutralene.)
 - b. Total available phosphorous: 16% by weight.
 - c. Total available potassium: 16% by weight.
- E. Maintenance Fertilizer:
 - 1. Initial Fertilizer (Fertilizer 'B'):
 - a. Total available Nitrogen: 21% by weight (of which 50% is derived from controlled release sources.)
 - b. Total available Phosphorous: 12% by weight.
 - c. Total available Potassium: 12% by weight.
 - 2. Follow-up Fertilizer (Fertilizer 'C'):
 - a. Nitrogen: 19% by weight.
 - b. Phosphorous: 4% by weight.
 - c. Potassium: 16% by weight.

- F. Dolomitic Limestone at minimum rate of 50 lbs. per 1,000 square foot. Gypsum to counteract salinity as recommended in report.
 - G. Other amendments as recommended in report; adjust the basic quantities of the following micronutrients as recommended in the report: iron, manganese, molybdenum, copper, zinc and boron.
 - H. See also Fertilizer Requirements under Section 3.08 Maintenance.
- 2.4 STAKES AND GUYS
- A. Material as per detail on plans, submit source for approval.
- 2.5 SELECTIVE HERBICIDE
- A. Where directed in the field, treat planting beds with a selective pre-emergent herbicide and remove all foreign weeds prior to acceptance.

PART 3 - EXECUTION

- 3.1 PREPARATION
- A. Clear and grub any areas shown beyond civil clearing limits as needed to install landscape work.
 - B. Clearing limits and subgrade shall be reviewed by Owner's Representative and approved by the Owner's Representative's representative prior to topsoil placement and finish grading.
- 3.2 DECOMPACTION/OVEREXCAVATION
- A. Wherever landscape is proposed over compacted areas that were previously paved, buildings, construction traffic areas, Contractor staging areas or areas otherwise detrimental to plant establishment, the Contractor shall completely remove all remnants of paving, crushed rock, quarry spalls, contaminants or other non-native material as directed by the Owner's Representative. Loosen the soil in these areas to a minimum depth of 12" below subgrade using mechanical means.
- 3.3 INVASIVE REMOVAL
- A. Remove all invasive plant species throughout entire site. Species include but are not limited to English Ivy, Himalayan Blackberry, English Holly, and Cherry Laurel.
 - B. Remove ivy from ground and tree trunks. Avoid damaging trees or existing native understory to remain.
 - C. Remove or kill entire plant and root structure of all invasive trees and shrubs.

- D. Continue removal throughout extended maintenance period.

3.4 PERFORMANCE

- A. Planting and Plant Relocation Time: Plant trees, shrubs, groundcover and lawn during periods which are normal for such work, as determined by season, weather conditions, and accepted practice. At the option and on the full responsibility of the subcontractor, planting operations may be conducted under unseasonable conditions without additional compensation.
- B. Plant Locations: After placement of topsoil, stake tree locations and position shrubs above ground as per drawings for approval of Owner's Representative. Make field adjustments to avoid obstructions to planting. Owner's Representative reserves the right to field adjust plant locations prior to planting.
- C. Planting Trees: Excavate tree pits 6" deeper and twice the diameter of the root ball. Excavated soil shall be removed from the site. Thoroughly scarify bottom of pits by shovel cutting to a depth of 12". Sides of pits shall also be shovel cut to help root penetration. Establish a firm mound to position the top of the root ball flush with finish grade of mulch layer.
- D. Place tree in upright position in center of pit, release root covering or spread roots. If wire cages are present, remove completely and dispose from site. Roots of trees shall be so placed as to have a natural spread and distribution and planting mix shall be carefully, thoroughly packed and puddled around them. Take care not to injure root system while backfilling and compacting. After water settles, fill again with planting mix and water compact to a grade of not more than 1/2" higher than the original ball. In seeded areas, finish grade smooth with surrounding area. Provide 3' diameter, 3" depth mulched circle around all trees in seeded areas.
 - 1. Fertilize trees at the soils test recommended rate applied uniformly around circumference of root spread under a cover of 2" of planting mix. Apply Agriform tablets and soil polymers per manufacturer's recommendations. Stake and guy trees immediately after planting as detailed. All supports, and trees shall stand vertical.
- E. Planting Shrubs and Ground Covers: After topsoil placement and approval of finish grade, excavate planting pockets at locations shown on drawings and as directed to a diameter of twice the root spread and to a depth that will ensure a 3-inch cushion of compacted planting mix below the root ball. Dispose of excavated soil on site as directed.
 - 1. Set plants upright in center of hole flush with finish grade, release root covering or spread roots. The roots of the plant shall be placed as to have a natural spread and distribution. Backfill with planting mix and provide slight depression as watering saucer. Care shall be taken not to injure the root system while backfilling and compacting the planting mix.
 - 2. Fertilize at the specified rate applied uniformly around the circumference of the root spread under a cover of 2" of planting mix. Apply Agriform tablets and soil polymers per

manufacturer's recommendations. Plant ground cover plants at spacing indicated in straight, evenly spaced rows.

