

SECTION 07410 – STANDING SEAM ROOF SYSTEM

PART 1 – GENERAL

RELATED DOCUMENTS:

Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work specified in this section.

Section 06100-Rough Carpentry
Section 07600-Flashing and Sheet Metal

SUMMARY:

This section includes the following:

1. Prefinished, prefabricated structural standing seam roof system with continuous interlocking seams.
2. Coordinate with installation of underlayment and existing roof substructure.
3. Provide color coordinated eave, gutter, downspouts, flashings, counter flashings, and other accessories.
4. Provide clips, fasteners, closures, and sealant as necessary to meet design criteria and ensure watertight installation.

SUBMITTALS:

Product Data:

1. Metal Roof System: Submit manufacturer's specifications, standard detail drawings, installation instructions, and warranty information.
2. Underlayment: Submit manufacturer's specifications, standard detail drawings, installation instructions, and warranty information.

Shop Drawings:

1. Submit three (3) copies of shop drawings indicating thickness and dimensions of parts, fastening and anchoring methods, details and locations of seams, transitions, and other provisions necessary for thermal expansion and contraction.
2. Indicate rood terminations, clearly showing flashings and change of direction caps.
3. Clearly indicate locations of field and factory applied sealants.
4. Show locations and types of hold-down clips and fasteners.
5. Provide plan showing layout of entire roof.

Samples:

1. Submit two samples, 12" long x full width panel showing proposed metal gauge, seam profile, and required finish.
2. Submit standard color samples on metal for Engineer's selection. Color and style of metal roofing to match existing Gymnasium Building.
3. Submit two (2) samples of each fastener used.

07410-1

Certification:

1. Submit manufacturer's certification that materials and finishes meet specification requirements.
2. Submit manufacturer's certification that Contractor is certified and approved to install and provide manufacturer's twenty (20) year warranty.

Quality Assurance:

1. Comply with requirements of applicable building codes and other agencies having jurisdiction of wind uplift rating of standing seam roofs.

Delivery, Storage, and Handling:

1. Protect products and accessories from damage and discoloration during transit and at project site. Store sheets and components in dry storage area to prevent condensation.
2. Do not overload roof structure with stored materials. Do not permit material storage or traffic on completed roof surfaces.
3. Upon receipt of panels and other materials, Contractor shall examine the shipment for damage and completeness.
4. Panels should be stored in a clean, dry place. One end should be elevated to allow moisture to run off.
5. Panels with strippable film must not be stored in the open, exposed to the sun.
6. Stack all materials to prevent damage and allow for adequate ventilation.

Warranty:

1. Paint finish shall have a twenty (20) year guarantee against cracking, peeling, chipping, delaminating, fading (not to exceed 5 N.B.S. units), and chalking (not to exceed a numerical rating of 8 when measured in accordance with standard procedures specified in ASTM D 659-74).
2. Galvalume material shall have a twenty (20) year guarantee against failure due to corrosion, rupture, or perforation.
3. Contractor shall furnish a guarantee covering watertightness off the roofing system for a period of two (2) years from the date of substantial completion.
4. A twenty (20) year manufacturer's warranty for watertightness shall be provided. This warranty shall guarantee Contractor's performance for a period of twenty (20) years. The manufacturer ensures that the Contractor will correct and roof leaks identified within the building beyond normal wear and tear. Liability is limited to actual cost of the repair work.

PART 2 – PRODUCTS

ACCEPTABLE MANUFACTURERS:

Subject to compliance with requirements, provide preformed standing seam roofing by Berridge Manufacturing, or approved equal.

MATERIALS:

Panels:

1. Prefinished Galvalume panels, ASTM AZ50 made up of 55% aluminum, 1.6% silicon, and the balance zinc as described in ASTM A792.
2. Standing seam system shall be 24 gauge Double-Lock Zee-Lock Standing Seam Roof System as manufactured by Berridge Manufacturing, or approved equal.
3. Sidelap to be mechanically double-locked with a powered seamer.
4. Finish shall be Kynar 500 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil primer coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesions, flexibility, and longevity as specified by the Kynar 500 finish supplier.
5. All panels shall be seamless and roll-formed by the manufacturer.
6. Strippable film shall be applied to the top of the painted coil to protect the finish during fabrication, shipping, and field handling. This strippable film must be removed before installation.

Accessory Materials:

1. Clip/Fastener Assemblies: One-piece 20 gauge clips should be 2" to 4" tall to meet the appropriate construction guidelines. Clips should be secured using two (2) fasteners of like metal type; self-drilling without washers; clips shall be fixed type.
2. Provide manufacturer's standard accessories and other items essential to completeness of standing seam roof installation.
3. Provide nylon seam end plugs for clean termination of panels.
4. Provide factory fabricated rib covers at roof slope transitions.
5. Provide transition rib covers where roofing changes directions.
6. Sealant: Verify with manufacturer that sealant type is acceptable for use with materials and meets all weatherability requirements.

Fabrication:

1. All exposed adjacent flashing shall be the same material and finish as the roof panels.
2. Hem all exposed edges of flashing on underside, 1/2-inch.
3. Panel assembly to bear Underwriter's Laboratories Label UL90, pursuant to Construction Number 334 and applicable Fire Ratings.

07410-3

PART 3 – EXECUTION

EXAMINATION:

1. Examine plywood decking to ensure proper attachment to framing.
2. Verify that roof decking is clean and smooth, free of depressions, waves or projections, level, and properly sloped to valleys and/or eaves.
3. Conflicts resulting from inspection findings should be resolved prior to roof system installation.

PREPERATION:

1. Install specified underlayment-self adhering air and moisture barrier (ice and water shield barrier), CCW WIP 300HT as manufactured by Carlisle Coatings and Waterproofing Inc., or approved equal.
2. Coordinate roof panel installation with all adjoining work to provide leak proof, secure, and non-corrosive installation. Contractor to protect panels and accessories against damage and discoloration.

INSTALLATION:

1. Comply with manufacturer's instructions for assembly, installation, and erection in order to achieve weathertight installation. Installation shall conform to standards set forth in the Architectural Sheet Metal Manual published by SMACNA.
2. Install panels in such a manner that horizontal lines are true and level and vertical lines are plumb.
3. Install started and edge trim before installing roof panels.
4. Attach panels using manufacturer's standard clips and fasteners, spaced in accordance with approved shop drawings.
5. Install sealants for preformed roofing panels as recommended by manufacturer.
6. Do not allow panels or trim to come into contact with dissimilar materials.
7. Do not allow traffic on completed roof. If required, Contractor to provide cushioned walk boards.
8. Protect installed roof panels and trim from damage caused by adjacent construction until completion of installation.
9. Remove and replace any panels or components which are damaged beyond successful repair.
10. At eave, rake, or valley, panels shall be hemmed and hooked onto receiving male trim piece.
11. Install hip, ridge, and roof to wall caps using zee closure.
12. Install gaskets, joint fillers, and sealants, per manufacturer's recommendations, where required for weatherproof performance of panel systems.

CLEANING AND PROTECTION:

1. Clean exposed surfaces of work promptly after completion of installation.
2. Clean any grease, finger marks, or stains from the panels per manufacturer's recommendations.
3. Excessive marring/scratches of the finish (as determined by the Engineer), shall be repaired and/or replaced at no cost to the Owner.
4. Protect work as required to ensure roofing will be without damage at time of final completion.

END OF SECTION 07410

SECTION 07700 – ROOF SPECIALTIES AND ACCESSORIES

PART 1 – GENERAL

RELATED DOCUMENTS:

Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division –1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent and locations of roof accessories is indicated on the drawings and by provisions of this section.

Types of units specified in this section include the following:

Gravity Turbine Roof Vents

Refer to roofing system sections of these specifications for roofing accessories to be built into roofing system (not work of this section).

SUBMITTALS:

Product Data; Roof Accessories: Submit manufacturer's technical product data, rough-in diagrams, details, installation instructions and general product recommendations.

Shop Drawings: Submit complete shop drawings indicating layouts, details, fittings, and dimensions.

Samples; Roof Accessories: Submit 2 samples, min. 8" square, of each exposed metal and plastic sheet materials, and 2 samples, min. 24" long, of formed or extruded exposed metal member; color and finish as specified.

Coordination Drawings: Submit coordination drawings for items interfacing with or supporting mechanical or electrical equipment, ductwork, piping, or conduit. Indicate dimensions and locations of items provided under this section, together with relationships and methods of attachment to adjacent construction and to mechanical/electrical items.

QUALITY ASSURANCE:

Standards: Comply with SMACNA "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and capflashing to coordinate with type of roofing indicated. Comply with "NRCA Roofing and Waterproofing Manual" details for installation of units.

PART 2 – PRODUCTS

GENERAL PRODUCT REQUIREMENTS:

Provide manufacturers' standard units, modified as necessary to comply with requirements. Shop fabricate each unit to greatest extent possible.

MATERIALS, GENERAL:

Zinc-Coated Steel: Commercial quality with 0.20 percent copper, ASTM A 525, G90 hot-dip galvanized, mill phosphatized.

Stainless Steel: AISI TYPE 302/304, ASTM A 167, 2D annealed finish except as otherwise indicated, temper as required for forming and performance.

Aluminum Sheet: ASTM B 209, alloy 3003, temper as required for forming and performance; AA-C22A41 clear anodized finish, except mill finish prepared for painting where indicated for field painting.

Extruded Aluminum: Manufacturer's standard extrusions of sizes and general profiles indicated, alloy 6063-T52; 0.078" minimum thickness for primary framing and curb member legs, 0.062" for secondary legs; AA-C22A41 dark bronze anodized finish on exposed members, except as otherwise indicated.

Insulation: Manufacturer's standard rigid or semi-rigid board of glass fiber of thicknesses indicated.

Wood Nailers: Softwood lumber, pressure treated with water-borne preservatives for above-ground use, complying with AWPB LP-2; not less than 1-1/2" thick.

Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

Gaskets: Tubular or fingered design of neoprene or polyvinyl chloride, or block design of sponge neoprene.

Bituminous Coating: FS TT-C494A or SSPC-Paint 12, solvent type bituminous mastic, nominally free of sulfur, compounded for 15-mil dry film thickness per coating.

Mastic Sealant: Polyisobutylene: nonhardening, nonskinning, nondrying, nonmigrating sealant.

Elastomeric Sealant: Generic type recommended by unit manufacturer, which is compatible with joint surfaces; comply with FS TT-S-00227E, TT-S00230C, or TT-S-001543A.

Roofing Cement: ASTM D 2822, asphaltic.

WIND TURBINE ROOF VENTS:

Turbine Roof Vents shall be wind driven finned round roof ventilators designed to remove air from the attic space areas above the ceiling joist. The vents shall be aluminum construction with a fixed base suction throat, minimum 12-inch in diameter, and rotating multi blade fin vent mounted for ease of movement above the base which shall displace air from within the define space to the exterior. The vents shall have flashing on the base which is to be integrally installed on the metal roof panels and sealed to prevent rainwater from entering the interior. The vents shall have a baked on enamel finish that closely matches the roof panels in color.

PART 3 – EXECUTION

INSTALLATION:

General: Comply with manufacturer's instructions and recommendations. Coordinate with installation of roof deck and other substrates to receive accessory units, and vapor barriers, roof insulation, roofing and flashing; as required to endure that each element of the work performs properly, and that combined elements are waterproof and weathertight. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.

Except as otherwise indicated install roof accessory items in accordance with construction details of "NRSA Roofing and Waterproofing Manual".

