Division 26

SECTION 260122
PRIMARY WIRING – 15KV NOMINAL

PART 1. GENERAL

1.01 REFERENCES

A. ICEA S-68-516/NEMA WC-8 Ethylene-Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

B. AEIC CS-6 Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69KV.

C. UL 1072 Medium-Voltage Power Cables.

D. IEEE 48 Standard Test Procedures and Requirements for High-Voltage Alternating-Current Cable Terminations.

1.02 SUBMITTALS

A. Submittals Package: Submit the data specified below for preliminary approval all at the same time as a package. After preliminary approval, submit the data and samples specified below for final approval all at the same time as a package.

B. Submit the following for preliminary approval:
   1. Complete manufacturer's construction details and specifications for the cables, including physical and electrical characteristics of insulation, shields and jackets.
   2. Overall dimension and ampacity of cable.
   3. Splicing and termination data, including the following:
      a. List of materials.
      b. Method of connecting conductors.
      c. Details of cable preparation.
      d. Method of applying materials (including quantities and recommended tools).
      e. Precautionary measures.
      f. Drawings showing method of splicing, complete with dimensions.
      g. Written statement from cable manufacturer that the specific splices and terminations submitted are acceptable.
      h. Written statement from splice/termination manufacturer that splices and terminations submitted are suitable for the proposed application.
   4. If ethylene-propylene rubber insulated cable is proposed for use, furnish cable manufacturer's certified copies of the AEIC qualification test for the cable being proposed, unless these documents are currently on file with the organization reviewing the submittals.

C. Final Approval: After preliminary approval, submit the following for final approval:
   1. Cable manufacturer's certified test data from tests performed on the completed cable.
   2. Written statement from cable manufacturer indicating recommended pulling compounds.
   3. Resume of each cable splicer's experience. Include:
      a. Details of type of high voltage splicing and terminations performed.
      b. Types of cables which were spliced.
      c. Job locations.
      d. Number of years performing splices and terminations.

e. Certificate of training from the splice/termination manufacturer for heat-shrinkable products, if used.

4. Catalog sheets, specifications and installation instructions for all products.
5. Company Field Advisor Data:
   a. Name, business address and telephone number of Company Field Advisor secured for the
   b. Certified statement from the Company, listing the qualifications of the Company Field Advisor.
   c. Services and each product for which authorization is given by the Company, listed specifically for this project.

D. Contract Closeout Submittals:
1. Test Report: High voltage after installation test report (BDC-362).
2. Certificates:
   a. Affidavit, signed by the cable manufacturer's Company Field Advisor, certifying that the cable has been installed in accordance with the manufacturer's recommendations and is operating properly.
   b. Affidavit, signed by the splice and termination manufacturer's Company Field Advisor, certifying that the splices and terminations were constructed in accordance with the manufacturer's recommendations and are operating properly.

1.03 QUALITY ASSURANCE

A. Company Field Advisor: Secure the services of the cable manufacturer's Company Field Advisor for a minimum of 16 working hours for the following:
1. Render advice regarding method of installing cable.
2. Inspection of equipment for installing cable.
3. Witness representative amount of cable pulling.
4. Witness construction of at least one splice and one termination by each cable splicer who will be doing the actual cable splicing.
   a. If the splices or terminations are other than the cable manufacturer's, secure the services of the splice and termination manufacturer's Company Field Advisor to concurrently witness construction of the splices and terminations and also certify with an affidavit that the splices and terminations were constructed in accordance with the splice and termination manufacturer's recommendations.
5. Witness high voltage after installation test.
6. Certify with an affidavit that the aforementioned particulars are satisfactory and the cable is installed in accordance with cable manufacturer's recommendations.

B. Testing Company: Secure the services of an approved testing company, such as one of those listed below, for a high voltage after installation test:
1. GE Energy Industrial Solutions, 180 Rotterdam Industrial Park, Rotterdam, NY 12306, (518) 378-6680.
2. High Voltage Electric Service, Inc., 6 Seward Street, Albany NY 12203 (518)-869-4961

1.04 DELIVERY, STORAGE AND HANDLING

A. Cable Delivery:
1. No insulated cable over one year old when delivered to the site will be accepted.

2. Keep ends of cables sealed at all times, except when making splices or terminations. Use soldered seals for lead sheath cables. For other type cables use heat shrinkable plastic end caps with sealant as produced by Raychem Corp., Thomas & Betts Corp., or other methods approved by cable manufacturer.
3. Include the following data durably marked on each reel:
   a. Facility name and address.
   b. Contractor's name.
   c. Project title.
   d. Date of manufacture.
   e. Cable size and voltage rating.
   f. Manufacturer's name.
   g. Linear feet of cable.

B. Cable Storage: Store where cable will be at optimum workability temperature recommended by cable manufacturer.

1.05 MAINTENANCE

A. Special Tools: Furnish one set of special tools for the assembly of premolded splices (if used). Store them at the Site where directed.

PART 2. PRODUCTS

2.01 CABLES

A. Cable Configuration: Single conductors.

B. Conductors: Annealed uncoated copper or annealed coated copper in conformance with the applicable standards for the type of insulation to be applied on the conductor.

C. Kerite Insulated Cables: In accordance with the following specific cable parameters:
   1. Rated 5KV between phases at an insulation level of 133 percent.

D. Ethylene-Propylene Rubber Insulated Cables: In accordance with ICEA S-68-516/NEMA WC-8 Standards Publication "Ethylene-Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy", Association of Edison Illuminating Companies Specification AEIC CS6-87 "Specifications for Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 through 69KV", and the following specific cable parameters:
   1. Rated 5KV between phases at an insulation level of 133 percent.

2.02 TERMINATIONS

A. Materials: All materials required for a complete termination the standard product of one manufacturer, designed specifically for the type of cable and conductor to be terminated.

B. Ampere Rating: Not less than ampere rating of cable.

C. Voltage Rating: Not less than voltage rating of cable.

D. Manufacturer: Furnish terminations by one of the manufacturers listed below, if acceptable to the cable manufacturer.
   1. IEEE 48 Class 3 Terminations:
      a. For Cables Without Lead Sheath: Adalet PLM's Overroll FSDT, Elastimold's 35MSC, or 35MTGI, with cable shield adapter, G & W Electric Co's Termination Kit, Kerite Co.'s Indoor Terminal IT, Mac Products Inc.'s Terminating Kit, Minnesota Mining & Mfg. Co.'s 3M Cold-Shrink Terminations, Plymouth Rubber Co.'s Plymouth Bishop Plypak or Stress Wrap Terminating Kit, or Raychem Corp.'s Heat-Shrinkable High Voltage Termination System.

2.03 SPLICES

A. Materials: All materials required for a complete splice the standard product of one manufacturer, designed specifically for the type of cable and conductor to be spliced.

B. Ampere Rating: Not less than ampere rating of cable.

C. Voltage Rating: Not less than voltage rating of cable.

D. Splices Installed in Wet Locations: Waterproof and submersible.

E. Manufacturer: Furnish splices by one of the manufacturers listed below, if acceptable to the cable manufacturer (field made epoxy-resin unit not acceptable):
   1. For Cables Without Lead Sheath:
      a. Tape Splices: Adalet-PLM's S Type Cable Splicing Kits, Kerite Co.'s Splice S, Mac Products Inc. Cable Splicing Kits, Minnesota Mining & Mfg. Co.'s 3M Splicing Kits, or Plymouth Rubber Co.'s Plymouth Bishop Plypak or Stress Wrap Splicing Kits.
      b. Premolded Splices: Elastimold's Premolded Splices.
      c. Heat-Shrinkable Splices: Raychem Corp.'s High Voltage Splices HVS.
      d. Cold-Shrink Splices: Minnesota Mining & Mfg. Co.'s 3M Cold-Shrink Splices Kits.
      e. Mechanical Splices: G & W Electric Co.'s Universal Splicing System.

2.04 CABLE DEAD ENDS (FULL VOLTAGE)

A. For Cable Without Lead Sheath: Elastimold's Premolded Splice with Dead-End Plug, G & W Electric Co.'s Universal Splicing System with sealing caps, or Raychem Corp.'s Live End Seals HVES.

2.05 ACCESSORIES

A. Pulling Compounds: As recommended by cable manufacturer.

B. Arc Proofing Tapes:
   1. Arc Proofing Tape: Mac Products Inc's AP30-30 or AP, Minnesota Mining & Mfg. Co.'s 3M 77, Plymouth Rubber Co.'s Plymouth Bishop 53 Plyarc, or Quelcor Inc.'s Quelpyre.

2. Glass Cloth Tape: Mac Products Inc.'s TAPGLA 5066, Minnesota Mining & Mfg. Co.'s 3M 69, or Plymouth Rubber Co.'s Plymouth Bishop 77 Plyglas.
3. Glass-Fiber Cord: Mac Products Inc.'s MAC 0527, or Quelcor Inc.'s QTC-250.

C. Tags: Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inches high.
1. Phenolic: Two color laminated engraver's stock, 1/16-inch minimum thickness, machine engraved to expose inner core color (white).
2. Aluminum: Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.

PART 3. EXECUTION

3.01 INSTALLATION

A. Cables:
1. Install cables in conduit after conduit system is completed.
2. Keep ends of cables sealed watertight at all times, except when making splices or terminations.
3. No grease, oil, lubricant other than approved pulling compound may be used to facilitate the pulling-in of cables.
4. Use pulling eye attached to conductor(s) for pulling in cables. Cable grip will not be allowed. Seal pulling eye attachment watertight.
5. Pull all cables with a dynamometer or strain gage incorporated into the pulling equipment. Do not pull cables unless the Owner's Representative is present to observe readings on the dynamometer or strain gage during the time of actual pulling. Do not exceed 80% of manufacturer's allowable strain for the size cable (3 conductor cable or 3 single conductor cables) being installed.

B. Terminations and Splices:
1. General: Splice and terminate cable in accordance with manufacturer's approved installation instructions, employing specific tools recommended by the manufacturer.
2. For Cables Without Lead Sheath:
   a. Use IEEE 48 Class 1 terminations to terminate cable in wet locations.
   b. Use IEEE 48 Class 1 terminations to terminate cable inside of outdoor equipment which is not equipped with space heaters (pad mounted switches, pad mounted transformers, etc). Class 1 or Class 3 terminations may be used to terminate cable inside of outdoor switchgear cubicles which are equipped with space heaters (metal-clad switchgear, metal-enclosed interrupter switchgear, etc.).
   c. Use IEEE 48 Class 1 or Class 3 Terminations to terminate cable in dry locations.
   d. Ground shield at splices and terminations.
   e. Incorporate solder dam or use other approved method to prevent moisture from entering splices through grounding conductor.

C. Arc Proofing: Arc proof feeders installed in a common pullbox or manhole:
1. Arc proof new feeders.
2. Arc proof existing feeders that are spliced to new feeders.

3. Arc proof each feeder as a unit with half-lapped layer of 55 mils thick arc proofing tape and random wrapped or laced with glass cloth tape or glass-fiber cord. For arc proofing tape less than 55 mils thick, add layers to equivalent of 55 mils thick arc proofing tape.