- F. Pit plant trees and shrubs in areas outside of clearing limits as shown on plans. Avoid disturbance to existing native vegetation to remain. Mulch all exposed soil to minimum 3" depth.
- G. Seed Bed Preparations: Apply Installation Fertilizer 'A' and dolomite limestone at the soils test recommended rate. Add other fertilizers as recommended in soils report. Rake to incorporate. Finish surfaces by raking smooth and even; lightly compact with roller. Level out surface undulations and irregularities to tolerances specified in Section 02200 and compact again as necessary.
- H. Lawn Seeding: After approval of finish grade, seed at the rate specified. Seed all areas using hydro-seeder and hydro-mulch at rate specified under Hydro-mulch Section.
- I. Timing: Seed only from March 15th to August 20th, or as approved by Owner's Representative. All seeding must be complete prior to project substantial completion date.
- J. Protection: Protect against harm from wind, storm water and trespassing. Treat and reseed damaged portions as required. Reseed as many times as necessary to achieve Guaranteed Replacement. Post signage indicating new seeding as necessary to prevent trespassing. Provide temporary orange construction fencing around seeded areas, until grass has become fully established as needed to prevent damage. Owner's Representative or Owner's Representative to determine when fencing can be removed.
- K. Reseeding: In areas which were seeded after October 15th, reseed and re-fertilize all areas where coverage is weak or sparse, as directed in the spring of the following year, and repair any settlement and/or erosion channels.
- L. Ongoing Maintenance: Contractor shall continue to maintain turf areas and weed the entire site until 60 days from Final Completion. See additional requirements under Section 3.08, 60-day Maintenance Period.
- M. Mulching: Immediately after completion of all planting, mulch all new planted areas to a minimum compacted depth of 3". Refer to site details for proper relationship of finished grade to adjacent paved areas, 1/2" below curbs/walks unless indicated otherwise. Mulch around existing trees and any areas of exposed soil outside of clearing limits.
- N. Pruning, Repair and Weeding: Upon completion of the work under this contract, all existing and new trees and shrubs shall be pruned as directed by Owner's Representative to control size, remove dead or damaged branching or to correct overall form.
 - 1. Pruning shall be done in such a manner as not to change the natural habit or shape of the plant. All cuts shall be made flush, leaving no stubs. On all cuts over 3/4" in diameter and bruises or scars on the bark, the injured cambium shall be traced back to living tissue and

removed. Wounds shall be smoothed and shaped so as not to retain water, and the treated area shall be coated with approved tree wound compound.

3.5 60-DAY MAINTENANCE PERIOD

- A. It shall be the Contractor's responsibility to continuously and vigorously maintain all the landscaped and seeded areas of this contract from time of installation until Substantial Completion of landscaped and seeded areas. Contractor shall also continue to maintain and weed all planting beds and seeded areas for 60 days after Final Completion. Sweep pavement clean and remove dead plants as directed by the Owner's Representative, who shall record plants removed.
- B. All plants shall be watered by thorough sprinkling as needed to keep the ground moist, the plants healthy, and to prevent wilting, including watering in areas not fully covered by an automatic irrigation system. Care shall be exercised to prevent soil erosion.
- C. Seeded Areas:
 - 1. Maintain by watering, weekly mowing (remove all clippings) continuous weeding, reseeding, fertilizing, herbicide treatment, rolling and top dressing, and other necessary operations to establish and maintain an even, dark green, deep rooted, thick and vigorous stand of grass. Temporarily water any areas that are not irrigated, until establishment.
 - 2. Replace any seeded/sodded areas which fail to show vigorous growth. Fill and seed all areas which settle, as specified. At the end of the maintenance period and prior to acceptance, the seeded/sodded areas shall be a flourishing, dense, vigorous, uniform, deeply rooted thick stand of specified grass with no bare spots and no weeds whatsoever.
 - 3. There shall be no foot or vehicle traffic on the seeded/sodded area whatsoever. Install a temporary 6' height chain link fence around all lawn areas until fully established. Maintain barriers around seeded areas until established, then remove from site.
 - 4. Edging: Mechanically edge all lawn borders once per month.
- D. Trees:
 - 1. Maintain in a vigorous, thriving condition by watering, pruning, cultivating, fertilizing, spraying, and other necessary operations. Spraying shall be done only as required and as approved by the Owner's Representative. Plants will not be accepted until active growth is evident. All tree supports, guys, tree wrap, etc., shall be kept intact and adjusted as required and effect in maintaining firm support throughout the guarantee period.
- E. Clean-up:

1. A general clean-up shall be made immediately after and as part of all work done in the area. The clean-up shall include the entire area under this contract. Adjacent areas shall be cleaned to the extent that the work done under the contract may scatter litter. Such clean-up shall include pick-up and removal from the contract area of all clippings, trimmings, leaves, and all other litter and debris originating from any source whatsoever. Remove flag labels from all plant material.

