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**THIS STAMP, ON THIS PROJECT APPLIES
ONLY TO SECTIONS AUTHORED BY
ELECTRICAL ENGINEER OF RECORD (EOR):**

**MATTHEW J. CASH, PE
FLUENT ENGINEERING, INC.
2110 STATE STREET
SALEM, OR 97301
503-447-5030**

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SECTION 26 00 01
GENERAL ELECTRICAL PROVISIONS

PART 1 - GENERAL

Products under this contract must meet minimum specifications requirements in detail without exception unless specifically noted and approved as provided in these Specifications. Equipment submitted for review must clearly state on cover sheet any differences from specified product. Equipment substitution or submittal review does not relieve Contractor from meeting all requirements of specified item. Time is of the essence.

1.01 DEFINITIONS

- A. Definitions herein are intended as advisory and shall not limit requirements within the Contract Documents. Where a conflict of definitions exists, the more stringent standard shall be used. Where a term is defined on a Drawing the Drawing definition shall be used for that drawing. Not all definitions are included. Trade standard terms are not defined.

1.02 CONTRACT DOCUMENTS

- A. The Contract Documents are inclusive. All requirements of all Contract Documents shall be binding as if repeated herein and within this Division as required by any other Division or Contract Document.
- B. This Division does not express or imply separation of the Contract Documents and shall not be considered as separation of the Work.
- C. See Advertisement For Bids, Instructions to Bidders, Supplemental Instructions to Bidders, General Conditions, Supplemental General Conditions, Drawings and Specifications, and modifications incorporated in the documents before execution of the Agreement.
- D. Conflicts: If any conflicts exist the more stringent is required.

1.03 SCOPE OF WORK

- A. General: Provide complete and functional electrical systems as specified, as shown on Drawings, as required, and as intended. Work generally includes, inspections, electrical distribution, lighting, devices, wiring systems, cabling, raceways, programming, and control systems.
- B. Omissions: Contractor shall be responsible for additional labor, or additional material necessary for the proper execution of the Work. Omissions of expressed reference to any item shall not relieve the responsibility to conform to the Contract Documents
- C. Scope of Electrical Work
1. All materials and workmanship shall be furnished for complete, tested, and operating electrical systems as shown on the drawings and specified herein.
 2. Electrical work is to include the service. Complete to the point of connection with the serving utility. Any changes of or work required by the serving utility, are part of this work and shall be fully included in the bid price.
 3. Work is also to include main distribution panel, feeder system and branch circuit panels. Complete branch circuit wiring. Light fixtures, wall switches, receptacles and similar items, exterior lighting and wiring, and wiring and

connection to all mechanical equipment, all fire alarm, phone system, unit phone wires, and kitchen equipment as required.

4. Provide Power Connections to Equipment provided by other subcontractors, specified not shown, and/or part of a complete and operable system. This equipment may, or may not be shown, may, or may not be on this project, and generally includes, and is not limited to:
 - a. Fire Alarm Control Panel (FACP), Fire Alarm Equipment Power Supplies, etc.
 - b. Lighting Control Panels, Lighting Controller Equipment, Lighting Controls.
 - c. Building Management Control System, Direct Digital Controls, HVAC Controls, and the like.
 - d. Window Treatments, Automatic Shades, Automatic Curtains, and the like.
 - e. Automatic Door Operators, ADA Doors, Sliding Automatic Doors, and the like.
 - f. Unitary, generally self-contained access controls.
 - g. Doorbells, door cameras, door locks, door strobes/flashers, etc.
 - h. Sump Pumps, freeze protection, and similar site equipment (including equipment located within the building footprint).
 - i. Domestic Water circulation pump(s).
 - j. Plumbing fixtures with automatic sink/flush valves, and the like.
 - k. Automatic plumbing electronic trap primers.
 5. Control Connections to unitary Equipment provided by other subcontractors, specified, not shown, and/or part of a complete and operable system. This equipment may, or may not be shown, may, or may not be included in the project, and generally includes, and is not limited to, control wiring for:
 - a. Window Treatments, Automatic Shades, Automatic Curtains, and the like.
 - b. Automatic Door Operators, ADA Doors, Sliding Automatic Doors, and the like.
 - c. Unitary, generally self-contained access controls
 - d. Doorbells, door cameras, door locks, door strobes/flashers, etc.
 - e. Sump Pump Controls, alarms, and the like.
 - f. Water Level/Monitoring alarms, controls, etc.
 - g. Automatic plumbing fixtures, and trap primer systems.
 6. The lists above are intended to indicate equipment that is generally shown/specified elsewhere. Where specified, and/or shown otherwise, and/or specified by electrical follow additional power, and control requirements as indicated.
- D. Provide Equipment per Manufacture's Operation, Installation, and Programming requirements. Follow manufacture's Guidelines, Installation manuals. Provide additional equipment and as required for a complete, and satisfactory Installation.

1.04 CONFORMANCE WITH REQUIREMENTS

- A. General: All Work shall conform to the reasonable requirements of the project within the scope of the project and authorizations. All work shall conform to the methods and requirements of Code at the location of the Work.
1. Access and inspection: All portions of the Work shall be accessible to inspections and review at all reasonable times during construction. Contractor is

responsible for providing access for review and inspection of the Work. Contractor shall secure written inspection reports prior to concealing Work. Contractor is responsible for damages to properly review the Work due to lack of at least 7 Days advance written notification to the Architect, and Engineer that Work is ready for inspection.

2. Plenums: Provide raceway where conductors, and/or cables are routed through plenums. If specifically noted, or specified raceway is not required, plenum routes may utilize conductors/cables rated for use in plenums, and shall be marked as such per NEC. Supporting devices utilized shall also be rated for use in plenums.
 3. Fire Stop Seal (firestopping) as required.
- B. Accounting: Provide general accounting information as to labor and equipment costs to assist in determination of modifications to the Contract. Provide accounting breakdown when required for securing Owner financing, or for analysis of equipment costs or equipment payback periods, as well as information for Owner incentives.

1.05 COORDINATION OF TRADES

- A. Check all other trade drawings to avert potential installation conflicts. Should major changes from the Drawings be required to resolve potential conflicts, notify the Architect and secure written approval and agreement on necessary adjustments prior to start of installation.
- B. Check all equipment locations and connections on the site for coordination with other Divisions equipment and connections and structure and the like.
- C. Contractor is responsible for scheduling trades to properly execute all the Work as intended.

1.06 STANDARD OF CARE AND QUALIFICATIONS

- A. General: Contractor shall be experienced and knowledgeable to Provide Work. Owner is not responsible for improper operation, noncompliance, or installation due to Contractor's lack of knowledge or experience. Upon request, and where requested herein the Contractor shall supply qualifications and experience. Drawings are presented with industry terms, statements, and trade practices and it is the responsibility of the Contractor to be familiar. Provide written notification prior to Bid to the Architect if any representation is not understood, or outside standard practice.
- B. Like Materials and Quality Control: All systems provided shall be new and of like materials provided through manufacturer authorized distributors. Provide equipment of same system and type by same manufacturer. Items of the same by different manufacturers will be rejected. Equipment shall conform to all applicable Code and applicable listing criteria as of the date of the Contract Documents. Equipment determined to be manufactured under any other listing or Code prior to the date of the Contract is not acceptable, even if the equipment is new or has not been used. All equipment provided to project shall be listed by an approved listing organization.

1.07 EXAMINATION OF SITE

- A. Examine Site of Work prior to making Bid. Ascertain all related physical conditions.
- B. Verify at the Site of Work prior to Bid scale dimensions shown due to exact locations, distances, and levels will be governed by actual field conditions.

- C. Owner will not be responsible for any loss or costs that may be incurred due to a Bidder's failure to fully inform themselves prior to Bid in regard to conditions pertaining to the Work and nature of the Work.

1.08 SPARE RACEWAY

- A. In addition to spare raceways required herein, provide spare raceways emanating from equipment pads where pads prevent access to equipment mounted on pads. Examples include transformers, MCC's, switchboards, generators, and the like. Route spares to landscaped areas at exterior locations or to equipment room interior accessible walls at interior locations.
- B. Provide not less than (2) 4" and (4) 2" spare raceway. Coordinate termination and route locations/direction with Owner. See Raceway Specifications. Additional Spare Raceway may be shown on Drawings, or required elsewhere herein.

1.09 MINOR DEVIATIONS

- A. Make minor changes in equipment locations and equipment connections as directed or required without extra cost.

1.10 RECORD DRAWINGS

- A. Maintain a marked set of prints at job site at all times. Show all changes from the original drawing set whether visible or concealed. Include all addendums, field orders, change orders, clarifications, request for information drawn responses, and deviations. Dimension accurately from building lines, floor, or curb elevations. Show exact location, elevation, and size of conduit/raceway, access panels and doors, equipment, and all other information pertinent to the Work.
- B. At project completion, submit marked set to Architect for review.

1.11 TRAINING

- A. See individual specifications sections for additional requirements.
- B. Provide training of Owner's selected staff for all electrical systems specified herein.
- C. Training of all systems shall be digitally recorded, and two copies shall be distributed to Owner.
- D. Notify and Coordinate with Owner for training and attendance not later than 15 Days prior to training.
- E. Provide 2.5 hours of general system training in addition to training indicated below.
 - 1. Pad mounted switchgear – 4 hours.
- F. Training shall be conducted by qualified individuals familiar with the Work, and with the equipment.
- G. Instructor shall be familiar with programming and operation of equipment and shall provide instruction to do such.
- H. Provide contact information to Owner for an additional 1 hours support for all electrical systems.
- I. Training shall not occur prior to systems being fully inspected, operational, and complete.

- J. Utilize necessary training materials, conduct training at project location including walk-through of equipment on-site.
- K. Provide Owner with all required Operation, Maintenance, and Programming manuals provided by equipment manufacturer.
- L. Owner shall determine attendee's at training, not the contractor. Contractor shall re-train if attendee's were not selected by the Owner.

1.12 WARRANTY

- A. Warrant Work, materials, and equipment for not less than one year.
- B. Provide additional warranty as required herein.

1.13 PRODUCTS

THIS PART NOT USED

1.14 EXECUTION

THIS PART NOT USED

END OF SECTION

SECTION 26 00 20
ELECTRICAL DEMOLITION

PART 1 - GENERAL**1.01 INTENT**

- A. The electrical system shall be adjusted to accommodate installation of the new work and is required to meet Code. Necessary adjustments are shown on Drawings and indicated herein.

1.02 EXISTING CONDITIONS

- A. The locations of existing utilities and equipment are shown in an approximate way only and have not been independently verified by the Owner or Owner's Representative. Contractor shall determine the exact location of every existing utility before commencing work, and agrees to be fully responsible for any and all damages which might be occasioned by the Contractor's failure to exactly locate and preserve utilities and equipment. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown.
- B. Existing equipment to be removed contains PCB's, Mercury, and other hazardous materials.

1.03 PRODUCTS

THIS PART NOT USED

PART 2 - EXECUTIONS**2.01 DEMOLITION**

- A. Existing electrical light fixtures are denoted on demolition plans. Verify exact location of existing light fixtures in the field. Only partial existing electrical shown. Locations of items shown on the Drawings as existing are partially based on field inspection of unconcealed equipment and record drawings that may contain errors. The contractor shall verify the accuracy of the information shown prior to bidding and provide such labor and material as is necessary to accomplish the intent of the Contract Documents.
- B. Remove existing fixtures, and associated electrical equipment from areas scheduled for remodeling, relocation, or demolition unless indicated as retained, or noted on the Drawings.
- C. Maintain continuity of existing systems that remain. Remove or relocate electrical boxes, conduit, wiring, equipment, fixtures, etc. as may be encountered in removed or remodeled areas in the existing affected by this work. Wiring which serves usable existing equipment shall be removed and restored clear of the construction or demolition. If existing junction boxes will be made inaccessible, or if abandoned outlets serve as feed through boxes for other existing electrical equipment which is being retained, new conduit and wire shall be provided to bypass the abandoned equipment. If existing conduits pass through areas being removed or remodeled, new conduit and wire shall be provided to reroute clear of the construction or demolition and maintain service to the existing load.

- D. Remove abandoned wiring, and leave site clean.
- E. Do not disconnect service without approval from the Owner and Utility. Coordinate demolition work with the utility.
- F. Verify with the General Contractor a location for storage of materials, supplies, tools, rubbish, etc. prior to start of Work.
- G. Include disposal costs in bid unless item is specifically noted as salvage to Owner, or retained. Include removal, retainment, and salvage to Owner costs in bid; including relocating equipment to another location on the Owner's site. Owner has first right of refusal for any other equipment scheduled for demolition not already noted as salvaged to Owner. Owner may elect to salvage any equipment scheduled for disposal.
- H. Protect equipment salvaged to Owner. For equipment with disposal/recycle/salvage value, such proceeds shall be passed to Owner through inclusion in total bid.
- I. Equipment being retained shall be protected from damage, stored, labeled and reused. Contractor is responsible for damage to retained equipment. Contractor is responsible for labeling retained equipment with non-damaging labels. Should Contractor not label retained equipment, labels become separated, and/or labeling is inaccurate, Contractor shall be responsible for costs to determine equipment type, labeling, as part of a survey to re-install retained equipment in a specific condition, location, with specific required function. Equipment varies and labeling/function type of retained equipment is essential to protect success, schedule, and budget. Contractor is responsible for schedule delays, and equipment costs, as a result of equipment damage, replacement equipment procurement, (due to Contractor's damage or not labeling properly), and/or labeling errors, omission, adherent.
- J. (E) Ballasts with PCB's and (E) Lamps: Contractor shall properly handle, prepare for disposal (such as box, barrel, etc.), and dispose of equipment as required. Recycling is to be used to the extent feasible where costs to recycle properly do not exceed cost to dispose of properly. (E) ballasts contain PCB's unless marked by the manufacturer on the ballast "No PCB's"
 - 1. Barrel leaking PCB ballasts per disposal requirements in approved barrels, not exceeding barreling volume/quantity allowances. Dispose of PCB's ballasts in a facility regulated under the Federal Toxic Substances Control Act.
 - 2. Non-leaking PCB ballasts not recycled shall be disposed at a PCB disposal facility in approved leak-proof containers.
 - 3. See DEQ Fact Sheets attached herein. Follow regulatory requirements for proper disposal of removed equipment. Submit certificate of disposal.

END OF SECTION

Managing Waste Lamps



State of Oregon
Department of
Environmental
Quality

Hazardous Waste
700 NE Multnomah St.,
Suite 600
Portland, OR 97232-4100
Phone: 503-229-5696
800-452-4011
Fax: 503-229-5675
www.oregon.gov/DEQ

Background

This fact sheet provides tips for persons who create or manage wastes from lamps containing hazardous materials. Detailed regulations for managing these wastes are in the federal Code of Federal Regulations (Title 40, Parts 260 and 273) and in Oregon Administrative Rule Chapter 340, Divisions 101 and 113.

Environmental concerns

Fluorescent lamps as well as high-intensity discharge lamps – including mercury vapor, high-pressure sodium and metal halide lamps from businesses – can contain levels of mercury and lead that make them hazardous waste when disposed. Businesses and governments in Oregon discard several million lamps each year, making these lamps the state’s largest source of mercury in the solid waste stream.

Mercury and lead are toxic metals that can accumulate in living tissue and cause adverse health effects. When a lamp breaks – either intentionally, during compaction or transport or while sent for incineration – metal vapors and lead- and mercury-contaminated dust enter the environment. This contaminates the air, surface water, groundwater and surface soil.

Mercury lamps

There are five basic approaches in dealing with using lamps containing mercury:

- Purchase lamps that contain amounts of mercury below hazardous waste levels; recycle glass, metal and low-level mercury
- Recycle waste lamps and reclaim the mercury
- Dispose of mercury-containing lamps as hazardous waste
- Dispose of lamps as solid waste in a landfill, if qualified (see below)
- Crush lamps and dispose of them as hazardous waste (see health warning on next page).

Lamp management disposal options

Most businesses have three legal options for disposing of waste lamps: universal waste, hazardous waste and special provisions for conditionally exempt generators.

Universal waste

(CFR Title 40, Part 273; OAR Chapter 340, Division 113). Universal wastes are a class of generated wastes which the U.S.

Environmental Protection Agency allows to be managed by alternative standard or “universal waste rule.” Advantages of managing waste lamps under this rule are:

- Universal wastes are not counted toward hazardous waste generator status
- Manifests are not required unless the waste lamps are transported through states or treated or disposed of in states that do not recognize mercury- containing lamps as a universal waste
- Waste lamps may be stored for up to a year, provided the facility tracks them by the date they became a waste
- Reduced recordkeeping, training and emergency preparedness compared with requirements for small- and large- quantity generators

Handlers of waste lamps managed under the universal waste rule must:

- Manage lamps in a way that prevents releases of the waste to the environment
- Place lamps in containers such as cardboard boxes or fiber drums, which are adequate to prevent breakage
- Keep containers closed
- Label each container with the words “Universal Waste – Lamps,” “Waste Lamps” or “Used Lamps”
- Immediately clean up broken or damaged lamps
- Store broken lamps in a closed, structurally sound container

Universal waste handlers are prohibited from crushing lamps or diluting them with other wastes. They must send waste lamps to a universal waste destination facility for recycling or disposal.

Hazardous waste (CFR 40, Parts 260-66, 268); OAR 340, Divisions 100-106, 108)

Hazardous waste management requirements include:

- Storing waste lamps in a proper container (to protect lamps from breakage)
- Manifesting and contracting with a registered hauler
- Paying necessary fees
- Completing additional training and emergency planning
- Managing waste to a permitted hazardous waste landfill or recycling facility

- Filing an annual report quantifying the amount of hazardous waste generated
- Meeting other requirements based on facility status

Conditionally exempt generator status (CFR 40, Part 261.5)

Before a waste generator qualifies as conditionally exempt, it must:

- Generate less than 220 pounds of hazardous waste each month
- Store less than 2,200 pounds of hazardous waste at any one time

Some municipal landfills don't allow disposal of hazardous waste from conditionally exempt generators. Check with your hauler and with DEQ's hazardous waste technical assistance program (contacts below). In this case, conditionally exempt generators should manage this material as a hazardous waste – via recycling or disposal.