D. Identification of Feeders: Identify feeders in manholes, pullboxes and in equipment to which they connect:
   1. Install tags on each insulated conductor indicating phase leg. Attach tags with non-ferrous metal wire. Install phase leg tags under arc proofing tapes.
   2. Install tags on each feeder indicating feeder number, date installed (month, year), type of cable, voltage rating, size, manufacturer. Attach tags to feeders with non-ferrous metal wire or brass chain. Install tags so that they are easily read without moving adjacent feeders or requiring removal of arc proofing tapes.

E. Phase Relationship: Connect feeders to maintain phase relationship through system. Phase legs of feeders shall match bus arrangements in equipment to which the feeders are connected.

3.02 FIELD QUALITY CONTROL

A. High Voltage After Installation Test:
   1. Have the cable installation tested by the testing company.
   2. Perform test after cable has been installed complete with all splicing, bonding, etc., and prior to placing cable into service.
   3. Perform test with potential and duration specified in manufacturer's submittal data data. Follow test procedure summarized on Test Record-Power Cable Proof Test form BDC-362 and applicable test methods in ICEA and AEIC Specifications.
   4. List results of the tests on form BDC-362 supplied by the Owner's Representative.
   5. Perform test in the presence of the Owner's Representative and the manufaturer's Field Advisor.

3.03 CABLE SCHEDULE

A. Use either of the following for primary wiring:
   1. Ethylene-propylene rubber insulated cable.

END OF SECTION 261220

SECTION 260441
SWITCHBOARDS

PART 1 GENERAL

1.01 REFERENCES

A. NEMA, and UL.

1.02 SUBMITTALS

A. Submittals Package: Submit the shop drawings, product data, and quality control submittals specified below at the same time as a package.

B. Shop Drawings; include the following for each switchboard:
   1. Front and plan view with overall dimensions.
   2. Details showing type of construction and available conduit space.
   3. Voltage rating, and continuous current rating of the through bus and distribution sections.
   4. Short-circuit current rating.
   5. Enumeration of each circuit breaker including frame size, ATE, number of poles, and interrupting capacity.
   6. Wiring and schematic diagrams.
   7. A coordinated selective scheme between the main device and feeder devices so that under fault conditions the feeder device clears the fault while the main device remains closed.
   8. A statement for each switchboard indicating that it will bear a UL label.

C. Product Data:
   1. Catalog sheets, specifications and installation instructions.
      a. For devices equipped with ground fault protection, include information sheets describing system testing instructions and test form which comply with UL 891 requirements entitled "45. Field Testing of Ground Fault Protection of Equipment."
   2. Bill of materials.
   3. Name, address and telephone number of nearest fully equipped service organization.

E. Quality Control Submittals:
   1. Company Field Advisor Data: Include:
      a. Name, business address and telephone number of Company Field Advisor secured for the required services.
      b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
      c. Services and each product for which authorization is given by the Company listed specifically for this project.

F. Contract Closeout Submittals:
   1. System acceptance test report.
   2. Certificate: Affidavit, signed by the Company Field Advisor, certifying that the system meets the contract requirements and is operating properly.

3. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Owner 's Representative.

1.03 QUALITY ASSURANCE

A. Equipment Qualifications For Products Other Than Those Specified:
   1. At the time of submission provide written notice to the Owner of the intent to propose an “or equal” for products other than those specified. Make the “or equal” submission in a timely manner to allow the Owner sufficient time to review the proposed product, perform inspections and witness test demonstrations.
   2. If products other than those specified are proposed for use furnish the name, address, and telephone numbers of at least 5 comparable installations that can prove the proposed products have performed satisfactorily for 3 years. Certify in writing that the owners of the 5 comparable installations will allow inspection of their installation by the Owner 's Representative and the Company Field Advisor.
      a. Make arrangements with the owners of 2 installations (selected by the Owner) for inspection of the installations by the Owner 's Representative. Also obtain the services of the Company Field Advisor for the proposed products to be present. Notify the Owner a minimum of 3 weeks prior to the availability of the installations for the inspection, and provide at least one alternative date for each inspection.
      b. Only references from the actual owner or owner’s representative (Security Supervisor, Maintenance Supervisor, etc.) will be accepted. References from dealers, system installers or others, who are not the actual owners of the proposed products, are not acceptable.
         1) Verify the accuracy of all references submitted prior to submission and certify in writing that the accuracy of the information has been confirmed.
   3. The product manufacturer shall have test facilities available that can demonstrate that the proposed products meet the contract requirements.
      a. Make arrangements with the test facility for the Owner 's Representative to witness test demonstrations. Also obtain the services of the Company Field Advisor for the proposed product to be present at the test facility. Notify the Owner a minimum of 3 weeks prior to the availability of the test facility, and provide at least one alternative date for the testing.
   4. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.

B. Company Field Advisor: Secure the services of a Company Field Advisor for a minimum of 8 working hours for the following:
   1. Render advice regarding switchboard installation, and final adjustment of the switchboard devices.
   2. Witness final system test and then certify with an affidavit that the switchboard is installed in accordance with the contract documents and is operating properly.
   3. Train facility personnel on the operation and maintenance of the switchboard devices (minimum of two 1 hour sessions).
   4. Explain available service programs to facility supervisory personnel for their consideration.

C. Service Availability: A fully equipped service organization shall be available to service the completed Work.

1.04 DELIVERY, STORAGE AND HANDLING

A. Protection: Provide supplemental heating devices, such as incandescent lamps or low wattage heaters within the enclosure or under a protective cover to control dampness. Maintain this protection from the time equipment is delivered to the site until it is energized.

PART 2 PRODUCTS

2.01 SWITCHBOARD

A. Cutler-Hammer/Eaton Corp.'s Pow-R-Line C, General Electric Co.'s AV-3 Line, Siemens Type SB or Square D Co.'s QED, having:
1. Ratings as indicated on drawings.
2. UL label "SUITABLE FOR USE AS SERVICE EQUIPMENT".
3. Front accessibility.
4. Sections flush at rear (rear alignment).
5. Main device: Stationary circuit breaker (see circuit breaker paragraph).
6. Fully rated copper bus bars.
   a. Ampere rating of through bus not less than frame size of main device.
7. Full length copper ground bus.
8. Sections that are designated "space" or "provision for future breaker" equipped with all accessories required to accept a future circuit breaker.
9. Space heaters with thermostatic control.
10. Circuit Breakers:
    a. Mounting: Group mounted, or individually mounted as necessary to accommodate the circuit breaker style and switchboard construction.
    b. Style: Molded case, or power circuit breakers, as required to accommodate the circuit breaker components.
    c. Trip Device: Programmable solid state.
    d. Interrupting Capacity: Equal to, or greater than, the short circuit rating required for the switchboard.
    e. Component Description: See switchboard One Line Diagram for specific components required for each circuit breaker. In addition to the specific components, equip each circuit breaker with additional components as required to achieve a coordinated selective scheme between the main device and the feeder devices.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install switchboards in accordance with NEMA Publication No. PB2.1 "Instructions for Proper Handling, Installation, Operation and Maintenance of Deadfront Distribution Switchboards".

1. Set and program the switchboard devices in accordance with the approved coordinated selective scheme.

B. Install foundation channels for anchoring and leveling of each switchboard.

C. Identification:
1. Install on the front of each switchboard, a phenolic nameplate with ½" high lettering indicating the designation of the switchboard as indicated on the One Line Diagram (black lettering on a white background).
2. Install on the front of each circuit breaker, a phenolic nameplate indicating load served by circuit breaker (black lettering on a white background).

3.02 FIELD QUALITY CONTROL

A. Preliminary System Test:
1. Preparation: Have the Company Field Advisor adjust the completed switchboard devices and then operate them long enough to assure that they are performing properly.
2. Run a preliminary test for the purpose of:
   a. Determining whether the switchboard is in a suitable condition to conduct an acceptance test.
   b. Checking instruments and equipment.
   c. Training facility personnel.

B. System Acceptance Test:
1. Preparation: Notify the Owner's Representative at least 3 working days prior to the test so arrangements can be made prior to the test to have a Facility Representative witness the test.
2. Make the following tests:
   a. Test devices which have ground fault protection in accordance with the approved information sheets and test form.
   b. Test programmable solid state trip devices in accordance with the manufacturer's recommendations.
3. Supply all equipment necessary for system adjustment and testing.
4. Submit written report of test results signed by the Company Field Advisor and the Owner's Representative.

END OF SECTION

SECTION 260519
WIRING, GENERAL – 600 VOLTS AND UNDER

PART 1. GENERAL

1.01 SUBMITTALS

A. Data: Catalog sheets, specifications and installation instructions.

1.02 PRODUCT DELIVERY

A. Mark and tag insulated conductors and cables for delivery to the site. Include:
   1. Contractor's name.
   2. Date of manufacture (month & year).
   3. Manufacturer's name.
   4. Data which explains the meaning of coded identification (UL assigned electrical reference numbers, UL assigned combination of color marker threads, etc.).
   5. Environmental suitability information (listed or marked "sunlight resistant" where exposed to direct rays of sun; wet locations listed/marked for use in wet locations; other applications listed/marked suitable for the applications).

PART 2. PRODUCTS

2.01 INSULATED CONDUCTORS AND CABLES

A. Date of Manufacture: No insulated conductor more than one year old when delivered to the site will be acceptable.

B. Acceptable Companies: American Insulated Wire Corp., BICC General Cable Industries Inc., Cerro Wire & Cable Co. Inc., Pirelli Cable Corp., or Southwire Co.

C. Conductors: Annealed uncoated copper or annealed coated copper in conformance with the applicable standards for the type of insulation to be applied on the conductor. Conductor sizes No. 8 and larger shall be stranded.

D. Types:
   1. Electric Light and Power Wiring:
      a. General: Rated 600V, NFPA 70 Type FEP, THHN, THW, THW-2, THWN, THWN-2, XHH, XHHW, XHHW-2.
      b. Metal-Clad Cable, NFPA 70 Article 334 Type MC:
         1) Interlocked flexible galvanized steel armor sheath, conforming to UL requirements for type MC metal clad cable.
         2) Insulated copper conductors, suitable for 600 volts, rated 90°C, one of the types listed in NFPA 70 Table 310-13 or of a type identified for use in Type MC cable.
         3) Internal full size copper ground conductor with green insulation.
         4) Acceptable Companies: AFC Cable Systems Inc., Coleman Cable Co.
         5) Connectors for MC cable: AFC Fitting Inc.'s AFC Series, Arlington Industries Inc.'s Saddle grip, or Thomas & Betts Co.'s Tite-Bite with anti-short bushings.

2. Class 1 Wiring:
   a. No. 18 and No. 16 AWG: Insulated copper conductors suitable for 600 volts, NFPA 70 types KF-2, KFF-2, PAFF, PF, PFF, PGF, PGFF, PTFF, SF-2, SFF-2, TF, TFF, TFN, TFFN, ZF, or ZFF.
   b. Larger than No. 16 AWG: Insulated copper conductors suitable for 600 volts, in compliance with NFPA 70 Article 310.
   c. Conductor with other types and thickness of insulation may be used if listed for Class 1 circuit use.
3. Class 2 Wiring:
   a. Multiconductor Cables: NFPA 70 Article 725, Types CL2P, CL2R, CL2.
   b. Other types of cables may be used in accordance with NFPA 70 Table 725-61 "Cable Uses and Permitted Substitutions", as approved.
4. Class 3 Wiring:
   a. Single Conductors No. 18 and No. 16 AWG: Same as Class 1 No. 18 and No. 16 AWG conductors except that:
      1) Conductors are also listed as CL3.
      2) Voltage rating not marked on cable except where cable has multiple listings and voltage marking is required for one or more of the listings.
   b. Multiconductor Cables: NFPA 70 Article 725, Types CL3P, CL3R, CL3.
   c. Other types of cables may be used in accordance with NFPA 70, Table 725-61 "Cable Uses and Permitted Substitutions", as approved.