F. 60-Day Maintenance Walkthrough

1. Schedule an inspection at the completion of the 60-day Maintenance to review plant beds and confirm that they are weed free.

3.6 ONE YEAR WARRANTY PERIOD FOR PLANTS

The warranty of all plant materials furnished and planted under this Contract shall be for one full year from the completion date of the 60-day maintenance period. Although not responsible for maintenance of the plant material during the warranty period, the Contractor should, for his own interest, assure himself that minimum care is being given to the plant materials, as he is liable for their health during the warranty period. At the end of the warranty period, the Owner's Representative will make another inspection to determine the condition of the plants. All plants not in a healthy growing condition, as determined by the Owner's Representative, will be noted and as soon as seasonal conditions permit, shall be removed from the site and replaced with plants of the same species and size as originally specified. Such replacement shall be made in the same manner as specified for the original plantings, and at no extra cost to the Owner. The Contractor is not responsible for vandalism. Remove all trees stakes and temporary irrigation at the end of the one-warranty period.

END OF SECTION

SECTION 32 9113.16

MULCHING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This section includes furnishing and installing mulch throughout all landscape beds.

1.2 SUBMITTALS

- A. One gallon zip-lock bag sample, as requested.
- B. Specified Technical Data from Supplier

PART 2 - PRODUCTS

2.1 MULCH

- A. Mulch:
 - 1. Mulch shall be "Fine Dark Bark" available from Pacific Topsoil, or approved substitution
 - 2. The mulch shall be processed to reduce weed seed, pathogens, and deleterious material, "rootable plants" and shall not contain paint, petroleum products, herbicides, fungicides, or other chemical residues that would be detrimental to plant life. Other deleterious material, plastic, glass, metal, or rocks shall not exceed 0.1 percent by weight or volume. Contractor is informed that evidence of "rootable plants" such as equisetum will be caused for Owner's Representative to direct Contractor to completely remove and replace all mulch at no cost to Owner.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review all topsoil subgrades to verify all landscape beds are 3 and an half inches below pavement edges and top of walls.

3.2 MULCH INSTALLATION

- A. If plants installed before mulch application, Contractor shall take precautions and measures to protect all installed trees, shrubs and groundcovers from the spreading of mulch.

Damaged plants will be replaced by Contractor at no cost to Owner.

- B. Install mulch to foot compacted depth of three inches in all landscape beds. Mulch depths shall be a uniform, roller compacted depth and shall be graded to produce a smooth landscape surface.
- C. Contractor shall compact mulch with lawn roller filled with water. Apply mulch as necessary to achieve a full two inch depth.

3.3 MAINTENANCE

- A. Contractor shall be responsible to weed and maintain mulched landscape beds to free of weeds to and to assure a full two inches of mulch depth up to and at the time of Final Acceptance.

END OF SECTION

SECTION 32 9119.13

TOPSOIL PLACEMENT AND GRADING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Furnish and Install Imported Topsoil.

1.2 REFERENCES

- A. ASTM D 1557: Method for Laboratory Compaction Characteristics of Soil using Modified Effort.
- B. WSDOT *Standard Specifications*.

1.3 DEFINITIONS

- A. Percent Compaction: The required in-place dry density of the material, expressed as a percentage of the maximum dry density of the same material determined by ASTM D1557 test procedure.
- B. Soil Subgrade: The soil surface on which topsoil is placed.
- C. Finished Grades: The final grade elevations indicated on the Drawings.
- D. Aesthetic Acceptance of Grades: Acceptance by the Owner in writing of the Aesthetic Correctness of the contours as observed by Owner. Aesthetic Acceptance does not address whether an area drains properly, whether the areas are at the correct elevation, or whether it has been compacted properly.
- E. Acceptance: Wherever the terms "acceptance" or "accepted" are used herein, they mean acceptance of the Owner in writing.
- F. Drawings: Contract Drawings, sections, and profiles showing finished surface grades.
- G. Elements with Fixed Elevations: Paths, paving, concrete pads, headers, footings, foundations, walls, and other structures with fixed-spot elevations.

1.4 SUBMITTALS

- A. Submit product data and 1-gallon zip- lock bag sample of Imported Topsoil.
- B. Submit 1-gallon sample of each type of soil amendment.

1.5 SITE CONDITIONS

A. Environmental Protection:

1. Soil Moisture Content: Do not work soil when moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily.

PART 2 - PRODUCTS

2.01 MATERIALS

A. IMPORTED TOPSOIL

Provide at 8" depth at landscape areas and 4" depth at hydroseeded areas.

Imported Topsoil shall consist of a uniform mixture of organic compost (20% by volume), Sandy Loam (40% by volume) and sand (40% by volume). Maximum clay content should be less than 5%.