Isolation: Where metal surfaces of units are to be installed in contact with noncompatible metal or corrosive substrates, including wood, apply bituminous coating on concealed metal surfaces, or provide other permanent separation.

Flange Seals: Except as otherwise indicated, set flanges of accessory units in a thick bed of roofing cement, to form a seal.

Cap Flashing: Where cap flashing is required as component of accessory, install to provide adequate waterproof overlap with bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

Operational Units: Test operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

CLEANING AND PROTECTION:

Clean exposed metal and plastic surfaces in accordance with manufacturer's instructions. Touch up damaged metal coatings.

END OF SECTION 07700

SECTION 07900 – JOINT SEALERS AND CAULKING

PART 1 – GENERAL

RELATED DOCUMENTS:

Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division –1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of each form and type of joint sealer is indicated on drawings.

SYSTEM PERFORMANCES:

Provide joint sealers that have been produced and installed to establish and maintain watertight and airtight continuous seals.

QUALITY ASSURANCE:

Installer Qualifications: Engage an Installer who has successfully completed within the last 3 years at least 3 joint sealer applications similar in type and size to that of this project and who will assign mechanics from these earlier applications to this project, of which one will serve as lead mechanic.

Single Source Responsibility for Joint Sealer Materials: Obtain joint sealer materials from a single manufacturer for each different product required.

Preconstruction Joint Sealer-Substrate Tests: Submit substrate materials representative of actual joint surfaces to be sealed to manufacturer of joint sealer products for laboratory testing of sealants for adhesion to primed and unprimed substrates and for compatibility with secondary seals as indicated below:

Use test methods standard with manufacturer to determine if priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealers to joint substrates under environmental conditions that will exist during actual installation.

Preconstruction Field Tests: Prior to installation of joint sealants, field-test their adhesion to joint substrates as follows:

Install joint sealants in 5-foot joint lengths using same materials and methods required for completed work. Allow sealants to cure before testing. Test adhesion to joint substrates by manually trying to pull joint sealant out of joint.

Locate test joints where indicated or, if not indicated, as directed by Engineer.

Perform field tests for each application indicated below:

Each type of elastomeric sealant and joint substrate application indicated.

Perform tests in Engineer's presence.

Field-Constructed Mock-Ups: Prior to installation of joint sealers, apply elastomeric sealants to the following selected building joints as indicated below for further verification of colors selected from sample submittals and to represent completed work for qualities of appearance, materials and application:

Joints in field-constructed mock-ups of assemblies specified in other sections, which are indicated to receive elastomeric joint sealants as work of this section.

Retain mock-ups during construction as standard for judging completed work.

SUBMITTALS:

Product Data: Submit manufacturer's technical data for each joint sealer product required, including instructions for joint preparation and joint sealer application.

Samples for Initial Selection Purposes: Submit manufacturer's standard bead samples consisting of strips of actual products showing full range of colors available, for each product exposed to view. Color will be selected by the Engineer.

Test Reports: Submit the following test reports:

Preconstruction joint sealer-substrate test results including recommendations of joint sealer manufacturer for joint preparation and application of joint sealers applicable to project conditions.

Certified test reports for elastomeric sealants evidencing compliance with requirements specified based on comprehensive testing of current product formulations within a 24-month period preceding date of submission of test reports to Engineer. Include test results for aged performances including hardness, strain resistance, adhesion and cohesion under cyclic movement, low-temperature flexibility, modulus of elasticity at 100% strain, effect of heat aging, and effect of accelerated weathering.

Preconstruction field test results reported by Installer indicating which products and joint preparation methods demonstrated acceptable adhesion to joint substrates.

Certificates: Submit certificates from manufacturers of joint sealers attesting that their products comply with specification requirements and are suitable for the use indicated.

DELIVERY, STORAGE, AND HANDLING:

Deliver materials to project site in original unopened containers or bundles with labels

informing about manufacture, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multicomponent materials.

Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

PROJECT CONDITIONS:

Environmental Conditions: Do not proceed with installation of joint sealers under the following conditions:

When ambient and substrate temperature conditions are outside the limits permitted by joint sealer manufacturer or below 40° F (4.4° C).

When joint substrates are wet due to rain, frost, condensation or other causes.

Joint Width Conditions: Do not proceed with installation of joint sealers when joint widths are more or less than allowed by joint sealer manufacturer for application indicated.

PART 2 – PRODUCTS

MATERIALS, GENERAL:

Compatibility: Provide joint sealers, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by testing and field experience.

ELASTOMERIC JOINT SEALANTS AND CAULKING:

Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those for Type, Grade, Class and Uses.

One-Part Non-Acid-Curing Silicone Sealant: Type S; Grade NS; Class 25; and complying with the following requirements for Uses, modulus and additional joint movement capability:

Use for perimeters of exterior openings where frames meet masonry, for control and expansion joints in exterior surfaces of exterior masonry walls.

Low Modulus: Tensile strength of 45 psi or less at 100% elongation when tested after 14 days at 77° F (20° C) and 50% relative humidity per ASTM D 412.

Additional capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand 50% increase and/or 50% decrease of joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920.

One-Part Nonsag Urethane Sealant: Type S; Grade NS; Class 25.

Use around interior perimeters of exterior openings, control and expansion joints on the interior of exterior walls, perimeter of interior frames (both sides), interior masonry vertical control joints (block to block, block to concrete, and intersecting masonry walls).

Available Products: Subject to compliance with requirements products which may be incorporated in the work include, but are not limited to, the following:

One-Part Non-Acid-Curing Low-Modulus Silicone Sealant:

"Chem-Calk 1000"; Bostick Construction Products Div.

"Dow Corning 790"; Dow Corning Corp.

"864" Pecora Corp.

"Omniseal"; Sonneborn Building Products Div., Rexnord Chem, Prod. Inc.

"Spectrum 1"; Tremco, Inc.

One-Part Nonsag Urethane Sealant:

"Chem-Calk 900"; Bostik Construction Products Div.

"Spec 300"; Geocel Corp.

"Vulkem 116"; Mameco International, Inc.

"Dynatrol 1"; Pecora Corp.

"Sikaflex 1A"; Sika Corp.

"Sonolastic NP 1"; Sonneborn Building Products Div., Rexnord Chem. Prod. Inc.

"Dymonic"; Tremco, Inc.

Sealant for exterior insulation and finish system shall be one of the following:

Tremco "Dymeric"

Pecora Dynatrol II

JOINT SEALANT BACKING:

General: Provide sealant backings of material and type which are nonstaining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

Plastic Foam Joint-Fillers: Preformed, compressible, resilient, non-waxing, extruded rods of plastic foam of material indicated below, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

Closed-cell polyethylene foam, non-gassing.

Rod Sizes:

<u>Joint Width</u> <u>Inches</u>	<u>Rod Diameter</u> <u>Inches</u>
3/16 or less	1/4
1/4	3/8
3/8	1/2
1/2	5/8
5/8	3/4
3/4	1
7/8	1-1/4
1-1/8	1-1/2
1-5/8	2

Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing bond between sealant and joint filler or other materials at back (3rd) surface of joint. Provide self-adhesive tape where applicable.

MISCELLANEOUS MATERIALS:

Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealer-substrate and field tests.

Cleaners for Nonporous Surfaces: Provide non-staining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.

Masking Tape: Provide non-staining, non-absorbent type compatible with joint sealants and to surfaces adjacent to joints.

PART 3 – EXECUTION

INSPECTION:

Require Installer to inspect joints indicated to receive joint sealers for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealer performance. Obtain Installer's written report listing any conditions detrimental to performance of joint sealer work. Do not allow joint sealer work to proceed until unsatisfactory conditions have been corrected.

PREPARATION:

Pre-Installation Meeting: At Contractor's direction, Installer, joint sealer manufacturers' representatives, and other trades whose work affects installation of joint sealers shall meet

at project site to review procedures and time schedule proposed for installation of joint sealers which is coordinated with other, related work.

Surface Cleaning of Joints: Clean out joints immediately before installing joint sealers to comply with recommendations of joint sealer manufacturers and the following requirements:

Remove all foreign material from joint substrates which could interfere with adhesion of joint sealer, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; oil; grease; waterproofing; water repellent; water; surface dirt and frost.

Clean concrete and masonry by brushing, grinding, blast cleaning, mechanical abrading, acid washing or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealers. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.

Remove laitance and form release agents from concrete.

Clean metal and other non-porous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealers.

Joint Priming: Prime joint substrates where indicated or where recommended by joint sealer manufacturer based on preconstruction joint sealer-substrate tests or prior experience. Apply primer to comply with joint sealer manufacturer's recommendations. Confine primers to areas of joint sealer bond; do not allow spillage or migration onto adjoining surfaces.

Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

INSTALLATION OF JOINT SEALERS:

General: Comply with joint sealer manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.

Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

Install joint-fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths, which allow optimum sealant movement capability.

Do not leave gaps between ends of joint-fillers.

Do not stretch, twist, puncture or tear joint-fillers.

Remove absorbent joint-fillers, which have become wet prior to sealant application and replace with dry material.

Install bond breaker tape, if required, between sealants and joint-fillers, compression seals or back of joints where required to prevent third-side adhesion of sealant to back of joint.

Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.

Tooling of Nonsag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth uniform beads of configuration indicated, to eliminate air pockets and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents, which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

Concave joint configuration per Figure 6A in ASTM C 962.

Use masking tape to protect adjacent surfaces of recessed tooled joints.

PROTECTION AND CLEANING:

Protect joint sealers during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.

Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

END OF SECTION 07900

SECTION 08110 – STEEL DOORS AND FRAMES

PART 1 – GENERAL

RELATED DOCUMENTS:

Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of standard steel doors and frames is shown and scheduled on drawings.

Other types of metal door work are specified in other Division 8 sections.

Builder's hardware is specified elsewhere in Division 8.

Glazing: Refer to "glass and glazing" section for glazing door units, including those indicated to be factory preglazed.

QUALITY ASSURANCE:

Provide doors and frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.

Manufacturer: Provide standard steel doors and frames by a single firm specializing in production of this type of work.

Provide steel doors and frames by one of the following:

Anweld Building Products Div.
Ceco Corp.
Curries Mfg. Inc.
Ditco Products Div.
Fenestra.
Mesker Industries, Inc.
Republic Builders Prod. Corp.
SteelCraft Mfg. Co.

Fire-Rated Assemblies: Provide fire-rated doors investigated and tested as fire door assemblies, complete with type of hardware to be used. Identify each fire door with recognized testing laboratory labels, indicating applicable fire rating of steel doors. Construct and install assemblies to comply with NFPA Standard No. 80, and as herein specified.

SUBMITTALS:

Product Data: Submit manufacturer's specifications for fabrication and installation, including data substantiating that products comply with requirements.

Shop Drawings: Submit for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.

DELIVERY, STORAGE AND HANDLING:

Deliver hollow metal work cartoned or crated to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory-finished doors.

Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided finish items are equal in all respects to new work and acceptable to Engineer; otherwise, remove and replace damaged items as directed.

Store doors and frames at building site under cover. Place units on wood sills at least 4" high, or otherwise store on floors in manner that will prevent rust and damage. Avoid use of non-vented plastic or canvas shelters, which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide ¼" spaces between stacked doors to promote air circulation.

PART 2 – PRODUCTS

MATERIALS:

Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM A 568.

Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

Galvanized Steel Sheets: Zinc-Coated carbon steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G60 zinc coating, mill phosphatized, for exterior units.