2.02 CONNECTORS

A. General:
   1. Connectors specified are part of a system. Furnish connectors and components, and use specific tools and methods as recommended by connector manufacturer to form complete connector system.
   2. Connectors shall be UL 486 A listed, or UL 486 B listed for combination dual rated copper/aluminum connectors (marked AL7CU for 75 degrees C rated circuits and AL9CU for 90 degrees C rated circuits).

B. Splices:
   1. Spring Type:
      a. Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s B-Cap, Electrical Products Div./3M's Scotchlok Type Y, R, G, B, O/B+, R/Y+, or B/G+, or Ideal Industries Inc.'s Wing Nuts or Wire Nuts.
      b. Rated 150° C, 600V; Ideal Industries Inc.'s High Temperature Wire-Nut Model 73B, 59B.
   2. Indent Type with Insulating Jacket:
      a. Rated 105° C, 600V; Buchanan/Ideal Industries Inc.'s Crimp Connectors, Ideal Industries Inc.'s Crimp Connectors, Penn-Union Corp.'s Penn-Crimps, or Thomas & Betts Corp.'s STA-KON.
   3. Indent Type (Uninsulated): Anderson/Hubbell's Versa-Crimp, VERSAtile, Blackburn/T&B Corp.'s Color-Coded Compression Connectors, Electrical Products Div./3M's Scotchlok 10000, 11000 Series, Framatome Connectors/Burndy's Hydent, Penn-Union Corp.'s BCU, BBCU Series, or Thomas & Betts Corp.'s Compression Connectors.

4. Connector Blocks: NIS Industires Inc.'s Polaris System, or Thomas & Betts Corp.'s Blackburn AMT Series.
5. Resin Splice Kits: Electrical Products Div./3M's Scotchcast Brand Kit Nos. 82A Series, 82-B1 or 90-B1, or Scotchcast Brand Resin Pressure Splicing Method.
6. Heat Shrinkable Splices: Electrical Products Div./3M's ITCSN, Raychem Corp.'s Thermofit Type WCS, or Thomas & Betts Corp.'s SHRINK-KON Insulators.
7. Cold Shrink Splices: Electrical Products Div./3M's 8420 Series.

C. Gutter Taps: Anderson/Hubbell's GP/GT with GTC Series Covers, Blackburn/T&B Corp.'s H-Tap Type CF with Type C Covers, Framatome Connectors/Burndy's Polytap KPU-AC, H-Crimpit Type YH with CF-FR Series Covers, ILSCO's GTA Series with GTC Series Covers, Ideal Industries Inc.'s Power-Connect GP, GT Series with GIC covers, NSI Industries Inc.'s Polaris System, OZ/Gedney Co.'s PMX or PT with PMXC, PTC Covers, Penn-Union Corp.'s CDT Series, or Thomas & Betts Corp.'s Color-Keyed H Tap CHT with HTC Covers.

D. Terminals: Nylon insulated pressure terminal connectors by Amp-Tyco/Electronics, Electrical Products Div./3M, Framatome Connectors/Burndy, Ideal Industries Inc., Panduit Corp., Penn-Union Corp., Thomas & Betts Corp., or Wiremold Co.

E. Lugs:
1. Single Cable (Compression Type Lugs): Copper, one- or 2-hole style (to suit conditions), long barrel; Anderson/Hubbell's VERSAtile VHCL, Blackburn/T&B Corp.'s Color-Coded CTL, LCN, Framatome Connectors/Burndy's Hylug YA, Electrical Products Div./3M Scotchlok 31036 or 31145 Series, Ideal Industries Inc.'s CCB or CCBL, NSI Industries Inc.'s L, LN Series, Penn-Union Corp.'s BBLU Series, or Thomas & Betts Corp.'s 54930BE or 54850BE Series.
2. Multiple Cable (Mechanical Type Lugs): Copper, configuration to suit conditions; Framatome Connectors/Burndy's Qiklug Series, NSI Industries Inc.'s Type TL, Penn-Union Corp.'s VI-TITE Terminal Lug Series, or Thomas & Betts Corp.'s Color-Keyed Locktite Series.

2.03 TAPES

A. Insulation Tapes:
1. Plastic Tape: Electrical Products Div./3M's Scotch Super 33+ or Scotch 88, Plymouth Rubber Co.'s Plymouth/ Bishop Premium 85CW.
2. Rubber Tape: Electrical Products Div./3M's Scotch 130C, or Plymouth Rubber Co.'s Plymouth/Bishop W963 Plysafe.

B. Moisture Sealing Tape: Electrical Products Div./3M's Scotch 2200 or 2210, or Plymouth Rubber Co.'s Plymouth/Bishop 4000 Plyseal-V.

C. Electrical Filler Tape: Electrical Products Div./3M's Scotchfil, or Plymouth Rubber Co.'s Plymouth/Bishop 125 Electrical Filler Tape.

D. Color Coding Tape: Electrical Products Div./3M's Scotch 35, or Plymouth Rubber Co.'s Plymouth/Bishop Premium 37 Color Coding.

E. Arc Proofing Tapes:
   1. Arc Proofing Tape: Electrical Products Div./3M's Scotch 77, Mac Products Inc.'s AP Series, or Plymouth Rubber Co.'s Plymouth/Bishop 53 Plyarc.
   2. Glass Cloth Tape: Electrical Products Div./3M's Scotch 27/Scotch 69, Mac Products Inc.'s TAPGLA 5066, or Plymouth Rubber Co.'s Plymouth/Bishop 77 Plyglas.
   3. Glass-Fiber Cord: Mac Products Inc's MAC 0527.

2.04 WIRE-PULLING COMPOUNDS

A. To suit type of insulation; American Polywater Corp.'s Polywater Series, Electric Products Div./3M's WL, WLX, or WLW, Greenlee Textron Inc.'s Y-ER-EAS, Cable Cream, Cable Gel, Winter Gel, Ideal Industries Inc.'s Yellow 77, Aqua-Gel II, Agua-Gel CW, or Thomas & Betts Corp.'s Series 15-230 Cable Pulling Lubricants, or Series 15-631 Wire Slick.

2.06 TAGS

A. Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inches high.
   1. Phenolic: Two color laminated engraver's stock, 1/16-inch minimum thickness, machine engraved to expose inner core color (white).
   2. Aluminum: Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.

2.07 WIRE MANAGEMENT PRODUCTS

A. Cable Clamps and Clips, Cable Ties, Spiral Wraps, etc: Catamount/T&B Corp., or Ideal Industries Inc.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install conductors in raceways after the raceway system is completed. Exceptions: Type MC, or other type specifically indicated on the drawings not to be installed in raceways.

B. No grease, oil, or lubricant other than wire-pulling compounds specified may be used to facilitate the installation of conductors.

3.02 CIRCUITING

A. Do not change, group or combine circuits other than as indicated on the drawings.

3.03 COMMON NEUTRAL CONDUCTOR

A. A common neutral shall not be used for 2 or 3 branch circuits.

3.04 CONDUCTOR SIZE

A. Conductor Size:
   1. For Electric Light and Power Branch Circuits: Install conductors of size shown on drawings. Where size is not indicated, the minimum size allowed is No. 12 AWG.
   2. For Class 1 Circuits:
      a. No. 18 and No. 16 AWG may be used provided they supply loads that do not exceed 6 amps (No. 18 AWG), or 8 amps (No. 16 AWG).
      b. Larger than No. 16 AWG: Use to supply loads not greater than the ampacities given in NFPA 70 Section 310-15.
   3. For Class 2 Circuits: Any size to suit application.
   4. For Class 3 Circuits: Minimum No. 18 AWG.

3.05 COLOR CODING

A. Color Coding for 208/120 Volt and 240/120 Volt Electric Light and Power Wiring:
   1. Color Code:
      a. 2 wire circuit - black, white.
      b. 3 wire circuit - black, red, white.
      c. 4 wire circuit - black, red, blue, white.
   2. White to be used only for an insulated grounded conductor (neutral). If neutral is not required use black and red, or black, red and blue for phase-to-phase circuits.
      a. "White" for Sizes No. 6 AWG or Smaller:
         1) Continuous white outer finish, or:
         2) Three continuous white stripes on other than green insulation along its continuous length.
      b. "White" for Sizes Larger Than No. 6 AWG:
         1) Continuous white outer finish, or:
         2) Three continuous white stripes on other than green insulation along its continuous length, or:
         3) Distinctive white markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install white color-coding tape at terminations, and at 1'-0" intervals in gutters, pullboxes, and manholes.
   3. Colors (Black, Red, Blue):
      a. For Branch Circuits: Continuous color outer finish.
      b. For Feeders:
         1) Continuous color outer finish, or:
         2) Color coding tapes encircling the conductors, installed on the conductors at time of their installation. Install color coding tapes at terminations, and at 1'-0" intervals in gutter, pullboxes, and manholes.

B. Color Coding For 277/480 Volt Electric Light and Power Wiring:
   1. Color Code:
      a. 2 wire circuit – brown, gray.
      b. 3 wire circuit – brown, yellow, gray.
      c. 4 wire circuit – brown, yellow, orange, gray.

2. Gray to be used only for an insulated grounded conductor (neutral). If neutral is not required use brown and yellow, or brown, yellow and orange for phase-to-phase circuits.
   a. "Gray" For Sizes No. 6 AWG or Smaller.
      1) Continuous gray outer finish.
   b. "Gray" For Sizes Larger Than No. 6 AWG:
      1) Distinctive gray markings (color coding tape) encircling the conductor, installed on the conductor at time of its installation. Install gray color-coding tape at terminations, and at 1'-0" intervals in gutters, pullboxes, and manholes.
   c. Colors (Brown, Yellow, Orange):
   d. For Branch Circuits: Continuous color outer finish.
   e. For Feeders:
      1) Continuous color outer finish, or:
      2) Color coding tapes encircling the conductors, installed on the conductors at the time of their installation. Install color coding tapes at terminations, and at 1' 0" intervals in gutters, pullboxes, and manholes.

C. More Than One Nominal Voltage System Within A Building: Permanently post the color-coding scheme at each branch-circuit panelboard.

D. Existing Color-Coding Scheme: Where an existing color-coding scheme is in use, match the existing color coding if it is in accordance with the requirements of NFPA 70.

E. Color Code for Wiring Other Than Electric Light and Power: In accordance with ICEA/NEMA WC-30 "Color Coding of Wires and Cables". Other coding methods may be used, as approved.