Solid waste considerations

(OAR 340-102-0011)

To manage waste lamp tubes as a solid waste, the waste cannot exhibit toxic characteristics for mercury or lead. The complete waste characterization must be based on laboratory analysis of lamps of the brand and model being disposed of. Waste lamps that don't exhibit hazardous waste characteristics may be disposed of in the municipal solid waste stream. Recycling is the preferred option.

For more on this, refer to DEQ's Hazardous Waste Determination fact sheet.

Crushing lamps

Universal waste regulations prohibit the crushing of universal waste lamps. Crushing is considered hazardous waste treatment. Applicable hazardous waste management and standards pertain to these generated wastes.

Crushing lamps poses human and environmental risks due to mercury vapor release. Crushing lamps in a drum top crushing unit reduces the waste volume. DEQ does not consider on-site lamp crushing a recycling process, even if the crushed glass is later sent to a recycling facility. This is because recycling involves reclaiming or recovering something of value from a waste. A drum top unit reduces waste volume but does not separate and reclaim the waste as recycling facilities do.

Crushing lamps is allowed if the lamps are managed under hazardous waste regulations or if the waste lamps are determined to be a solid waste before crushing. If solid waste bulbs are crushed with hazardous waste bulbs, the mixture must be managed as hazardous waste. Lamps must be crushed in commercially available crushing units designed to control mercury emissions.

Lamp collection services

The following is a partial list of firms that offer waste lamp services. DEQ does not endorse specific recyclers or disposal firms.

By providing this list, DEQ doesn't imply that the companies comply with applicable laws. DEQ cautions waste generators to personally evaluate the services and environmental compliance status of any company they use to manage their waste.

Waste Management

*Portland, OR
1-800-833-3505*

Northwest Hazmat, Inc.

*Springfield, OR
1-541-988-9823
Spill response services*

Lighting Resources Inc.

*Ontario, CA
1-888-923-7252*

Waste-Pro

*La Grande, OR
541-963-5459*

Total Reclaim

*Portland, OR
503-281-1899*

AERC Recycling Solutions

*30677 Huntwood Ave.
Hayward, CA 94544
Phone: 510-429-1129
Fax: 510-429-1498*

Philip Services Corporation

*20245 77th Ave
South Kent, WA 98032
1-800-548-8797*

Veolia Environmental Services

*Vancouver, WA
1-360-260-0882*

Where to find more information

DEQ has other fact sheets about handling mercury-containing materials. Search 'Mercury Containing' on the DEQ website

DEQ's universal waste regulations are in [Oregon Administrative Rules Chapter 340, Division 113](#)

DEQ's hazardous waste regulations are in [Oregon Administrative Rules Chapter 340, Division 102](#)

Other related federal requirements of interest are on the federal website for Title 40, "Protection of the Environment."

- Part 261 (hazardous waste identification)
- Part 262 (hazardous waste generators)
- Part 273 (universal waste)

DEQ regional offices and assistance

For more assistance, see the DEQ hazardous waste program specialist in your area.

Northwest Region Office: 700 NE Multnomah St, Suite 600, Portland, OR 97232-4100, 503-229-5696

Bend office: 475 NE Bellevue, Suite 110, Bend, OR 97701, 541-388-6146

Pendleton office: 800 SE Emigrant, Suite 330, Pendleton, OR 97801, 541-276-4063

Salem office: 4026 Fairview Industrial Dr, SE, Salem, OR 97302, 503-378-8240

Eugene office: 165 E. 7th Ave., Suite 100, Eugene, OR 97401, 541-686-7838

Alternative formats

Documents can be provided upon request in an alternate format for individuals with disabilities or in a language other than English for people with limited English skills. To request a document in another format or language, call DEQ in Portland at 503-229-5696, or toll-free in Oregon at 1-800-452-4011, ext. 5696; or email deqinfo@deq.state.or.us.

SECTION 26 00 26
SUBMITTALS AND SHOP DRAWINGS

PART 1 - GENERAL**1.01 REQUIREMENTS**

- A. Refer to Division 1
- B. Organization
 1. Provide 3-ring type hard cover notebook with 3-hole punch product data sheets.
 2. Order submittals in logical form with tab dividers indicating specification section, and specification title
 3. Equipment shown on schedules shall be in logical order as the equipment appears on the schedule (i.e. light fixture type A precedes light fixture type Z), and be submitted with IDs matching schedule(s).
 4. Submit 5 copies for review. Not all copies will be returned to Contractor.
 5. Clearly readable electronic submittals are permitted instead of initial hard copies provided they are printed by the Contractor with the O&M Manuals for Owner's hard-copy.
 - a. Contractor is responsible to verify receipt of electronic submittals by Engineer.
 - b. Electronic Submittals shall include the project title in the subject line with unique submittal number, and description of submittal.
 - c. Submit to Email address: submittals@fluentengineering.com
 - 1) Fluent Engineering has no limit on E-mail sizes; however, from time to time our email service provider may restrict incoming e-mails beyond our control.
 - 2) Contractor is responsible for any damage as a result of viruses or other malicious software or links to such contained with submittal
 - 3) Fluent Engineering will accept only PDF electronic files. ZIP files, links, images files, images within an email message, and Dropbox type services, etc. will not be opened/accepted.
 - 4) Open file sharing programs such as Dropbox are not permitted and are considered a compromise of project security / non-disclosure agreements.
 - 5) Coordinate with Engineer if PDF E-mail is too large to be sent.
 - 6) Engineer may elect on a case by case basis to utilize the/a Contractor's online submittal system with Owner's approval.
 - 7) Otherwise, use hardcopy format.
- C. Allow no less than 20 Days for review by Engineer.
- D. Contractor is responsible to submit and verify receipt of comments for all submittals.
- E. Resubmittals shall clearly indicate changes. Only revised items not marked as accepted will be reviewed. Items previously accepted will not be reviewed again, and may continue to indicate accepted on review forms unless Contractor submits a separate RFI, or letter requesting another review of that specific item and describes what changes from the previously accepted item. The Engineer's review may or may not indicate if an items status has changed. For the purposes of this paragraph submittals marked as "make

corrections noted”, ‘D’ letter codes, or similar are considered accepted. “Revise and Resubmit”, “Rejected”, or similar are not accepted.

- F. Contractor is responsible for Engineer’s fees after three submittal reviews of equipment of the same specification section.
- G. Substitutions shall be separately submitted. Submit substitution request form as outlined by Division 01, and/or Division 00, if no form specified, provide CSI Substitution After Bidding Form, complete, signed, and filled out as to reason(s) for substitution request.
- H. Submittals do not satisfy requirement(s) to “coordinate”, “verify”, “make sure”, or other direction to the Contractor to actively determine. For example, if “verify finish” with another party direction is given, the EOR is not providing that verification with an accepted review. Submit RFI, or other specified action (such as discussed meeting minutes) to satisfy such direction.
- I. No item requiring review shall be delivered to the site or otherwise provided to the Project until submittals have been reviewed by the Engineer.

1.02 DEFINITIONS

- A. **Manufacturing Data:** Information regarding the product(s) and equipment issued by the manufacturer as described below.
- B. **Manufacturer's Label:** Manufacturer's label shall include a typewritten list of manufacturer's name, sizes and model or catalog numbers.
- C. **Manufacturer's Catalog Data:** Manufacturer's catalog data shall include standard catalog information (Cut Sheets) marked to indicate specific equipment and options for complete and functional system. All components of the system shall be included. Include listing information. Include installation instructions.
- D. **Manufacturer's Technical and Engineering Data:** Manufacturer's technical and engineering data shall include materials, dimensions, details, installation instructions, weights, capacities, illustrations, wiring diagrams, control diagrams, control schematics, piping diagrams, connection diagrams, performance data, trip curves, listings, mix design, test results, and any other information required for a complete evaluation of the equipment specified, and to verify compliance with the Contract Documents. All available details shall be included with any modifications to the equipment indicated. All manufacturers and associated model numbers used for complete system shall be indicated.
- E. **Programming Data:** Provide complete technician-level programming and configuration information necessary to install, adjust, restore, and maintain the Controls. Include as applicable:
 - 1. **Sequence of Operation / Programming Matrix** – Tabular or narrative description of control logic and cause–effect relationships, coordinated with Contract Documents.
 - 2. **Protection and Safety Settings** – All adjustable trip points, setpoints, delays, interlocks, and safety limits required for safe and compliant operation.
 - 3. **Programming Tools / Interfaces** – Identification of software, interface hardware, cables/adapters, and communication protocols necessary to access and modify system programming in the field.
 - 4. **Programming Interface Software** – Name, version, and licensing status (temporary or permanent) number of users, user level (admin, operator,

- 5. Future Replacement / Reprogramming Data – Instructions and data sets enabling replacement components to be programmed or reprogrammed to match as-left conditions without additional engineering.
- F. Shop Drawings: Shop drawings are Construction drawings of items manufactured specifically for this project. Shop drawings shall include dimensions, construction details, weights, and additional information to identify the physical features of the system or piece of equipment. Drawings shall be adequately sized and scaled for a complete review.
- G. Samples: Samples include actual example of the equipment to be installed. Include actual color, finish, and functioning replica of equipment to be installed. Samples will be returned to the Contractor when submitted with pre-paid postage.
- H. Certifications and Qualifications: Submit list of past projects with same systems. Submit information listing references, copies of certificates issued by manufacturer, school, and standards organizations. Submit information mandated in specific specification section.

1.03 SUBMITTALS REQUIRED

- A. Product Evaluation Data. 5 copies of product literature. The submittal schedule for product evaluation data is as indicated below. Each item requiring a submittal is given the following code:
 - L Manufacturer's Label
 - C Manufacturer's catalog data (Cuts)
 - E Manufacturer's technical and engineering data
 - P Programming Data
 - S Shop drawings
 - SA Samples
 - CR Certifications
 - Q Qualifications

1.04 SUBMITTAL SCHEDULE

Division 26 - Electrical

Section 26 05 13- MEDIUM VOLTAGE CABLE	C, E
Section 26 05 19- BUILDING WIRE AND CABLES	C
Section 26 05 26- GROUNDING	C
Section 26 05 29- SUPPORTING DEVICES	L
Section 26 05 33- RACEWAYS & FITTINGS	L
Section 26 05 33.16- OUTLET, JUNCTION, AND PULL BOXES	C
Section 26 05 53- ELECTRICAL IDENTIFICATION	L,SA
Section 26 05 60- OVERCURRENT PROTECTIVE DEVICES	C,E,S
Section 26 05 83- WIRE CONNECTIONS	L
Section 26 11 16.11- UNIT SUBSTATION SECTION.....	C,E,S
Section 26 12 19- OIL FILLED TRASNFORMER.....	C,E,S
Section 26 13 10- MEDIUM VOLTAGE OUTDOOR PAD MOUNTED SWITCHGEAR.....	C,E,S,P
Section 26 24 18- SPD (SURGE PROTECTION) EQUIPMENT.....	C,E,S
Section 26 27 26- WIRING DEVICES	C,E,S
Section 26 29 12- DISCONNECTS & MANUAL MOTOR STARTER	C,S
Section 26 33 13- EMERGENCY POWER PACKS.....	C,E,S
Section 26 51 13.10- LAMPS	C

Section 26 51 13.20- LIGHTING FIXTURESC,S

PART 2 - PRODUCTS
THIS PART NOT USED

PART 3 - EXECUTION
THIS PART NOT USED

END OF SECTION

SECTION 26 05 13
MEDIUM VOLTAGE CABLE

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Provide, terminate, and connect medium voltage cables.

1.02 CONTRACT CONDITIONS

- A. Work of this Section is bound by the Contract Conditions and Division 1, bound herewith, in addition to this Specification and accompanying Drawings

1.03 APPLICABLE STANDARDS

- A. National Fire Protection Association (NFPA)
1. NFPA 70 National Electrical Code
- B. Insulated Power Cable Engineers Association (IPCEA)
1. S-93-969 5-46kV Shielded Power Cable for Use in Transmission and Distribution of Electrical Energy (NMEA WC-74)
- C. Underwriters Laboratories (UL)
1. UL 1072-2006 Medium Voltage Power Cable

1.04 SUBMITTALS

- A. Submit WC -74 manufacturers certified reports to Engineer. Certified copies shall show conformance with the referenced standards and shall be reviewed prior to delivery of cable.
- B. Submit test results indicated herein when requested, and at Contract Closeout.

PART 2 - PRODUCTS**2.01 MATERIAL, MEDIUM VOLTAGE CABLE:**

- A. Medium voltage cable shall be in accordance with the NEC, IPEA, and as shown on the Drawings.
- B. Shall be single conductor stranded copper type as shown on the Drawings.
- C. Insulation:
1. Insulation level shall be 133 percent.
a. Types:
1) Ethylene propylene rubber insulation shall be thermosetting, light and heat stabilized. Cable type abbreviation, EPR.
2) Polyethylene insulation shall be thermosetting, light and heat stabilized, chemically crosslinked. Cable type abbreviation, CCLP.
3) Within vaults, switchgear rooms and equipment assemblies where the incoming feeder cables are not suitable for connections between the protective equipment, disconnects and transformers, install suitable, approved cables.

- D. Conductors and insulation shall be wrapped separately with semi-conducting tape.
- E. Insulation shall be wrapped with non-magnetic, metallic shielding.
- F. Heavy duty, overall protective jackets of chlorosulphonated polyethylene, neoprene, polyvinyl chloride or equal shall enclose cable.
- G. Cable temperature ratings for continuous operation, emergency overload operation and short circuit operation shall be not less than the IPCEA Standard for the respective cable.
- H. Manufacturer's name, size, insulation type, and other pertinent information shall be marked or molded clearly on the overall jacket's outside surface or incorporated on marker tapes within the cables at reasonable intervals.

2.02 MATERIAL, TERMINATIONS

- A. The materials shall be compatible with the conductors, insulations and protective jackets on the cables and wires.
- B. The terminations shall insulate and protect the conductors not less than the insulation and protective jackets on the cables and wires which protect the conductors.
- C. Terminating Fittings:
 - 1. Shall be heavy duty, pressure type fittings which will assure satisfactory performance of the connections under conditions of temperature cycling and magnetic forces from available short circuit currents.
 - 2. The fittings shall be suitable designed and the proper size for the cables and wires being spliced and terminated.
- D. Terminating Kits:
 - 1. General
 - a. Shall be assembled by the manufacturer or supplier of the material and shall be packaged for individual splices and terminations or for groups of splices and terminations.
 - b. Shall consist of materials designed for the cables being spliced and terminated and shall be suitable for the prevailing environmental conditions.
 - c. Shall include detail drawings and printed instructions for each type of splice and termination being installed, as prepared by the manufacturers of the materials in the kits.
 - d. Detail drawings and printed instructions shall indicate the cable type, voltage rating, manufacturer's name and catalog numbers for the materials indicated.
 - e. Voltage ratings for the splices and terminations shall be not less than the voltage ratings for the cables on which they are being installed.
 - f. Reduce stress and absorb shock/expansion as required by termination equipment manufacturer and cable manufacturer (include stress-cone as indicated herein).
 - g. Deadbreak for dead-front equipment rated above 200A. 600A Rated.
 - h. Loadbreak for dead-front equipment rated 200A or below. 200A Rated.
 - i. See drawings for additional requirements.
- E. Taped Terminations:
 - 1. Insulating and semi-conducting rubber tapes shall withstand 200 percent elongation without cracking, rupturing or reducing their electrical and self-bonding characteristics by more than 5 percent.

- F. Epoxy Resin Kits shall be as follows:
1. Compatible with the cable insulations and jackets and make the splice watertight and submersible.
 2. Thermosetting and generate its own heat so that external fire or heat will not be required.
 3. Set solid and cure in approximately 60 minutes in 70 degree F ambient temperature.
 4. Not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.
 5. Furnished in pre-measured quantities, sized for each termination, with two resin components in an easy mixing plastic bag which will permit mixing the resin without entrapping air or contaminants. Other methods of packaging and mixing the epoxy resin components will be considered for approval, provided they include adequate safeguards to assure precise proportioning of the resin components and to prevent entrapping air and contaminants.
 6. Use snap together, longitudinally-split, interlocking seam, transplant mold bodies or taped frameworks, injection fittings and injection gun or pouring equipment. Completely fill voids within the splices and terminations.

2.03 MATERIAL, FIREPROOFING TAPE

- A. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- B. The tape shall consist of a flexible, conformable fabric of organic composition coated one side with flame-retardant elastomer.
- C. The tape shall not deteriorate when subjected to water, gases, salt water, sewage, or fungus. It shall be resistant to sunlight and ultraviolet light.
- D. The finished application shall withstand a 200 ampere arc for not less than 30 seconds.
- E. Securing Tape: Shall be glass cloth electrical tape not less than 7 mils thick, and 3/4-inch wide.

PART 3 - EXECUTION

3.01 INSTALLATION, MEDIUM VOLTAGE CABLE

- A. Installation shall be in accordance with the NEC, and as shown on the Drawings.
- B. Splices are not permitted on this project unless expressly accepted, per instance, by EOR. Splice kit indicated herein is for contingency purposes only.
- C. Use suitable lubricating compounds on the cables and wires to prevent damage to them during pull. Provide compounds that are not injurious to the cable and wire jackets, and do not harden or become adhesive.
- D. Splices only in manholes and accessible junction boxes.
- E. In manholes, underground raceways and other outdoor locations:
1. Seal the cable ends prior to pulling them in to prevent the entry of moisture.
 2. For ethylene propylene rubber and polyethylene insulated cables, use bags of epoxy resin which are not less than 1/4-inch larger in diameter than the overall diameter of the cable. Clean each end of each cable before installing the epoxy resin over it.

- F. Provide ground shield and connect to termination equipment/feed as required. Include ground conductor where required per NEC.

3.02 INSTALLATION AND TERMINATIONS

- A. Install the materials as recommended by their manufacturer including special precautions pertaining to air temperature during installations.
- B. Ethylene Propylene Rubber and Polyethylene Insulated Cables:
 - 1. Install taped splices and termination or premolded rubber splices and terminations.
- C. Installation shall be accomplished by qualified personnel trained to accomplish high voltage equipment installations. All instructions of the manufacturer shall be followed in detail.

3.03 INSTALLATION, FIREPROOFING

- A. Cover all power cables located in manholes, handholes and junction boxes with arcproof and fireproof tape.
- B. Apply the tape in single layer, one-half lapped or as recommended by the manufacturer. Install the tape with the coated side towards the cable and extend it not less than 1-inch into each duct
- C. Secure the tape in place by a random wrap of glass cloth tape.