Sand Gradation

Sieve size	Percent Passing
3/8"	100
1/4"	99-100
US No. 4	98-100
US No. 8	92-100
US No. 16	82-100
US No. 30	50-80
US No. 50	10-30
US No. 100	0-5
200 wet sieve	0-2

Compost shall Fine Compost in compliance with WSDOTSS 9-14.4(8).

Sandy Loam shall comply with USDA Soil Texture Triangle and shall comply with the following gradation:

Clay	1-5%
Silt	35-45%
Sand	50-60%

Imported Topsoil pH shall be between 5.5 to 7.5 (to be determined by a certified soil testing lab).

Imported Topsoil mixture shall be uniform and free of any contaminants (i.e. weed seed, foreign debris, root-able plant parts, etc.). Soils should also be free of any pesticide residues (to be determined by a certified soil testing lab). Contractor is informed that any evidence of root-able plant parts such as equisetum will result in the complete removal and

replacement of all Imported Topsoil. Soil mix shall be stored/covered accordingly to prevent wetting or saturation.

Imported Topsoil is to be used in all landscape planter beds with the exception of the raised planter beds and above garage and vault structures.

- B. Grading Equipment: Appropriate size and flexibility to achieve the sculptural forms, profiles, straight slopes, and slope rounding indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Subgrade:

1. Verification: Verify that the subgrades have been graded to within one tenth of a foot (minus the topsoil depth) of the grades shown on the Drawings.
2. Aesthetic Acceptance: Verify that Owner has given the subgrade aesthetic acceptance. Do not place topsoil or rototill subgrade until Consultant has accepted subgrade for aesthetic correctness.
3. Notification of Discrepancies: Notify the Owner in writing of any discrepancies.

3.2 SURVEY REQUIREMENTS

- A. Lines and Levels: Establish lines and levels, locate and lay out by instrumentation and similar appropriate means for all planting area finish grades.
- B. General Staking: Provide a sufficient quantity of grade stakes as required to provide minimum depth layer of topsoil.

3.3 PREPARATION

A. Protection of Existing Conditions:

1. General: Use every possible precaution to prevent damage to existing conditions to remain such as structures, utilities, irrigation systems, plant materials and paving on or adjacent to the site of the Work.

B. Surface Preparation:

1. Inspection: Inspect subgrade soil for stones over one inch in diameter, sticks, oils, chemicals, plaster, concrete, and other deleterious materials.
2. Removal: Perform all Work when necessary to remove the deleterious materials before and after subgrade preparation.

3.4 PREPARING SUBGRADE

- A. Prepare subgrade to avoid excessive compaction. If Owner determines that excessive compaction has occurred, it shall be corrected as follows:

1. Scarify with a rototiller to a depth of 4 inches minimum in one direction.

Note: This Work shall occur subsequent to Irrigation Work and immediately before Topsoil Placement.

3.5 TOPSOIL PLACEMENT

- A. Imported Topsoil at Landscape Areas

1. Place Imported Topsoil evenly over indicated compacted subgrade in landscape areas to the depths shown on Drawings.

3.6 FINISH GRADING OPERATIONS

- A. General: Grade with uniform slope between points where elevations are given or between such points and existing grades, unless indicated otherwise.

- B. Soil Surface Tolerances

1. Allowances: Make proper allowances for settlement, spoils from plant pits, etc.

- C. Surface Drainage:

1. Slope finish grades to drain surface water away from buildings, walks, paving, and other structures unless otherwise indicated.
2. Slope finish grades to drain surface water to catch basins, area drains or swales as shown on the Drawings.

- D. Depressions and Loose Material: Fill and compact depressions, and remove all loose material to finish surface true to line and grade, presenting a smooth, compacted, and unyielding surface.

- E. Roller Compact with sod roller filled with water. Add Imported Topsoil as necessary to achieve finish grades.

- F. Excessive Compaction: Rip areas that have become compacted more than 85 percent compaction to a 12-inch depth. Roto-till and blade smooth prior to planting and irrigation.

- G. Imported Topsoil shall be installed three and half inches (3-1/2") lower than all adjacent pavement surfaces and top of walls. Grade a 12" wide @ 2%-4% transition from pavements. Transitions shall be graded uniform and smooth with no surface irregularities.

- H. Remove all visible evidence of wood debris and stones from all finish grades and dispose off-site.

3.7 PROTECTION

- A. Contractor is informed that physical and visual damage to any constructed improvement, including equipment wheel/track marks may result in the removal and replacement of damaged improvement, at the sole discretion of the Owner. Contractor shall schedule work and deploy measures to protect all constructed improvements.
- B. Erosion: Correct erosion and siltation damage at no cost to the Owner.
- C. Settlement Repair: Correct settlement within the Warranty period at no cost to the Owner.
- D. Drainage: Keep surface of topsoil in such condition that it will drain readily and effectively.
- E. Materials, Tools, and Equipment: In handling materials and operating tools and equipment, protect the topsoil from damage by laying down planks, plywood, or other accepted protective materials where required.
- F. Vehicular Traffic: Do not allow vehicles to travel in a single track. If ruts are formed, blade the topsoil smooth.
- G. Storage of Materials: Do not store or stockpile materials on topsoil.
- H. Dust Control: Use water trucks or temporary irrigation and take all precautions needed to prevent a dust nuisance to adjacent public or private properties.