3.06 IDENTIFICATION

A. Identification Tags: Use tags to identify feeders and designated circuits. Install tags so that they are easily read without moving adjacent feeders or requiring removal of arc proofing tapes. Attach tags with non-ferrous wire or brass chain.
   1. Interior Feeders: Identify each feeder in pullboxes and gutters. Identify by feeder number and size.
   2. Exterior Feeders: Identify each feeder in manholes and in interior pullboxes and gutters. Identify by feeder number and size, and also indicate building number and panel designation from which feeder originates.
3. Street and Grounds Lighting Circuits: Identify each circuit in manholes and lighting standard bases. Identify by circuit number and size, and also indicate building number and panel designation from which circuit originates.

B. Identification Plaque: Where a building or structure is supplied by more than one service, or has any combination of feeders, branch circuits, or services passing through it, install a permanent plaque or directory at each service, feeder and branch circuit disconnect location denoting all other services, feeders, or branch circuits supplying that building or structure or passing through that building or structure and the area served by each.

3.07 WIRE MANAGEMENT

A. Use wire management products to bundle, route, and support wiring in junction boxes, pullboxes, wireways, gutters, channels, and other locations where wiring is accessible.

3.08 EQUIPMENT GROUNDING CONDUCTOR

A. Install equipment grounding conductor:
   1. Where specified in other Sections or indicated on the drawings.
   2. In conjunction with circuits recommended by equipment manufacturers to have equipment grounding conductor.

B. Equipment grounding conductor is not intended as a current carrying conductor under normal operating circumstances.

C. Color Coding for Equipment Grounding Conductor:
   1. Color Code: Green.
   2. "Green" For sizes No. 6 AWG or Smaller:
      a. Continuous green outer finish, or:
      b. Continuous green outer finish with one or more yellow stripes, or:
      c. Bare copper (see exception below).
   3. "Green" For Sizes Larger Than No. 6:
      a. Stripping the insulation or covering from the entire exposed length (see exception below).
      b. Marking the exposed insulation or covering with green color-coding tapes.
      c. Identify at each end and at every point where the equipment grounding conductor is accessible.

3.09 SPECIAL GROUNDING CONDUCTORS

A. Technical Power System Grounding (Equipment grounding conductor isolated from the premises grounded conductor except at a single grounded termination point): Install an insulated grounding conductor running with the circuit conductors for isolated receptacles or utilization equipment requiring an isolated ground:
   1. Color Code: Green.
   2. "Green" For Isolated Grounding Conductor:
      a. Continuous green outer finish, or:
      b. Continuous green outer finish with one or more yellow stripes, and:
      c. Different than the "green" used for the equipment grounding conductor run with the circuit (where required).
   3. Install label at every point where the conductor is accessible, identifying it as an "Isolated Grounding Conductor".

3.10 ARC PROOFING

A. Arc proof feeders installed in a common pullbox or manhole as follows:
   1. Arc proof new feeders.
   2. Arc proof existing feeders that are spliced to new feeders.

3. Arc proof each feeder as a unit (except feeders consisting of multiple sets of conductors).
4. Arc proof feeders consisting of multiple sets of conductors by arc proofing each set of conductors as a unit.
5. Arc proof feeders with half-lapped layer of 55 mils thick arc proofing tape and random wrapped or laced with glass cloth tape or glass-fiber cord. For arc proofing tape less than 55 mils thick, add layers to equivalent of 55 mils thick arc proofing tape.

3.11 INSULATED CONDUCTOR AND CABLE SCHEDULE - TYPES AND USE

A. Electric Light and Power Circuits:
   1. FEP, THHN, THW, THW-2, THWN, THWN-2, XHH, XHHW, or XHHW-2: Wiring in dry or damp locations (except where special type insulation is required).
   2. THWN, THWN-2, XHHW, XHHW-2, USE, or USE-2: Wiring in wet locations (except where type USE or USE-2 insulated conductors are specifically required, or special type insulation is required).
   3. THHN, THWN or THWN-2: Wiring installed in existing raceway systems (except where special type insulation is required).
   4. THHN, THW-2, THWN-2, XHHW, or XHHW-2: Wiring for electric discharge lighting circuits (fluorescent, HID), except where fixture listing requires wiring rated higher than 90° C.
   5. USE, or USE-2: Wiring indicated on the drawings to be direct burial in earth.
   6. USE, or USE-2 Marked “Sunlight Resistant”:
      a. Service entrance wiring from overhead service to the service equipment.
      b. Wiring exposed to the weather and unprotected (except where special type insulation is required).
   7. MC:
      a. Branch circuit wiring in movable metal partitions.
         1) Install conductors in accordance with partition manufacturer’s recommendations.

C. Class 1 Circuits: Use Class 1 wiring specified in Part 2 (except where special type insulation is required).

D. Class 2 Circuits: Use Class 2 wiring specified in Part 2 (except where special type insulation is required).

E. Class 3 Circuits: Use Class 3 wiring specified in Part 2 (except where special type insulation is required).

3.12 CONNECTOR SCHEDULE - TYPES AND USE

A. Temperature Rating: Use connectors that have a temperature rating, equal to, or greater than the temperature rating of the conductors to which they are connected.

B. Splices: Splices shall be used in lighting and 120V receptacle wiring only, and shall only be made in junction boxes:
   1. Dry Locations:
      a. For Conductors No. 8 AWG or Smaller: Use spring type pressure connectors, indent type pressure connectors with insulating jackets, or connector blocks (except where special type splices are required).

b. For Conductors No. 6 AWG or Larger: Use connector blocks or uninsulated indent type pressure connectors. Fill indentions in uninsulated connectors with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with heat shrinkable splices or cold shrink splices.
c. Gutter Taps in Panelboards: For uninsulated type gutter taps fill indentions with electrical filler tape and apply insulation tape to insulation equivalent of the conductor, or insulate with gutter tap cover.

2. Damp Locations: As specified for dry locations, except apply moisture sealing tape over the entire insulated connection (moisture sealing tape not required if heat shrinkable splices or cold shrink splices are used).
3. Wet Locations: Use uninsulated indent type pressure connectors and insulate with resin splice kits, cold shrink splices or heat shrinkable splices. Exception: Splices above ground which are totally enclosed and protected in NEMA 3R, 4, 4X enclosures may be spliced as specified for damp locations.

C. Terminations:
1. For Conductors No. 10 AWG or Smaller: Use terminals for:
a. Connecting wiring to equipment designed for use with terminals.
2. For Conductors No. 8 AWG or Larger: Use compression or mechanical type lugs for:
a. Connecting cables to flat bus bars.
b. Connecting cables to equipment designed for use with lugs.
3. For Conductor Sizes Larger than Terminal Capacity on Equipment: Reduce the larger conductor to the maximum conductor size that terminal can accommodate (reduced section not longer than one foot). Use compression or mechanical type connectors suitable for reducing connection.

END OF SECTION 260519

SECTION 260526
SERVICE GROUNDING AND BONDING

PART 1. GENERAL

1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

PART 2. PRODUCTS

2.01 MATERIALS

A. Ground Clamps (Cable to Pipe): Blackburn/T&B Corp.'s GUV, Framatome Connectors/Burndy Corp.'s GAR, GD, GP, GK, or OZ/Gedney Co.'s ABG, CG.

B. Ground Clamps (Cable to Rod): Blackburn/T&B Corp.'s GG, GGH, JAB, JABH, GUV, Dossert Corp.'s GN, GPC, Framatome Connectors/Burndy Corp.'s GP, GX, GRC, or OZ/Gedney Co.'s ABG.

C. Ground Lugs: Copper, one- or 2-hole style (to suit conditions), long barrel; Anderson/Hubbell's VERSAtile VHCL, Blackburn/T&B Corp.'s Color-Coded CTL, LCN, Framatome Connectors/Burndy's Hylug YA, Electrical Products Div./3M Scotchlok 31036 or 31145 Series, Ideal Industries Inc.'s CCB or CCBL, or Thomas & Betts Corp.'s 54930BE or 54850BE Series.

D. Exothermic Type Weld: Erico Inc.'s Cadweld Process, or Furseweld/T&B Corp.'s Exothermic Welding System.

E. Compression Connectors: Amp Inc.'s Ampact Copper Grounding System, or Burndy Corp.'s Hyground System.

F. Rod Electrodes: Copper clad (minimum 0.010 jacket) ground rods minimum 3/4 inches diameter by 10'-0" long.

G. Plate Electrodes: Copper plates minimum 0.06 inches thick by 2'-0" square feet of surface area.

H. Grounding Electrode Conductors and Bonding Conductors: Copper conductors, bare or insulated with THW, THW-2, XHHW, XHHW-2, THWN, THWN-2 or THHN insulation.

I. Hardware: Silicon-bronze bolts, nuts, flat and lock washers etc. as manufactured by Dossert Corp., Framatome Connectors/Burndy Corp., or OZ/Gedney Co.

PART 3. EXECUTION

3.01 INSTALLATION

A. Connections:
   1. Make grounding and bonding connections, except buried connections, with silicon-bronze hardware and ground clamps, ground lugs or compression connectors, to suit job conditions.
   2. For buried connections use exothermic type weld or compression connectors.

END OF SECTION 260526

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1. GENERAL

1.01 SUBMITTALS

A. Shop Drawings: Show support details if different from methods specified or shown on the drawings.

B. Product Data: Catalog sheets, specifications and installation instructions.

PART 2. PRODUCTS

2.01 ANCHORING DEVICES

A. Sleeve Anchors (FS FF-S-325 Group II, Type 3, Class 3): Molly/Emhart's Parasleeve Series, Phillips' Red Head AN, HN, FS Series, or Ramset's Dynabolt Series.

B. Wedge Anchors (FS FF-S-325 Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly/Emhart's Parabolt Series, Phillips' Red Head WS, or Ramset's Trubolt Series.

C. Self-Drilling Anchors (FS FF-S-325 Group III, Type 1): Phillips' Red Head Series S or Ramset's Ram Drill Series.

D. Non-Drilling Anchors (FS FF-S-325 Group VIII, Type 1): Hilti's Drop-In Anchor Series, Phillips' Red Head J Series, or Ramset's Dynaset Series.

E. Stud Anchors (FS FF-S-325 Group VIII, Type 2): Phillips' Red Head JS Series.

2.02 CAST-IN-PLACE CONCRETE INSERTS

A. Continuous Slotted Type Concrete Insert, Galvanized:
   1. Load Rating 1300 lbs./ft.: Kindorf's D-986.
   2. Load Rating 2400 lbs./ft.: Kindorf's D-980.
   3. Load Rating 3000 lbs./ft.: Hohmann & Barnard Inc.'s Type CS-H.
   4. Load Rating 4500 lbs./ft.: Hohmann & Barnard Inc.'s Type CS-HD.

B. Threaded Type Concrete Insert: Galvanized ferrous castings, internally threaded.

C. Wedge Type Concrete Insert: Galvanized box-type ferrous castings, designed to accept bolts having special wedge-shaped heads.

2.03 MISCELLANEOUS FASTENERS

A. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work, selected from the following: Furnish galvanized fasteners for exterior use, or for items anchored to exterior walls, except where stainless steel is indicated.
   1. Standard Bolts and Nuts: ASTM A 307, Grade A, regular hexagon head.
   2. Lag Bolts: FS FF-B-561, square head type.
   3. Machine Screws: FS FF-S-92, cadmium plated steel.