3.04 FEEDER IDENTIFICATION

- A. In each manhole, pullbox, and termination point install permanent tags on cables and wires of each circuit to clearly designate their identification and voltage. The tags shall be the embossed brass type and shall also show the cable type and voltage rating. Position the tags so they will be easy to read after the fireproofing is installed.

3.05 FIELD TESTS FOR MEDIUM VOLTAGE CABLE

- A. New Cable
 - 1. Acceptance tests shall be performed on new cable.
 - 2. Provide High Potential Tests and Dielectric Absorption Tests. Verify conformance with manufacturer's specifications and herein.
 - 3. Test and verify ringing and document ringing procedure and verification results to assure cables are properly phased. Match existing (replaced line) cable phase-to-phase configuration.
 - 4. Test new cable after installation, and terminations have been made, but before connection to service equipment. See Sequence on Drawings.
- B. High Potential Test:
 - 1. Leakage current test shall be by high potential D.C. step voltage method.
 - 2. Prior to high potential test, test the cable and shields for continuity, shorts, and grounds.
 - 3. High potential test shall measure the leakage current from each conductor to the insulation shield. Use corona shields, guard rings, taping, mason jars, or plastic gabs to prevent corona current from influencing the readings. Unprepared cable shield ends shall be trimmed back 1-inch or more for each 10 kV of test voltage.
 - 4. Safety Precautions:

5. Exercise suitable and adequate safety measures prior to, during, and after the high potential tests, including placing warning signs and preventing people and equipment from being exposed to the test voltage, including within tunnels. Coordinate testing time and date with Owner.

C. Test Voltages:

1. New shielded EPR and CCLP cable D.C. test voltages shall be as follows:

Wire Size	Test Voltage KV		
Rated Circuit Voltage	AWG or	100%	133%
Phase-to-Phase Volts	MCM	Insulation Level	Insulation Level
8001 - 15000	2 - 1000	55	65

D. High Potential Test Method:

1. Apply voltage in approximately 8 to 10 equal steps.
2. Raise the voltage slowly between steps.
3. At the end of each step, allow the charging current to decay, and time of the interval of decay.
4. Read the leakage current and plot a curve of leakage current versus test voltage on graph paper as the test progresses. Read the leakage current at the same time interval for each voltage step.
5. Stop the test if leakage currents increase excessively or a "knee" appears in the curve before maximum test voltage is reached.
 - a. For new cable, replace the cable and repeat the test.
6. Upon reaching maximum test voltage, hold the voltage for five (5) minutes. Read the leakage current at 30 second intervals and plot a curve of leakage current versus time on the same graph paper as the step voltage curve.
 - a. Stop the test if leakage current starts to rise or decreases and, again, starts to rise. Leakage current should decrease and stabilize for good cable.
7. Terminate test and allow sufficient discharge time before testing the next conductor.
8. Include test documentation at shut-down coordination meeting. Submit test documentation when requested by Owner or Engineer and Submit test documentation with Contract Closeout documentation.

E. Dielectric Absorption Test:

1. Completely isolate extraneous electrical connections to new cable at terminations and joints.
2. Safety precautions shall be observed. Each cable shall be given a full dielectric absorption test with a 5000/12000V insulation resistance test set.
3. Test shall be applied for a long enough time to charge the cable.
4. Readings shall be recorded every 15 seconds during the first 3 minutes, and 1 minute intervals thereafter.
5. Test shall continue until three equal readings 1 minute apart are obtained. Readings shall not be less than 200 megohms at an ambient temperature of 68 degrees F. Readings taken at other temperatures shall be corrected accordingly.
6. Verify test results per manufacturer requirements, Reference Standards, and herein.
7. Include test documentation at shut-down coordination meeting. Submit test documentation when requested by Owner or Engineer and Submit test documentation with Contract Closeout documentation.

END OF SECTION

SECTION 26 05 16
DRY TYPE TRANSFORMERS

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Relocate (E) transformer in chiller building (TR3).

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
- B. Institute of Electrical and Electronics Engineers (IEEE)
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 70 National Electrical Code
- D. Underwriters Laboratory (UL)
 - 1. UL1561 Standard for Dry-Type General Purpose and Power Transformers
- E. UL 5085 Low Voltage Transformers
 - 1. UL 506: Standard for Specialty Transformers- OSHA Adopted Safety Requirements
- F. National Electrical Manufacturers Association (NEMA)
- G. National Electrical Contractors Association (NECA)
 - 1. NECA 409 Standard for Installing and Maintaining Dry-Type Transformers
- H. American Society for Testing and Materials (ASTM)

PART 2 - PRODUCTS**2.01 GROUNDING**

- A. Visibly ground core and coils to frame of transformer with flexible grounding strap of size required by Code.
- B. Secondary Neutral: Connect to closest effectively grounded approved grounding electrode, per NEC 250.26.

2.02 VIBRATION DAMPENERS

- A. General: Neoprene pads size in accordance with manufacturer's loading data.
- B. Floor Mount: Rubber in compression vibration dampener. Consolidated Kinetics, Type R; or Mason Industries, type N.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Install equipment according to manufacturer's installation recommendations and installation requirements in addition to requirements herein and as shown.

3.02 VIBRATION CONTROL

- A. Primary and Secondary Conduit Connection: LFMC_with ground conductor, not less than 24-inch length.
- B. Mounting: Mount transformers on vibration dampeners.

3.03 FIELD ADJUSTMENTS

- A. Adjust taps to deliver appropriate secondary voltage.

3.04 FIELD TESTING

- A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION

SECTION 26 05 19
BUILDING WIRE & CABLES

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Wires and Cables

1.02 REFERENCE STANDARDS

- A. National Fire Protection Association (NFPA).
 - 1. NFPA 70 National Electrical Code.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Deliver new wire and new cable to site in new packaging with standard cable coils/reels. Packaging shall clearly show length, wire size, wire/cable type, and manufacturer.
- B. Protect products from weather, moisture, and damage.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Building Wiring & Insulation: Copper, 98 percent conductivity, stranded. Solid may be used at contractor's option for wire smaller than #8 AWG. 600 Volt insulation, Type THHN for dry interior and damp interior locations. Type THW, THWN or XHHW for wet locations, and exterior locations.
- B. Conductor cable with conductors smaller than #12 AWG for branch circuits not permitted.
- C. Exterior cables exposed to sunlight shall be listed "sunlight resistant."
- D. Control panel wiring no smaller than #14 AWG stranded switchboard Type MTW unless otherwise specified on the Drawings or required by system manufacturer.
- E. Motor control wires shall be no smaller than #14 AWG.
- F. Wire for other areas as shown on the Drawings.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Parallel feeders shall have identical conductor length.
- B. Use UL listed pulling lubricant for greater than equivalent #4 AWG wire diameter.
- C. Use UL listed pulling lubricant for pulls greater than 75 feet.
- D. Remove moisture from raceway prior to wire pull.
- E. Provide copper grounding conductors. Provide a ground wire through conduits. Utilize the ground wire as the equipment grounding conductor no smaller than #12 AWG otherwise sized as shown and per NEC.

- F. Do not splice feeders, or services. Splices only permitted in accessible junction or outlet boxes where circuit routes deviate. Do not splice or tap branch circuits terminating in a single outlet.
- G. Color code conductors per NEC to designate neutral, phase, and ground as follows:
- | | |
|-----------|--------------------------------------|
| CONDUCTOR | 120/208 |
| Phase A | Black, or per (E) facility standard |
| Phase B | Red, or per (E) facility standard |
| Phase C | Blue, or per (E) facility standard |
| Neutral | White |
| Ground | Green |
| Travelers | Pink, or per (E) facility standard |
|
 | |
| CONDUCTOR | 480/277 |
| Phase A | Brown, or per (E) facility standard |
| Phase B | Purple, or per (E) facility standard |
| Phase C | Yellow, or per (E) facility standard |
| Neutral | White |
| Ground | Green |
| Travelers | Pink, or per (E) facility standard |
- H. Identify facility High-Leg with signage and consistent coloring (Orange) as required by NEC.
- I. If (E) facility standards do not differentiate phase by color, or offer suitable marking, and/or differentiate voltage, provide unique identification marking, coloring on new.
- J. Wires shall be factory color coded. Coloring shall be integral to the insulation. Plastic tape permitted on #6 AWG and larger where insulation coloring is not available or practical. Apply tape in spiral half-lap over exposed portions of cable at all locations that cable is accessible.
- K. Conductors shall be identified with circuit number where conductors are accessible such as at terminals, outlets, switches, circuit breakers, motor control centers, etc. Identify the ends of a given conductor circuit the same.
- L. Do not install wires of different voltage systems in same raceway, box, or other enclosure. Control voltage is permitted in same enclosure only where specific equipment is listed for multiple voltage use, and a listed voltage barrier is provided.
- M. Radius of cable bends shall not be less than 10 times the outer diameter of the cable unless specifically noted difference such as on a cable/VFD cable schedule.
- N. Do not install cable within conduit per NEC.
- O. Follow standards of practice for storage, handling, and termination of aluminum conductors. Provide anti-oxidation gel, and remove any oxidation by approved means when terminating conductors.
- P. Route parallel or perpendicular to building lines.
- Q. No Cable (power, low voltage, etc.) shall be unconcealed in any finished area.

END OF SECTION

SECTION 26 05 26 GROUNDING

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Electrical systems grounding.
- B. Signal systems grounding.

1.02 APPLICABLE STANDARDS

- A. Underwriters Laboratories (UL)
 - 1. UL 467 Standard for Grounding and Bonding Equipment
- B. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. IEEE 81 Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
 - 2. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems

1.03 APPLICABLE REGULATIONS

- A. National Fire Protection Association (NFPA)
 - 1. NFPA 70 National Electrical Code (NEC)
- B. NEC references below are based on the 2023 edition. Contractor shall meet current NEC requirements.

1.04 TESTS

- A. Measure ground grid resistance with earth test megger and provide additional listed and approved earth grounding devices and conductors as required until resistance is 25 ohms or less. Inform engineer in writing, if resistance is greater than 5 ohms.

PART 2 - PRODUCTS

2.01 GROUNDING ELECTRODES

- A. Encased Electrode: NEC 250.52(A). One, no smaller than #4 bare solid copper conductor. Install in concrete foundation or footing near contact with earth. Connect to steel reinforcing bars, where available, not less than two times.
- B. Ground Rods: 3/4" diameter, 8' long, copper, with approved clamp near surface. Listed as ground rod for direct contact with earth.
- C. Grounding Electrode: NEC 250.52(A).

2.02 GROUNDING CONDUCTORS, AND JUMPERS

- A. Size: Per NEC 250.
- B. Material: Copper.
- C. Protection: Conductors not in raceway or concealed shall be insulated. Provide raceway where shown or required for physical protection.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Regardless of TESTS results above, Provide not less than the following:
 - 1. Underground Metal Cold Water Pipe electrode; If underground Metal Cold Water Pipe is not present Provide Ground Ring.
 - 2. Encased Electrode.
 - 3. Two (2) Ground Rods or Ground Rods as shown.
 - 4. Connection to building steel when present.
 - 5. System is NEC 250.104
- B. Grounding Electrodes: Bond all electrodes together. Do not provide other type of electrode than shown without written approval. Provide additional quantity of electrodes as required by TESTS above.
- C. Provide access to all grounding electrode conductor connections.
- D. Electrically bypass water meters when required by utility with use of full-size bonding jumper rated for location installed and with pipe clamps routed around and clear of meter.

3.02 POWER AND SIGNAL SYSTEM GROUNDING

- A. All equipment grounding conductors shall be routed through same equipment conductor raceway from beginning to end (distribution source to load).
- B. Every metallic raceway (including Liquidtight Flexible Metal Conduit) circuit/feeder is intended to have dual ground paths from the raceway itself, and the separate equipment grounding conductor within the raceway.
- C. Metallic raceways are not approved as equipment grounds.
- D. Circuit Grounding: Install grounding bushings, studs, and jumpers at distribution centers, pullboxes, motor control centers, panelboards, and junction boxes.
- E. Ground Connections: Clean surfaces thoroughly before applying ground lugs or clamps. If surface is coated, the coating must be removed down to the conductive material. After the coating has been removed, apply a listed and approved noncorrosive compound to cleaned surface and connections. Where galvanizing is removed from metal, it shall be re-applied or painted.
- F. Bonding Jumpers: Provide with green insulation and size not smaller than per NEC and larger where shown. Connection to neutral only at service neutral bar. Bonding jumpers shall be contiguous without break, joint, or splice.
- G. Service Panel:
 - 1. Connect the various feeder green grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 - 2. Connect the grounding electrode conductor to the ground bus.
 - 3. Connect the neutral to the ground bus as the main bonding jumper unless shown differently on Drawings. Provide neutral to ground bond where otherwise indicated on Drawings.
 - 4. Connect metallic conduits, which terminate without mechanical conductive connection to the enclosure, by grounding bushings and ground wire to the ground bus.

- H. Feeders and Branch Circuits: Install green grounding conductors with feeders and branch circuits. Additional locations and systems as shown.
- I. Raceway Systems:
 - 1. Ground all metallic enclosed raceway systems.
 - 2. All enclosed raceway connecting to equipment shall contain a grounding conductor.
 - 3. Conduit systems shall contain a grounding conductor.
 - 4. Bond grounding conductor at beginning and end of raceway provided for mechanical protection containing only a grounding conductor.
- J. Boxes, Cabinets, Enclosures, and Panelboards:
 - 1. Bond the grounding wires to each pullbox, junction box, outlet box, cabinets, and other enclosures through which the ground conductors pass.
 - 2. Provide lugs in each box and enclosure for ground wire termination.
 - 3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.
- K. Receptacles - Refer to Section 26 27 26.
- L. Ground lighting fixtures to the equipment grounding conductor of the wiring system.
- M. Fixed electrical equipment shall have a ground lug installed for termination of the equipment ground conductor.
- N. Motors: Install a separate insulated equipment grounding conductor from the equipment ground connection in the motor controller through the raceway and flexible conduit to the ground terminal on the motor housing. Ground motor controller through feeder raceway. No reductions.
- O. Control and Signaling Equipment: Ground metallic enclosures and raceways, terminate shields and drain wires to building ground system. Provide additional grounding as required by equipment manufacturer.

3.03 TESTING

- A. Test per IEEE 81.
- B. Grounding Electrode Conductor:
 - 1. Measure resistance between switchboard ground bus and each grounding electrode, using a Megger and a single length of additional wire.
 - 2. Measure resistance between both ends of the additional wire used.
 - 3. Grounding Electrode Conductor resistance is the difference between 1 and 2.
 - 4. Correct any inadequate connections as indicated.

END OF SECTION

SECTION 26 05 29 SUPPORTING DEVICES

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Raceway Supports.
- B. Cable supports.
- C. Provide all hardware and materials to support, as required, a complete and congruent raceway system.

1.02 APPLICABLE STANDARDS

- A. National Fire Protection Association (NFPA)
 - 1. NFPA 70 National Electrical Code
- B. Underwriters Laboratories (UL)
 - 1. UL 2239 Hardware for the Support of Conduit, Tubing, and Cable
- C. National Electrical Contractors Association (NECA)
 - 1. ECA 101 Standard for Installing Steel Conduit

PART 2 - PRODUCTS

2.01 RACEWAY SUPPORTS

- A. Single Runs: Steel rod hangers, galvanized single hole conduit straps, or ring bolt type hangers with spring clips. Adhesives, tape, staples, clamps (including beam clamps), zip/wire ties, or "J-nails" not acceptable.
- B. Multiple Runs: Rack with 25 percent spare capacity. Maximum width per manufacturer's recommendations.
- C. Vertical Runs: U-channel support with conduit fittings.
- D. All hardware such as inserts, straps, bolts, nuts, screws and washers shall be galvanized or plated steel.
- E. PVC coated galvanized steel in exterior and wet locations.
- F. Channel manufacturers: Kindorf, Unistrut, or approved.

2.02 CABLE SUPPORTS

- A. Approved plastic coated wire-ties.
- B. Approved PVC coated hangers.
- C. Building studs as permitted by Code and specifications.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Supporting devices shall be listed for the location installed. Supports shall be of like material of raceway and be rated for location installed.
- B. Layout to maintain headroom, neat mechanical appearance, and to support equipment loads required.
- C. Exact location and spacing between supports per manufacturer's recommendations and NEC requirements.
- D. Provide adequate spacing to prevent moisture build-up. All runs of conduit shall be arranged so as to be devoid of traps wherever possible.
- E. Cable "Sag" greater than 3-Inches from valley to peak of run, not acceptable.

END OF SECTION

**SECTION 26 05 33
RACEWAY & FITTINGS**

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Conduit, Fittings, and Tubing.
- B. Flexible Conduit.

1.02 REFERENCE STANDARDS

- A. National Fire Protection Association (NFPA).
 - 1. NFPA 70 National Electrical Code--Chapter 3.
 - 2. Underwriters Laboratories (UL) 6,
 - 3. UL797
 - 4. UL1990

PART 2 - PRODUCTS**2.01 MATERIALS AND COMPONENTS**

- A. General: No smaller than $\frac{3}{4}$ -inch unless otherwise shown or indicated herein.
- B. Conduit and Tubing: Electrical metallic tubing, galvanized rigid steel threaded conduit, Schedule 40 PVC.
- C. Flexible Conduit: Flexible plastic jacketed type with liquidtight connectors and steel wrap armor (liquidtight flexible metallic conduit).
- D. Fittings:
 - 1. General: Listed and approved for purpose. Water, gas, concrete tight where required.
 - 2. Electrical Metallic Tubing (EMT): Connectors to be steel. All connectors shall have factory insulated throats. Couplers and connectors shall be compression, setscrew type.
 - 3. Galvanized Rigid Steel Conduit (GRC): Threaded. Do not use pressure type. Provide factory insulated throats on bushings.
 - 4. PV Coated Galvanized Rigid Steel Conduit (PGRC): Same as GRC, with PVC coating meeting UL White Book Guidance, Steel Tube Institute.
 - 5. Liquidtight Flexible Metallic Conduit: Continuous copper ground in core; approved watertight.
- E. Expansion Joints: Offset or sliding type with bending straps and clamps. Listed for purpose.
- F. Entrance Seal: Shall be modular, mechanical type, consisting of inter-locking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening. The elastomeric element shall be sized and selected per manufacturer's recommendations. Garlock Link-Seal or approved.
- G. Underground Marking Tape: 6-inches wide, yellow, low-density polyethylene 4 mil thickness. Imprinted: "CAUTION: STOP DIGGING - BURIED ELECTRIC LINE BELOW" and current date. Tape for telephone line similar, except green.