3.08 CLEANUP & REMOVAL

- A. Daily: Keep all areas of Work clean, neat, and orderly at all times.
- B. Absolutely no stockpiling of any topsoil on pavement surfaces shall be permitted at any time during construction.
- C. Final: Clean up and remove all excess Imported Topsoil deleterious materials and debris from the entire Work area prior to Final Completion.

END OF SECTION

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SECTION 331000

WATER UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work includes but is not limited to the following:
 - 1. Connections to existing water mains.
 - 2. Coordination with the Clallam County PUD and Clallam County Fire-Rescue.
 - 3. Furnishing and installing waterline, gate valves, check valves, fittings.
 - 4. Furnishing and installing fire hydrants in accordance with Port Angeles Fire Department Standard.
 - 5. Connections to new building water systems.

1.02 RELATED SECTIONS

- A. Coordinate related work specified in other parts of the Project Manual, including but not limited to following:
 - 1. Section 310000 - Earthwork

1.03 REFERENCES

A. Clallam County PUD	Standard Construction Specifications
B. WSDOT-APWA Municipal Construction, Current Edition	Standard Specifications for Road, Bridge, and
C. Standard Details	N/A
D. UPC	Uniform Plumbing Code.
E. AWWA	American Water Works Association Standards
F. Geotechnical Report Zenovic & Associates Inc. June 9, 2026	Lot 24 Eklund Heights – Soils Investigation,

1.04 PERMITS

- A. Clallam County permit fees, abandonment fees, bonds, and inspections are to be obtained, paid for and scheduled by the Contractor.

1.05 DIMENSIONS AND LAYOUTS

- A. See Section 311000 Site Clearing.

1.06 CONTRACTOR REQUIREMENTS

- A. The contractor shall meet all requirements of Clallam County PUD.
- B. The Contractor is responsible for coordinating any water system shutdowns with Clallam County PUD, Peninsula Housing Authority, and Clallam County Fire-Rescue.
- C. The contractor is responsible for coordinating the phasing of the installation of the water system and fire hydrants with Clallam County PUD and Clallam County Fire-Rescue. At all times the contractor shall provide adequate fire coverage per the Clallam County Fire-Rescue requirements.

1.07 WARRANTIES

- A. The Contractor shall warranty that the water system extension and all parts shall remain in proper working condition, order, and repair for a period of two (2) years from the date of final acceptance of the ex-tension by the Owner. The Contractor shall repair or replace at its own expense, any work or material that proves defective during the warranty period. When corrections of defects occurring within the warranty period are made, the Contractor shall further warrant the corrected work for (2) years after acceptance of the corrected work by the Owner.

1.08 SUBMITTALS

- A. Provide product data sheets for approval prior to construction.

PART 2 PRODUCTS

2.01 CONTRACTOR SHALL MEET ALL REQUIREMENTS OF THE CLALLAM COUNTY PUD

2.02 DUCTILE IRON PIPE

- A. Ductile iron pipe shall be manufactured in accordance with AWWA C151. Cement mortar lining shall be standard thickness in accordance with AWWA C104. Rubber gasket joints shall be in accordance with AWWA C111.
- B. Ductile iron pipe shall be American Fastite Joint pipe, US Pipe Tyton Joint pipe or approved equal.

- C. Where restrained ductile iron pipe is required, pipe shall be American Fastite Joint pipe with Fast-Grip gasket or US Pipe Tyton Joint pipe with Field Lok gasket, or approved equal

2.03 DUCTILE IRON FITTINGS

- A. Ductile iron fittings shall be per Clallam County PUD Standard Construction Specifications Division 1.

2.04 FIRE HYDRANTS

- A. Fire hydrants shall be per Clallam County PUD Standard Construction Specifications Division 1.

2.05 LOCATING WIRE

- A. All water mains and side services installed shall have 10-gauge stranded copper wire with 600-volt insulation placed in the trench over the water main and the ends brought up into the valve boxes. Said locating wire shall also be placed over the water service line (new lines only). All connections or splicing shall be made with Split Bolt Wire Connectors. Shall be Essex or approved equal.

2.06 BEDDING AND BACKFILL MATERIAL

- A. Bedding and backfill material shall conform to Section 310000 Earthwork.

2.07 GATE VALVES – ALL RESILIENT WEDGE

- A. Gate valves shall be per Clallam County PUD Standard Construction Specifications Division

2.08 BUTTERFLY VALVES

- A. Butterfly valves shall be per Clallam County PUD Standard Construction Specifications Division 1.

2.09 VALVE BOXES

- A. Valve boxes shall be per Clallam County PUD Standard Construction Specifications Division 1.