4. Machine Bolts: FS FF-B-584 heads; FF-N-836 nuts.
5. Wood Screws: FS FF-S-111 flat head carbon steel.
6. Plain Washers: FS FF-W-92, round, general assembly grade carbon steel.
7. Lock Washers: FS FF-W-84, helical spring type carbon steel.
8. Toggle Bolts: Tumble-wing type; FS FF-B-588, type, class and style as required to sustain load.

B. Stainless Steel Fasteners: Type 302 for interior Work; Type 316 for exterior Work; Phillips head screws and bolts for exposed Work unless otherwise specified.

2.04 TPR (THE PEEL RIVET) FASTENERS

A. 1/4-inch diameter, threadless fasteners distributed by Subcon Products, 315 Fairfield Road, Fairfield, NJ 07004 (800) 634-5979.

2.05 POWDER DRIVEN FASTENER SYSTEMS

A. Olin Corp.'s Ramset Fastening Systems, or Phillips Drill Company Inc.'s Red Head Powder Actuated Systems.

2.06 HANGER RODS

A. Mild low carbon steel, unless otherwise specified; fully threaded or threaded each end, with nuts as required to position and lock rod in place. Unless galvanized or cadmium plated, provide a shop coat of red lead or zinc chromate primer paint.

2.07 "C" BEAM CLAMPS

A. With Conduit Hangers:
1. For 1 Inch Conduit Maximum: B-Line Systems Inc.'s BG-8, BP-8 Series, Caddy/Erico Products Inc.'s BC-8P and BC-8PSM Series, or GB Electrical Inc.'s HIT 110-412 Series.
2. For 3 Inch Conduit Maximum: Appleton Electric Co.'s BH-500 Series beam clamp with H50W/B Series hangers, Kindorf's 500 Series beam clamp with 6HO-B Series hanger, or OZ/Gedney Co.'s IS-500 Series beam clamp with H-OWB Series hanger.
3. For 4 Inch Conduit Maximum: Kindorf's E-231 beam clamp and E-234 anchor clip and C-149 series lay-in hanger; Unistrut Corp.'s P2676 beam clamp and P-1659A Series anchor clip with J1205 Series lay in hanger.

B. For Hanger Rods:
1. For 1/4-Inch Hanger Rods: B-Line Systems Inc.'s BC, Caddy/Erico Products Inc.'s BC, GB Electrical Inc.'s HIT 110, Kindorf's 500, 510, or Unistrut Corp.'s P1648S, P2398S, P2675, P2676.
2. For 3/8 Inch Hanger Rods: Caddy/Erico Products Inc.'s BC, Kindorf's 231-3/8, 502, or Unistrut Corp.'s P1649AS, P2401S, P2675, P2676.
3. For 1/2 Inch Rods: Appleton Electric Co. BH-500 Series, Kindorf's 500 Series, 231-1/2, OZ/Gedney Co.'s IS-500 Series, or Unistrut Corp.'s P1650AS, P2403S, P2676.
4. For 5/8 Inch Rods: Unistrut Corp.'s P1651AS beam clamp and P1656A Series anchor clip.
5. For 3/4 Inch Rods: Unistrut Corp.'s P1653S beam clamp and P1656A Series anchor clip.

2.08 CHANNEL SUPPORT SYSTEM

A. Channel Material: 12 gage steel.

B. Finishes:
   1. Phosphate and baked green enamel/epoxy.
   2. Pre-galvanized.
   3. Electro-galvanized.
   4. Hot dipped galvanized.
   5. Polyvinyl chloride (PVC), minimum 15 mils thick.

C. Fittings: Same material and finish as channel.

D. UL Listed Systems:
   1. B-Line Systems Inc.'s B-22 (1-5/8 x 1-5/8 inches), B-12 (1-5/8 x 2-7/16 inches), B-11 (1-5/8 x 3-1/4 inches).
   2. Grinell Corp.'s Allied Power-Strut PS 200 (1-5/8 x 1-5/8 inches), PS 150 (1-5/8 x 2-7/16 inches), PS 100 (1-5/8 x 3-1/4 inches).
   3. Kindorf's B-900 (1-1/2 x 1-1/2 inches), B-901 (1-1/2 x 1-7/8 inches), B-902 (1-1/2 x 3 inches).
   4. Unistrut Corp.'s P-3000 (1-3/8 x 1-5/8 inches), P-5500 (1-5/8 x 2-7/16 inches), P-5000 (1-5/8 x 3-1/4 inches).
   5. Versabar Corp.'s VA-1 (1-5/8 x 1-5/8 inches), VA-3 (1-5/8 x 2-1/2 inches).

2.09 MISCELLANEOUS FITTINGS

A. Side Beam Brackets: B-Line Systems Inc.'s B102, B103, B371-2, Kindorf's B-915, or Versabar Corp.'s VF-2305, VF-2507.

B. Pipe Straps:
   1. Two Hole Steel Conduit Straps: B-Line Systems Inc.'s B-2100 Series, Kindorf's C-144 Series, or Unistrut Corp.'s P-2558 Series.
   2. One Hole Malleable Iron Clamps: Kindorf's HS-400 Series, or OZ/ Gedney Co.'s 14-G Series, 15-G Series (EMT).

C. Deck Clamps: Caddy/Erico Products Inc.'s DH-4-T1 Series.

D. Fixture Stud and Strap: OZ/Gedney Co.'s SL-134, or Steel City's FE-431.

E. Supporting Fittings for Pendent Mounted Industrial Type Fluorescent Fixtures on Exposed Conduit System:
   1. Ball Hanger: Appleton Electric Co.'s AL Series, or Crouse-Hinds Co.'s AL Series.
   2. Flexible Fixture Hanger: Appleton Electric Co.'s UNJ-50, UNJ-75, or Crouse-Hinds Co.'s UNJ115.
   3. Flexible (Hook Type) Fixture Hanger: Appleton Electric Co.'s FHHF, or Crouse-Hinds Co.'s UNH-1.
   4. Eyelet: Unistrut Corp.'s M2250.
   5. Eyelet with Stud: Kindorf's H262, or Unistrut Corp.'s M2350.

6. Conduit Hook: Appleton Electric Co.'s FHSN, or Crouse-Hinds Co.'s UNH-13.

F. Supporting Fasteners (Metal Stud Construction): Metal stud supports, clips and accessories as produced by Caddy/Erico Products Inc.

PART 3. EXECUTION

3.01 INSTALLATION

A. Where specific fasteners are not specified or indicated for securing items to in-place construction, provide appropriate type, size, and number of fasteners for a secure, rigid installation.

B. Install anchoring devices and other fasteners in accordance with manufacturer's printed instructions.

C. Make attachments to structural steel wherever possible.

3.02 FASTENER SCHEDULE

A. Material:
1. Use cadmium or zinc coated anchors and fasteners in dry locations.
2. Use hot dipped galvanized or stainless-steel anchors and fasteners in damp and wet locations.
3. For corrosive atmospheres or other extreme environmental conditions, use fasteners made of materials suitable for the conditions.
4. Fasteners in process areas or areas subject to corrosive fumes or process liquids shall be PVC coated.

B. Types and Use: Unless otherwise specified or indicated use:
1. Cast-in-place concrete inserts in fresh concrete construction for direct pull-out loads such as shelf angles or fabricated metal items and supports attached to concrete slab ceilings.
2. Anchoring devices to fasten items to solid masonry and concrete when the anchor is not subjected to pull out loads, or vibration in shear loads.
3. Toggle bolts to fasten items to hollow masonry and stud partitions.
4. TPR fasteners to fasten items to plywood backed gypsum board ceilings.
5. Metallic fasteners installed with electrically operated or powder driven tools for approved applications, except:
   a. Do not use powder driven drive pins or expansion nails.
   b. Do not attach powder driven or welded studs to structural steel less than 3/16 inch thick.
   c. Do not support a load, in excess of 250 lbs from any single welded or powder driven stud.
   d. Do not use powder driven fasteners in precast concrete.

3.03 ATTACHMENT SCHEDULE

A. General: Make attachments to structural steel or steel bar joists wherever possible. Provide intermediate structural steel members where required by support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of 5.

1. Make attachments to steel bar joists at panel points of joists.
2. Do not drill holes in main structural steel members.
3. Use "C" beam clamps for attachment to steel beams.

B. Where it is not possible to make attachments to structural steel or steel bar joists, use the following methods of attachment to suit type of construction unless otherwise specified or indicated on the drawings:
   1. Attachment to Steel Roof Decking (No Concrete Fill):
      a. Decking with Hanger Tabs: Use deck clamps.
      b. Decking Without Hanger Tabs:
         1) Before Roofing Has Been Applied: Use 3/8-inch threaded steel rod welded to a 4 x 4 x 1/4-inch steel plate and installed through 1/2-inch hole in roof deck.
         2) After Roofing Has Been Applied: Use welding studs, or self-drilling/tapping fasteners. Exercise extreme care when installing fasteners to avoid damage to roofing.
   2. Attachment to Concrete Filled Steel Decks (Total thickness, 2-1/2 inches or more):
      a. Before Fill Has Been Placed:
         1) Use thru-bolts and fish plates.
         2) Use welded studs. Do not support a load in excess of 250 pounds from a single welded stud.
      b. After Fill Has Been Placed: Use welded studs. Do not support a load in excess of 250 lbs from a single welded stud.
   3. Attachment to Cast-In-Place Concrete:
      a. Fresh Concrete: Use cast-in-place concrete inserts.
   4. Attachment to Cored Precast Concrete Decks:
      a. New Construction: Use thru-bolts and fish plates before Construction Work Contractor has placed roofing insulation over the decks. Contractor shall not drill into or power fasten to bottom of precast plank.
   5. Attachment to Hollow Block or Tile Filled Concrete Deck:
      a. New Construction: Use cast-in-place concrete inserts by having Construction Work Contractor omitting blocks and pouring solid blocks with insert where required.
   6. Attachment to Waffle Type Concrete Decks:
      a. New Construction:
         1) Use cast-in-place concrete inserts in fresh concrete.
         2) If concrete fill has been applied over deck, thru-bolts and fish plates may be used where additional concrete or roofing is to be placed over the deck.
   7. Attachment to Precast Concrete Planks: Use anchoring devices, except do not make attachments to precast concrete planks less than 2-3/4 inches thick.
   8. Attachment to Precast Concrete Tee Construction:
      a. New Construction:
         1) Use tee hanger inserts between adjacent flanges.
         2) Use thru-bolts and fish plates, except at roof deck without concrete fill.
         3) Use anchoring devices installed in webs of tees. Install anchoring devices as high as possible in the webs.
      c. Do not use powder driven fasteners.
      d. Exercise extreme care in drilling holes to avoid damage to reinforcement.
   9. Attachment to Wood Construction: Use side beam brackets fastened to the sides of wood members to make attachments for hangers.

a. Under 15 lbs Load: Attach side beam brackets to wood members with 2 No. 18 x 1-1/2-inch-long wood screws, or 2 No. 16 x 1-1/2-inch-long drive screws.
b. Over 15 lbs Load: Attach side beam brackets to wood members with bolts and nuts or lag bolts. Do not use lag bolts in wooden members having a nominal thickness (beam face) under 2 inches in size. Install bolts and nuts or lag bolts in the side of wood members at the mid-point or slightly above. Install plain washers under all nuts.