- H. Conduit seal: Shall be modular, mechanical type. Listed for use., concentric cable/conductor seals on inside of raceway. Waterproof, Rextec or approved system.

2.02 TYPE

- A. Utilize PGRC in concrete with concrete-tight connectors.
- B. Utilize GRC for exterior with watertight connectors.
- C. Utilize electrical metallic tubing concealed in finished interior spaces.
- D. Utilize electrical metallic tubing exposed in unfinished spaces, where not subject to physical damage.
- E. For underground conduit, utilize Schedule 40 PVC or PGRC. Provide PGRC elbows and PGRC risers through penetrations where PVC is used.
- F. Utilize surface metal raceways for exposed runs in finished areas. Paint to match wall finish. Use only where shown on Drawings, or where approved.
- G. Connections to motors, vibrating equipment, and movable equipment shall be with flexible metallic conduit listed for use as ground or liquidtight flexible metallic conduit (with ground conductor core). Use liquidtight type in damp locations. No smaller than 1/2-inch for motor connections. Use 3/8-inch only for light fixture wiring where provided by light fixture manufacturer. Provide sufficient length of flexible conduit to stop vibration into connecting support. Sizes not noted on the Drawings shall be as required by the NEC and no smaller than upstream connection conduit size. Flex shall not be sole means of ground path, include conductor within flex for dual ground pathways (raceway and conductor).

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install raceway concealed in all areas where required concealment not required in mechanical and electrical rooms, connections to motors, above suspended ceilings, and underfloor spaces.
- B. Coordinate installation of conduit in masonry, cabinetry, and building slab work.
- C. Underground Raceways: Watertight, including fittings, slope 3 inches per 100 feet downward from building. Install underground marking tape. Bury 6 inches to 8 inches below grade directly above raceway. Seal exterior junction boxes or provide with drainage.
- D. Galvanized rigid steel conduit installed in contact with earth shall be wrapped with 2-half laps of 10 mil, all weather, corrosion protection tape. Underground Galvanized rigid steel shall be PVC coated type.
- E. Provide GRC (use PGRC) per NEC 344.10 (including 344.10(B)(1))
- F. Route all conduits parallel or perpendicular to building lines.
- G. Vertical Runs: Straight and plumb.
- H. Raceways Running in Groups: Run at same elevation, properly spaced and supported.

- I. Install conduit in concrete slab with minimum 2-inch cover. Do not install conduit larger than one inch maximum in concrete slabs unless approved.
- J. Do not interfere with placement of concrete re-bar. Place raceway between re-bar layers. Space at least 8-inches on center. Space as far as possible where terminating at same area. Secure raceway, boxes, inserts, etc. by mechanical means prior to pour.
- K. Install conduit free with no dents or bruises. Cap ends to prevent entry of foreign materials and moisture.
- L. Clean raceway before installation of conductor.
- M. Alter conduit routing to avoid obstructions, minimizing crossovers. Avoid use of bends and offsets where possible. Only bend raceway with an approved conduit bending machine or approved hand (hickey) bender.
- N. Provide listed expansion complete fittings with grounding jumpers where conduits intersect building expansion joints and for longer runs where conduit expansion may be excessive.
- O. Allow minimum of 6 inches clearance at flues, steam pipes, and heat sources.
- P. Dissimilar Metals: Avoid contact with pipe or duct runs of other systems.
- Q. Lengths and Bends: Maximum number of bends in any run shall be the equivalent of four quarter bends (360 degrees total). Maximum length of any run shall be 300 feet, less 50 feet for each equivalent quarter bend. Provide Junction and pull boxes to meet these limits.
- R. Provide entrance seal for all exterior wall, underground, and exterior slab raceway penetrations.
- S. Provide conduit seal where shown, detailed, specified (exterior underground junction boxes), and required.
- T. All empty raceways shall be provided with pull string or #12 conductor. Provide #12 conductor for exterior empty PVC raceways.

END OF SECTION

SECTION 26 05 33.16
OUTLET, JUNCTION, AND PULLBOXES

PART 1 - GENERAL**1.01 DESCRIPTION OF WORK**

- A. Provide electrical boxes and fittings as required for a complete, protected, and operable system.
- B. Comply with local Codes and NEC as required for Providing electrical boxes and fittings.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI).
 - 1. C73 Series Dimensions of Attachment Plugs and Receptacles
- B. National Electrical Manufacturers Association (NEMA)
 - 1. OS 1 Sheet-Steel Outlets Boxes, Device Boxes, Covers, and Box Supports
 - 2. FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

1.03 APPLICABLE REGULATIONS

- A. American National Standards Institute (ANSI).
 - 1. C2 National Electrical Safety Code (ANSI/IEEE C2)
- B. National Fire Protection Association (NFPA).
 - 1. NFPA 70 National Electrical Code.
- C. Underwriters' Laboratories (UL).
 - 1. UL50 Cabinets and Boxes (ANSI/UL50).
 - 2. UL514 Outlet Boxes and Fittings (ANSI/UL514).

PART 2 - PRODUCTS**2.01 OUTLET BOXES:**

- A. No smaller than 4-inch, 1-1/2-inches deep box. Provide raised covers where required for surface mounted outlets, plaster rings on flush outlets. Provide tile rings where flush outlets installed in tile. Concrete type where installed in concrete.
- B. Receptacle Outlets and Flush Switch: 4-inch square box, 1-1/2-inches deep, with single or two-gang plaster ring.
- C. Match one piece gang boxes to number of devices, install one device per gang. Devices requiring more than one-gang shall be installed in individual boxes matched to device size. Do not exceed 5-gang configuration per row of devices at same location.
- D. Provide galvanized steel interior dry location outlet wiring boxes for emt raceway shaped and sized, to conform to each individual location and installation. Provide with factory knockouts in back and sides, and with threaded holes with screws for securing box covers or devices.

- E. Provide outlet box accessories as required. Accessories include mounting brackets, wallboard hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes. Choice of accessories is Contractor's option.
- F. Outlet Box Covers:
 - 1. Flush Mounting: Bevelled, 302 stainless steel, match device installed or full cover where no device installed.
 - 2. Surface Mounting: Bevelled, steel, pressure formed, match device installed or full cover where no device installed.

2.02 WEATHERPROOF / WET LOCATION OUTLET BOXES:

- A. Provide corrosion-resistant cast metal weatherproof outlet wiring boxes, shaped and sized, to conform to each individual location and installation. Provide with threaded conduit ends, suitably configured for each application, including face plate gasket and corrosion proof fasteners.
- B. Weatherproof boxes shall have smooth sides, gray finish.
- C. Boxes used in contact with earth shall be cast iron alloy with gasketed screw cover and water-tight hubs.
- D. Weatherproof Plates: Cast metal, gasketed for switches provide spring loaded sealed door(s).
- E. Weatherproof Receptacle Outlet Cover: Cast metal, NEMA 3R, In-Use type, with locking tab. Match device configuration. 3 ¼ -inches internal depth. T&B CK series, or approved

2.03 WEATHERPROOF JUNCTION AND PULL BOXES:

- A. Provide galvanized sheet steel junction and pull boxes, with screw-on covers; of the type, shape and size, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

2.04 KNOCKOUT CLOSURES:

- A. Provide punched-steel knockout closures for steel boxes.

2.05 PULLBOXES

- A. Provide sheet metal in interior dry locations for EMT raceway. Provide cast metal in exterior, or damp locations. Type and material shall conform to National Electrical Code, with screw-on cover.
- B. Flush Mounted Pullboxes: Provide overlapping covers with flush head screws, finished in light gray enamel.
- C. Box volumes shall meet NEC for size and number of entering conduits and cables.

2.06 UNDERGROUND PULLBOXES

- A. Underground Pull Boxes: Cast concrete with suitable concrete cover to withhold loads in location installed. Provide heavy-duty traffic cover where installed with vehicle traffic. Cover and box shall not deform and be rated for location installed. Provide drainage and no less than 4 feet compacted gravel below installation. Size, and configuration to match installation. Provide where required, and shown on Drawings.

PART 3 - EXECUTION**3.01 INSTALLATION**

- A. Match one piece gang boxes to number of devices, install one device per gang. Do not exceed 4-gang configurations per row of devices at same location.
- B. Locate outlet boxes flush other than in mechanical rooms, electrical rooms, and above suspended ceilings. Provide insulation behind box to prevent condensation for boxes mounted in exterior walls.
- C. Provide insulation behind box for walls with insulation for sound reduction.
- D. Coordinate location and mounting heights with built-in units and cabinetry. Outlet mounting height shall be at same level required for equipment served.
- E. When mounting receptacle, or voice/voice outlet boxes above bench or counter, mount box to the side (horizontally) for finished receptacle grounding pole at left.
- F. Locate pullboxes and junction boxes concealed above suspended ceilings or in electrical rooms, mechanical rooms, or unfinished areas.
- G. Support: Provide adequate support of all outlet boxes. Secure boxes independent raceway, by attaching directly to building structure by approved means.
- H. Identify each junction and pullbox with system description including branch circuit numbers of enclosed circuits, and voltage.
- I. Secure all raceway to entering boxes with approved bushings, and locknuts.
- J. Do not mount boxes back-to-back. Boxes on opposite sides of wall shall be separated by at least 3 inches.
- K. Maintain sound transmission and fire properties of surface installed. Provide appropriate fire stop and sound stop materials as required to maintain these properties.
- L. Provide separate boxes where two voltage systems have equipment at same location. Provide separate boxes for equipment on emergency power system.

END OF SECTION

SECTION 26 05 53
ELECTRICAL IDENTIFICATION

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Permanent Identification of system components.

1.02 APPLICABLE REGULATIONS

- A. National Fire Protection Association (NFPA)
 - 1. NFPA 70: National Electrical Code.

1.03 SUBMITTAL

- A. Provide sample of each label type upon request.

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Phenolic Nameplate:
 - 1. Three -layer, white front and back with black core.
 - 2. Neatly engraved through outer layer to show white characters on black background.
 - 3. Beveled edges, print lettering.
 - 4. Other colors as specified or shown. Use red for fire alarm, or fire sprinkler only.
- B. Stenciling and Silk Screening: Printed lettering with enamel or lacquer paints. Legends contrasting with the background on which applied
- C. Panelboard Directory Card: Fiberboard typed. Laminate or place in protective cover.
- D. Concealed Box Labels: Permanent black ink such as “Sharpie” pen with neat and legible writing. Red permanent ink for fire alarm.
- E. Concealed Conductor Labels: Listed white tape wrapped around individual conductor or cable, with permanent black ink with printed lettering
- F. Permanent Self-Adhesive Labels: Temperature, moisture and UV resistant. Metallic and reflective background with printed contrasting lettering.
- G. Exterior Weather-proof Adhesive Label. Temperature, moisture and UV resistant with printed contrasting lettering.
- H. Outlet / Device covers: Clear / transparent tape with matching printed black ink letter / numbering.
- I. Power Conductor Labels: Flame resistant UL224 Listed, 600V rated, wrap around label shrinkable sleeve type. White label with black lettering. Impact, Inc AWMS series or approved label system.
- J. Medium voltage: brass as indicated in respective section.

PART 3 - EXECUTION**3.01 EQUIPMENT TO BE IDENTIFIED**

- A. Motor starters, panels, lighting panels and the disconnecting devices contained therein.
- B. Egress/Emergency Lighting
- C. Power Conductors (at Panel/Lighting Control Panel/Line Terminal Blocks)
- D. Remote Emergency Inverters
- E. Disconnects.
- F. Control panels, starters, pushbutton stations, pilot lights and other control devices.
- G. Transformers.
- H. Remote control devices.
- I. Conductors at both device and terminal strip terminations for control and instrumentation cables and conductors.
- J. Other items as specified, required by NEC, or noted on Drawings
 - 1. Including and not limited to Arc-Flash Hazard (NEC 110.16), Available Fault current (NEC 110.24), protection ratings, etc. Code required markings shall be adhered/affixed/integrated into to equipment from factory with factory labeling/nameplates.
- K. Devices in lighting panels and power panels shall be identified on the panelboard directory card.
- L. Receptacles and Switches (clear transparent on device cover)
- M. Junction Boxes.

3.02 PHENOLIC NAMEPLATES

- A. Power panels shall be labeled on the door of the interior with a nameplate. Letters for panels shall be printed and no less than 1/2 inch high.
- B. Provide nameplate on switchboard
- C. Provide nameplates where specified and as shown.

3.03 POWER CONDUCTOR LABELS – UNDER 1000V

- A. Label at emanating location (source)- i.e. home run termination.
- B. Applicable to every power source over 70V.
- C. Label ~ 1-inch from breaker lug, Relay Lug, Terminal Block. Orient for view toward open readily viewable side.
- D. Label each Hot Conductor, Label Neutral Conductor(s) as indicated. Circuit Ground Labeling is not required.
 - 1. Every new conductor home-run at emanating power panel.
 - a. Load name shall be used, not circuit number. Refer to description in panel schedule.
 - b. Associate/same label Neutral on same circuits
 - 2. Every existing conductor home-run at emanating power panel where re-named if existing.

- a. Load name shall be used, not circuit number. Refer to description in panel schedule.
 - b. Existing Multi-Wire Branch Circuits (shared) Neutral- Label as “SHARED” or “MULTI-WIRE” with associated circuits, unique circuit identification required/abbreviations acceptable. If associated circuiting is unknown, label only as “SHARED” or “MULTI-WIRE” without associated circuiting is acceptable.
 - c. Associate/same label Neutral on same circuits that are not existing Multi-wire branch circuits.
3. Other Source, or Terminal Block power source labeling associated with power conductor home-runs in power distribution system. N/A to unit equipment unless unit equipment remotely serves other equipment. Example Equipment may include
 - a. Lighting Inverter Sources (Panels)
 - b. Generator(s)
 - c. Remote Battery Packs
 4. Circuit numbers shall not be indicated, numbers only are not acceptable, load name required for future re-configuration of panel.

3.04 APPLYING IDENTIFICATION

- A. Stenciled letters shall be applied by brush or by spraying.
- B. Nameplates shall be attached with either adhesive or screws. If adhesive is used, it shall adequately adhere to the surface installed.

3.05 IDENTIFICATION REQUIREMENTS

- A. Indicate Voltage for all concealed labels, and for Disconnects, panelboard and switchboard identification.
- B. Identification for disconnecting devices contained in panels and motor control centers shall show the equipment name and location by floor, area, and direction to adequately indicate location of load. Do not include Voltage when the Voltage is the same as for the panel or motor control center.
- C. Nameplates on disconnect devices located in the area but not part of a panel or motor control center shall have the equipment name, power source identification, and voltage designation. Nameplates for disconnect devices located remotely from the equipment shall also show the equipment location by floor, area, and direction to adequately indicate location of load.
- D. All indicators and controls for control panels, starters, and the like shall be labeled, such as (Start, Stop, On, Off, Reset, Fault, etc.).
- E. Panelboard directory cards shall list the circuit numbers and show the equipment name and location supplied by the circuits. Equipment locations shall be shown by floor, area and direction, or by room numbers.
- F. Device covers to include serving circuit and panelboard name, include at receptacles, switches, outlets, system furniture connections, floor boxes, etc. Apply clear/ translucent adhesive tape with typed black lettering not more than 1/4” in height via use of label maker

END OF SECTION

SECTION 26 05 60
OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Circuit Breakers.
- B. Fuses.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI).
 - 1. C37.16 Preferred Ratings, Related Requirements, and Application Recommendations for Low Voltage Power Circuit Breakers and AC Power Circuit Protectors.
 - 2. C37.17 Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers.
 - 3. C37.50 Test Procedure for Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures.
 - 4. C97.1 Low Voltage Cartridge Fuses 600 Volts or Less.
- B. Institute of Electrical and Electronic Engineers, Inc. (IEEE).
 - 1. 20-73 Low Voltage AC Power Circuit Breakers Used in Enclosures: ANSI C37.13.
- C. National Electrical Manufacturer's Association (NEMA).
 - 1. FU-1 Low Voltage Cartridge Fuses.

1.03 APPLICABLE REGULATIONS

- A. Underwriters' Laboratories (UL).
 - 1. UL 489-72 Molded Case Circuit Breakers and Circuit Breaker Enclosures.
 - 2. UL 198 E Class R Fuses.
 - 3. UL 869 Service Disconnects
 - 4. UL 1066 Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures
- B. National Fire Protection Association (NFPA).
 - 1. NFPA 70 National Electrical Code.

1.04 QUALITY CONTROL

- A. Breakers shall be inherently coordinated with feeder breakers by manufacture.
- B. Breakers shall be of the same manufacturer.

PART 2 - PRODUCTS**2.01 CIRCUIT BREAKERS**

- A. Construction
 - 1. Bolt-on connection to bus.

2. Thermal-magnetic, molded case, with inverse time current overload and instantaneous magnetic tripping.
 3. Quick-make, quick-break, with tripped indication clearly shown by breaker handle taking a position between ON and OFF.
 4. Multiple phase breakers shall have a common internal trip. Do not use handle ties between single pole breakers.
 5. Breaker shall be switch (T) rated.
 6. Include locking handle for each breaker provided it does not impede GFI/AFCI or other testing requirements. Utilize for maintenance lock-out tag-out.
 7. Where used as service disconnects, breakers shall be listed for use as service entrance equipment and shall include locking handle.
 8. Breakers, 400 amps and larger, shall include externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the breaker trip mechanism to operate as well as exercising the breaker latch and operating mechanisms.
 9. Fully rated at fault current of panel or switchboard.
 10. Inherently coordinated by manufacturer with upstream protection device.
- B. Breakers in unit substation 100A and large:
1. Shall include externally operable mechanical means to trip the circuit breaker, enabling maintenance personnel to verify the ability of the breaker trip mechanism to operate as well as exercising the breaker latch and operating mechanisms.
 2. Long Delay Protection (Long Delay Pickup, Long Delay Time) setting
 3. Short Delay Protection (Short Delay Pickup, Short Delay Time) setting
 4. Instantaneous Setting
 5. Ground Fault Protection (Ground Fault Pickup, Ground Fault Delay)
 6. Maintenance mode selection (engage/disengage instantaneous tripping for Arc flash safety)
 7. Locking cover
 8. Fully rated at fault current of unit substation distribution.