2.10 CONCRETE MARKER POSTS

- A. A concrete valve marker post shall be 4" minimum square section and a minimum length of 42", with beveled edges and containing at least one (1) 3/8" diameter bar of reinforcing steel.

2.11 FIRE HYDRANT GUARD POSTS

- A. Concrete fire hydrant guard posts shall be made of precast reinforced concrete, nine (6) inches in diameter, six (6) feet long.

2.12 SERVICE SADDLES

- A. Service saddles shall be per Clallam County PUD Standard Construction Specifications Division 1.

2.13 TAPS AND CUT-INS

- A. All taps and cut ins into existing mains shall be made by the County. Contractor shall coordinate with the County to provide connection and shall pay fees associated with connection.

2.14 DOUBLE DETECTOR CHECK VALVE

- A. Double Detector Check Valve shall be on the approved Washington State DOH list of approved devices and shall conform to Clallam County PUD Standard Construction Specifications Division 1.

2.15 BUILDING CONNECTIONS

- A. Service connections shall be per Clallam County PUD Standards and WSDOT/APWA Section 9-30.6.

2.16 TRACER TAPE

- A. Utility pipe tracer tape shall be detectable below ground surface, color coded, with utility name printed on tape. Conductive warning tape required over all water pipe. Tape shall be manufacturer's standard permanent, bright-colored, continuous printed plastic tape, aluminum backed, intended for direct-burial service. Tape shall be not less than 6" wide x 4 mils thick.

Piping	Color	Wording
1. Domestic Water	Blue	Caution Domestic Water
2. Fire Water	Blue	Caution Fire Water
3. Irrigation Water	Blue	Caution Irrigation Water

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that trench is ready to receive work, and excavations, dimensions, and elevations are as indicated on Drawings.
- B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATIONS

- A. General.
 - 1. All installations shall conform to the WSDOT APWA Standards.
 - 2. All trenching shall conform to the Washington Administrative Code (WAC) 296-155 requirements for Excavation, Trenching and Shoring.
 - 3. Standard Specification Section 7-10, unless otherwise specified by Clallam County PUD.
 - 4. Pipe will have bedding unless otherwise noted.
 - 5. Join pipe sections in such a manner as not to damage the lining or coating. Any damage to the lining or coating shall be repaired by the Contractor and at the Contractor's expense.
- B. Install pipe, fittings, and appurtenances in accordance with WSDOT APWA Standards and in accordance with manufacturer's instructions.
- C. Install tracer tape per manufacturer's direction above all water lines.

3.03 CONNECTIONS TO EXISTING SYSTEMS

- A. Connections to existing mains shall be by Clallam County PUD. The contractor shall coordinate.
- B. Contractor shall extend piping to floor flange within building for new services and shall connect 5 feet beyond exterior building face for existing buildings. Contractor shall coordinate all connections with building plumbing Contractor.

3.04 FIRE HYDRANT INSTALLATION

- A. Fire hydrant installations shall be in accordance with Clallam County PUD requirements.

3.05 TESTING AND DISINFECTION

- A. Pressure test pipe in accordance with Clallam County PUD Standards and Section 7-09.3(23) of WSDOT-APWA.

- B. The contractor is responsible for all cost associated with the water line testing and inspection.
- C. Disinfection of Water lines shall be in accordance with Clallam County PUD Specifications. After disinfection, dispose of all contaminated water per Clallam County PUD Standards.

END OF SECTION

SECTION 333000

SANITARY SEWER UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Work includes but is not limited to following.
 - 1. Furnishing and installing sanitary sewer piping, and cleanouts.
 - 2. Coordination and connections to existing and new side sewers.

1.02 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including and Supplementary Conditions and Division 01 Specification Sections, apply to this section. Coordinate related work specified in other parts of the Project Manual, including but not limited to the following:
 - 1. Section 310000 - Maintenance of Earthwork.

1.03 REFERENCES

A. Washington State DOE	Washington State Department of Ecology Criteria for Sewage Works Design.
B. City of Port Angeles	City of Port Angeles Urban Services Standards & Guidelines.
C. WSDOT/APWA	Standard Specifications for Road, Bridge, and Municipal Construction, Current Edition
D. Standard Details	City of Port Angeles Urban Services Standards & Guidelines

1.04 PERMITS

- A. General: All permits, fees and inspections are to be obtained or scheduled by the Contractor at his expense.

1.05 DIMENSIONS AND LAYOUTS

- A. See Section 311000 Site Clearing.

- B. The Contractor is responsible for preserving all benchmarks and stakes and the replacement of any that are displaced or missing.
- C. The Contractor is responsible for review of all records relative to the existing underground utilities. The Contractor is responsible for avoiding damages to these facilities and shall restore all utilities at its own expense. The Contractor is to notify the Owner's Representative immediately of underground utilities encountered, which are not shown on the Engineer's record.

1.06 SUBMITTALS

- A. Provide data sheets for all proposed materials.