LOAD	LAG BOLT SIZE	BOLT DIA.
15 lbs to 30 lbs	3/8 x 1-3/4 inches	3/8 inch
31 lbs to 50 lbs	1/2 x 2 inches	1/2 inch
Over 50 lbs to load limit of structure.	Use bolt & nut	5/8 inch

c. Bottom chord of wood trusses may be utilized as structural support, but method of attachment must be specifically approved.
d. Do not make attachments to the diagonal or vertical members of wood trusses.
e. Do not make attachments to the nailing strips on top of steel beams.

10. Attachment to Metal Stud Construction: Use supporting fasteners manufactured specifically for the attachment of raceways and boxes to metal stud construction.
    a. Support and attach outlet boxes so that they cannot torque/twist. Either:
        1) Use bar hanger assembly, or:
        2) In addition to attachment to the stud, also provide far side box support.

3.04 CONDUIT SUPPORT SCHEDULE

A. Provide number of supports as required by National Electrical Code.

B. Use pipe straps and specified method of attachment where conduit is installed proximate to surface of wood or masonry construction.
    1. Use hangers secured to surface with specified method of attachment where conduit is suspended from the surface.

C. Use "C" beam clamps and hangers where conduit is supported from steel beams.

D. Use deck clamps and hangers where conduit is supported from steel decking having hanger tabs.
    1. Where conduit is supported from steel decking which does not have hanger tabs, use clamps and hangers secured to decking, utilizing specified method of attachment.

E. Use channel support system supported from structural steel for multiple parallel conduit runs.

F. Where conduits are installed above ceiling, do not rest conduit directly on runner bars, T-Bars, etc.
    1. Conduit Sizes 2-1/2 Inches and Smaller: Support conduit from ceiling supports or from construction above ceiling.
    2. Conduit Sizes Over 2-1/2 Inches: Support conduit from beams, joists, or trusses above ceiling.

3.05 LIGHTING FIXTURE SUPPORT SCHEDULE

A. General: Do not support fixtures from ceilings or ceiling supports unless it is specified or indicated on the drawings to do so.
   1. Support fixtures with hanger rods attached to beams, joists, or trusses. Hanger rod diameter, largest standard size that will fit in mounting holes of fixture.
      a. Where approved, channel supports may span and rest upon the lower chord of trusses and be utilized for the support of lighting fixtures.
      b. Where approved, channel supports may span and be attached to the underside of beams, joists, or trusses and be utilized for the support of lighting fixtures.
   2. Use 2 nuts and 2 washers on lower end of each hanger rod to hold and adjust fixture (one nut and washer above top of fixture housing, one nut and washer below top of fixture housing).
      a. Where specified that an adequately supported outlet box is to support a fixture or be utilized as one point of support, support the box so that it may be adjusted to bring the face of the outlet box even with surface of ceiling.

B. Specific Installations Where Fixtures May Be Supported from New Ceilings Being Installed by Construction Work Contractor:
   1. Support surface mounted fluorescent fixtures and incandescent fixtures directly from plywood backed gypsum board ceilings.
   2. Support surface mounted fluorescent fixtures and incandescent fixtures directly from framing or furring members of fire rated suspended ceilings (double gypsum board).
   3. Support recessed mounted fluorescent fixtures and incandescent fixtures directly from furring members of furred gypsum board ceilings.
   4. Support recessed mounted fluorescent fixtures and incandescent fixtures directly from the suspension system of suspended acoustical ceilings. Exception: Support each fixture weighing more than 50 pounds (including lamps) independent of the suspended ceiling grid.
   5. Deliver documents which state actual fixture weights and indicate fixture locations to the Construction Work Contractor (thru the Owner's Representative).

C. Number of Supports for Ceiling Mounted Lighting Fixtures: Provide at least the following number of supports. Provide additional supports when recommended by fixture manufacturer or shown on the drawings.
   1. Commercial and Industrial Fluorescent Fixtures:
      a. Support individual fluorescent fixtures less than 2 feet wide at 2 points.
      b. Support continuous row fluorescent fixtures less than 2 feet wide at points equal to the number of fixtures plus one. Uniformly distribute the points of support over the row of fixtures.
      c. Support individual fluorescent fixtures 2 feet or wider at 4 corners.
      d. Support continuous row fluorescent fixtures 2 feet or wider at points equal to twice the number of fixtures plus 2. Uniformly distribute the points of support over the row of fixtures.
      e. An adequately supported outlet box may be utilized as one point of support for fixtures weighing less than 50 pounds.
   2. Vandal Resistant, and Minimum-Security Fluorescent Fixtures:
      a. Support individual fluorescent fixtures less than 2 feet wide at 4 corners.

b. Support continuous row fluorescent fixtures less than 2 feet wide at points equal to twice the number of fixtures. Uniformly distribute the points of support.
c. Support individual fluorescent fixtures 2 feet or wider at each corner and one support midway along each side of longest axis (6 supports total).
d. Support continuous row fluorescent fixtures 2 feet or wider at points equal to 4 times the number of fixtures. Uniformly distribute the points of support.
e. An adequately supported outlet box may be utilized as one point of support for fixtures weighing less than 50 pounds.

3. Medium Security Fluorescent Fixtures: Support each fixture at minimum of 6 points (each corner and midway along each side of longest axis). Outlet box shall not be counted as a point of support.
4. Maximum Security Fluorescent Fixtures: Support each fixture at minimum of 8 points (each corner, and 2 supports spaced equally along each side of longest axis). Outlet box shall not be counted as a point of support.
5. Mercury Vapor, Metal Halide, and High-Pressure Sodium Fixtures:
   a. Commercial Style: Support fixture at 2 points.
   b. Industrial Style: Support individual fixtures at one point.
   c. Vandal Resistant Style: Support fixture at 4 points.
   d. An adequately supported outlet box may be utilized as one point of support for fixtures weighing less than 50 pounds.
6. Commercial and Industrial Incandescent Fixtures: Support fixture from adequately supported outlet box, to suit fixture design (fixture weight less than 50 pounds).
7. Vandal Resistant Incandescent Fixtures: Support fixture from adequately supported outlet box to suit fixture design, plus 2 fasteners through back of fixture into suitable construction behind fixture.

D. Number of Supports for Wall Mounted Lighting Fixtures: Provide at least the following number of supports. Provide additional supports when recommended by fixture manufacturer or shown on the drawings.
1. Commercial and Industrial Fluorescent Fixtures:
   a. Support individual fluorescent fixtures 2 feet long or less at 2 points.
   b. Support individual fluorescent fixtures over 2 feet long at 3 points.
   c. Support continuous row fluorescent fixtures at points equal to twice the number of fixtures. Uniformly distribute the points of support.
   d. An adequately supported outlet box may be utilized as one point of support for fixtures weighing less than 50 pounds.
2. Vandal Resistant, and Minimum-Security Fluorescent Fixtures:
   a. Support individual fluorescent fixtures 2 feet long or less at 4 points (each corner).
   b. Support individual fluorescent fixtures over 2 feet long at 6 points (each corner and midway along each side of longest axis).
   c. Support continuous row fluorescent fixtures at points equal to 6 times the number of fixtures. Uniformly distribute the points of support.
   d. An adequately supported outlet box may be utilized as one point of support for fixtures weighing less than 50 pounds.
3. Medium Security, and Maximum-Security Fluorescent Fixtures:
   a. Support each fluorescent fixture 2 feet long or less at minimum of 4 points (each corner).
   b. Support each fluorescent fixture over 2 feet long, to 3 feet long at a minimum of 6

points (each corner and midway along each side of longest axis).

c. Support each fluorescent fixture over 3 feet long, to 8 foot long at minimum of 8 points (each corner, and 2 supports spaced equally along each side of longest axis).

d. Outlet box shall not be counted as a point of support.

4. Metal Halide, and High-Pressure Sodium Fixtures:

a. Commercial and Industrial Style: Support fixture at 2 points (Support arm mounted style at 4 points).

b. An adequately supported outlet box may be used as one point of support for fixtures weighing less than 50 pounds.

5. Commercial and Industrial Incandescent Fixtures: Support fixture from adequately supported outlet box, to suit fixture design (fixture weight less than 50 pounds).

3.06 CHANNEL SUPPORT SYSTEM SCHEDULE

A. Use channel support system where specified or indicated on the drawings.

B. Channel supports may be used, as approved, to accommodate mounting of equipment.

C. Material and Finish:

1. Dry Locations: Use 12 gage steel channel support system having any one of the specified finishes.

2. Damp Locations: Use 12 gage steel channel support system having any one of the specified finishes except green epoxy/enamel.

3. Wet Locations: Use 12 gage steel channel support system having hot dipped galvanized, or PVC finish.

END OF SECTION 260529

SECTION 260533
INTERIOR RACEWAYS, FITTINGS, AND ACCESSORIES

PART 1. GENERAL

1.01 REFERENCES

A. NEMA, ANSI, and UL.

1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

1.03 MAINTENANCE

A. Spare Parts: Furnish the following items in the manufacturer's original containers labeled with the names of the items and locations where the items would be used. Store them at the site where directed:
   1. Touch up coating compound for plastic coated rigid metal conduit (one spray type can and one non-spray can with brush top).

PART 2. PRODUCTS

2.01 RACEWAYS

A. Rigid Ferrous Metal Conduit: Steel, hot dipped galvanized on the outside and inside, UL categorized as Rigid Ferrous Metal Conduit (identified on UL Listing Mark as Rigid Metal Conduit - Steel or Rigid Steel Conduit), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.

B. Intermediate Ferrous Metal Conduit: Steel, galvanized on the outside and enameled on the inside, UL categorized as Intermediate Ferrous Metal Conduit (identified on UL Listing Mark as Intermediate Metal Conduit or IMC), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.

C. Electrical Metallic Tubing: Steel, galvanized on the outside and enameled on the inside, UL categorized as Electrical Metallic Tubing (identified on UL Listing Mark as Electrical Metallic Tubing), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.

D. Flexible Metal Conduit: Galvanized steel strip shaped into interlocking convolutions, UL categorized as Flexible Metal Conduit (identified on UL Listing Mark as Flexible Steel Conduit or Flexible Steel Conduit Type RW), by AFC Cable Systems Inc., Anamet Electrical Inc., Electri-Flex Co., or International Metal Hose Co.

E. Liquid-tight Flexible Metal Conduit: UL categorized as liquid-tight flexible metal conduit (identified on UL Listing Mark as Liquid-Tight Flexible Metal Conduit, also specifically marked with temperature and environment application data), by AFC Cable Systems Inc., Anamet Electrical Inc., Electri-Flex Co., or Universal Metal Hose Co.