2.02 GFI BRANCH CIRCUIT BREAKERS

- A. Meet construction requirements herein.
- B. Ground fault protection with integral push-to-test button.
- C. Class 1.
- D. Adjustable setting pickup from 0.03 to 30 Amps.
- E. Adjustable time delay from instantaneous to 2.0 seconds.

2.03 TESTING

- A. By Manufacturer at factory. Timed thermal trip test and timed magnetic trip test.
- B. As required by local authority.
- C. Submit test results to Engineer upon request.

2.04 FUSES

- A. Feeder, Branch Circuit and Service Entrance Fuses: 600 amperes and below, UL Class J or RK1 current limiting type, 600 volt 200,000 ampere interrupting capacity.

- B. Motor and Inductive Circuit Fuses: UL class RK5 time delay current limiting type, 600 volt, 200,000 ampere interrupting capacity.
- C. Control Circuit Fuses: UL Class J or R current, limiting type, 600V.
- D. Manufacturer: Bussmann, or approved

PART 3 - EXECUTION

3.01 CIRCUIT BREAKER INSTALLATION

- A. Label each breaker located in switchboard or separate enclosure to indicate load served.
- B. Adjust settings on breakers to operate properly under actual field conditions and to provide selective system coordination.
- C. Post breaker settings in electrical rooms, alongside one-line.
- D. Torque breakers to bus per manufacturer's requirements and installation procedures.

3.02 FUSE INSTALLATION

- A. Label each switch to indicate type and rating of fuse installed.
- B. All fuses shall be selected to provide selective system coordination.
- C. Provide the greater of 10%, or not less than 3 spare fuses of each size, and rating used.

END OF SECTION

SECTION 26 05 83
WIRE CONNECTIONS

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Wires Connectors

1.02 REFERENCE STANDARDS

- A. National Fire Protection Association (NFPA).
 - 1. NFPA 70 National Electrical Code.
- B. Underwriters' Laboratories, Inc (UL)
 - 1. UL 486A through UL 486E
- C. American National Standards Institute (ANSI)
 - 1. ANSI/UL 467

PART 2 - PRODUCTS**2.01 TWIST-ON CONNECTOR**

- A. Pressure-type wound spring twist on connector.
- B. Solderless pressure connectors.
- C. Shell rating of 105 degrees C.
- D. "Push-On" or "punch" type connectors not permitted.
- E. Use for up to #8 AWG sizes.

2.02 MULTI-TAP CONNECTOR

- A. 600V Fully insulated, chemical resistant insulation coating.
- B. 90 °C Rated
- C. Fully rated for SCA in locations installed.
- D. Torque wrench lug tightening
- E. Clear insulation (Vision Tap) transparent design for conductor placement verification.
- F. Removable plugs, pre-filled oxide inhibitor
- G. AL/CU Rated Terminals
- H. For J-Box use only, new feeder extensions not permitted
- I. Not for submersible use.
- J. NSI (Polaris) ITD Vision Tap Series, Burndy Clear Series, or approved.

2.03 COMPRESSION ADAPTER

- A. Dual rated for use with both aluminum and copper cable conductors.
- B. Diameter and ampacity as current carrying equivalent copper wire.

- C. Pre-filled with approved joint compound
- D. Connectors shall be clearly marked with Catalog Number, wire size and color-coded die index number.
- E. Burndy “Hyplug” type AYP or equal by T&B, or approved.

2.04 TERMINAL, CRIMP TYPE

- A. Flat; fork tongue, or flat circular matched to terminal size.
- B. Color coded to wire size.
- C. T&B “Sta-Kon”, or approved.

2.05 WP COATING

- A. Liquid
- B. For use as an outer seal on vinyl tape splice, fast-drying, suitable for use for direct burial and moisture protection.
- C. 3M Scotchkote Electrical Coating FD, or approved

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Provide Twist-On Connectors at taps and splices for conductors no larger than #10 AWG. Provide only in approved junction and outlet boxes.
- B. Provide Compression Adapters for terminating a single conductor into mechanical connectors such as a circuit breaker or set screw lugs. Provide only where required for AL/CU transitions or where lugs require adapters.
- C. Provide Crimp terminal at all Control voltage terminal blocks, unless otherwise recommended by manufacturer.
- D. =Do not nick conductor when stripping insulation. No “ringing”
- E. Conductor and cable shall not be reduced at the terminal for connections.
- F. Connectors shall be approved and listed for the purpose used.
- G. Wrap all twist-on connectors with listed tape to maintain equivalent insulation of wire.
 - 1. Exterior, Underground, and WP connections shall include 2-coats of WP Coating.
- H. Remove any obstructions on connection to maintain continuity prior to installation of connectors, such as paint, dirt, and construction materials.
- I. Copper conductors can be terminated in approved compression or mechanical connector, including set screws.
- J. Provide slack at equipment to allow for a neat termination, access to conductors, and ability to repair or replace equipment.
- K. Connections shall not be made where in-contact with moisture. Utilize fully unbroken conductor through entire run.

END OF SECTION

SECTION 26 11 16.11
SECONDARY UNIT SUBSTATIONS – SECONDARY LESS THAN 1000V

PART 1 - GENERAL

1.01 SCOPE

- A. Time is of the essence, owner funding expires.
- B. The Contractor shall furnish and install the secondary unit substation(s) complete from the incoming line terminals to the outgoing line terminals as specified herein and as shown on the contract drawings.
- C. The secondary unit substation shall consist of primary equipment, transformer and secondary equipment as specified below. The manufacturer of the unit substation shall furnish and coordinate all major components of the substations, including incoming primary equipment section, transformer and low-voltage section, as well as circuit breakers, fusible switches, and metering components. Provide a single warranty covering all substation assemblies, transformers and components.
- D. Connections between the primary device and transformer shall be bus, and between the transformer and secondary shall be flexible bus braid.
- E. Outdoor primary and secondary equipment shall be of weatherproof construction, rodent proof and shall contain 277-volt heaters as required.
- F. Unit substation shall not exceed the footprint shown on the drawings without separate written approval by the engineer. Acceptance of submittal does not constitute approval of footprint. The shown footprint includes field constraints that cannot be modified by the manufacturer. Contractor is responsible to adjust field conditions to accommodate equipment provided should it exceed footprint shown.
- G. Contractor in coordination with manufacturer is responsible for installation of equipment sections such that equipment fits through existing elements such as ramps, doorways, gates, pathways, etc.
- H. Provide entire unit vibration isolation on pads in addition to separate transformer vibration isolation.
- I. Seismic mounting requirements for location installed. Provide seismic mounting as required for location for entire unit structure, and supporting elements.

1.02 REFERENCES

- A. The secondary unit substation shall be designed, assembled, tested and installed in accordance with latest applicable standards of NEMA, IEEE and ANSI, applicable to its three major sections:
 - 1. MV Metal-Clad Switchgear – NEMA SG4, SG5; ANSI C37
 - 2. MV Metal-Enclosed Switchgear – NEMA SG4, SG5; ANSI C37
 - 3. MV Load Interrupter Switchgear – NEMA SG4, SG5; ANSI C37
 - 4. Secondary Substation Transformers – NEMA 210, IEEE 100, ANSI C57
 - 5. LV Metal-Enclosed Switchgear – ANSI C37, UL 1558
 - 6. LV Distribution Switchboards – NEMA PB-2, UL 891

- B. The medium voltage load interrupter switchgear and all components shall be designed, manufactured and tested in accordance with the latest applicable standards as follows:
 - 1. ANSI/IEEE C37.20.3
 - 2. ANSI/IEEE C37.20.4
 - 3. ANSI C37.22
 - 4. ANSI C37.57, C37.58
 - 5. CSA 22.2 No.31-M89 (5/15 kV ratings only)
 - 6. EEMAC G8-3.3

1.03 SUBMITTALS – FOR REVIEW/ACCEPTANCE

- A. The following information shall be submitted to the Engineer:
 - 1. Master drawing index
 - 2. Front view elevation
 - 3. Floor plan
 - 4. Single line
 - 5. Schematic diagram
 - 6. Nameplate schedule
 - 7. Component list
 - 8. Conduit entry/exit locations
 - 9. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 - d. Basic Impulse level for equipment over 600 volts
 - e. kVA
 - 10. Major component ratings including:
 - a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
 - 11. Cable terminal sizes
 - 12. Connection details between close-coupled assemblies
 - 13. Composite front view and floor plan of close-coupled assemblies
 - 14. Impedance for transformers
 - 15. Product data sheets
 - 16. Busway connection

1.04 SUBMITTALS – FOR CONSTRUCTION

- A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed Paragraph 1.04, and shall incorporate all changes made during the manufacturing process
 - 2. Wiring diagrams
 - 3. Certified production test reports
 - 4. Installation information

1.05 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list

of installations with similar equipment shall be provided demonstrating compliance with this requirement.

- C. Provide Seismic rated equipment as follows:
 - 1. Provide: Minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
 - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, coordinate with structural. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
 - b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
 - c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. Copy of these instructions shall be included with the equipment at time of shipment.
- B. Each switchgear assembly shall be split into shipping groups for handling as indicated on the drawings or per the manufacturer's recommendations. Shipping groups shall be designed to be shipped by truck, rail or ship. Shipping groups shall be bolted to skids. Accessories shall be packaged and shipped separately. Each switchgear shipping group shall be equipped with lifting eyes for handling solely by crane.

1.07 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins, and renewal parts lists where applicable for the complete assembly and each major component.

PART 2 - PRODUCTS

2.01 PRIMARY EQUIPMENT

- A. Quality control: Square D , Eaton or approved.
 - 1. Provide alternate front access only mv section G&W, S&C, or approved. If not by Eaton, SquareD, or approved.
- B. Ratings
 - 1. Switchgear assembly ratings shall be as follows:
 - a. Nominal System Voltage 12470 (15kV Class); three-phase four wire
 - b. System Grounding; solid
 - c. Maximum Design Voltage; 15 kV
 - d. BIL; 95 kV
 - e. Main Cross Bus Momentary Current (10 Cycle); 40 kA Asymmetrical RMS
 - f. Main Cross Bus 2-Second short circuit current; 25 kA Symmetrical RMS
 - g. Non-Fused Switch (Continuous and Load Break); 200 Amperes

- h. Non-Fused Switch Fault close (3 times, minimum for 4.76 & 15 kV; 40 kA Asymmetrical
- i. Non-Fused Switch 2-Second Short Circuit Current; 25 kA Sym RMS

C. 15 kV Construction

1. The metal-enclosed load interrupter switchgear shall consist of deadfront, completely metal-enclosed vertical sections containing load interrupter switches noted on the drawings or specified herein.
2. The following features shall be supplied on every vertical section containing a three-pole, two-position open-closed switch:
 - a. A minimum 8-inch x 16-inch high-impact viewing window that permits full view of the position of all three switch blades through the closed door. The window shall not be more than 58 inches above the switch pad level to allow ease of inspection.
 - b. The door shall be interlocked with the switch so that:
 - 1) The switch must be opened before the door can be opened
 - 2) The door must be closed before the switch can be closed
 - c. A hinged grounded metal barrier that is bolted closed in front of every switch to prevent inadvertent contact with any live part, yet allows for a full-view inspection on the switch blade position
 - d. Provision for padlocking the switch in the open or closed position
 - e. Green OPEN, Red CLOSED switch position indicators with the words "Open" and "Closed" in English
 - f. A hinged cover with rustproof quarter turn nylon latches over the switch operating mechanism to discourage casual tampering
 - g. The switch shall be removable from the structure as a complete operational component.
 - h. Live parts (Bus) guards where being accessed.
3. Vertical section construction shall be of the universal frame type using die-formed and bolted parts. Enclosing covers and doors shall be fabricated from steel whose thickness shall be equal to or greater than those specified in ANSI/IEEE C37.20.3. No owner removable hardware for covers or doors shall be thread-forming type. To facilitate installation and maintenance of cables and bus in each vertical section, a split removable top cover shall be provided. A G90 grade galvanized base shall isolate equipment from contact with the concrete pad providing protection from rust. Heavy-duty hot dipped galvanized anchor clips shall be provided to anchor the switchgear to the concrete pad.
4. Each vertical section containing a switch shall have a single, full-length, flanged front door and shall be equipped with two (2) rotary latch-type padlockable handles. Provision shall be made for operating the switch and storing the removable handle without opening the full length door.
5. Each load interrupter switch shall have the following features:
 - a. Three-pole gang-operated mechanism
 - b. Manual quick-make, quick-break over-toggle-type mechanism that does not require the use of a chain or a cable for operation, and utilizes a heavy-duty coil spring to provide opening and closing energy
 - c. The speed of opening and closing the switch shall be independent of the operator, and it shall be impossible to tease the switch into any intermediate position under normal operation
 - d. Separate main and break contacts to provide maximum endurance for fault close and load interrupting duty

- e. Insulating barriers between each phase and between the outer phases and the enclosure
 - f. A maintenance provision for slow closing the switch to check switch blade engagement and slow opening the switch to check operation of the arc interrupting contacts.
- D. Bus
1. All phase bus conductors shall be silver-plated copper
 2. Ground bus shall be silver-plated copper and be directly fastened to a galvanized metal surface of each vertical section, and be of a size sufficient to carry the rated (2-second) current of the switchgear assembly.
 3. A neutral bus shall be provided only when indicated on the drawings. It shall be insulated for 1000 Vac to ground. The current rating of the neutral bus shall be 200 amperes.
- E. Bus Insulation System
1. All bus shall be supported utilizing a high strength and high creep, support providing 10.5-inch of creep distance between phases and ground. The molded fins shall be constructed of high track resistant insulation.
 2. All standoff insulators on switches and fuse mountings shall be glass polyester
- F. Wiring/Terminations
1. One (1) terminal pad per phase shall be provided for attaching contractor-supplied cable terminal lugs for a maximum of two (2) conductors per phase of the sizes indicated on the drawings. Sufficient space shall be allowed for contractor supplied electrical stress relief termination devices.
 2. Small wiring, fuse blocks and terminal blocks within the vertical section shall be furnished as indicated on the drawings. Each control wire shall be labeled with wire markers. Terminal blocks shall be provided for owner's connections to other apparatus.
- G. Transformer Connections
1. A transformer primary load interrupter switch shall include the following when for an outdoor dry type secondary unit substation VPE type transformer. See items below.
 2. Cable or bus bar connection from the load side of the fuse (or load side of an unfused switch) to the HV terminal pad locations of the transformer
 3. Include a connection for the ground bar termination to connect the switch enclosure to the transformer enclosure
 4. Provide a 15" throat with a 5" flange (20" altogether) with flange dimensions to match the dimensions of the transformer flange.
 5. Optionally connect to FR3 oil filled outdoor unit if WP dry type is not available.
 6. Cable or bus bar connection from the load side of the fuse (or load side of an unfused switch) to the HV bushing terminal pad on the primary of the transformer.
 7. Include a connection for the ground bar to connect the switch enclosure to the transformer enclosure
- H. Nameplates
1. A nameplate shall be mounted on the front door of each switch vertical section in accordance with the drawings. Phenolic.
- I. Finish

1. Prior to assembly, all enclosing steel shall be thoroughly cleaned and phosphatized. A powder coating shall be applied electrostatically, then fused-on by baking in an oven. The coating is to have a thickness of not less than 1.5 mils. The finish shall have the following properties:

Impact resistance (ASTM D-2794); 60 direct/60 indirect
Pencil hardness (ASTM D-3363); H
Flexibility (ASTM D-522); Pass 1/8-inch mandrel
Salt spray (ASTM B117-85 [20]); 600 hours
Color; ANSI 61 gray

2.02 TRANSFORMERS

A. Ratings

1. kVA Rating; 500
2. Impedance; Not to exceed 7%, Shall not be below 3%
3. HV; 12,470V Delta
4. HV De-energized Taps; +/- 2 - 2-1/2% full capacity
5. LV; 480/277V Wye

B. Construction

1. Transformer shall be cooled by natural air convection (AA).
2. The electrical insulation system shall utilize Class H material in a fully rated 220 degrees C system. Transformer design temperature rise shall be based on a 30 degrees C average ambient over a 24-hour period with a maximum of 40 degrees C. Solid insulation in the transformer shall consist of inorganic materials such as porcelain, glass fiber, electrical grade glass polyester, electrical grade epoxy, or Nomex. All insulating materials must be rated for continuous 220 degree C duty. The insulation between the high- and low-voltage coils shall be more than sufficient for the voltage stress without the need of a varnish.
3. The transformer shall be designed for a temperature rise of 115 degrees C and shall be capable of operating at 125% above base nameplate kVA capacity continuously without any loss of life.
 - a. Provide for Oregon Energy Code ASHRAE 90.1.
4. The transformer shall be designed to meet the sound level standards for transformers as defined in NEMA TR1. The measurement procedure shall be as specified in ANSI C57.12.90.
 - a. Provide quiet operation.
5. The transformer shall be UL labeled.
6. High-voltage and low-voltage windings shall be copper. Insulation between layers of the windings shall be by Insuldur paper or approved.
7. The entire core and coil assembly shall be Vacuum Pressure Encapsulated (VPE) with a silicone resin per MIL-1-24092. The total VPE process shall apply a four (4) cycle shield of silicone resin to the coils and a two (2) cycle protective shield to the bus, core and support structure. The VPE process shall effectively encapsulate the entire core and coil assembly which results in a transformer which is virtually impermeable to moisture, dust, dirt, salt, air, and other industrial contaminants.
8. The high- and low-voltage coil assembly shall be preheated to evaporate any moisture, then placed into a vacuum pressure tank. The air in the tank shall be evacuated; and at extremely low absolute pressure, all air bubbles are to be drawn

out of the insulating materials. The resin shall be introduced to a level that submerges all parts while the vacuum is maintained. Then the vacuum shall be released and pressure applied, after which the coil shall be removed and placed in an oven for several hours in order for the resin to catalyze into a composite mass, completely sealing and binding the winding.