PART 2 PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE

- A. Sewer mains shall be PVC, ASTM D3034, SDR 35 or ASTM F789 with joints and rubber gaskets conforming to ASTM D3212 and ASTM F477.

2.02 DUCTILE IRON PIPE

- 2.03** Ductile iron pipe conforming to ASTM A21.51 or AWWA C151 and shall be cement mortar lined, push-on joint, or mechanical joint, Class 50

2.04 CLEANOUTS

- A. Clean-outs shall conform to Contract Documents and City of Port Angeles Standard Detail.

2.05 SANITARY SEWER MANHOLES

- A. Sanitary Sewer Manholes per City of Port Angeles Standard Details. Ring and cover shall be bolt locking.

2.06 TRACER TAPE

- A. Utility pipe tracer tape shall be detectable below ground surface, color coded, with utility name printed on tape. Conductive warning tape required over all sewer pipe. Tape shall be manufacturer's standard permanent, bright-colored, continuous printed plastic tape, aluminum backed, intended for direct-burial service. Tape shall be not less than 6" wide x 4 mils thick.

- 1. Tape Schedule:

Piping

Color

Wording

a. Sanitary Sewer

Green

Caution Sanitary Sewer

PART 3 EXECUTION

3.01 TRENCHING

- A. Trenching shall be in accordance with Section 7-17.3(1) of WSDOT-APWA. Excavation shall be made to alignment, elevation, grade and slope as indicated on the drawings.
- B. Accomplish trenching utilizing equipment with slope and depth control, such as, "laser plane control system" so as to ensure accuracy in the bottom of the trench and placement of the pipe. No high points above designated invert or calculated trench bottom elevation will be permitted. No sloughing of site material or loose excavated soil will be permitted in trenches.

3.02 TRENCHES

- A. Trenches shall be in straight lines as indicated on the drawings. Where feasible, trench width at the top shall be no greater than 24". If sloughing of trench side is encountered, a cribbing form will be required to maintain trench side stability. Excavate to a depth below invert grade to allow for bedding as specified.
- B. Keep the trench free from water until pipe is laid and backfilled. Divert all surface water so as not to enter the trench. Entirely remove boulders, rocks, roots and other obstructions, or cut out to the width of the trench and to a depth of 6" below the elevation of bottom of pipe. Remove and dispose of all loose and excess excavated materials off-site at Contractor's prearranged location.

3.03 PIPE INSTALLATION

- A. Install pipe in accordance with Section 7-17.3(2) of WSDOT-APWA and the manufacturer's recommendations.
- B. Make all connections with approved fittings as recommended and furnished by the manufacturer. Make connections to existing sewer lines at locations shown on the drawings.
- C. Install tracer tape per manufacturer's direction above all sewer lines.

3.04 BEDDING AND BACKFILLING

- A. Bedding shall be installed in accordance with Section 310000 and contract drawings.
- B. Backfilling shall be in accordance with Section 310000.

3.05 CLEANING AND TESTING

- A. Cleaning and Testing shall be in accordance with WSDOT-APWA Section 7-17.3 and the City of Port Angeles Standards. The contractor is responsible for all coordination and cost associated with the cleaning and testing.
- B. Unacceptable pipe runs will be removed and replaced with new pipe their entirety and re-tested at no additional cost to the owner.

3.06 AS-BUILT PLANS

- A. The Contractor is responsible for providing accurate As-Built plans in accordance these specifications.

END OF SECTION

STORM DRAIN UTILITIES

1.01 SECTION INCLUDES

- ## 1.02 RELATED SECTIONS

- ### 1.03 REFERENCES

- ## 1.04 PERMITS

- ## 1.05 DIMENSIONS AND LAYOUTS

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- C. The Contractor is responsible for review of all the Engineer's records relative to the existing under-ground utilities. The Contractor is responsible for avoiding damage to these facilities and shall restore all utilities at its own expense.
- D. The Contractor is to notify the Owner's Representative immediately of underground utilities encountered, which are not shown on the Engineer's record.

1.06 SUBMITTALS

- A. Provide data sheets for all proposed materials.

PART 2 PRODUCTS

2.01 POLYVINYL CHLORIDE (PVC) PIPE

- A. PVC pipe shall conform to Section 9-5.12 of WSDOT-APWA. Pipe shall be ASTM 3034, SDR 35, with rubber gasket joints. PVC pipe may be used in areas where cover over pipe is three (3) feet or greater.
- B. Connections to catch basins or manholes shall be by an AC or GPK manhole adaptor.

2.02 DUCTILE IRON PIPE

- A. Ductile iron pipe shall conform to AWWA C151 Class 52 with push-on joints. Ductile iron pipe shall be cement mortar lined conforming to AWWA C104.

2.03 POLYETHYLENE PIPE (CPEP)

- A. Double walled smooth interior corrugated polyethylene pipe CPEP. Pipe shall meet the requirements of AASHTO M252 Type S for pipe 8 inches in diameter and less, and AASHTO M294 Type S, for pipe 12 inches in diameter and greater. Fittings and couplings for pipe 12-inches in diameter and greater shall be watertight.