F. Surface Metal Raceway, Fittings and Accessories: By Thomas & Betts Corp., Mono-Systems Inc. or Wiremold Co. Area and conductor capacity indicated for each size raceway is for

reference. Follow manufacturer's recommended raceway capacity for all types and sizes of conductors:

1. Size 1: Nominal area .3 sq. in. min., 4 No. 12 THW max.; Thomas & Betts B400, Mono-Systems SMS 700, or Wiremold's V700.
2. Size 2: Nominal area .75 sq. in. min., 11 No. 12 THW max.; Thomas & Betts SR250, Mono-Systems SMS2100, Wiremold's 2100.
3. Size 3: Nominal area 2.8 sq. in. min., 43 No. 12 THW max.; Thomas & Betts SR500, Mono-Systems SMS3200, or Wiremold's G3000.
4. Size 4: Nominal area 7.5 sq. in. min., 119 No. 12 THW max.; Thomas & Betts SR600, Mono-Systems SMS4200, or Wiremold's G4000.
5. Size 5: Nominal area 15.9 sq. in. min., 252 No. 12 THW max.; Thomas & Betts SR700, Mono-Systems SMS4400, or Wiremold's G6000.

G. Wireways, Fittings and Accessories:
   1. NEMA 1 (Without Knockouts): Hoffman Enclosures Inc. Bulletin F-40, Hubbell/Wegmann's HSK, Lee Products Co.'s S Series, Rittal/Electromate's EW & EWHC Lay-In Wireway System, or Square D Co.'s Square-Duct Class 5100.

H. Plastic Coated Rigid Metal Conduit, Fittings, and Accessories: Rigid ferrous metal conduit, fittings, and accessories coated with 40 mils thick polyvinylchloride coating; Ocal/T&B Corp.'s Ocal-Blue System, PCD Inc.'s KorKap, KorKap XL, or Robroy Industries' Plasti-bond or Perma-Cote System.

2.02 FITTINGS AND ACCESSORIES

A. Insulated Bushings:
   1. Threaded, malleable iron/zinc electroplate with 105 degrees C minimum plastic insulated throat; Appleton Electric Co.'s BU50I Series, Cooper/Crouse-Hinds' 1031 Series, OZ/Gedney Co.'s IBC-50 Series, Raco Inc.'s 1132 Series, Steel City/T & B Corp.'s BI-901 Series, or Thomas & Betts Corp.'s 1222 Series.
   2. Threaded malleable iron with 150 degrees C plastic throat; Appleton Electric Co.'s BU501 Series, Cooper/Crouse-Hinds' H1031 Series, or OZ/Gedney Co.'s IBC-50 Series.

B. Plastic Bushings for 1/2- and 3/4-Inch Conduit:
   1. 105 degrees C minimum temperature rating; Appleton Electric Co.'s BBU50, BBU75, Blackburn (T & B Corp.'s) 50 BB, 75 BB, Cooper/Crouse-Hinds' 931,932, or OZ/Gedney Co.'s IB-50, IB-75, Raco Inc.'s 1402, 1403, Steel City/T & B Corp.'s BU-501, BU-502, or Thomas & Betts Corp.'s 222, 223.
   2. 150 degrees C temperature rating; Appleton Electric Co.'s BBU50H, BBU75H, Cooper/Crouse-Hinds' H-931, H-932, or OZ/Gedney Co.'s A-50, A-75.

C. Insulated Grounding Bushings:
   1. Threaded, malleable iron/zinc electroplate with 105 degrees C minimum plastic insulated liner, and ground lug; Appleton Electric Co.'s GIB-50 Series, Cooper/Crouse-Hinds' GLL Series, OZ/Gedney Co.'s IBC-50L Series, Raco Inc.'s 1212 Series, Steel City/T & B Corp.'s BG-801 (1/2 to 2") Series, or Thomas & Betts Corp.'s 3870.
   2. Threaded malleable iron/zinc electroplate with 150 degrees C plastic insulated liner, and ground lug; Appleton Electric Co.'s GIB Series, Cooper/Crouse-Hinds' HGLL Series, or OZ/Gedney Co.'s IBC-50L Series, or Thomas & Betts Corp.'s 3870.

D. Connectors and Couplings:
   1. Locknuts: UL, steel/zinc electroplate; Appleton Electric Co.'s BL-50 Series, Cooper/Crouse-Hinds' 11 Series, OZ/Gedney Co.'s 1-50S Series, Raco Inc.'s 1002 Series, Steel City/T&B Corp.'s LN-101 Series, or Thomas & Betts Corp.'s 141 Series.
   2. Grounding Wedge: Thomas & Betts Corp.'s 3650 Series.
   3. Couplings for Rigid Metal and IMC Conduit: Standard galvanized threaded couplings as furnished by conduit manufacturer, Allied Tube & Conduit Corp.'s Kwik-Couple, or Thomas & Betts Corp.'s Shamrock.
   4. Three Piece Conduit Coupling for Rigid Metal and IMC Conduit: Steel, malleable iron, zinc electroplate; Allied Tube & Conduit Corp.'s Kwik-Couple, Appleton Electric Co.'s EC-50 Series, Cooper/Crouse-Hinds' 190M Series, OZ/Gedney Co.'s 4-50 Series, Raco Inc.'s 1502 Series, Steel City/T & B Corp.s EK-401 Series, or Thomas & Betts Corp.'s 675 Series.
   5. Electrical Metallic Tubing Couplings and Insulated Connectors: Compression type, steel/zinc electroplate; Appleton Electric Co.'s TW-50CS1, TWC-50CS Series, Cooper/Crouse-Hinds' 1650, 660S Series, Raco Inc.'s 2912, 2922 Series, Steel City/T & B Corp.'s TC-711 Series, or Thomas & Betts Corp.'s 5120, 5123 Series.
   6. Flexible Metal Conduit Connectors: Arlington Industries Inc.'s Saddle-Grip, OZ/Gedney Co.'s C-8T, 24-34T, ACV-50T Series, or Thomas & Betts Corp.'s Nylon Insulated Tite-Bite Series.
   7. Liquid-tight Flexible Metal Conduit Connectors: Steel, malleable iron, zinc electroplate, insulated throat; Appleton Electric Co.'s STB Series, Cooper/Crouse-Hinds' LTB Series, OZ/Gedney Co.'s 4Q-50T Series, Raco Inc.'s 3512 Series, Steel City/T & B Corp.'s LT-701 Series, or Thomas & Betts Corp.'s 5332 Series.

E. Conduit Bodies (Threaded):
   1. Malleable Iron/Zinc Electroplate: Zinc electroplate malleable iron or cast-iron alloy bodies with zinc electroplate steel covers; Appleton Electric Co.'s Unilets, Cooper/Crouse-Hinds' Condulets, OZ/Gedney Co.'s Conduit Bodies, or Thomas & Betts Corp.'s Conduit Bodies.

F. Expansion Fittings:
   1. Malleable Iron, Zinc Electroplate Finish: Appleton Electric Co.'s XJ or OZ/Gedney Co.'s AX (TX for EMT), with external bonding jumper.
   2. Electrogalvanized Steel: Cooper/Crouse-Hinds' XJG (XJG-EMT for EMT), or Thomas & Betts Corp.'s XJG, with internal grounding.

G. Deflection Fittings: Appleton Electric Co.'s DF, Cooper/Crouse-Hinds' XD, or OZ/Gedney Co.'s Type DX.

H. Hazardous Location Fittings:
   1. Sealing Fittings: Appleton Electric Co.'s EYS, ESU w/Kwiko sealing compound and fiber filler, Cooper/Crouse-Hinds' EYS, EZS w/Chico A sealing compound and Chico X filler, OZ/Gedney Co.'s EY, EYA with EYC sealing compound and EYF damming fiber, or Thomas & Betts Corp.'s. EYS w/Chico A sealing compound and Chico X filler.
   2. Other Type Fittings: As required to suit installation requirements, by Appleton Electric Co., Cooper/Crouse-Hinds, OZ/Gedney Co, or Thomas & Betts Corp.

I. Sealant for Raceways Exposed to Different Temperatures: Sealing compounds and accessories to suit installation; Appleton Electric Co.'s DUC, or Kwiko Sealing Compound with fiber filler, Cooper/Crouse-Hinds' Chico A Sealing Compound with Chico X fiber, Electrical Products Division 3M Scotch products, OZ Gedney Co.'s DUX or EYC sealing compound with EYF damming fiber, or Thomas & Betts Corp.'s Blackburn DX.

J. Vertical Conductor Supports: Kellems/Hubbell Inc.'s Conduit Riser Grips, or OZ/Gedney Co.'s Type M, Type R.

K. Pulling-In-Line for Installation in Spare and Empty Raceways: Polypropylene monofilament utility line; Greenlee Textron Inc.'s Poly Line 430, 431, or Ideal Industries Powr-Fish Pull-Line 31-340 Series.

PART 3. EXECUTION

3.01 RACEWAY INSTALLATION - GENERAL

A. Number of Raceways: Do not change number of raceways to less than the number indicated on the drawings.
   1. Each raceway shall enclose one circuit unless otherwise indicated on the drawings.

B. Number of Raceways: Do not change number of raceways to less than the number indicated on the drawings except when appropriate for advantageous reuse of existing exposed and concealed raceways (the contract documents do not indicate location, number, size or condition of existing raceways). Existing raceways may be reused if the following conditions are met:
   1. The existing raceway must be of adequate size for the new conductors to be installed therein (NFPA 70 Chapter 9, Tables 1, 4, & 5; Appendix C, Tables C1-C12a). More circuits may be enclosed by existing raceways than the circuiting shown on the drawings provided conductor sizes are increased to compensate for derating (adjustment factors) and other considerations required by NFPA 70 Article 310-15.
   2. Remove existing conductors.
   3. Demonstrate to the Owner's Representative that the existing raceway is clear of obstructions and in good condition.
   4. Check ground continuity. When ground continuity of existing raceway is inadequate install insulated grounding bushings, grounding wedges, bonding straps, grounding jumpers or equipment grounding conductors to establish effective path to ground.
   5. Install insulated bushings to replace damaged or missing bushings. Replace non-insulated bushings with insulated bushings on raceway sizes 1 inch and larger.
   6. Install vertical conductor supports to replace existing or missing vertical conductor supports.
   7. Install extension rings on existing boxes when the number of new conductors installed therein exceeds NFPA 70 requirements.
   8. Furnish the Owner's Representative with marked up drawings showing size and routing of existing raceways with number and size of new conductors installed therein.

C. Raceways for Future Use (Spare Raceways and Empty Raceways): Draw fish tape through raceways in the presence of the Owner's Representative to show that the raceway is clear of obstructions.
   1. Leave a pulling-in line in each spare and empty raceway.

D. Conduit Installed Concealed:
   1. Where possible install conduit concealed unless otherwise indicated on the drawings.
   2. Existing Construction:
      a. Run conduit in existing chases and hung ceilings.
      b. If conduit cannot be installed concealed due to conditions encountered in the building, report such conditions and await approval in writing before proceeding.
   3. New Construction:
      a. Run conduit in the ceilings, walls, and partitions.
      b. Install conduit under slabs on grade or under slabs above finished ceilings where indicated on the drawings. Concrete slabs that are both ceilings and floors shall be treated as floor slabs.
         1) Conduit Under Slab on Grade:
            a) Run conduit under vapor barrier, if any.
            b) Install equipment grounding conductor in each conduit. Bond at boxes and equipment to which conduit is connected.
         2) Conduit Under Slab, Above Finished Ceiling:
            a) Attach conduit to bottom of slab or structure supporting the slab.
            b) Firestop through-penetrations of the slab.
   4. If any portions of the conduit system cannot be installed concealed due to conditions encountered in the building, report such conditions and await approval in writing before proceeding.