9. The transformer shall be supplied in a knockdown case design, for ease in fitting through limited openings, and shall be of heavy gauge sheet steel construction, equipped with removable panels for access to the core and coils. Front and rear panels shall incorporate lowered ventilating grills.
 10. Provide NEMA 3R or better enclosure.
 11. FR3 oil filled meeting requirements of section 26 12 00 may be used if WP dry type not available. Must be part of unit assembly (not separate).
- C. Accessories
1. Transformer shall include:
 - a. Diagram instruction plate.
 - b. Provisions for lifting and jacking.
 - c. Removable center panel for access to high-voltage strap-type connector taps for de-energized tap changing.
 - d. Two ground pads with continuous ground bus.
 - e. Vibration Isolation (In addition to Entire Unit Substation)
- D. Finish
1. The paint shall be applied using an electrostatically deposited dry powder system to a minimum of three (3) mils average thickness. Units shall be painted ANSI 61, match the primary and secondary equipment.
- E. Terminal Compartments/Flange Connections
1. Connections between the primary device and transformer shall be bus, and between the transformer and secondary shall be flexible bus braid.

2.03 SECONDARY EQUIPMENT

- A. Secondary Distribution
1. Provide per 26 05 60 Overcurrent Protection Devices.
 2. Provide per 26 24 16 Switchboards.
 3. Provide per 26 24 18 SPD.
- B. Accessories
1. Provide integral SPD.
 2. See Drawings for configurations, Overcurrent Protection Devices spares/spaces, etc.
- C. Miscellaneous Devices
1. Control/Accessory power transformers with primary and secondary protection shall be provided, as indicated on the drawings, or as required for proper operation of the equipment. Power shall be integral, not separate (shore power) if available.
- D. Enclosures
1. NEMA 3R enclosure or better.
- E. Nameplates
1. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be

laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

2. Refer to Labeling Requirements for Engineer of Record, Owner, and Project Data in Switchboards Specification Section.
3. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

F. Finish

1. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light grey.

PART 3 - EXECUTION

3.01 FACTORY TESTING

- A. Standard factory tests shall be performed on the primary equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
 1. Provide additional testing as specified within other applicable specifications.
- B. The manufacturer shall provide three (3) certified copies of factory test reports.
- C. Factory tests as outlined above shall be reviewed for acceptance by the owner's representative.
 1. The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed

3.02 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and startup of the equipment specified under this section. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained herein.
- B. The Contractor shall provide three (3) copies of the manufacturer's field startup report.

3.03 MANUFACTURER'S CERTIFICATION

- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

3.04 INSTALLATION

- A. All necessary hardware to secure the assembly in place shall be provided.

END OF SECTION

SECTION 26 12 00
OIL FILLED TRANSFORMERS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Time is of the essence, owner funding expires.
- B. Provide transformers, including mounts, hardware, grounding, connections, and other accessories for a complete and operational installation.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)
- B. Institute of Electrical and Electronics Engineers (IEEE)
- C. National Fire Protection Association (NFPA)
 - 1. NFPA 70 National Electrical Code
- D. Underwriters Laboratory (UL)
- E. National Electrical Manufacturers Association (NEMA)
- F. National Electrical Contractors Association (NECA)
- G. American Society for Testing and Materials (ASTM)

1.03 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Provide Seismic tested equipment as follows:
 - 1. The manufacturer shall certify the equipment based upon a dynamic and/or static structural computer analysis of the entire assembly structure and its components, provided it is based upon actual seismic testing from similar equipment. The analysis shall be based upon all applicable seismic requirements of the current Oregon Building Code (IBC) per Site Classification. The forces in the vertical direction shall be at least 66% of those in the horizontal direction. The analysis shall cover a frequency range from 1 to 100Hz. Guidelines for the installation consistent with these requirements shall be provided by the equipment manufacture and based upon testing of representative equipment. Equipment certification acceptance criteria shall be based upon the ability for the equipment to be returned to service immediately after a seismic event within the above requirements without the need for repairs.
 - 2. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

- a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, coordinated with structural. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
- b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.05 FIELD MEASUREMENTS

1. Measure primary and secondary voltages and make appropriate tap adjustments.

1.06 QUALITY ASSURANCE

- A. Acceptable Manufacturers:
 1. Square D, Eaton, or approved.

PART 2 - PRODUCTS

2.01 RATINGS

- A. The ratings of the transformer shall be as shown on the drawings. Not more than 7% Impedance.

2.02 CONSTRUCTION

- A. The unit shall be FR3 filled and shall be in accordance with the latest edition of the NEC. High fire point fluids shall be Factory Mutual and UL listed.
- B. The transformer shall carry its continuous rating with average winding or temperature rise by resistance that shall not exceed 65 degrees C rise, based on an average ambient of 30 degrees C over 24 hours with a maximum of 40 degrees C.
- C. The transformer shall be designed to meet the sound level standards for liquid transformers as defined in NEMA and ANSI.
- D. High-voltage and low-voltage windings shall be aluminum. Insulation between layers of the windings shall be by thermally set insulating paper or equal.
- E. The main transformer tank and attached components shall be designed to withstand pressures greater than the required operating design value without permanent deformation. Construction shall consist of carbon steel reinforced with external, internal or sidewall braces. All seams and joints shall be continuously welded.

- F. The assembly shall be individually welded and receive a quality control pressurized check for leaks. The entire tank assembly shall receive a similar leak test before tanking. A final six-hour leak test shall be performed.
- G. The transformer(s) shall be compartmental-type, self-cooled and tamper-resistant for mounting on a pad. The unit shall restrict the entry of water into the compartments so as not to impair its operation. There shall be no exposed screws, bolts or other fastening devices which are externally removable.
- H. The transformer(s) shall consist of a transformer tank and full-height, bolt-on high- and low-voltage cable terminating compartments located side-by-side separated by a rigid metal barrier. Each compartment shall have separate doors, designed to provide access to the high-voltage compartment only after the low-voltage has been opened. There shall be at least one additional fastening device accessible only after the low-voltage door has been opened, which must be removed to open the high-voltage door. Doors shall be mounted flush with the cabinet frame. The low-voltage door shall have a handle-operated, three-point latching mechanism designed to be secured with a single padlock. A hex-head or penta-head bolt shall be incorporated into the low-voltage door latching mechanism. Both high and low-voltage doors shall be incorporated into the low-voltage door latching mechanism. Both high and low-voltage doors shall be equipped with stainless steel hinges and door stops to secure them in the open position.
- I. Compartment sills, doors and covers shall be removable to facilitate cable pulling and installation. The high-voltage door shall be on the left with the low-voltage door on the right. Compartments shall be designed for cable entry from below.
- J. Transformer(s) shall be supplied with a welded or bolted main tank cover and be of a sealed-tank construction designed to withstand a pressure of 7 psig without permanent distortion. The tank cover shall be designed to shed water and be supplied with a tamper-resistant access handhole sized to allow access to internal bushing and switch connections. Transformers supplied with "less flammable" fluids shall be manufactured to withstand 12 psig without rupture. The transformer shall remain effectively sealed for a top-oil temperature of -5 degrees C to 105 degrees C. When necessary to meet the temperature rise rating specified, cooling panels shall be provided.
- K. The transformer manufacturer shall certify that the transformer is non-PCB containing less than 1 part per million detectable PCBs. Nonflammable transformer liquids including askarel and insulating liquids containing tetrachloroethylene, perchloroethylene, chlorine compounds, or halogenated compounds are not acceptable and shall not be provided.
- L. When high-voltage taps are specified, full-capacity taps shall be provided with a tap changing mechanism designed for de-energized operation. The tap changer operator shall be located within one of the compartments.
- M. The coil windings shall be designed to reduce losses and manufactured with the conductor material as specified above. All insulating materials shall be rated for 120 degrees C class.
- N. For grounded wye to grounded wye application, the core assembly shall be a 5-legged, distributed-gap, wound core, designed to meet NEMA TR-1 sound levels measured per ANSI standards. For ratings above 2500 kVA, a stacked core design may be utilized.
- O. The core material shall be high-grade, grain-oriented, non-aging silicon core steel with high magnetic permeability, low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below saturation to allow for a minimum of 10 percent

overvoltage excitation. The cores shall be properly annealed to reduce stresses induced during the manufacturing processes and reduce core losses.

- P. The core frame shall be designed to provide maximum support of the core and coil assembly. The core frame shall be welded or bolted to ensure maximum short-circuit strength.
- Q. The core and coil assembly shall be designed and manufactured to meet the short-circuit requirements of ANSI C57.12.90. The core and coil assembly shall be baked in an oven prior to tanking to “set” the epoxy coating on the insulating paper and remove moisture from the insulation prior to vacuum filling.
- R. Transformer shall be vacuum-filled with the appropriate fluid as indicated above. The process shall be of sufficient vacuum and duration to ensure that the core and coil assembly is free of moisture prior to filling the tank.

2.03 ACCESSORIES

- A. Transformer features and accessories shall include:
 - 1. Dial-type thermometer
 - 2. Liquid level gauge
 - 3. Pressure-vacuum gauge
 - 4. Drain valve with sample valve
 - 5. Pressure relief valve
 - 6. Non-PCB label
 - 7. Upper fill/filter press connection or valve

2.04 PRIMARY CONNECTIONS

- A. Transformer primary connections shall be 200 A deadfront load break wells and inserts for cable sizes shown on the drawings.

2.05 PRIMARY FUSING

- A. Provide the following fuses:
 - 1. Provide oil-immersed, loadbreak bay-o-net overload sensing fuses in series with under oil partial range current limiting fuses.

2.06 FINISH

- A. Transformer units shall include suitable outdoor paint finish. The paint shall be applied using an electrostatically deposited dry powder system to a minimum of three (3) mils average thickness. Units shall be painted padmount green, Munsell No.7GY3.29/1.5

PART 3 - EXECUTION

3.01 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest applicable ANSI and NEMA standards.
 - 1. Resistance measurements of all windings on the rated voltage connection
 - 2. Ratio tests on the rated voltage connection and on all tap connections
 - 3. Polarity and phase-relation tests on the rated voltage connections
 - 4. No-load loss at rated voltage on the rated voltage connection

5. Exciting current at rated voltage on the rated voltage connection
 6. Impedance and load loss at rated current on the rated voltage connection
 7. Applied potential test
 8. Induced potential tests
- B. The manufacturer shall provide three (3) certified copies of factory test reports to the Engineer upon request.

3.02 INSTALLATION

- A. Install equipment according to manufacturer's installation recommendations and installation requirements in addition to requirements herein and as shown.
- B. Install on concrete pad where shown on drawings. Transformer shall be installed level and plumb with the building construction.

3.03 FIELD ADJUSTMENTS

- A. The taps of the transformer shall be adjusted to produce the full rated voltage of the transformer at the service switchboard which is connected to the transformer secondary.

3.04 FIELD TESTING

- A. Measure primary and secondary voltages for proper tap settings.
- B. Megger primary and secondary windings.

END OF SECTION

SECTION 26 13 10
MEDIUM VOLTAGE SWITCHGEAR

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. SF6 insulated, electronically controlled fault interrupters.

1.02 REFERENCE STANDARDS

- A. IEEE C57.12.28, IEEE 37.72, IEEE 37.74, IEEE 37.60, IEEE 386
- B. National Fire Protection Association (NFPA).
1. NFPA 70 National Electrical Code.
- C. ASTM A167 (ASTM International) – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- D. IEEE C57.12.28 (Institute of Electrical and Electronics Engineers) – Pad Mounted Equipment - Enclosure Integrity.
- E. IEEE C37.74 (Institute of Electrical and Electronics Engineers) – Requirements for Subsurface, Vault, and Pad-Mounted Load-Interrupter Switchgear and Fused Load-Interrupter Switchgear for Alternating Current Systems Up To 38 kV.
- F. IEEE 37.112 (Institute of Electrical and Electronics Engineers) – Inverse-Time Characteristic Equations for Overcurrent Relays
- G. IEEE Std. 386 (Institute of Electrical and Electronics Engineers) – Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.
- H. IEEE Std. C37.62 (Institute of Electrical and Electronics Engineers) – Pad-Mounted Dry Vault, Submersible, and Overhead Fault Interrupters for Alternating Current Systems Up to and including 38 kV.
- I. NFPA 70 (National Fire Protection Association) – National Electrical Code.

1.03 QUALITY ASSURANCE

- A. Manufacturers:
1. G&W, or approved.

1.04 SUBMITTALS

- A. Shop Drawings:
1. Dimensioned outline drawings.
2. Required clearances.
3. Lifting and support points, equipment weight.
4. Schematic Drawings:
a. Single-line Drawings
b. Three-line Wiring Diagrams for:
1) Power
2) Control Systems
3) Differentiate between manufacturer-installed and field-installed wiring.
4) Annunciator

- 5) Generator connections/interties. Generator controls.
- B. Protective Relay Programmer (Programmer) Qualification from SEL, or approved indicating: Submit qualifications showing the following items.
1. Factory certifications.
 2. Understanding of required generator interties, including closed transition.
 3. Example settings summary and TCC's including monitored variable boundaries.
 4. Name of technician(s).
 5. Training experience (training of owners).
- C. Closeout Submittal:
1. Field Quality Control Test Results
 - a. Test procedures.
 - b. Test results.
 - c. Corrective action taken to achieve required functions.
 - d. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

1.05 QUALIFICATIONS

- A. Programming of Protective Relay (Programmer): Not less than 5-years experience programming specified relay. Factory trained; factory authorized. Not less than the following elements are required:
1. Calculations, formulas, settings, and documenting as-found, and as-left settings.
 2. Comprehension of project documents including but not limited to: Drawings, Specifications, Project manual, Shop drawings and the like.
 3. Protective Relay logic, and formulas.
 4. Event report interpretation, software interface, relay user interface, and input/output programming.
 5. Switching sequences, closed transition requirements, lock-outs, and latching.
 6. Relay monitoring, alarms, and remote outputs as well as SCADA interface.
 7. Medium Voltage experience, construction site, and safety protocols including, but not limited to NFPA 70 E.
 8. Arc-Flash hazards, and Arc-Fault ratings.
 9. Intertie with 3rd party equipment including power generation, utility, etc.

1.06 EXTRA MATERIALS

- A. Touchup Paint.
- B. Insulating covers for unused ways.

PART 2 - PRODUCTS

2.01 MEDIUM VOLTAGE PAD MOUNTED SWITCHES

- A. Ratings and Requirements
1. Construction shall be a dead front design. Switches shall be shipped factory filled with SF6 gas conforming to ASTM D-2472. Trident or approved dielectric switches also acceptable without additional cost.
 2. Each switching way is to be equipped with an internally mounted operating mechanism capable of providing quick-make, quick-break operation in either switching direction. Switch positions are to be clearly identified, padlockable and adaptable to keylock schemes. The operating mechanism shall be actuated from

outside the switch tank with an operating handle. The operating shaft shall be made of stainless steel. A double “O” ring type operating shaft seal shall be used. Switch contacts shall be plated, high-conductivity copper alloy with arcing tips of copper/tungsten alloy. The contacts shall be designed such that arcing does not occur in the area of main current interchange and contact pressure will increase with increased current flow. Stationary contacts shall be supported independent of the cable entrance bushings. Switch contacts shall be clearly visible in the open position through viewing windows.

3. Motor operator, or magnetic actuator for automatic closing of source ways. Motor operator or automatic (Trident or approved) to be included on all ways.
4. Maximum interrupting time shall be three cycles (50 msec). Movable contact shaft shall be flagged to indicate the contact position, open or closed.
5. Switch Ratings. The Switch shall be rated:

SELECTION OF RATINGS	IEEE/IEC
Maximum Design Voltage, kV	15.5
Load Break Switch Impulse Level (BIL) Voltage, kV	110
Fault Interrupter Impulse Level (BIL) Voltage, kV	95
Continuous Current, Amperes	630
Load break Current, Amperes	630
One Minute Withstand (dry), AC kV	35
Production Test Rating	34
15 Minute Withstand, DC kV	53
Momentary Current, kA, ASYM	40
Fault-Close Current, kA, ASYM	40
One Second Current, kA, SYM	25
Fault Interrupting Rating, kA, SYM	12.5
Mechanical Endurance, Operations	2000
Load Break Switch Operations at 600 Amperes	1200

6. Interrupters shall be tested to IEEE C37.60 Fault Interrupter Duty per the table below.

Percent of Maximum: Interrupting Rating	Approx. Interrupting: Current Amps	No. of Fault: Interruptions
15-20%	2000	44

45-55%	6000	56
90-100%	12000	16
Total Number of Fault Interruptions: 116		

2.02 CONSTRUCTION AND TESTING

- A. Each switch shall undergo the following production testing. Test reports must be available upon request.
 - 1. Each switch shall be factory filled with SF6 gas. The gas shall be checked for moisture content. N/A to Trident or approved system.
 - 2. Each switch shall undergo an SF6 leak check to verify the integrity of the tank, seals, and gaskets. N/A to Trident or approved system.
 - 3. A mechanical operation check of each switching mechanism.
 - 4. AC hi-pot tested one minute phase-to-phase, phase-to-ground and across the open contacts.
 - 5. Circuit resistance shall be checked.
 - 6. Primary current injection test to test CTs, trip mechanism, and electronic control.

- B. Switch Configuration & Construction
 - 1. Pad mount Enclosure
 - a. The enclosure shall be fabricated of 12-gauge galvanized steel and manufactured to ANSI C37.72 and C57.12.28 standards. The enclosure shall be tamper-resistant incorporating hinged access doors with penta-head locking bolts and provisions for padlocking. The enclosure shall be provided with lifting provisions and painted matching generator enclosure color, light brown.
 - b. Each switch shall be equipped with 3-phase load break switch ways and 3-phase fault interrupter ways configurable for 1-phase or 3-phase operation.
 - c. Switches shall be designed for front access to cables and operators.
 - 2. Quick disconnect fitting to remove the pressure gauge without loss of SF6 gas as applicable.
 - 3. Provisions to mount a key interlock after installation.
 - 4. Auxiliary switches to mount two (2) Form C contacts for remote switch position indication of the load break switch.
 - 5. Auxiliary switches to mount two Form C contacts for remote switch position indication of the fault interrupter.
 - 6. Junction box for wiring alarms, remote switch position contacts, or external power source for Electronic Control.
 - 7. Operation counters.
 - 8. Elevated height for pad mount (no vault).