Supports and Anchors: Fabricate of not less than 18 gauge galvanized sheet steel.

Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanized items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

Shop Applied Paint:

Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.

FABRICATION, GENERAL:

Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. Provide 14 ga. for exterior and 16 ga. for interior.

Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from only cold-rolled steel.

Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel (at fabricator's option).

Fabricate exterior doors, panels, and frames from galvanized sheet steel. Close top and bottom of exterior doors as integral part of door construction or by addition of inverted steel channels. Provide 16 ga. for exterior doors.

Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

Thermal-Rated (Insulating) Assemblies:

At exterior locations and elsewhere as shown or scheduled, provide doors which have been fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236.

Unless otherwise indicated, max. apparent U factor for thermal-rated assemblies is 0.24 BTU/hr (ft²)° F.

Finish Hardware Preparation:

Prepare doors and frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 Series specifications for door and frame preparation for hardware.

Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.

Locate finish hardware as shown on final shop drawings or, if not shown, in accordance with "Recommended Locations for Builder's Hardware," published by Door and Hardware Institute.

Shop Painting:

Clean, treat, and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.

Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive finish paint.

STANDARD STEEL DOORS:

Provide metal doors of types and styles indicated on drawings or schedules. Provide 16 ga. for exterior and 18 ga. for interior.

STANDARD STEEL FRAMES:

Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on drawings and schedules. Conceal fastenings, unless otherwise indicated. Provide 14 ga. for exterior and 16 ga. for interior.

Fabricate frames with mitered corners, welded construction for all applications.

Form exterior frames of hot dip galvanized steel.

Door Silencers: Except on weather-stripped frames, drill stops to receive 2 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.

Manufacturer's "stick-on" silencers will be acceptable in lieu of drilled type.

Plaster Guards: Provide 26 gauge steel plaster guards or mortar boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operations.

PART 3 – EXECUTION

INSPECTION:

Installer must examine substrate and conditions under which steel doors and frames are to be installed and must notify Contractor in writing of any conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

INSTALLATION:

General: Install standard steel doors, frames, and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.

Placing Frames:

Comply with provision of SDI-105 "Recommended Erection Instructions For Steel Frames," unless otherwise indicated.

Except for frames located at in-place concrete or masonry and at drywall installations, place frames prior to construction of enclosed walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

In masonry construction, locate 3 wall anchors per jamb at hinge and strike levels. Building-in of anchors and grouting of frames is specified in Division 4.

At in-place concrete or masonry construction, set frames and secure to adjacent construction with machine screws and masonry anchorage devices.

Install fire-rated frames in accordance with NFPA Std. No. 80.

In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In open steel stud partitions, place studs in wall anchor notches and wire tie. In closed steel stud partitions, attach wall anchors to studs with tapping screws.

Door Installation:

Fit hollow metal doors accurately in frames, within clearances specified in SDI-100.

Place fire-rated doors with clearances as specified in NFPA Std. No. 80.

ADJUST AND CLEAN:

Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

Protection Removal: Immediately prior to final inspection, remove protective plastic wrapping from prefinished doors.

Final Adjustments: Check and readjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.

END OF SECTION 08110

SECTION 10440 – SPECIALTY SIGNS

PART 1 – GENERAL

RELATED DOCUMENTS:

Drawings and General Provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

DESCRIPTION OF WORK:

Extent of specialty signs is shown on drawings.

Forms of specialty signs required include the following:

Project Signs: The Contractor shall provide and maintain professional quality signs for the project measuring four feet by eight feet (4' x 8') wide and in height on which the information, provided in the Branding Guidelines portion of the Specifications, shall be placed. The sign shall display the fonts, colors, and logos as shown in the Branding Guidelines. Signs will be placed at locations designated by the Engineer. The contractor shall maintain the sign for the duration of the project.

SUBMITTALS:

Product Data: Submit technical data and installation instructions for each type of sign required.

MATERIALS:

The Project Signs shall be produced in outdoor rigid material, which can be plywood, metal, PVC, or Colorplast, as outlined in the Branding Guidelines.

PART 2 – MANUFACTURERS: (NOT APPLICABLE)

PART 3 – EXECUTION

INSTALLATION:

General: Locate sign units and accessories where shown or scheduled, using mounting methods of the type described.

END OF SECTION 10440

SECTION 011700 – ULTRAVIOLET DISINFECTION EQUIPMENT

PART 1 – GENERAL

SUMMARY

Furnish all labor, materials, equipment and appurtenances required to provide a closed vessel, pressurized flow, high intensity medium pressure lamp, ultraviolet (UV) disinfection system complete with an automatic mechanical/chemical cleaning system and UV intensity monitoring. The UV system shall be complete and operational with all control equipment and accessories specified herein and as shown on the contract drawings.

The UV disinfection system shall be purchased from Trojan Technologies, the Base Bid Manufacturer, by the Contractor. The system shall be installed by the Contractor and tested and commissioned by Trojan Technologies, as specified in this section.

QUALITY ASSURANCE

Pre-qualification Requirements: Any alternate UV Manufacturer that is not named or listed as an approved equal must submit the following fifteen (15) days prior to bid to be considered for approval:

The UV Manufacturer shall be regularly engaged in the manufacture of UV systems with a proven track record of at least one hundred (100) installations in North America, each with a flow rate of at least 1.0 USMGD (158 m³/hr). The manufacturer shall provide documentation of their experience with UV disinfection systems in municipal drinking water applications.

The UV Manufacturer shall submit a Bioassay Validation Report for the proposed reactor. The bioassay testing and results shall have been validated by a qualified independent third (3rd) party in full compliance with EPA 815-R-06-007, *Ultraviolet Disinfection Guidance Manual For The Final Long Term 2 Enhanced Surface Water Treatment Rule*, released November 2006.

1. Bioassay testing shall evaluate reactor performance over the range of flow rates from 0.2 to 6.5 USMGD, UV Transmittance (UVT) from 70% to 98% (measured at 254 nm, 1 cm path length) and MS2 Reduction Equivalent Dose (RED) ranging from 10 to 110 mJ/cm², or T1 Reduction Equivalent Dose (RED) ranging from 2 to 24 mJ/cm². The bioassay testing must encompass the range of design and operating conditions described herein. ***Extrapolations to flow rates, UV Transmittance values, or UV doses outside the range actually tested, shall not be permitted.***
2. Bioassay testing shall also verify that the headloss generated by the proposed reactor is less than or equal to the specified limits.
3. Pre-qualification submittals from the UV manufacturer shall include a complete and detailed proposal of equipment offered, including the number of lamps proposed and a detailed description of any exceptions taken to the specification.

4. Documentation of the UV manufacturer's service capabilities including location and experience.
5. All UV manufacturers shall be required to pre-qualify, unless the manufacturer is the Base Bid Manufacturer.

SYSTEM DESCRIPTION

Design Criteria:

The UV Manufacturer shall provide equipment to disinfect water with the following characteristics:

Peak (Design) Flow:	7	MGD(US)
Average Flow:	3	MGD(US)
Min Flow:	xxx	MGD(US)
Design UVT:	80	% (at 254 nm, 1 cm path length)
Water Temperature:	1 °C to 30 °C	
Turbidity:	<5 NTU	
Max Inlet Pressure:	xxx	psig

Design Dose: The UV disinfection system shall be designed to deliver the Reduction Equivalent Dose (RED) specified in Section 1.3.C, Performance Requirements. To ensure the UV system can deliver the RED at the end of lamp life, with fouled sleeves, the RED shall incorporate a Combined Aging and Fouling Factor (CAF) calculated as $CAF = EOLL \times FF$, where EOLL is the ratio of the lamp output at the end of the lamp life relative to the new lamp output, and FF is the Fouling Factor. The FF shall be 0.5 for UV Systems with no sleeve wiping system, 0.75 for UV Systems with mechanical only sleeve wiping system, or 0.95 for UV Systems with an *on-line* combined chemical and mechanical sleeve wiping system. EOLL (End Of Lamp Life) output shall be 80% of the specified new lamp output. A higher value shall be permitted only if the EOLL output has been validated by 3rd Party witnessed testing of the output at the end of the warranted lamp life.

- a) The RED shall be delivered under the Peak (Design) Flow and Design UVT condition specified in 1.3.A.1, with the largest unit out of service.
 - b) Systems without an automatic on-line mechanical and chemical cleaning system shall include provisions to automatically chemically clean the lamps.
 - c) RED must be verified by third party witnessed bioassay testing per Section 1.2.A.3.
2. Hydraulics:
- a) Headloss through each UV reactor shall not exceed 30 1 water column (in w.c.) under peak flow conditions.

B. System Components:

1. The UV system shall be comprised of the following components:

- a) UV Reactors: 2
- b) Number of lamps per reactor: 4
- c) Control Power Panel(s): 1 per reactor
- d) UV Intensity Sensor(s):
- e) Automatic Cleaning System: On-line Chemical/Mechanical

C. Performance Requirements:

1. The UV Manufacturer shall provide a written guarantee that the equipment will continuously meet the specified performance requirements for each unit as follows:

The UV disinfection system shall be capable of providing 1.0 log of Cryptosporidium at the Peak (Design) Flow and Design UVT condition specified in 1.3.A.1.

The UV Manufacturer must have a 3rd Party Validation report meeting the requirements of 1.2.A.3 and 1.2.A.4. The Validation report must substantiate that the UV system is capable of delivering an RED (Reduction Equivalent Dose) mJ/cm^2 , for the design conditions stated in 1.3.A.1, and the design dose considerations in 1.3.A.2, as follows:

$\text{RED} = D_{\text{req'd}} * \text{VF} * \text{SF}$, where

$D_{\text{req'd}}$ (dose required) = $2.5 \text{ mJ}/\text{cm}^2$ for 1.0 log credit for cryptosporidium (Ref Table 1.4 *Ultraviolet Disinfection Guidance Manual* (UVDGM)); for example, $12 \text{ mJ}/\text{cm}^2$ for 3.0 log credit for Cryptosporidium)

VF = UV system Validation Factor calculated using the method outlined in the UVDGM (unique to each manufacturer and system)

SF = Safety factor to account for site uncertainties (flowmeter accuracy, online UVT accuracy, flow split differentials, minor upstream/downstream piping differences etc.) = 1.25 (value at discretion of the engineer)

At the time of bid, the UV Manufacturer must provide a Validation Certificate, to demonstrate that they have obtained 3rd Party Validation that covers the full range of design and operating conditions (flow rate and UVT) described in Section 1.3.A.1. The selected UV Manufacturer must provide the Validation Report as part of the submittal package to substantiate the dose delivery (RED), and calculation of the Validation Factor used above.

2. The system shall be able to continue providing disinfection while the automatic cleaning system is in operation.
3. The system shall be able to continue providing disinfection while the UV intensity sensor calibration is being checked.
3. System shall be designed to operate in an environment with ambient relative humidity of 5-90% and ambient air temperature of 0-40°C.

SUBMITTALS

Submit for review, engineering drawings showing the following:

Complete description in sufficient detail to permit comparison with the specifications.

Dimensions and installation requirements.

Descriptive information including catalogue cuts and manufacturers' specifications for all major components.

Electrical schematics and layouts.

GUARANTEE

Equipment: The equipment furnished under this section (excluding UV lamps) shall be free of defects in materials and workmanship, including damages that may be incurred during shipping for a period of one (1) year from start-up or 18 months after shipment, whichever occurs first.

UV Lamps: The UV lamps shall be warranted for 5,000 hours of operation (prorated after 3,000 hours) or 36 calendar months from shipment, whichever occurs first.