2.04 CORRUGATED PVC PIPE

- A. Corrugated PVC pipe shall be IPEX Ultra Rib or approved equal double walled smooth interior corrugated PVC pipe. Corrugated PVC pipe shall conform to ASTM F794 and shall be watertight.

2.05 CLEANOUTS

- A. Cleanouts shall conform to the Contract Documents. All cleanout covers will be locking.

2.06 COUPLINGS AND JOINTS

- A. Tees on existing pipe shall be connected by core drilling and flexible connections.

- B. Pipe to pipe connections shall be made with a flexible gasketed coupling, adapter or coupling-adapter to make a watertight joint. Couplings shall be those manufactured by Romac or Caulder or approved equal.

2.07 BEDDING AND BACKFILL MATERIAL.

- A. Bedding and backfill material shall conform to Section 310000 and the drawing details.

2.08 CONCRETE CATCH BASINS

- A. Type 1 catch basins shall be constructed of pre-cast units by Associated Sand and Gravel or approved equal in accordance with the Clallam County Standard Details. Metal frame and grate shall conform to Clallam County Standard Details. All grates shall have locking bolts.
- B. Type 2- 48" and 54" catch basins shall be constructed of pre-cast units by Associated Sand and Gravel or approved equal in accordance with Clallam County Standard Details. Metal ring and cover shall conform to Clallam County Standard Details. All lids shall have locking bolts and shall be marked "DRAIN."

2.09 WATER QUALITY TREATMENT SYSTEM

- A. Water quality treatment system shall be Contech Concrete Catchbasin Stormfilter stormwater treatment system as manufactured by Contech Engineered Solutions (or approved equal), sized and configured in accordance with the project drawings.

2.10 TRACER TAPE

- A. Utility pipe tracer tape shall be detectable below ground surface, color coded, with utility name printed on tape. Conductive warning tape is required over drainage pipe. Tape shall be manufacturer's standard permanent, bright-colored, continuous printed plastic tape, aluminum backed, intended for direct-burial service. Tape shall be not less than 6" wide x 4 mils thick.

- 1. Tape Schedule:

Piping	Color	Wording
a. Storm Sewer	Green	Caution Storm Sewer

PART 3 EXECUTION

3.01 TRENCHING

- A. Excavation and preparation of the trench shall be in accordance with Section 7-04.3(1) of WSDOT-APWA. All trenching shall conform to the Washington Administrative Code (WAC) 296-155 requirements for Excavation, Trenching and Shoring.
- B. Excavation shall be made to alignment, elevation, grade and slope as indicated on the drawings. Trenching shall be accomplished utilizing equipment with slope and depth control, such as "laser plane control system," so as to ensure accuracy in the bottom of the trench and placement of the pipe. No high points above designated invert or calculated trench bottom elevation will be permitted. No sloughing of site material or loose excavated soil will be permitted in trenches.
- C. Hand dig excavation within the drip line of trees. Cut no roots larger than 1 inch. At no time shall roots be pulled by equipment.

3.02 TRENCHES

- A. Trenches shall be in straight lines as indicated on the drawings. Where feasible, trench width at the top shall be no greater than 24". If sloughing of trench side is encountered, a cribbing form will be required to maintain trench side stability. Excavate to a depth below invert grade to allow for bedding as specified.
- B. Keep the trench free from water until the pipe is laid and backfilled. Divert all surface water so as not to enter the trench. Entirely remove boulders, rocks, roots and other obstructions, or cut out to the width of the trench and to a depth of 6" below the elevation of bottom of pipe. Remove and dispose of all loose and excess excavated materials off-site at Contractor's pre-arranged location.

3.03 PIPE INSTALLATION

- A. Install pipe in accordance with the Section 7-04.3(2) of WSDOT-APWA. Provide ductile iron pipe where top of storm drainpipe is less than 1'0" below finished grade under paved areas.
- B. Make all connections with approved fittings. Join pipe and fittings by flexible compression rings conforming to ASTM C443. Make connections to existing storm sewer lines at locations shown on the drawings.

3.04 BEDDING AND BACKFILLING

- A. Bedding in accordance with Section 310000 and the project drawings.
- B. Backfill trenches in accordance with Section 310000.

3.05 CLEANING AND TESTING

- A. Clean and test in conformance with Section 7-04.3(4) of WSDOT-APWA. All new lines shall be subjected to testing after installation. Tests shall be exfiltration test or air pressure test. Conduct tests in the presence of the Owner's representative or Engineer.
- B. Clean existing storm lines and catch basins following completion of new storm drain installation. Mechanically remove all sediment displaced from lines from the system, and do not flush downstream. Contractor shall take extreme care to prevent any sediment from being always discharged into the downstream system during construction.
- C. Unacceptable pipe runs will be removed and replaced with new pipe their entirety and re-tested at no additional cost to the owner.

END OF SECTION

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