- C. Cables Entrances
 - 1. 600-amp G&W Quik-Change disconnectable apparatus bushings.
 - 2. Parallel connections for every way, loop, and spare.

- D. Components
 - 1. The following shall be included as standard:
 - a. Mild steel tank. Eliminate if Trident or approved.
 - b. Fixed operating handles for each load break switch and fault interrupter.
 - c. Gas pressure gauge and fill valve.

- d. Sufficient grounding provisions for all cable entrances.
 - e. Stainless steel three-line diagram and corrosion-resistant nameplates.
 - f. Switch operating handles with padlock provision.
 - g. Parking stands for each bushing.
 - h. (1) viewing window per load break switch to view open contact position.
 - i. (1) viewing window per fault interrupter to view vacuum bottle position.
 - j. Provision to mount future low-pressure alarm.
 - k. Status annunciator.
2. Control Station
 - a. Provide in NEMA 4X or greater sealed enclosure with environmental controls as required (active/passive ventilation, heating, humidity control, etc.). Provide humidistat, thermostat, etc. as required to maintain environmental requirements of equipment installed.
 - b. Lockable
 - c. Additional enclosure allocation space for required UPS, batteries, remotes, etc. as required.
3. Insulation
 - a. Solid dielectric.
4. Voltage Sensors:
 - a. As required, internal mounted
 - b. Accuracy +/- 2%, ratio as required for 12,470V Line-to-Line 3-Phase.
5. Integral control/access power.
 - a. No shore/Auxiliary connections to equipment available. Fully self-contained.
 - b. Provide integral transformers as required.
6. Protective Relays:
 - a. Schweitzer Engineering Laboratories (SEL) matching facility communication & automation standard.
 - b. Flush Mounted, or Semi-Flush mounted Microprocessor controlled (IEEE C37.90) protection relay with LED status, LCD interface. Factory integrated (Field fabricated kits are not permitted).
 - c. Inputs (Protection Functions): adjustable, not less than the following for each way:
 - 1) Way Interlock (ATS, Utility Isolation)
 - 2) Way Make before Break (Closed Transition)
 - 3) DC Battery Monitor
 - 4) UPS Monitor
 - 5) Sequential Events Recorder
 - 6) Breaker Failure Protection
 - 7) Breaker Wear Monitor
 - 8) Breaker Open/Manually Operated Monitor (See Alarms)
 - 9) 27 (Undervoltage)
 - 10) 32 (Power Monitoring)
 - 11) 50P (Phase Instantaneous Overcurrent)
 - 12) 50G (Ground Instantaneous Overcurrent)
 - 13) 50N (Neutral Instantaneous Overcurrent)
 - 14) 50Q (Negative-Sequence Overcurrent)
 - 15) 51P (Phase Time Overcurrent)
 - 16) 51G (Ground Time Overcurrent)
 - 17) 51N (Neutral Time Overcurrent)
 - 18) 51Q (Negative-Sequence Time Overcurrent)

- 19) 55 (Power Factor)
 - 20) 59 (Overvoltage)
 - 21) 59G (Zero-Sequence Overvoltage)
 - 22) 59Q (Negative-Sequence Overvoltage)
 - 23) 81 (Frequency)
 - 24) LOP60 (Loss of Potential)
- d. Outputs: Not less than one per protection device shown. Contact Ratings 6A continuous, 30A surge, 125V DC. High-speed, each interconnected with protection, switching, and controls, along with interlocking/lock-out as required. Include test function, test switch each.
 - e. Alarm Contacts: Provide alarm contacts as required for alarm functions specified herein. Additional alarms to include:
 - 1) General Relay Fault/Failure.
 - 2) Battery voltage monitor. Adjustable limits for:
 - a) Low level warning
 - b) Low level fail
 - c) Charger, Fault
 - d) UPS Fault
 - f. Breaker/Switch Status-
 - 1) Manually Open
 - 2) Motor/actuator Operator Fault
 - 3) Fail to Close
 - g. Annunciator requirements
 - 1) Visible without requirement to open enclosure, audible from 5-feet from closed enclosure.
 - h. IRIG-B: The relay shall include an interface port for a demodulated IRIG-B time synchronization input signal. The relays shall generate a time synchronizing signal to provide a synchronizing signal to other relays.
 - i. Communications Protocols: The relay shall come equipped with following protocols, whether used by application or not. Refer to paragraph titled "AUTOMATION" of this Section for supervisory, control, and data acquisition requirements.
 - 1) Protocols shall include ASCII, Compressed ASCII, DNP3.0, IEC61850, IEEE C37.118 Synchrophasor data, Telnet, FTP, Modbus, and Mirrored Bits.
 - 2) Digital Relay-to-Relay Communications. The relay shall include send and receive logic elements and provide analog and virtual terminal service in two communications ports for dedicated relay-to-relay communication.
 - 3) IEC 61850 Ethernet Communications. The relay shall provide IEC 61850 compliant communications. The IEC 61850 capability shall include GOOSE messaging and defined logical node data points.
 - j. Communications Ports: Provide ports as follows.
 - 1) Front EIA-232 serial port for uploading and downloading settings, event reports, and data via laptop computer.
 - 2) Port 1 shall be dual redundant 100Base-FX multimode fiber ports for Ethernet communications. Ports shall operate in failover mode. Ports shall support FTP file transfer protocol,

- IEEE 61850 protocol, IEEE 61850 GOOSE messaging, and DNP 3.0 protocol with up to three DNP sessions.
- 3) Port 2 shall be serial fiber port supporting Mirrored Bits protocol for transfer tripping.
 - 4) Port 3 shall be serial EIA-232 port supporting ASCII, DNP, MOD, EVMSG, and PMU.
 - 5) Port 4 shall be serial EIA-232 port supporting ASCII, DNP, MOD, EVMSG, and PMU.
7. Real Time Automation Controller (RTAC):
 - a. Provide an RTAC for every two pad mounted switches located in the same vicinity.
 - b. Manufacturer: Schweitzer Engineering Laboratories – Model SEL-3505 platform.
 - c. Substitutions: Approved equal.
 - d. Real Time Automation Controller (RTAC).
 - e. Product Description: Microprocessor based, substation hardened, real time automation controller.
 - f. Power Supply: 24 volts DC.
 - g. Ethernet Connections: One single mode 100BASE-FX fiber optic connection and one 10/100 BASE-T Ethernet connection.
 - h. Input/Output (IO): 1 Outputs, 1 Inputs rated for 24 volts DC.
 - i. Client Protocols: SEL, DNP3, Modbus, IEEE C37.118 Synchrophasors, L&G 8979, and IEC 61850 MMS.
 - j. Server Protocols: SEL, DNP3, Modbus, IEEE C37.118 Synchrophasors, L&G 8979, SES- 92, and IEC 60870-5-101/104.
 - k. Peer to Peer Protocols: Mirrored Bits and IEC 61850 GOOSE.
 - l. Rear Serial Ports: Four EIA-232 serial ports.
 - m. Conformal Coating: Provide conformal coating for outdoor substations within 1 mile of salt water.
 8. Batteries, Charger, and UPS
 - a. Provide battery(ies), charger(s), and UPS('s) as required.
 9. Voltage Transformer Connection:
 - a. Provide 600A loop-feed bushing for connection to and external voltage transformer. See One-Line.
 10. Factory Production Tests
 - a. Each way (and interrupter) be factory tested as follows. Test reports shall be submitted with O&M manuals. Owner expressly does not accept equipment (or delivery of such) if any required test is indicated as failed, and/or not passed.
 - 1) Circuit resistance.
 - 2) Mechanical operational check.
 - 3) Each solid dielectric module shall be inspected for voids. Include X-ray or other non-contact penetration inspection with partial discharge to verify void-free materials.
 - 4) AC hi-pot test for not less than one minute phase-to-phase, phase-to-ground and across open contacts at limits per reference standards herein.

E. Labeling

1. Hazard Alerting Signs:

- a. The exterior of the pad mount enclosure shall be provided with “Warning--Keep Out--Hazardous Voltage Inside--Can Shock, Burn, or Cause Death” signs. Each unit of switchgear shall be provided with a “Danger--Hazardous Voltage--Failure to Follow These Instructions Will Likely Cause Shock, Burns, or Death” sign. The text shall further indicate that operating personnel must know and obey the employer’s work rules, know the hazards involved, and use proper protective equipment and tools to work on this equipment. Each unit of switchgear shall be provided with a “Danger--Keep Away--Hazardous Voltage--Will Shock, Burn, or Cause Death” sign.
2. Nameplates, Ratings Labels, and Connection Diagrams:
 - a. Each unit of switchgear shall be provided with WP nameplate indicating the manufacturer’s name, catalog number, model number, date of manufacture, and serial number. Each unit of switchgear shall be provided with a WP ratings label indicating the following: voltage rating; main bus continuous rating; short-circuit rating; fault interrupter ratings including interrupting and duty-cycle fault-closing; and load break switch ratings including duty-cycle fault-closing and short-time.

2.03 ELECTRONIC CONTROL

- A. An electronic control shall be provided to monitor load and fault current on all three phases of the fault interrupter. Each phase shall have a current transformer mounted inside the switch tank to provide control power and current sensing. No external power source shall be required for overcurrent protection. Operational temperature range of the control shall be -40°C to +65°C. Maximum time for power up and ready-to-trip when closing on a circuit shall be ten percent of the trip time or 1/2 cycle, whichever is greater. Trip selection may be made with the fault interrupter energized.

Type 3 Plus

The control shall include 60 pre-loaded and 5 user created time current characteristic (TCC). All setting options shall be accomplished using the Vacuum Fluorescent Display or a computer. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. The control shall allow for multiple curve modification options for each minimum trip setting (phase and ground) including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. The control shall allow for two settings groups (protection and alternate). The control shall allow for two TCC curves for each protection settings group (one for phase and the other for phase imbalance (ground fault)). The control shall include an option for single or three phase trip (Phase Imbalance/ Ground Fault shall not be available when the control is set for single phase trip). The control shall include a Sequence of Events Recorder (SER) which shall include the last 16 causes of trip. The control programming software shall include password protection, the ability to download the SER, and the ability to save and print setting files.

Type Protection Relay

Include every function specified by type selected, plus functions as identified herein (Protective Functions) customized for specific installation.

[SEL relay protection settings per generator manufacturer]

Provide additional as shown on one-line. Auxiliary trip input for generator. Closed transition, generator controls, and cool down timers, etc. as required. Remote fault/alarm annunciation. Type electronic control selected, functions may be by protection relay such

that Type 1, Type 3 EZ Set, Type 3 Plus are not required provided protection relay provides each function included, and additional required.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install pad mounted switchgear on concrete pad in accordance with manufacturer's instructions. Provide vibration isolation.
- B. Verify mounting supports are properly sized and located.

3.02 IDENTIFICATION

- A. Provide additional warning and caution signs where indicated or required by the Authority Having Jurisdiction.

3.03 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to startup, program, or program verify, and inspect installation of the equipment. The manufacturer's representative shall provide technical assistance, and direction as required for a complete operational system as specified, intended, and required.

3.04 CLEANING

- A. Clean complete exterior and interior of equipment free of construction splatters, dirt, debris, etc.

3.05 TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel in accordance with the following.
 1. Train maintenance personnel for estimated 4 hours. Include training on alarms, maintenance, maintenance schedules, automatic operation, service calls, programmer contact, emergency procedures, servicing, etc.
 2. Lock-out protections
 3. Train system as a whole- Protection Relay, and Pad Mounted Switch as system
 4. Digitally record training
 5. See General Electrical Provisions for additional training requirements.
 6. G&W, or approved.

END OF SECTION

SECTION 26 24 16 SWITCHBOARDS

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide switchboards to include protection, switching, required interconnections, instrumentation and control wiring for a complete and satisfactory operating system.
- B. Relocate (E) switchboard in Chiller Building.

1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturer's Association (NEMA)
 - 1. NEMA PB-2: Dead-Front Distribution Switchboards
 - 2. NEMA KS-1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- B. Underwriters Laboratories (UL)
 - 1. UL 891: Standard for Dead-Front Switchboards
 - 2. UL 50: Standard for Enclosures for Electrical Equipment
 - 3. UL 869A: Reference Standard for Service Equipment

1.03 QUALITY ASSURANCE

- A. Acceptable Manufacturers: Eaton, Square D, or approved.
- B. (E) Relocated is siemens (ITE).

1.04 SUBMITTALS

- A. Shop Drawings:
 - 1. Certified elevations, power and control diagrams, material list.
 - 2. Individual circuit breakers, switches, ground fault, instrumentation.
- B. Tripping Coordination:
 - 1. Tripping curves of adjustable circuit breakers and fuses.
 - 2. Manufacturer's recommended settings of time delays and adjustments of adjustable circuit breakers which demonstrate selective coordination.

PART 2 - PRODUCTS

2.01 CONSTRUCTION

- A. General:
 - 1. Switchboards completely factory assembled, wiring and tested before delivery.
 - 2. Each switching and circuit protective device to have visible ON/OFF permanent labeling, and rating information.
 - 3. Construct for seismic zone where equipment is installed.
 - 4. Fault current not less than 65,000 AIC.
 - 5. Provide Surge Protection Device.
- B. Frame & Enclosure:

1. Deadfront type with metal enclosed, self-supporting vertical sections bolted together to form a rigid assembly incorporating switching and protective devices. Structures shall be die-formed frame members bolted and braced with captive self-tapping bolts. Side, top, front and rear covers are code gauge steel with formed edges and are bolted to the switchboard structure.
 2. Provide ventilation openings where required.
 3. Self-supporting structure independent of wall supports.
 4. Depth: Adequate to accommodate safe mounting and connecting of equipment.
 5. Sections shall align flush and plumb with each other.
 6. Top and rear shall be covered with removable captive screw-on plates having formed edges all around.
 7. All covers secured by self-tapping screws, or screws with captive nuts.
- C. Bussing:
1. Tin plated aluminum of sufficient size to limit temperature rise to 65oC based on UL tests.
 2. Brace per available fault current.
 3. Connections bolted using plated hardware.
 4. A-B-C type bus arrangement, arrangement as required for installation.
 5. Supply main bus splices between adjacent distribution sections.
 6. Neutral Bus: Full size. Bond to ground bus in main service switchboard at one point per Code.
 7. Ground Bus: 50% size. Furnish bus and lug extending entire length of switchboard. Firmly secure to each vertical section structure. Shall ground switchboard enclosure.
- D. Conductors Lugs:
1. Bolted to bus or circuit breaker.
 2. Rated Al/Cu.
- E. Doors:
1. WP where required, show swing on submittal.
 2. Locking type
 3. Door swing shall not conflict with other doors on switchboard, or equipment where installed. Fully open, each section such that no one section door operation impedes another section door operation and/or from opening fully 90-degrees
- F. Finish: Exterior and interior steel surfaces properly cleaned and finished with industry standard gray baked enamel over a rust-inhibiting phosphatized primer coating approved by the paint manufacturer. All hardware to be plated.

2.02 PROTECTION EQUIPMENT

- A. Circuit breakers are to be completely front accessible and front connectable.
- B. Breakers are to be mounted in switchboard to permit installation, maintenance, and testing without reaching over any line side bussing.
- C. No common mounting brackets or electrical bus connectors.
- D. Breaker connections requiring leaf and coil springs which could loosen or fly apart during a fault are not acceptable.

2.03 MOUNTING PAD

- A. Solid Concrete with screed off top, troweled smooth, beveled edge. 3.5 inches high, length and width to match equipment or not more than 1.5 inches wider than equipment.
- B. Where switchboards are installed over a combustibile floor, provide suitable non combustibile material on the floor under the equipment in conformance with NEC.

2.04 IDENTIFICATION

- A. General:
 - 1. Per NEC
 - 2. Nameplate Location: On switchboard exterior, visible from working space.
- B. Manufacturers Nameplates: Each vertical section to have a metallic nameplate indicating manufacturer's name, assembly date, switchboard type, ratings, bus bracing and factory order number.
- C. Installation Nameplate: Provide phenolic nameplate near switchgear with the following information:
 - 1. Project Name
 - 2. Installing contractor
 - 3. General Contractor
 - 4. Firms: SHN Engineering, Fluent Engineering, Inc.
 - 5. Electrical Engineer of Record: "Matthew J. Cash, PE"
 - 6. Date Installed
- D. Switchboard Nameplate:
 - 1. Location: Switchboard top center
- E. Service Disconnects Nameplate:
 - 1. Type: Phenolic
 - 2. Wording: "SERVICE DISCONNECT".
 - 3. Location: Adjacent to each switch or breaker that serves to disconnect the utility power source.
 - 4. Where alternate sources of power are installed, provide fixed sign per NEC 700.8.
- F. Individual Switches and Breakers:
 - 1. Indicate Load served (equipment name).
 - 2. Mount Adjacent to handle.

2.05 POWER ONE-LINE DIAGRAM – INTERIOR LOCATIONS

- A. Provide record building one-line diagram in room with switchgear. Laminate, and mount near switchboard.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Align bus sections before bolting. Tighten with torque wrench. Torque to manufacturer's requirements.
- B. Level and securely fasten switchboards to mounting pads. Utilize all mounting hardware included with switchboard.
- C. Check all internal bus connections prior to enclosing. Re-torque as required.

- D. Provide adequate cable supports for cables entering switchboards from point of entry to termination.

END OF SECTION

SECTION 26 24 18
SURGE PROTECTION DEVICE (SPD) EQUIPMENT

PART 1 - GENERAL**1.01 DESCRIPTION**

- A. Provide surge suppression device (SPD) (previously known as TVSS- Transient Voltage Surge Suppression) equipment for the electrical distribution system.