PART 2-PRODUCTS

MANUFACTURER

The physical layout of the system shown on the contract drawings and the equipment specified herein are based solely upon the Trojan UVSwift™, as manufactured by Trojan Technologies, London, Ontario, Canada or prior approved equal.

- A. To be acceptable, the UV system must operate in a closed vessel, use high intensity medium pressure UV lamps, use fully electronic ballasts with multiple power settings, and incorporate an automatic on-line mechanical/chemical sleeve cleaning system for both lamp sleeves and sensor sleeves/windows.
- B. To be acceptable, the UV system must fit within the given dimensions with no modifications.
- C. To be considered as an alternate, in addition to the Pre-Qualification Requirements listed in Section 1.2.A, UV disinfection systems that use only mechanical wiping must have the ability to periodically be cleaned using a chemical recirculation tank. To be acceptable, the cleaning solution must be ANSI/NSF Standard 60 Certified for Drinking

Water Treatment Chemicals. All tanks, cleaning chemicals, valves, power supplies and associated piping shall be supplied by the UV manufacturer. The UV manufacturer shall be responsible for supplying all equipment including any equipment not specifically listed that may be required to perform chemical cleaning, including complete controls integration. Contractor shall be responsible for installation. Contractor to make suitable arrangements for chemical to be safely drained from site. **UV disinfection systems that do not have a mechanical and chemical cleaning system will not be accepted.**

DESIGN, CONSTRUCTION AND MATERIALS

UV Reactor:

1. The UV Reactor shall be of welded construction manufactured from Type 316L stainless steel. The UV Reactor shall be pickled, passivated and bead blasted for uniform external finish.
2. UV Reactor shall occupy a plan footprint no greater than 6 ft². To be considered as an alternate, UV Manufacturers whose reactors occupy greater than 6 ft² shall demonstrate to the satisfaction of the Engineer the proper placement of the reactor within the current design layout.
3. The UV Reactor shall be designed to handle a maximum operating pressure of 150 psig, and shall be fully assembled and hydrostatically tested to 1.5 times the rated operating pressure, for at least 10 minutes without leakage, in the factory prior to shipment.
4. Each UV Reactor shall be supplied with 12 inch ANSI 150 lb flanged inlet/outlet connections.
5. Each UV Reactor shall be a nominal 12 inches in diameter.
6. Each UV Reactor shall fit within a 21 inch pipe length.
7. Each UV reactor shall consist of high intensity medium pressure UV lamps arranged horizontally and perpendicular to the direction of flow.
8. Each lamp shall be enclosed in an individual quartz sleeve, one end of which shall be closed and the other sealed with compressed o-rings.
9. Each quartz sleeve shall be independently sealed within the reactor.
10. The UV reactor shall be designed such that operating personnel at the plant can change the lamps without draining the reactor.
11. The UV reactor shall be provided with access ports for easy access to the quartz sleeves and cleaning system.

12. All access for reactor components, including lamps, sleeves and cleaning system shall be from the same side. Designs requiring access from more than one side of the reactor are not permitted.
13. Piping shall be designed so that the reactor will be full of water at all times. Air trapped in the reactor shall result in reactor shut down to avoid overheating.
14. The UV reactor shall be installed either vertically or horizontally, however lamps must be installed horizontally.
15. The UV Lamps shall reach maximum UV output within three (3) minutes (defined as the warm-up period). If discharging water that *may* not have received specified dose levels during the warm-up period is not acceptable, then a separate cooling water line *may* be required. Cooling water is *not required* for reactor start-up as long as the minimum in-line flow rates are initiated within the allowable "zero flow" operation time. If it is expected that the minimum in-line flow rates can not be initiated within the allowable "zero flow" operation time, or if the plant desires to operate the reactors in "Hot Standby" mode (i.e. the lamps are powered, but process water is not being passed through the reactor), then cooling water is required.
16. Dry weight of the reactor shall not exceed 300 lbs / 136 kg.
17. Wet weight of the reactor shall not exceed 430 lbs / 195 kg. If pipe supports are necessary, they shall be supplied by Others.
18. All wetted components within the reactor shall be NSF 61 certified.

UV Lamps:

1. The UV lamps shall be high intensity, medium pressure type with a 12 inch arc length and a maximum power input of 3.0 kW.
2. The filament shall be significantly rugged to withstand shock and vibration.
3. The lamp bases shall be resistant to UV and ozone.
4. The lamps shall be operated by variable output electronic ballasts with 1% power increments, from 26% to 100% of full rated output.

UV Lamp Sleeves:

1. The UV lamp sleeves shall be manufactured from Type 021 AL, fully annealed clear fused quartz tubing.
2. Lamp sleeves shall be domed at one end.
3. The open end of the lamp sleeve shall be sealed by means of an o-ring and Type 316 stainless steel compression plate.

UV Intensity Sensor(s):

1. The UV Intensity Sensor(s) shall be located inside the reactor and contained within protective quartz sleeves.

2. One (1) sensor shall be provided per lamp.
3. Sensor(s) shall incorporate SiC diodes, and provide NIST-traceable measurement with a total absolute uncertainty of 15% or less at an 80% confidence level.
4. Sensor(s) must meet the requirements of the EPA 815-R-06-007. Sensor(s) must filter out wavelengths below 240 nm, and have a spectral response peaking between 250 nm and 280 nm with less than 10% coming from wavelengths greater than 300 nm.
5. The complete Sensor assembly and the internal circuit board containing the diode shall each be serialized.

Ballasts:

1. Ballasts shall be of a high frequency output, fully electronic design with a minimum efficiency of 95% at full load, and a power factor of 99% or better.
2. Ballasts shall have a variable operation range of 26% to 100% of full rated output and be adjustable in 1% increments.
3. The maximum allowable total current harmonic distortion (current THD) shall not exceed 10% at the maximum power level.
4. Each ballast shall supply power to one (1) lamp only.
5. Ballasts shall have a mean design life expectancy of at least 10 years.

Control Power Panel (CPP):

1. Power distribution and control for each UV Reactor shall be through the associated CPP. The CPP shall house all power supplies and control hardware.
2. The CPP shall be designed to operate with the following electrical supply:
480/277 VAC 3 phase 60Hz, 4 wire + ground
3. The maximum total power consumption rating per CPP shall be no greater than _____ amps maximum current per phase (unbalanced load).
4. The CPP enclosure shall be epoxy painted carbon steel.
5. The CPP enclosure shall be Type 12 (IP54), ventilated.
6. The CPP enclosure shall be forced-air cooled.
7. Signal wiring interfacing the UV Reactor with the CPP, shall be as shown on the contract drawings.
8. The CPP shall be installed within 20 feet (6 meters) (external running cable length) of the UV Reactor.
9. Each CPP shall be provided with a lockable disconnect handle that shall shut down the reactor/cabinet power when the cabinet door is opened.
10. CPP enclosure shall be floor mounted.

11. CPP enclosure dimensions shall not exceed 48" (1219 mm) high x 36" (914 mm) wide x 18" (457 mm) deep. Weight shall not exceed 300 lbs (136 kg).

Control and Instrumentation:

1. General

- a) One (1) Control Power Panel (CPP) is provided for each UV Reactor. All control hardware and software for a given reactor is contained within the associated CPP.
- b) Each UV reactor shall be controlled independently.
- c) Each UV reactor shall be controlled by an Allen Bradley Compact Logix L32 which continuously monitors and controls the UV reactor's functions. Custom electronics, an input flow signal (supplied by others), and the UV sensor(s), provide the PLC with the necessary indications of system parameters.
- d) Control of multiple reactors shall be accomplished through SCADA (by Others).

2. Operator Interface

- a) Complete control and monitoring of each UVSWIFT™ reactor shall be accomplished through the operator interface located on the CPP.
- b) The operator interface shall be the Allen Bradley Panelview+ 700.
- c) The operator interface shall be menu driven, and shall display the following system information when prompted: reactor status, individual lamp status, lamp operating hours, RED (dose), UV Intensity, power level, alarms, alarm history.
- d) The most recent alarms shall be displayed on the operator interface when prompted, recorded by alarm type, date and time of occurrence, and date and time of correction.

3. Remote Monitoring/Control

- a) The communication between the UV reactors and the plant control center shall be through the following protocol:
 - Allen Bradley – Ethernet
- b) Each reactor shall be capable of being placed in either Local or Remote mode.
- c) Each system shall be provided with the following customer interface hardwired I/O:
 - Discrete input for Reactor On/Off Control from remote location.
 - Discrete output indicating Critical Alarm.
 - Discrete output indicating Major Alarm.
 - Discrete output indicating Minor Alarm.
 - Discrete output indicating System Ready.
 - Discrete ON/OFF status.
 - 4-20ma Flow Signal Analog input.

- 4-20ma UV Dose Analog output.
- 4-20ma UV Intensity Analog output.

Dose-Pacing:

1. A dose-pacing system shall be supplied to modulate the lamp power levels based on the flow rate, UV sensor signal(s) and UV transmission values according to the Validation report.
2. The system shall be dose-paced such that as the flow rate, water quality, and lamp conditions change, the UV RED (dose) target shall be achieved while conserving power.

Safety Features:

1. Each UV Reactor shall be equipped with a temperature switch to prevent the reactor from overheating. The temperature switch shall be wired to the CPP, and shall shut the reactor down and initiate a critical alarm condition when activated.
2. Each UV Reactor shall be equipped with a water level sensor to prevent operation of the UV lamps in air. The level sensor shall be wired to the CPP and shall shut the reactor down and initiate a critical alarm condition if low water level is detected.
3. Each UV Reactor shall be equipped with a cover to protect the lamps electrical connections. For Operator safety, the protective cover shall be equipped with a switch to disconnect power to the lamps when the cover is removed.
4. Each CPP and reactor shall be equipped with an Emergency Stop button to shut off power to the lamps.

On-line UV Transmission Monitor (Trojan OptiView™):

1. An on-line UV Transmission (UVT) monitor shall be supplied to automatically monitor the UV Transmission of the process stream (measured at 254 nm, 1 cm pathlength). UV Transmission range shall be 70% to 100%.
2. The UVT Monitor shall include a UV lamp, UV sensor, drive system, system controller and operator interface.
3. The operator interface shall display the system status and allow for manual on/off system control. The operator interface of the Trojan OptiView™ system shall be located on the door of the enclosure.
4. Enclosure shall be stainless steel, Type 4X. Enclosure shall wall mounted and weigh no more than 65 pounds / 30 kg.
5. Inlet/outlet fittings to be 3/8" female for connection to process stream and drain. Supply tubing/piping (by Others) shall be a maximum of 1/4" internal diameter.
6. Enclosure dimensions shall be no greater than 20 inches (508 mm) wide by 20 inches (508 mm) high and 10 inches (254 mm) deep.

7. A 4-20 mA output shall be provided for data transmission to remote devices. A discrete common alarm shall be provided for remote indication of alarm condition.
8. The system shall be designed to handle flow rates of 0.1 gpm (0.4 l/min.) – 0.5 gpm (2.0 l/min) at a maximum inlet pressure of 30 psi. If flow regulators and/or pressure reducers are required to maintain specified minimum and maximum values, they shall be provided by Others.
9. Power supply to the OptiView™ system shall be 120V, single phase, 60 Hz, 250 VA.
10. OptiView™ panel shall be UL, CSA, and CE approved.
11. OptiView™ panel to be installed in an indoor, non-freezing environment.
12. The process stream temperature range to be 36-104°F (2-40°C).
13. The expected life of the OptiView™ lamp shall be 9,000 hours.

Cleaning System:

1. Each UV Reactor shall be equipped with an automatic on-line sleeve cleaning system.
2. The cleaning system shall be driven by an electric motor via an internal screw drive.
3. The cleaning system shall provide both mechanical and chemical cleaning abilities for the lamp sleeves, and mechanical cleaning abilities for the UV Sensor sleeves/windows, complete with an automatically initiated and controlled cleaning cycle. The cleaning system shall be fully operational while still providing disinfection.
4. Cleaning cycle intervals shall be field adjustable via the operator interface. Manual cleaning system control shall also be through the operator interface.
5. The system shall be provided with the cleaning reagents and solutions required for initial equipment testing and equipment start-up.
6. Cleaning reagents and solutions used shall be NSF™ 60 approved.

Spare Parts:

The following spare parts and safety equipment shall be supplied:

1. 4 UV Lamps
2. 4 sleeves
3. 1 set of seals and o-rings per reactor
4. 1 set of replacement wiper seals per reactor
5. 1 Face Shield, able to block UV light wavelengths between 200 and 400nm
6. Cleaning solution for 1 year of operation

PART 3-EXECUTION

INSTALLATION

In accordance with the contract drawings, manufacturer's engineering drawings and instructions.

MANUFACTURER'S SERVICES

- A. Installation Supervision: As required by phone or fax.
- B. Start-up and Operator training: 2-3 full days on site, per reactor.
- C. Service scheduling: As required during the warranty period.

END OF SECTION 11700

SECTION 15010 – MECHANICAL – GENERAL PROVISIONS

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

The General Conditions of these Specifications, along with Special Provisions, Information to Bidders, and any other pertinent information and documents shall apply the same as if repeated herein. Refer to Division 1.

1.02 DIVISION 15 SECTIONS

Division 15 is divided into Sections for convenience purposes.

15010 – General Provisions

15200 – Heating, Ventilation and Air Conditioning

1.03 DRAWINGS

A. Plans and detailed sketches are submitted to limit, explain and define conditions, specified requirements, pipe sizes, and manner of erecting Work. Structural or other conditions may require certain Modifications from the manner of installation shown, and such deviations are permissible and shall be made as required, but specified sizes and requirements necessary for satisfactory operations shall remain unchanged. It may be necessary to shift ducts or pipes or to change the shape of the ducts, and these changes shall be made as required. All other changes must be referred to the Engineer for approval before proceeding. Extra charges will not be allowed for these changes.

B. The Contractor should realize that the Drawings could delve into every step, sequence of operation necessary for the completion of the Project without drawing on the Contractors experience or ingenuity. However, only typical details are shown on the Drawings. In cases where the Contractor is not certain about the method of installation of his Work, he shall ask for Details. Lack of Details will not be an excuse for improper installation.

1.04 QUALITY ASSURANCE

A. All materials, equipment, and accessories installed under this Contract shall conform to all rules, codes, etc. as recommended by National Associations governing the manufacturer, rating and testing of such materials, equipment, and accessories. All materials must be new, of the best quality and first class in every respect. Whenever directed by the Engineer, the Contractor shall submit a sample for approval before proceeding.

B. This Contractor shall protect the entire system and all parts thereof from injury, throughout the progress and up to the acceptance of the Work. Failure to do so shall be sufficient cause for the Engineer to reject any piece of equipment.

C. Where local laws or regulations provide that certain accessories such as gauges, thermometers, relief valves and parts to be installed on equipment, it shall be understood that such equipment shall be furnished complete with the necessary accessories whether or not called for in these Specifications.

1.05 MANUFACTURER, TRADE NAMES, AND EQUIVALENCY REVIEW

Whenever manufacturers or trade names are mentioned in these Specifications or Plans, the words "or equivalent" shall be assumed to follow whether or not so stated. Manufacturers or trade names are used to establish a standard of quality only and should not in any way be construed to infer a preference. See Architectural Section of Specifications for Time Limit Requirements for Equivalency Review (Instruction to bidders).

1.06 A.S.M.E.

All unfired pressure vessels shall be built in accordance with A.S.M.E. Code and so stamped. Furnish shop Certificates for each vessel.

1.07 PAINTING

All painting shall be by the General Contractor's Painting Subcontractor. All pipe, pipe covering, ducts, equipment, supports, hangers, etc. exposed in building or in mechanical equipment room shall be painted. Requirements covering paints, workmanship, and preparation of surfaces as stated in the Architectural Painting Specifications shall govern.

1.08 FILL AND CHARGES FOR EQUIPMENT

Fill and charge the materials or chemicals all devices or equipment required to comply with manufacturer's guarantee or required for proper operation of the equipment.

1.09 LAWS AND CODES

A. The entire Mechanical Work shall comply with the rules and regulations of the City, Parish, and State in which this Project is being constructed, including the State Fire Marshal and State Board of Health. All modifications required by these authorities shall be made without additional charge to the Owner. The Mechanical Contractor shall report these changes to the Engineer and secure his approval before Work is started.

B. In addition to the codes heretofore mentioned, all mechanical Work and Equipment shall conform to the applicable portions of the following specifications, codes, and regulations:

1. American Society of Heating, Refrigeration and Air Conditioning Engineers
2. National Electrical Code
3. National Fire Protection Association
4. American Society of Mechanical Engineers
5. Life Safety Code, NFPA 101
6. Louisiana Building Code

1.09 UTILITIES

- A. The location and elevations of all utilities are based on available surveys and utility maps and are reasonably accurate. However, they shall serve as a general guide only, and the Contractor shall visit the site and verify the location and elevation of all services to his own satisfaction, in order to determine the amount of Work required for the execution of the Contract.
- B. In case major changes are required, this fact, together with the reasons therefore, shall be submitted to the Engineer in writing, not less than seven (7) days before the date of bidding. Failure to comply with this requirement will make the Contractor liable for any changes, additions, and expense necessary for the successful completion of the Project.
- C. Cutting and patching of all streets, walks, and other paved areas necessary for the successful completion of this Contract shall be included in this Contract.
- D. The Contractor shall contact the various utility companies, determine the extent of their requirements, and he shall include in his bid all lawful fees and payments required by these companies for service connections, extensions from mains to meters, street patching, etc. Meter deposits, costs, etc. by the General Contractor, to be placed in Owner's name at project completion.

1.10 PERMITS AND INSPECTIONS

- A. Secure all permits and inspections and pay fees for permits and inspections necessary for completion and acceptance of Work. Notify Engineer and proper authorities in ample time when any Work is ready for inspection. Obtain certificates of inspection and approval from inspection agencies having jurisdiction.
- B. The Owner is responsible for sewage assessments and/or property taxes as may be applicable.

1.11 VISIT TO JOB SITE

Visit and examine Project Site Prior to bid opening to determine all conditions which may affect the Work. Notify Engineer, in writing, seven (7) days prior to opening of bids of any discrepancies. No additional compensation will be allowed for failure to visit Project Site.

1.12 SHOP DRAWINGS/SUBMITTALS

- A. Before proceeding with Work and/or within thirty (30) days after award of the General Contract for this Work the Mechanical Contractor shall furnish to the Engineer complete Shop Drawings of such apparatus, equipment, controls, insulation, etc. to be provided in this Project. These Drawings shall give dimensions, weights, mounting data, performance curves and other pertinent information.
- B. Engineer's approval of Shop Drawings shall not relieve the Contractor from the responsibility of incorrectly figure dimensions, or any other errors that may be contained in these Drawings. The omission from the Shop Drawings of any materials shown on the Contract Drawings or specified, even though reviewed by the Engineer, shall not relieve this Contractor from furnishing and erecting same.
- C. Submittals required for the following:
- | | |
|--------------------------|---------------------------------|
| Plumbing Fixtures | Condensing Units |
| Water Heater/Return Pump | Air Handling Units |
| Cleanouts | Supply/Exhaust Fans |
| Valves | Duct Insulation and Accessories |
| Insulation (pipe) | Grilles, Louvers, Dampers |
| Dryer Vent | Insulation (Duct and Pipe) |
| Washer Box | Temperature Controls |
- D. Seven (7) sets of blueline prints of Shop Drawings or Submittals shall be submitted to the Engineer for approval. Any Drawings disapproved shall be resubmitted. Submit all Shop Drawings at the same time. No separate items will be accepted.

1.13 OPERATING AND MAINTENANCE INSTRUCTIONS

Provide Owner with three (3) copies of printed instructions indicating various pieces of equipment by name and model number, complete with parts list and maintenance and repair instructions. This information shall be bound in canvas covered notebooks. Substantial Completion of the project will not be recommended without compliance with this paragraph.

1.14 RECORD DRAWINGS

Contractor shall be furnished a complete set of Blueline Drawings which shall be marked up by the Contractor as Work progresses to reflect all items of installation which differ from Work shown on Contract Documents. Record Drawings shall be neatly done, not sketchy or free-hand. Final payment will be withheld until Drawings are furnished.

1.15 GUARANTEE

- A. The Contractor shall guarantee all materials, equipment and workmanship for a period of one (1) year from the date of final acceptance of the Project. This guarantee shall include the furnishing of all labor and materials necessary to make any repairs, adjustments, or replacements of any equipment, parts, etc. necessary to restore the Project to first class condition. This guarantee shall not include replacement of filters. Air Conditioning Compressors shall be warranted for an additional four (4) years beyond the one (1) year overall warranty. Additional four (4) year warranty shall include compressor replacement, not including labor, refrigerant, freight, etc. NOTE: The additional four (4) year warranty shall be for new replacement compressor, not re-built compressors or field repaired compressors.
- B. Should the Contractor's office be in excess of a 50-mile radius of this Project, he shall appoint a local, qualified Contractor to perform any emergency repairs and adjustments required during the guaranteed period. The Contractor appointed to provide emergency services shall be submitted to the Engineer for his approval.

PART 2 – PRODUCTS

2.01 MACHINERY GUARDS

This Contractor shall provide V-belt guards for each V-belt drive or other hazardous drive. Guard shall enclose drive entirely and shall have holes for taking tachometer readings.

2.02 ACCESS PANELS

Furnish and install access panels where valves, dampers, etc, are concealed in walls, ceilings, or floors, or otherwise inaccessible. Panels shall be Karp DSC-214M, stainless steel, #4 satin polish or Williams WB-GP, stainless steel, #4 satin polish.

2.03 HANGERS AND MISCELLANEOUS

- A. This Contractor shall furnish and install all escutcheons, inserts, thimbles, hangers, etc. required for the proper support and installation of his equipment and piping. Cooperate with other Trades in locating and placing these items.
- B. Provide sleeves for all pipes passing through walls, floors, beams, etc. Sleeves passing through structural members shall be of cast iron or Schedule 40 steel pipe. Sleeves passing through non-structural walls or floors shall be 22 gauge galvanized iron. Joints between sleeves and pipes passing through floors shall be made watertight with plastic materials. Where pipes pass through waterproofing members, flashing and sleeves shall be installed.

- C. Provide malleable iron split ring hangers or trapeze hangers with rod supports throughout. Strap hangers or wire will not be accepted. Maximum spacing of hangers for cast iron pipe shall be 5'; for other piping, the following schedule shall govern.