1.02 REFERENCE STANDARDS

- A. Underwriters Laboratories (UL)
1. UL 1449 Standard for Transient Voltage Surge Suppressers
 2. UL 1283 Standard for Safety for Electromagnetic Interference Filters
- B. American National Standards Institute (ANSI)
1. C62.41 IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

PART 2 - PRODUCTS**2.01 INTEGRAL SWITCHBOARD/UNIT SUBSTATION SURGE SUPPRESSOR**

- A. Provide in every Switchboard.
- B. Unit shall be rated for Category C location per ANSI/IEEE C62.41-1991.
- C. Unit shall be factory integrated into switchboard.
- D. Each unit module shall be fused with a surge rated fuse and incorporate a thermal cutout device.
- E. Minimum surge current capability shall be 120,000 amperes per phase, measured between L-N & L-G.
- F. Unit diagnostics, mounted in distribution equipment, shall include the following:
1. Operational LEDs to indicate loss of protection and circuit fully operational for each protection status.
 2. Dual LCD surge counter for L-N and L-G modes
 3. Audible alarm with silence toggle switch
- G. The internal design of the unit shall have a minimum EMI/RFI filtering of -50 dB from 100kHz to 100MHz.
- H. The UL 1449 Listed and Recognized Component Suppression Voltage ratings shall not exceed:
1. 330 Volts for 120/208 or 240 voltage configurations.
 2. 700 Volts for 480 voltage configurations.
- I. All required "burn-in" tests shall be conducted at factory, prior to shipment.
- J. Rated not less than 200,000 AIC.
- K. Acceptable manufacturer: Advanced Protection Technologies, by switchboard manufacturer, or approved.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. System shall be complete.
- B. Comply with applicable Sections of this Division.

3.02 WARRANTY

- A. Full five year warranty by manufacturer and includes unlimited replacement of all components.

END OF SECTION

**SECTION 26 27 26
WIRING DEVICES****PART 1 - GENERAL****1.01 WORK INCLUDED**

- A. Wall Switches.
- B. Receptacles.
- C. Ground Fault Receptacles.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI).
 - 1. C73 Series Dimensions of Attachment Plugs and Receptacles.
- B. National Electrical Manufacturer's Association (NEMA).
 - 1. WD 6 Wiring Devices- Dimensional Requirements
 - 2. WD 1 General Color Requirements for Wiring Devices.
- C. National Fire Protection Association (NFPA).
 - 1. NFPA 70 National Electrical Code.
- D. Underwriters' Laboratory (UL).
 - 1. UL-20 Standard for Snap Switches.
 - 2. UL 498 Attachment Plugs and Receptacles
 - 3. UL 467 Grounding and Bonding Equipment
 - 4. UL 514D Cover Plates for Flush-Mounted Wiring Devices
 - 5. 2006 UL 943 Safety for Ground-Fault Circuit-Interrupters

1.03 QUALITY ASSURANCE

- A. Provide type 5362 receptacles.
- B. Acceptable Manufacturers: Hubbell, Pass and Seymour, Arrow-Hart, Leviton, or approved

PART 2 - PRODUCTS**2.01 MATERIALS**

- A. Switches: 120/277 Volt. AC Quiet, slow make, slow break design, toggle style handle, with totally enclosed case, 20 Ampere, specification grade. Provide matching two-pole, three-way and four-way switches.
- B. Receptacles: 20 Ampere (unless otherwise indicated), 125 Volts (unless otherwise shown), duplex, polarized, full gang size, specification grade, separate ground terminal, 20 Amp. break-off tab for split circuit wiring.
- C. Ground Fault (GFI) Receptacles: 20 Ampere, specification grade duplex receptacle with integral ground fault circuit interrupter. LED operation indicator. Test and reset buttons. End of life protection- GFI component failure results in no power delivered to equipment (2006 UL 943).
- D. Wall Plates: 302 Stainless Steel, Match device configuration.

- E. Colors:
 - 1. Gray Receptacles, Gray Switches: In finished areas that are not dark brown in color.
 - 2. Brown Receptacles, Brown Switches & Brown Nylon Wall Plate: In finished areas with dark brown or dark wood finish.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Do not use back wiring wells, terminate conductors on mechanical screw terminals.
- B. Do not use GFI-Feed through function, GFI receptacles with test, reset, etc. required at each location where GFI is required.
- C. Provide Tamper Proof type receptables where children may be present. Provide in common areas open to the public including bathrooms, and any other area open to the public. Provide in areas where children may visit. Provide also in areas per NEC. Generally, Tamper Proof is not required: on Roofs, on Ceilings, in Mechanical/Electrical Rooms.
- D. Provide wiring devices as shown.
- E. Install devices plumb and consistent with building lines. Wall Plates shall make contact on four corners and shall fit flush with device.
- F. Devices to include same configuration outlet box, cover, wall plate and other necessary installation materials for a complete operating circuit.
- G. Mount switches 42 inches (to center line of faceplate) above floor except as otherwise noted on the Drawings.
- H. Coordinate mounting locations with architectural details.
- I. Mount receptacles vertically at 15 inches (to bottom of faceplate) above finished floor, with grounding pole at bottom.
- J. Coordinate receptacle height with benches and counters.
- K. When mounting receptacle above bench or counter, mount receptacle to the side with grounding pole at left.
- L. Where installed with disposal: Provide split switched GFI receptacle (or GFI via Breaker) for receptacles mounted under sinks. Provide switch for ½ duplex receptacle in approved ADA location such as under sink within counter, or above counter if ADA accessible. Delete switch if air-switch or other control device is specified.
- M. Grounding: Install a separate bare conductor between the receptacle strap grounding (green) screw and a screw into the outlet box. Self-grounding strap not approved as grounding means.
- N. Where existing receptacle circuiting is changed to emergency power, remove existing receptacle, and replace with distinctive color per NEC. Replace with like receptacle removed including GFI, AFCI, etc.1

END OF SECTION

SECTION 26 29 12
DISCONNECTS & MANUAL STARTERS

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Provide motor disconnects as shown, and as required by Codes.
- B. Provide circuit disconnects as shown, and as required by Codes.
- C. Provide manual motor starters for single phase motors below one horsepower where disconnect is shown as required by Codes.
- D. Disconnects to include adequate support, required hardware, and accessories for complete functional installation.
- E. Section provided for contingency.

1.02 APPLICABLE REGULATION

- A. Conform to National Electrical Code and inspection authority.
- B. Provide disconnects rated for the location installed, as required by National Electrical Code, as shown, and as indicated herein.

1.03 REFERENCE STANDARDS

- A. Underwriters' Laboratory (UL).
 - 1. UL-98 Enclosed Switches.
- B. National Electrical Manufacturer's Association (NEMA).
 - 1. NEMA KS-1 Enclosed Switches.

PART 2 - PRODUCTS**2.01 MANUAL MOTOR STARTER**

- A. Toggle horsepower rated, switch with thermal overload and pilot light.
- B. Switch tab for locking switch in "OFF" Position.

2.02 DISCONNECT

- A. Motor and circuit disconnects shall have a UL label.
- B. Construction: Dry, Indoor Locations shall be not less than NEMA 1. Enclosures for outdoor, or wet locations shall be not less than NEMA 3R. Rated at 600 Volt. Operational handle on outside of enclosure. Heavy duty, quick make, quick break. Number of poles and ampacity as noted or required by Code. Fusible with dual element fuses where shown. Short circuit rating sufficient to withstand the available fault current. Solid ground, solid neutral.
- C. Compression lugs or set-screw lugs approved for use with copper wire.
- D. ON/OFF Positions clearly marked.
- E. Lockable in "OFF" position.

- F. Interlock:
 - 1. Prevents switch from being opened when "ON."
 - 2. Prevents closing switch when cover is open.
 - 3. Provide defeater to permit authorized personnel to open door and inspect switch when "ON," or operate with cover open.

2.03 COMBINATION MOTOR STARTER AND DISCONNECT

- A. Include features of Disconnect above.
- B. Provide molded case magnetic only circuit breakers with operating handle and lock-off facility.
- C. Provide contactors with three overload relays.
- D. Holding coil at 120 Volts.
- E. Provide pilot lights in cover, red & green neon or LED type.
- F. Provide reset button, and Hand-Off-Automatic switch in cover, field convertible to Off/Auto or Start/Stop momentary pushbutton.
- G. Provide starters with a sufficient number of auxiliary contacts (N.O. and N.C.) to afford the control and interlocking required in addition to standard auxiliary holding contacts supplied with each contactor.
- H. Provide control transformer with 120 volt secondary voltage of sufficient capacity to handle operating coil and associated controls. Protect transformers with fuses on primary and secondary sides of transformers as required by Code.
- I. Minimum size NEMA 1.
- J. Enclosure for dry, indoor locations: NEMA 1, drip-proof. Others as required by location.

PART 3 - EXECUTION

3.01 INSTALLATION

- 1. Install motor and circuit disconnects as recommended by manufacturer, required by Code, required by UL, and where shown.
- 2. Maintain Code clearances and access.
- 3. Provide Manual Motor Starter where shown for single phase motors rated less than one horsepower. Manual Motor Starter is not required for motors with integral thermal overload protection. Provide Switch with locking tab for motors with integral thermal overload protection. Provide Manual Motor Starters as required for single phase motors without integral or other protection, otherwise provide Disconnect.
- 4. Provide a phenolic nameplate on each disconnect identifying the equipment item served.
- 5. Independently support disconnects. Do not mount disconnects on vibrating, HVAC, or Plumbing equipment.
- 6. Install heaters correlated with full load current of motors provided.
- 7. Set overload devices according to measured current of motors provided.

END OF SECTION

SECTION 26 33 13
EMERGENCY POWER PACKS

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Emergency Lighting Battery Power Packs

PART 2 - PRODUCTS**2.01 GENERAL**

- A. Power packs shall be UL listed and conform to Code requirements for emergency power devices.
- B. Power packs shall fit into physical space allotted for such by lighting equipment manufacturer with temperature limits and heat transfer protections. Mount in ballast compartment, or external for retrofit fixtures only.
- C. In upgrades to existing fixture applications emergency power pack to be located concealed above drop ceiling unless unsupported for specified power pack. Provide mounted near or on-top of fixture in fire rated enclosure. IC rated where required and meeting enclosure, fire, and temperature rating by power pack manufacturer.

2.02 OPERATION

- A. Unit shall be capable of powering the specified lamp combinations for not less than 90 minutes at full operating lumens of the lamp(s).
- B. Include provision for switched battery packs.
 - 1. Lamp(s) switch ON/OFF under normal power conditions. Switched circuit shall be bypassed under emergency power conditions or loss of normal power.
- C. Provide self-testing system
 - 1. Automated self-testing. If problem is detected, status indicator light flashes, and an audible alarm is heard
 - 2. Automated test schedule, unit switches to and operates on its emergency power:
 - a. 30 seconds every 30 days
 - b. 90 minutes once a year if permitted by AHJ

2.03 CONSTRUCTION

- A. Solid-State, high frequency output, remote battery pack with the following:
 - 1. Transfer relay
 - 2. Sealed, Self-restoring battery charger
 - 3. Transistor type inverter ballast
- B. Remote test switch and disarrangement signal indicator light to be flush wall mounted. Provide nameplate "Emergency Light Test Switch"
- C. Suitable for operation on either 120 or 277 Volts.
- D. Self-Testing system with visual, and audible alarm.

2.04 QUALITY ASSURANCE

- A. Acceptable manufacturer: Bodine or approved.
- B. Basis of Design: Bodine with remote test switch, plate, and audible alarm.
- C. Initial Contractor Testing: After initial full charge, test emergency power units by shutting down normal power for over 90 minutes. Replace any units that fail prior to 90 minutes. Coordinate test schedule with Engineer.
- D. Warranty: Provide 5-year product warranty.

PART 3 - EXECUTION

3.01 MOUNTING – REMOTE TEST SWITCH

- A. Mount remote test switch near fixture, and in location approved by Owner, Architect, and AHJ.
- B. Mount on drop ceiling where power pack installed with ACT, or where approved by AHJ.
- C. Mount in accessible locations where power pack installed in hard-lids.

END OF SECTION

**SECTION 26 51 13.10
LAMPS – LED MODULES**

PART 1 - GENERAL

1.01 WORK INCLUDED

- A. Provide and install lamps in all light fixtures as required in this Division and shown.

PART 2 - PRODUCTS

2.01 LED MODULES

- A. 80 to 90+ CRI, 4000K color temperature unless otherwise indicated on lighting schedule.
- B. Full compatibility with provided driver. Driver to be dimmable where specified and compatible with specified emergency power solution.
- C. LED drivers to be fully protected, last not less than 7 years, and include integral surge protection.
- D. 0-10V DC Dimming where indicated with dimming.
- E. 0-10V DC Dimming when included as standard no additional costs.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install lamps in accordance with manufacturer's instructions.

3.02 WARRANTY

- A. Provide not less than 5 year warranty for LEDs. Provide greater as included by manufacturer. Provide replacement labor allowance.

END OF SECTION

**SECTION 26 51 13.20
LIGHTING FIXTURES**

PART 1 - GENERAL**1.01 WORK INCLUDED**

- A. Provide complete, supported, trimmed and finished lighting system operational for the use intended.

1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturer's Association (NEMA).
- B. American National Standards Association (ANSI)
 - 1. ANSI C62.41 IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
- C. Underwriters Laboratories (UL)
 - 1. UL 1598 Luminaires
 - 2. UL 1029 Standard for High-Intensity-Discharge Lamp Ballasts
 - 3. UL 8750 Safety Standard for Light Emitting Diode Equipment for Use in Lighting Products
- D. National Fire Protection Association (NFPA)
 - 1. NFPA 70 National Electrical Code
- E. Oregon Energy Code

1.03 COORDINATION

- A. Verify compatibility and coordination of other materials with luminaire and ceiling system, and mounting system. Inform discrepancies to the Architect, and do not order until clarified.
- B. Coordinate with Division 23 to avoid conflicts with mechanical equipment.

1.04 QUALITY CONTROL

- A. Acceptable Manufacturers- Refer to Fixture Schedule.

PART 2 - PRODUCTS**2.01 GENERAL**

- A. Provide support and trim hardware required for adequate support and approved appearance of mounted equipment.
- B. Factory balanced. Provide concealed weighted material to offset ballast and other component weight. Fixtures that do not hang or mount level are not acceptable.
- C. Provide A12 lens, semi-diffuse, not less than 0.125 thick acrylic or per lighting fixture schedule.
- D. Fixtures installed in insulated cavities shall be IC rated.

- E. Provide fire rated enclosures for all fixtures installed in fire rated structures and fire rated ceilings. Enclosure shall be of the same rating as to not compromise the full rating of the structure where installed. Fixtures used in fire rated enclosures shall be UL listed for such installation and shall have 3-inches clear from enclosure on all sides.
- F. Equipment shall be certified, and approved per Oregon Energy Code.

2.02 LED LUMINAIRES

- A. Painted finish, no exposed materials with potential to oxidize. Additional or other requirements per Lighting Fixture Schedule.
- B. Not less than 20-gauge steel housing and reflectors unless otherwise indicated and per light fixture schedule.
- C. Provide Hinged Frames with Catches; removable for cleaning without tools. Support lay-in lenses on four sides with flip ends on short dimension. Include captive removable and reusable hardware to secure lens to frame.
- D. Design Luminaire to adequately dissipate heat from LEDs/lamp, driver/ballast, and battery pack.
- E. Provide formed endplates and trim.
- F. Suitable for mounting where shown.

2.03 RECESSED LUMINAIRES

- A. Conductors rated for area and for conductor connections.
- B. Flush and plumb with exposed surface, no gaps, include required trim rings and materials of adequate type for flush appearance.

2.04 PENDANTS/CABLE HANGERS

- A. Pendant: Shall be contiguous, and color matched to fixture. Pendant type shall include swivel sockets permitting normal fixture motion and self-adjustment. Include color matched canopy at structural attachment. Provide safety cables secured to structure, wrapped around or through pendant where recommended by fixture manufacturer to independently support fixture. Route conductors through pendant as per manufacturer requirements.
- B. Visible Cable: Field adjustable length, with extra coiled and concealed. Equal lengths, with 18-inches. Additional cable and for future adjustments. Locking ring to adequately hold fixture at desired mounting height. Cable stop to prevent fixture from sliding off end of cable.
- C. J-Box at Ceiling (may be in addition to J-box at structure), separately supported, per NEC.

2.05 CABLE HUNG FIXTURE CORDS

- A. Visible Cords: Straight (not pigtail type) along length of cable, black, by fixture manufacturer. Shall not provide supporting function.

PART 3 - EXECUTION

3.01 GENERAL

- A. Replace any damage to fixture, lamps, lens, or other lighting components with new fixture. Damage includes paint spray, and other construction materials adhering to fixtures. Damage or altering fixture as a result of mounting or placing fixture into applicable space is not acceptable.
- B. Install per requirements of Oregon Energy Code.
- C. Provide 0-10V dimming if included as standard, or as specified, and/or shown. The lighting fixture schedule and fixture dimming indication, and/or fixture includes dimming as standard has been developed with this requirement, and intends to include dimming in areas where fixtures are provided with dimming, even when fixtures include dimming without a specific indication on the lighting plans/schedule that dimming is required.

3.02 COORDINATION

- A. See Reflected Ceiling plan for exact location of equipment and ceiling construction.
- B. See Finish Schedule for additional finish requirements.
- C. Coordinate fixture mounting system prior to ordering fixtures.
- D. Provide price breakdown accounting as required and requested by Oregon Energy Trust, or Engineer.

3.03 ACCESS

- A. All fixtures shall have Code accessible supplies. Use reach-through type where recessed in non-accessible spaces.

3.04 SUPPORT

- A. Suspended ceiling:
 - 1. Attach light fixtures to the suspended ceiling system where installed. Attachment shall have capacity of 5 times fixture weight in all directions.
 - 2. Support fixtures with not smaller than number 12 AWG hangers attached to the grid members within 3 inches of the corner of each fixture, attached to building structure.
 - 3. Attach two not smaller than number 12 AWG hangers from the fixture housing to the building structure.
 - 4. Support pendent-hung lighting fixtures directly from the structure above with not smaller than number 9 AWG wire or approved alternate support.
 - 5. J-box at every fixture mounted to structure.
- B. Support all fixtures from structure rated at least five times support weight.
- C. J-box for every suspended or recessed in suspended ceiling fixtures.

3.05 SURFACE MOUNTING

- A. Attach with mechanical means to secure fixture flush with structure. Attach at each corner of fixture not less than four places to building structure. Round fixtures shall be attached by forming a tripod configuration. Single center connection is not acceptable.
- B. Seal around fixture so no light trespass can be observed.

3.06 ACCEPTANCE

- A. Remove all debris, bugs, and other foreign materials from lamps and fixture housings. Clean all lamps, shades, reflectors, and lens removing all temporary labels, debris, dirt, and dust per manufacturer guidelines.

END OF SECTION