<u>Dia. Size</u> <u>(inches)</u>	<u>Sched. 40 Black</u> <u>Iron</u>	<u>Type "L" or "K"</u> <u>Copper</u>	<u>Sched. 40</u> <u>PVC</u>	<u>Sched. 80</u> <u>PVC</u>
¾" - 1¼"	8'	6'	4.5'	5.5'
1½" - 2½"	10'	10'	5.5'	6.5'
3"	12'	12'	6'	7'
4" - 6"	14'	14'	7'	8.5'
8" - 12"	16'		8'	10'

- D. Provide galvanized iron shields between hangers and pipe covering. See Plans and Insulation Specifications for wood inserts.
- E. Provide steel riser clamps on vertical risers at floors to support pipes.
- F. Provide chrome plated brass escutcheons wherever pipes pass through floors, walls, or ceiling in exposed or finished areas. Utilize Carborundum Fyre Putty or Metalines 525 fire stopping sealants where piping penetrates firewalls, floors, or ceilings.

2.04 VALVES AND DI-ELECTRIC UNIONS

- A. Furnish and install all valves and di-electric unions, stops, connections, etc. shown on Plans and necessary to make complete system in working order. Provide valves on inlet and outlet of all equipment.

- B. Valves and di-electric unions shall be as follows:

Quarter Turn	- Nibco S & T 580-NS; Red-White
Ball Valves	- 5049F w/extension stem; or equal
Di-electric Unions	- EPCO EA, FXS, EAC; Watts 3003, 3001A; or equal

2.05 MOTORS, STARTERS, AND ELECTRICAL WORK

- A. The Mechanical contractor shall furnish all motors for each piece of motor-driven equipment, unless shown otherwise. The Mechanical Contractor shall furnish these pieces of equipment to the Electrical Contractor, complete with all required diagrams, etc. for his installation.
- B. The Electrical Subcontractor shall do all wiring required for the installation of the mechanical equipment, including interlocking, power wiring, etc. All Work shall be in accordance with the National Electrical Code requirements wiring workmanship, etc. as called for in the Electrical Specifications. The Mechanical Contractor shall provide approved wiring diagrams of all equipment, controls, etc. to the Electrical Contractor for his installation. Coordinate all Work to provide a complete system in working order.

- C. All motors for the mechanical equipment shall be of the 40°C rise type and shall be furnished and installed by the Mechanical Contractor. All motors shall be wound for plus or minus 10 of specified voltage.
- D. Motors ½ HP and smaller shall be 120 or 240 volt, single phase, 60 cycle, and motors above ½ HP shall be 240 volt, three phase, 60 cycle, unless noted otherwise on Plans or hereinafter.
- E. All electrical equipment shall have Underwriters' Label and shall meet the standards of the National Electrical Code and N.E.M.A.
- F. Starters shall be furnished by the Electrical Contractor and shall have field auxiliary contacts; two (2) per starter, "H-O-A" switches shall be supplied only where called for, see Temperature Control Specifications.

PART 3 – EXECUTION

3.01 SUPERVISION

- A. The Contractor shall provide competent supervision of the Work from beginning to completion and final acceptance. To the best of his ability, he shall keep the same foreman and workmen through the Project duration.
- B. During the progress of the Work, it shall be subject to observation by the representative of the Engineer, and at these specified times, the Contractor shall furnish required information.

3.02 PROTECTION OF WORK

- A. The Contractor shall protect all equipment, fixtures, and Work from damage. Damaged Work will be rejected and replaced at the expense of the Contractor. Where possible, all rooms containing new fixtures shall be kept locked until the building is turned over to the owner. Immediately after installation of each fixture it shall be covered with a fixture protector.
- B. Piping shall be racked and handled in a manner to prevent entrance of dirt and foreign matter. Open pipe ends shall be plugged or capped during erection.

3.03 FOUNDATION AND SUPPORT

This Contractor shall furnish and install all foundations and supports required for all his equipment, unless indicated otherwise on Drawings.

3.04 GROUNDS AND CHASES

This Contractor shall see that all required chases, grounds, holes and accessories necessary for the installation of this Work are properly built in as the Work progresses; otherwise, he shall bear the cost of providing same.

3.05 CUTTING AND PATCHING

Initial cutting and patching shall be the responsibility of the General Contractor, with the Mechanical Contractor responsible for laying out and marking any and all holes required for the reception of his Work. No structural beams or joists shall be cut or thimbled without first receiving the approval of the Owner. After initial surfacing has been done, any further cutting, patching, and painting shall be done at the mechanical Contractor's own expense.

3.06 EXCAVATION AND BACKFILL

A. This Contractor shall do all excavating necessary to lay the specified services. After services have been tested, inspected and approved by the authorized inspectors, the trenches shall be backfilled with approved materials in 6" layers and tamped thoroughly to the satisfaction of all parties concerned.

B. Where specified compaction methods and requirements are called for elsewhere in these Specifications, this Contractor shall meet these requirements, and all Work shall be performed as specified herein.

C. Cart away from the premises all unnecessary dirt, rubbish, etc. as indicated.

3.07 REPAIRING ROADWAYS AND WALKS

Where this Contractor cuts or breaks roadways or walks to lay the piping, he shall repair or replace these sections.

3.08 INTERFERENCES

In general, the Drawings are diagrammatic, and the Contractor shall install his Work in a manner interferences between the various Trades is avoided.

3.09 CLOSING IN UNINSPECTED WORK

Do not cover up or enclose Work until it has been properly completed inspected and approved. Should any of the Work be covered up or enclosed prior to all required inspections and approvals, uncover Work as required and, after it has been completely inspected and approved, make all repairs and replacements with such materials as are necessary to the approval of the Engineer and at no additional cost to the Owner.

3.10 CLEANING AND ADJUSTING

A. Upon completion of his Work, the Contractor shall clean and adjust all equipment, plumbing fixtures, piping, ductwork, control valves, filters (provide new filters if throwaway style is specified) and leave the entire installations in proper working order.

- B. On plumbing fixtures, thoroughly flush hot and cold systems and clean strainers. Use only a cleaning solution approved by manufacturer of the plumbing item.
- C. Contractor shall adjust all equipment and system to operate at capacities and quantities scheduled or shown on Plans and shall furnish all thermometers, velometers, gauges, etc. required to adjust and balance the system properly.
- D. Prior to requesting final inspection by the Engineer, the Contractor shall have a complete coordination and adjusting meeting of all of his sub-contractors directly responsible for the control, operation or balance of any portion of the system.
- E. At the time of this meeting, each and every sequence of operation shall be checked to assure proper operation. Notify the Engineer in writing ten (10) days prior to this meeting instructing him of the time, date, and whom you are requesting be present. This Project will not be accepted until the above provisions are met to the satisfaction of the Engineer.

END OF SECTION 15010

SECTION 15200 – HEATING, VENTILATION AND AIR CONDITIONING

PART 1 – GENERAL

1.01 SPECIAL NOTICE

The General Conditions of the Construction, Supplementary Conditions, all Division 1 Sections of Specifications, and Section 15010 –Mechanical – General Provisions and all other relevant Documents are part of this Work. The references to certain paragraphs are intended to point out specific items to the Contractor but in no way relieves him of the responsibility of complying with all relevant parts of the entire Specifications.

1.02 SCOPE

A. This Section calls for furnishing of all labor and materials necessary to provide and install the complete through the wall HVAC Package Terminal Air Conditioning Unit with electric heat strip.

B. HVAC Unit:

The through the wall Package Terminal Air Conditioning Unit shall be a Model DMQC09R30S1 as manufactured by Applied Comfort, Whirlpool, Retro Air or an approved equal. The unit shall be a 277 Volt 3 Phase 60 HZ 15 Amp 9,000 BTU Cooling Unit. With an efficiency rating of 10.6. Unit shall be capable of producing 300 CFM and ventilating 40 CFM. The heat strip shall be an electric 3 KW resistance type. The controls for the unit shall be standard mounted to the unit itself with thermostat and fan speed.

The unit shall be mounted through the block wall with the appropriate fasteners as per the manufacturer's specifications and shall include the wall sleeve, stamped steel grille, and required filters.

C. All systems shall be provided complete as shown on Plans and to meet existing conditions. All equipment and materials used shall be new and of the quality specified in every respect.

D. The accompanying Drawings show the general arrangement of all pipes and the location of all apparatus, however, where local conditions necessitate change, these changes shall be made upon the approval of the Engineer at no additional cost to the Owner. The various Contractors must cooperate in installing their Work to the end that there will be no conflict of space required.

1.03 QUALITY ASSURANCE

Use only thoroughly trained and experienced workmen, completely familiar with the items required and the manufacturer's correct recommended methods of installation. In acceptance or rejection of the finished installation, no allowance will be made for lack of skill on the part of the installer.

1.04 PRODUCT HANDLING

Use all means necessary to protect the materials of this Section before, during and after installation and to protect the installed Work and Materials of all other Trades. In the event of damage, immediately make all repairs and replacements necessary for the approval of the Engineer and at no additional cost to the Owner.

PART 3 – EXECUTION

3.01 SURFACE CONDITIONS

- A. Prior to all Work of this Section, carefully inspect the installed Work of Other Trades and verify that all such Work is complete to the point where this installation may properly commence.
- B. Verify that the Work of this Section may be installed in accordance with all pertinent codes and regulations and the approved Shop Drawings.
- C. In the event of discrepancy, immediately notify the Engineer. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 INSTALLATION OF EQUIPMENT

- A. Avoid interferences with structure and the Work of other Trades; do not cut into load carrying members without the specified approval of the Engineer.
- B. Check each piece of equipment in the system for defects, verifying that all are properly furnished and installed, that all items function properly and that all adjustments have been made.

3.03 TESTING

- A. Contractor shall test unit for proper operation and make all other test required by the Engineer, or other governing authorities, at no additional cost to the Owner.

3.04 CLEANING UP

Prior to acceptance of the building, thoroughly clean all exposed portions of the HVAC System installation, removing all non-required labels and all traces of foreign substance. Perform all touch-up painting of all equipment.

END OF SECTION 15200

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, and a schedule of proposed dates, times, length of instruction time, and instructors' names.

1.3 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate content of training with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Engineer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training: Develop a learning objective and teaching outline for each session. Include a description of specific skills and knowledge that participant is expected to master. For each session, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.

- f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
2. Documentation: Review the following items in detail:
- a. Emergency manuals.
 - b. Operations manuals.
 - c. Maintenance manuals.
 - d. Project record documents.
 - e. Identification systems.
 - f. Warranties and bonds.
 - g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.

7. Maintenance: Include the following:
 - a. Inspection procedures.
 - b. Types of cleaning agents to be used and methods of cleaning.
 - c. List of cleaning agents and methods of cleaning detrimental to product.
 - d. Procedures for routine cleaning
 - e. Procedures for preventive maintenance.
 - f. Procedures for routine maintenance.
 - g. Instruction on use of special tools.

8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction.

3.2 INSTRUCTION

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 1. Supplier will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
- B. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 1. Schedule training with Owner, through Engineer, with at least seven days' advance notice.
- C. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- D. Evaluation: At conclusion of each training session, assess and document each participant's mastery of module by use of a demonstration performance-based test.

END OF SECTION 017900

DIVISION - ELECTRICAL

SECTION 260000 - ELECTRICAL GENERAL REQUIREMENTS

DIVISION OF SPECIFICATIONS

For bidding purposes only, the Electrical Specifications are divided into twelve (12) parts as follows:

- Section 017900 – Demonstration and Training
- Section 260000 - Electrical General Requirements
- Section 260519 – Low-Voltage Electrical Power Conductors and Cables
- Section 260526 – Grounding and Bonding for Electrical Systems
- Section 260529 – Hanger and Supports for Electrical Systems
- Section 260533 – Raceways and Boxes for Electrical Systems
- Section 260553 – Identification for Electrical Systems
- Section 262416 – Panelboards
- Section 262419 – Motor-Control Centers
- Section 262726 – Wiring Devices
- Section 265100 – Interior Lighting
- Section 265600 – Exterior Lighting

Section 260000 of the Specifications applies to other Electrical Sections 017900, 260519, 260526, 260529, 260533, 260553, 262416, 262419, 262726, 265100, and 265600 equally. Also, the General Conditions of the General Specifications are made part of these Specifications and apply the same as attached hereto.

SCOPE

Contractor shall furnish and install all materials and equipment, and provide all labor, transportation, tools, etc., necessary for the Electrical Work hereinafter described, all in accordance with the intent of these Specifications and accompanying Drawings. Electrical Work shall include but not be limited to installation of all service entrance equipment, panelboards, starters, fused disconnect switches, non-fused disconnect switches, generators, fuses, wire and conduit systems and any other associated hardware required to install a complete electrical system.

It is the intent of the Drawings and Specifications to require the Contractor to install a complete electrical installation, fully erected, properly installed in a workmanlike manner and left in a proper operating condition, with this Contractor furnishing and installing everything necessary to complete all electrical Work.

Electrical Work called for or implied by the electrical Drawings and Specifications including General Conditions and Addenda shall form a part of this Contract. CONTRACTOR is cautioned to read the entire Specifications for this job and to thoroughly familiarize himself with all requirements.

GENERAL REQUIREMENTS

These Specifications, together with the accompanying Drawings, require a complete installation in successful operating condition, with this Contractor furnishing and installing all miscellaneous electrical items necessary to complete the Work properly per Plans and Specifications.

Contractor shall check the Electrical Specifications and Drawings with the remainder of the set, and bring to the Engineer's attention any conflicts or variations as soon as noted.

Specifications and accompanying Drawings apply to all Contracts or Subcontracts entered into for supplying material, equipment or labor for the construction of Work specified herein and shown on Drawings.

Contractor shall protect all electrical equipment against injury during and after installation at his expense. He shall replace lost or damaged items prior to acceptance of Work at his expense.

Contractor shall protect Owner, and his agent including Engineer, from any and all damage and expense, caused by this Contractor or his employee, arising from the fulfillment of Contract and at completion of Work, repair all damages done.

All surplus material shall be removed daily from the job site at the completion of Work.

NOTE: No Work shall be covered up until it has been inspected and approved by this Engineer and the proper authorities where required.

CONTRACTOR'S QUALIFICATIONS

The electrical Contractor bidding on this Work acknowledges that he fully understands the scope of the Work and design, and that he has the ability and experience to install all electrical Work per these Plans and Specifications.

WORKMANSHIP

All Work shall be done in a neat and professional manner by qualified electricians in accordance with the latest version of the "National Electrical Code" (NEC).

PERMITS

Contractor shall obtain and pay for all construction permits and shall pay all governmental charges and inspection fees necessary for the performance of his Work, which are applicable at the time of this Bid. This Contractor shall also pay all public utility charges.

EQUAL BRAND PRODUCTS

The name of a certain brand, make, manufacturer, or definite specifications is to denote the quality standard of the article desired, but does not restrict bidders to the specific brand, make, manufacturer, or specification named. It is to set forth and convey to prospective bidders the general style, type, character, and quality of article desired.

When in specifications or contract documents a particular brand, make of material, device, or equipment is shown or specified, such brand, make of material, device, or equipment shall be regarded merely as a standard.

PRIOR APPROVAL

Substitution of specified items can only be made with prior approval. If a potential supplier wishes to submit for prior approval a particular product other than a product specified in the contract documents, he shall do so to the Prime Design Professional by written request submitted with red lined brochures no later than seven working days (7) days prior to Bid opening. Approval of submitted request is solely at the discretion of the Prime Design Professional.

After receipt of prior approval submittal, the Prime Design Professional will check the data and if found acceptable, shall furnish to both the public entity and the potential supplier written approval or denial of the product submitted. The Prime Design Professional will list the substitution in an addendum, listing items which are approved as equal in quality to those specified.

APPROVAL BY TRADE NAME ONLY

Final approval of Manufacturers approved by Trade Name Only will be granted if and only if the proposed equipment is equal to or better than the specified equipment, meets or exceeds all specified design conditions and parameters and can be installed with no additional cost to the Owner or Prime Design Professional.

SHOP DRAWINGS

Contractor shall submit to the Engineer for approval seven (7) copies of all Shop Drawings called for in these Specifications. Any catalog data submitted as Shop Drawings shall be clearly designated by red line or other procedure that will clearly indicate the equipment submitted for approval. Shop Drawings shall be required on all materials specified on the Drawings or within the Specifications.

WIRE

All wire shall be type THWN stranded copper wire or as specified on the Plans. Unless otherwise specified no wire smaller than # 12 AWG shall be used. All wires shall be color coded in accordance with Article 200 and 110.15 of the NEC. Individual phases of each power circuit shall be color coded in accordance with NFPA 70:2008-210.5 at points near each end of the cables and in each junction box or device box as follows:

277/480/3/60 Systems – Phase A	Brown
Phase B	Orange
Phase C	Yellow
Neutral	Gray
Ground	Green

120/208/3/60 Systems – Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

CONDUIT - GENERAL

CONTRACTOR shall furnish and install a complete conduit system as detailed on the Drawings and Conduit Schedules. All conduits shall be permanently labeled with their perspective conduit number.

FLEXIBLE METAL CONDUIT (FMC)

All indoor motor driven equipment such as Air handling units, blowers, exhaust fans, fan coil units, etc., shall utilize FMC for the final connection installed in accordance with Article 348 of the NEC.

FLEXIBLE METAL CONDUIT IN EXCESS OF SIX FEET

Series runs or daisy chains of flexible metal conduit exceeding six (6) feet in length require a separate ground wire in order to meet the requirements of 110.54 (B), 250.118, and 250.134 of the NEC. The ground wire shall be sized in accordance with NEC Table 250.122

LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

All outdoor motor driven equipment such as air conditioning roof top units, chillers and condensing units, pumps, etc., shall utilize LFNC for the final connection to the unit. All LFNC shall be installed in accordance with Article 356 of NEC.

LIQUIDTIGHT FLEXIBLE METALLIC CONDUIT (LFMC)

All outdoor motor driven equipment such as air conditioning roof top units, chillers and condensing units, pumps, etc., shall utilize LFMC for the final connection to the unit. All LFMC shall be installed in accordance with Article 350 of NEC.

RIGID NONMETALLIC CONDUIT (RNC)

Rigid nonmetallic conduit shall be installed only where shown on Plans. Only the schedule size shown on the Conduit Schedule shall be allowed. Only schedule 80 RNC shall be allowed. All RNC shall be rigid polyvinyl chloride (PVC). All RNC shall be installed in accordance with Article 352 of the NEC. No RNC shall be covered up until after inspection by this ENGINEER. All RNC shall bear the Underwriter's Laboratories (UL) label. All RNC risers shall contain one expansion joint. All RNC above grade shall be installed with expansion joints in accordance with 2011:NFPA 70, Table 352.44.

ELECTRICAL METALLIC TUBING (EMT)

All electrical metallic tubing shall be installed in accordance with Article 358 of the NEC. Bends in the tubing shall be so made that the tubing will not be effectively reduced. The radius of the curve of the inner edge of any field bend shall not be less than shown in Table 2, Chapter 9 of the NEC. All cut ends of EMT shall be reamed to remove rough edges. EMT shall be as a complete system as provided in Article 300 of the NEC and shall be securely fastened in place at least every ten (10) feet within three (3) feet of each outlet box.

RIGID METAL CONDUIT (RMC)

All rigid metal conduit shall be galvanized coated and shall be installed in accordance with Article 344 of the NEC. All field threads shall be painted with galvanizing paint after make-up. All underground joints shall be wrapped with duct tape after make-up.

SWITCHBOARD/PANELBOARD GENERAL

All switchboards and panelboards shall be installed in accordance with Section 408 of the NEC. Paragraphs 408.3 (E) and 408.4 of the NEC shall apply without exception.

SWITCHBOARD/PANELBOARD INSTALLATION

The cabinet, consisting of a box and removable front, should be installed, leveled up, and securely fastened to the mounting surface, utilizing all of the mounting holes provided in the panelboard cabinet. It is important that the cabinet be secured to a flat and even surface, or otherwise adjusted to keep the back of the panelboard true and plumb. Conduits can then be installed in the walls of the box through conduit openings or knockouts provided for that purpose. After conduits are installed, all unused openings should be closed to keep dust and moisture out of the panelboard cabinet. After wires are pulled in the conduits and before the panelboard interior is installed, the cabinet should be inspected to see that none of the corrosion-prevention finish has been scratched off during installation. If it is scratched off, paint or other protective coating should be applied to keep the cabinet from corroding in the bare places.

Until installation, the panelboard interior should be kept in a clean, dry, at normal temperature location. Panelboards are packed at the factory to withstand shipment and reasonable handling on the job. Care should be exercised to avoid damage to the panelboard while unpacking and handling prior to installation.

After unpacking, and before installation in the cabinet, the panelboard should be carefully inspected to see that all connection and mounting screws are tight. Connections may be loosened during shipment or handling after leaving the factory. The interior should then be installed and secured in place in the cabinet by the mounting means to permit alignment of the panelboard interior and cover even though the cabinet may not be exactly flush.

The panelboard interior should then be connected, making sure that the wires are tightly secured in the terminals provided. After connecting, the wires should be neatly arranged

in the gutters. It must be remembered that the wires in the gutters of the panelboard generate heat within the panelboard enclosure, and accordingly, unnecessary or excessive amounts of wiring in the panelboard gutters are a source of panelboard heating difficulties.

After the panelboard interior is connected, the cabinet should be carefully cleaned of cut ends of wire and foreign substances, and the door and trim immediately installed to protect the panelboard and wiring. If the building is not completed before the panelboard front is installed heavy cardboard or other material should be used to protect the panelboard and its wiring from damage, dirt, and defacing during building construction. Before electric power is supplied to the panelboard, all wiring should be checked and tested for grounds, short circuits, etc.

TESTING AND INSPECTIONS

Contractor shall be required to demonstrate the integrity of the grounding raceways and conductor insulation. If necessary, all circuits or as many as required may be meggered by the Contractor upon request by the Engineer to correct any abnormal or potentially abnormal electrical connection.

DRAWINGS

Drawings are intended to furnish the Contractor with specific information pertaining to size of wires, capacity of equipment, location and manner of erection of critical items. These Drawings are not intended to furnish the Contractor with a step-by-step set of instructions for completion of the Project. Any changes deemed necessary by this Contractor shall be submitted to this Engineer for approval.

CUTTING AND PATCHING

All cutting required to complete the electrical system per Plans and Specifications shall be the responsibility of this Contractor. All patching required shall be the responsibility of this Contractor.

POWER COMPANY UTILITIES

The Drawings show only the general location of utilities. This Contractor shall visit the job site to verify location, elevations, and method of connection to utilities before bidding Work.

If it is found that there are reasons why utilities cannot be installed where shown, reasons shall be submitted in writing to this Engineer not less than seven (7) days before Bid date. Failure of Contractor to notify this Engineer will not relieve the Contractor from the responsibility of installing his Work to meet these conditions.

This Contractor shall contact Nancy Aucoin with Entergy at 888-413-3188 regarding Entergy's cost to provide power to the site. Contractor shall include any and all Entergy utility charges for service to the site in his Bid.

LAYING OUT OF WORK

Contractor shall provide accurate instruments for laying out the Work properly.

DAMAGE TO BUILDING, GROUNDS, ETC.

Contractor shall protect his Work from rain, wind, storm, or any other weather conditions until completion and acceptance and any damage caused by such elements shall be repaired by this Contractor and made acceptable at no additional cost to Owner. This Contractor shall be responsible for all damages caused by his operations to trees, shrubs, street, and general landscape and shall repair all such damages.

FOUNDATIONS AND SUPPORTS

Contractor shall furnish and install all concrete foundations and steel supports required for his equipment unless otherwise specified.

CLEANING AND ADJUSTING

Upon completion of this Project the Contractor shall clean and adjust all equipment he had installed.

EXCAVATING

Contractor shall make all necessary excavations and do all backfilling for proper execution of this Work, removing all dirt and debris out and away from the building. Backfill shall be well tamped, in 9" layers, and shall be free of debris. The finished fill shall be thoroughly watered.

SUPERVISION

Contractor shall personally, or through an authorized and competent representative, constantly supervise the Work from beginning to completion and final acceptance.

INSPECTIONS

During its progress, electrical Work shall be subject to inspection by representatives of the Engineer at which times the Contractor shall furnish required information.

SLEEVES, INSERTS, AND OPENINGS

Contractor shall lay out and install his Work in advance of pouring concrete floors or walls. He shall furnish and install all sleeves and/or openings through floor or walls required for passage of conduits, pipes, or ducts installed by him. Sleeves shall be of 16 gauge galvanized sheet steel rigidly supported and suitably packed to prevent ingress of wet concrete.

Contractor shall furnish and install all inserts and hangers required to support all conduit, cable, pull boxes, etc.

FIRE STOPPING

All conduits entering and leaving the new partition walls shall be fire stopped in accordance with NFPA Fire Standards. Fire stop rating shall be a minimum of two hours in accordance with Manufacturer's recommendations. Fire stopping material shall be as specified by Engineer or as manufactured by Flamesafe & KBS, 3M, or equal.

END OF SECTION 260000

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2, and Type THHN-2-THWN-2.

2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper Stranded
- B. Branch Circuits: Copper Stranded.

3.2 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

- A. 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-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.4 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or Specifications or comparable product by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Dossert; AFL Telecommunications LLC.
 - 3. ERICO International Corporation.
 - 4. Fushi Copperweld Inc.
 - 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
 - 6. Harger Lightning and Grounding.
 - 7. ILSCO.
 - 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
 - 9. Robbins Lightning, Inc.
 - 10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: As specified.
4. Bonding Conductor: As specified.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel 3/4 inch by 10 feet .

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 4 AWG and smaller, and stranded conductors for No. 2 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, as specified.
 1. Bury at least 24 inches below grade.
- C. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Pad-Mounted Transformers and Switches: Install two ground rods around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install copper conductor in accordance with Entergy Standards.

3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- F. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 2. For grounding electrode system, install at least two rods spaced at least 6 feet from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
 1. Metal Water Service Pipe: Install 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; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

3.6 - FIELD QUALITY CONTROL

- A. Perform tests and inspections. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.3 ACTION SUBMITTALS

- A. Product Data: For steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 1. Trapeze hangers. Include Product Data for components.
 2. Steel slotted channel systems. Include Product Data for components.
 3. Equipment supports.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 6. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

- a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
- a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
- 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps MSS Type 19, 21, 23, 25, or 27 complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

I. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 280528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. EMT: Comply with ANSI C80.3 and UL 797.
- C. FMC: Comply with UL 1; aluminum.
- D. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

- E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 - 2. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper where required.
- F. Joint Compound for GRC or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ENT: Comply with NEMA TC 13 and UL 1653.
- C. RNC: Type EPC-80-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Continuous HDPE: Comply with UL 651B.
- F. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- G. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- H. Fittings for LFNC: Comply with UL 514B.
- I. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- J. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Indoor Type 1, Outdoor Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- E. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5.
- C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- D. Tele-Power Poles:
 1. Material: Galvanized steel with ivory baked-enamel finish.
 2. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Metal Floor Boxes:
 - 1. Material: Cast metal.
 - 2. Type: Fully adjustable.
 - 3. Shape: Rectangular.
 - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes: Nonadjustable, round.
 - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb
 - 1. Listing and labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- M. Gangable boxes are prohibited.
- N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Indoor NEMA Type 1 Outdoor NEMA Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic.
3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Interior Type 1, Exterior Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with **open** bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

1. Standard: Comply with SCTE 77.
2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC."
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: RNC, Type EPC-80-PVC.
 - 2. Concealed Conduit, Aboveground: RNC, Type EPC-80-PVC.
 - 3. Underground Conduit: RNC, Type EPC-80-PVC, concrete encased.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC or LFNC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

- B. Indoors: Apply raceway products as specified below unless otherwise indicated.
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: GRC.

- C. Minimum Raceway Size: 1/2-inch trade size.

- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - 3. EMT: Use setscrew or compression, steel or cast-metal fittings. Comply with NEMA FB 2.10.
 - 4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

- F. Install surface raceways only where indicated on Drawings.

- G. Do not install nonmetallic conduit where ambient temperature exceeds **120 deg F**.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Support conduit within 12 inches of enclosures to which attached.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- O. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- P. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces.
- Q. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Where otherwise required by NFPA 70.
- R. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 50 deg F and that has straight-run length that exceeds 10 feet .
 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per degree F of temperature change for PVC conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- S. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 1. Use LFMC in damp or wet locations subject to severe physical damage.
 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- T. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- U. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between the box and cover plate or the supported equipment and box.
- V. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- W. Locate boxes so that cover or plate will not span different building finishes.
- X. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Y. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- Z. Set metal floor boxes level and flush with finished floor surface.
- AA. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 1. Excavate trench bottom to provide firm and uniform support for conduit.
 2. Install backfill.
 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
 4. Install manufactured duct elbows for stub-up at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies.

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

- ##### A. Product Data: For each electrical identification product indicated.

1.3 QUALITY ASSURANCE

- ##### A. Comply with ANSI A13.1.
- ##### B. Comply with NFPA 70.
- ##### C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- ##### D. Comply with ANSI Z535.4 for safety signs and labels.
- ##### E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- ##### A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- ##### B. Colors for Raceways Carrying Circuits at 600 V or Less:
1. Black letters on an orange field.
 2. Legend: Indicate voltage.

- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.3 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.
- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
 - 4. Fire Alarm.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

- a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- F. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
- 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

- c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION 260553

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Include evidence of NRTL listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Include wiring diagrams for power, signal, and control wiring.
 - 8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.3 INFORMATIONAL SUBMITTALS

- A. Panelboard schedules for installation in panelboards.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

1.6 WARRANTY

1. Warranty Period: ONE 1 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures Flush- and surface - mounted cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1
 - b. Outdoor Locations: NEMA 250, Type 3R
 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 4. Directory Card: Inside panelboard door, mounted in transparent card holder.
- B. Incoming Mains Location: Top and bottom.
- C. Phase, Neutral, and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 1. Material Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus Configured Terminators: Mechanical type.
 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- E. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- G. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by an NRTL.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2. Surge suppression shall be installed in Panelboard "UV".

2.3 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1, power and feeder distribution type.
- D. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- E. Mains: Circuit breaker and Lugs only.
- F. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- G. Branch Overcurrent Protective Devices: For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- D. Mains Circuit breaker or lugs only.
- E. Branch Overcurrent Protective Devices - Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.5 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, 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 setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 - 5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.

2.6 INTERRUPTING CAPACITY

- A. All 277/480 volt panelboards shall be braced for 100,000 amps minimum symmetrical. All 277/480 volt circuit breakers shall have a minimum interrupting capacity of 14,000 amps symmetrical.

2.7 PANELBOARDS

- A. Panelboard "UV" shall be 277/480 volt, three phase, four wire, NEMA-1, surface mount, 100 amp main breaker. Panelboard shall be supplied with ground bus and circuit breakers sized as shown in the Conduit, Panelboard, and Circuit Breaker Schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties.
- H. Comply with NECA 1.

3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262416

SECTION 262419 – MOTOR-CONTROL CENTERS

DIVISION OF SPECIFICATIONS

SCOPE

Contractor shall modify existing Motor Control Center "MCCN" by adding a new 3P-100 amp circuit breaker bucket, 480 volts, 25 KAIC to provide power to the new Panelboard "UV".

END OF SECTION 262419

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.
4. Solid-state fan speed controls.
5. Wall-switch and exterior occupancy sensors.
6. Communications outlets.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
 2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Cooper; 5351 (single), CR5362 (duplex).
 - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 GFCI RECEPTACLES

- A. General Description:
1. Straight blade, feed-through type.
 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Cooper; VGF20.
 - b. Hubbell; GFR5352L.
 - c. Pass & Seymour; 2095.

- d. Leviton; 7590.

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

- 1) Single Pole:
 - 2) Cooper; AH1221.
 - 3) Hubbell; HBL1221.
 - 4) Leviton; 1221-2.
 - 5) Pass & Seymour; CSB20AC1.
- 6) Two Pole:
 - 7) Cooper; AH1222.
 - 8) Hubbell; HBL1222.
 - 9) Leviton; 1222-2.
 - 10) Pass & Seymour; CSB20AC2.
- 11) Three Way:
 - 12) Cooper; AH1223.
 - 13) Hubbell; HBL1223.
 - 14) Leviton; 1223-2.
 - 15) Pass & Seymour; CSB20AC3.
- 16) Four Way:
 - 17) Cooper; AH1224.
 - 18) Hubbell; HBL1224.
 - 19) Leviton; 1224-2.
 - 20) Pass & Seymour; CSB20AC4.

C. Pilot-Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; AH1221PL for 120 and 277 V.
- b. Hubbell; HBL1201PL for 120 and 277 V.
- c. Leviton; 1221-LH1.
- d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; AH1221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
2. Description: Single pole, with factory-supplied key in lieu of switch handle.

2.6 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: Smooth, high-impact thermoplastic 0.035-inch
 3. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant thermoplastic with lockable cover.

2.7 FINISHES

- A. Device Color:
 1. Wiring Devices Connected to Normal Power System As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: Red
 3. TVSS Devices: Blue.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Wiring device will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Lighting fixture supports.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings or Specifications.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

D. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

- a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage .

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.4 LUMINAIRES

A. Luminaire "FD" is a LED luminaire and specified on the drawings or equal.

EXECUTION

3.0 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

B. Comply with NFPA 70 for minimum fixture supports.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

END OF SECTION 265100

SECTION 265600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior luminaires with lamps and drivers.
 - 2. Luminaire-mounted photoelectric relays.

1.2 ACTION SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings or Specifications.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.

- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.
- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- M. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: As selected from manufacturer's standard catalog of colors.
 - b. Color: As selected by Engineer from manufacturer's full range.
- N. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color: Dark bronze.

- O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

- a. "USES ONLY" and include specific lamp type.
- b. Lamp tube configuration (twin, quad, triple), base type, and nominal wattage for compact fluorescent luminaires.
- c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
- d. Start type (preheat, rapid start, instant start) compact fluorescent luminaires.
- e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
- f. CCT and CRI for all luminaires.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRES

A. Luminaire "FA" is a LED luminaire as specified on the drawing or equal.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

END OF SECTION 265600