E. Conduits Penetrating Concrete Floor Slabs (Concrete slabs that are both ceilings and floors shall be treated as floor slabs):
   1. Provide a minimum of 2 inches between conduits that vertically penetrate elevated concrete slabs.

F. Conduit Installed Exposed:
   1. Install conduit exposed where indicated on the drawings.
   2. Install conduit tight to the surface of the building construction unless otherwise indicated or directed.
   3. Install vertical runs perpendicular to the floor.
   4. Install runs on the ceiling perpendicular or parallel to the walls.
   5. Install horizontal runs parallel to the floor.
   6. Do not run conduits near heating pipes.
   7. Installation of conduit directly on the floor will not be permitted.

F. Conduit Size: Not smaller than 1/2-inch electrical trade size. Where type FEP, THHN, THWN, THWN-2, XHH, XHHW, or XHHW-2 conductors are specified for use under Section 16121, the minimum allowable conduit size for new Work shall be based on Type THW conductors.

G. Conduit Bends: For 1/2- and 3/4-inch conduits, bends may be made with manual benders. For all conduit sizes larger than 3/4 inch, manufactured or field fabricated offsets or bends may be used. Make field fabricated offsets or bends with an approved hydraulic bender.

3.02 RACEWAY INSTALLATION - SPECIAL AREAS

A. Conduit in Hazardous Areas: Install Work in hazardous areas in accordance with the NFPA 70. The hazardous areas and the degree of hazard for each area are indicated on the drawings.
   1. Install sealing fittings in concealed conduit runs in a recessed box with blank face plate to match other face plates in the area.

3.03 RACEWAY SCHEDULE

A. Rigid Ferrous Metal Conduit: Install in all locations unless otherwise specified or indicated on the drawings.

B. Intermediate Ferrous Metal Conduit: May be installed in all dry and damp locations except:
   1. Hazardous areas.
   2. Where other type raceways are specified or indicated on the drawings.

C. Electrical Metallic Tubing:
   1. May be installed concealed as branch circuit conduits above suspended ceilings where conduit does not support fixtures or other equipment.
   2. May be installed concealed as branch circuit conduits in hollow areas in dry locations, including:
      a. Hollow concrete masonry units, except where cores are to be filled.
      b. Drywall construction with sheet metal studs, except where studs are less than 3-1/2 inches deep.

D. Flexible Metal Conduit: Install equipment grounding conductor in the flexible metal conduit and bond at each box or equipment to which conduit is connected:
   1. Use for final conduit connection to recessed lighting fixtures in suspended ceilings. Use 4 to 6 feet of flexible metal conduit, minimum size 1/2 inch, between junction box and fixture. Locate junction box at least 1 foot from fixture and accessible if the fixture is removed.
   2. Use 1 to 3 feet of flexible metal conduit for final conduit connection to:
      a. Dry type transformers.
      b. Non-Process Equipment subject to vibration (dry locations).
      c. Non-Process Equipment requiring flexible connection for adjustment or alignment (dry locations).
   3. Use for concealed branch circuit conduits above existing non-removable suspended ceilings where rigid type raceways cannot be installed due to inaccessibility of space above ceiling.
   4. May be installed concealed as branch circuit conduits in drywall construction with sheet metal studs, except where studs are less than 3-1/2 inches deep.

E. Liquid-tight Flexible Metal Conduit: Install equipment grounding conductor in liquid-tight flexible metal conduit and bond at each box or equipment to which conduit is connected:
   1. Use 1 to 3 feet of liquid-tight flexible metal conduit (UL listed and marked suitable for the installation’s temperature and environmental conditions) for final conduit connection to:
      a. Motors with weather-protected or totally enclosed housings.
      b. Equipment subject to vibration (damp and wet locations).

c. Equipment requiring flexible connection for adjustment or alignment (damp and wet locations).

F. Surface Metal Raceway: Use as exposed raceway system in finished spaces at locations indicated on the drawings.
1. Use surface metal raceway system of size required for number of wires to be installed therein. Use specific size when indicated on the drawings.
2. Do not run raceway through walls that have a plaster finish nor through masonry walls or floors. Install a pipe sleeve, or a short length of conduit with junction boxes or adapter fittings for raceway runs through such areas. Run raceway along top of baseboards, care being taken to avoid telephone and other signal wiring. Where raceway crosses chair railing or picture molding, cut the chair railing or picture molding to permit the raceway to lie flat against the wall. Run raceway around door frames and other openings. Run raceway on ceiling or walls perpendicular to or parallel with walls and floors.
3 Secure raceways at intervals not exceeding 36 inches.
4. Install separate equipment grounding conductor for grounding of equipment. The raceway alone will not be considered suitable for use as an effective path to ground.
5. Outlet box covers for pendant mounted fluorescent fixtures may be omitted if the fixture canopy is notched to receive the raceway and the canopy fits snugly against the ceiling.
6. Where equipment is mounted on an outlet box and the equipment base is larger than the outlet box, provide finishing collar around equipment base and outlet box or provide finishing collar/outlet box:
a. Finishing Collar: Same finish and peripheral dimensions as the equipment base, including provisions for mounting, slots to fit over raceway and of depth to cover outlet box and extend back to ceiling or wall.
b. Combination Finishing Collar/Outlet Box: Same finish and peripheral dimensions as the equipment base to be mounted thereon, gage or thickness of metal as required by NFPA 70, including provision for mounting and knockouts for entrance of raceway.

G. Wireways: May be used indoors in dry locations for exposed raceway between grouped, wall mounted equipment.

H. Plastic Coated Rigid Metal Conduit: Use at locations indicated on drawings.

3.04 FITTINGS AND ACCESSORIES SCHEDULE

A. General:
1. Use fittings and accessories that have a temperature rating equal to, or higher than the temperature rating of the conductors to be installed within the raceway.
2. Use zinc electroplate or hot dipped galvanized steel/malleable iron or cast-iron alloy fittings and accessories in conjunction with ferrous raceways in dry and damp locations unless otherwise specified or indicated on the drawings.
3. Use insulated grounding bushings or grounding wedges on ends of conduit for terminating and bonding equipment grounding conductors, when required, if cabinet or boxes are not equipped with grounding/bonding screws or lugs.
4. Use caps or plugs to seal ends of conduits until wiring is installed to exclude foreign material.

5. Use insulated grounding bushings on the ends of conduits that are not directly connected to the enclosure, such as stub-ups under equipment, etc., and bond between bushings and enclosure with equipment grounding conductor.
6. Use expansion fittings where raceways cross expansion joints (exposed, concealed, buried).
7. Use deflection fittings where raceways cross expansion joints that move in more than one plane.
8. Use 2 locknuts and an insulated bushing on end of each conduit entering sheet metal cabinet or box in dry or damp locations.
    a. Plastic bushing may be used on 1/2- and 3/4-inch conduit in lieu of insulated bushing.
    b. Terminate conduit ends within cabinet/box at the same level.

B. For Rigid and Intermediate Metal Conduit: Use threaded fittings and accessories. Use 3-piece conduit coupling where neither piece of conduit can be rotated.

C. For Electrical Metallic Tubing: Use compression type connectors and couplings.

D. For Flexible Metal Conduit: Use flexible metal conduit connectors.

E. For Liquid-tight Flexible Metal Conduit: Use liquid-tight connectors.

F. For Surface Metal Raceway: Use raceway manufacturer's standard fittings and accessories.

G. For Wireways: Use wireway manufacturer's standard fittings and accessories.

H. For Plastic Coated Rigid Metal Conduit: Use conduit manufacturer's PVC coated fittings and accessories.

END OF SECTION 260533

SECTION 260533.1
OUTLET, JUNCTION, AND PULL BOXES

PART 1. GENERAL

1.01 REFERENCES

A. NEMA, and UL.

1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.
   1. For fire rated construction, prove that materials and installation methods proposed for use are in accordance with the listing requirements of the classified construction.

PART 2. PRODUCTS

2.01 GALVANIZED STEEL OUTLET BOXES

A. Standard galvanized steel boxes and device covers by Appleton Electric Co., Beck Mfg./Picoma Industries, Cooper/Crouse-Hinds, Raco/Div. of Hubbell, or Steel City/T & B Corp.

2.02 GALVANIZED STEEL JUNCTION AND PULL BOXES

A. Code gage, galvanized steel screw cover boxes by Delta Metal Products Inc., Hoffman Enclosures Inc., Hubbell Wiegmann, Lee Products Co., or Rittal/Electromate.

2.03 THREADED TYPE BOXES:

A. Outlet Boxes:
   1. For Dry, Damp Locations: Zinc electroplate malleable iron or cast-iron alloy boxes by Appleton Electric Co., Cooper/Crouse-Hinds Co., or OZ/ Gedney Co., with zinc electroplate steel covers to suit application.
   2. For Wet Locations: Malleable iron or cast-iron alloy boxes with hot dipped galvanized or other specified corrosion resistant finish as produced by Cooper/Crouse-Hinds (hot dipped galvanized or Corro-free epoxy powder coat), or OZ/Gedney Co. (hot dipped galvanized), with stainless steel cover screws, and malleable iron covers gasketed to suit application.

B. Junction and Pull Boxes:
   1. For Dry, Damp Locations: Zinc electroplate cast iron boxes by Appleton Electric Co., Cooper/Crouse-Hinds, or OZ/Gedney Co., with zinc electroplate steel or cast-iron cover.
   2. For Wet Locations: Cast iron boxes by Cooper/Crouse-Hinds' (hot dipped galvanized or Corro-free epoxy powder coat), or OZ/Gedney Co. (hot dipped galvanized), with stainless steel cover screws and cast-iron cover gasketed to suit application.

C. Conduit Bodies, Threaded (Provided with a Volume Marking):
   1. For Dry, Damp Location: Zinc electroplate malleable iron or cast-iron alloy bodies with zinc electroplate steel covers; Appleton Electric Co.'s Unilets, Cooper/Crouse-Hinds' Condulets, or OZ/Gedney Co.'s Conduit Bodies.
   2. For Wet Locations: Malleable iron or cast-iron alloy bodies with hot dipped galvanized or other specified corrosion resistant finish; Cooper/Crouse-Hinds' Condulets (hot dipped

galvanized or Corro-free epoxy power coat), or OZ/Gedney Co.'s Conduit Bodies (hot dipped galvanized) with stainless steel cover screws and malleable iron covers gasketed to suit application.

2.04 CORROSION RESISTANT BOXES

A. Plastic Coated Outlet and Junction Boxes: Threaded type malleable iron boxes coated with 40 mils thick polyvinylchloride coating; Ocal/T&B Corp.'s Ocal-Blue System, PCD Inc.'s KorKap, KorKap XL, or Robroy Industries' Plastibond or Perma-Cote System.

B. Non-Metallic Junction and Pullboxes: Glass fiber reinforced polyester; Carlon/Div. of Lamon and Sessions' Himeline Series, Cooper/Crouse-Hinds' Krydon Products, or Robroy Industries' Stahlin Enclosures.

2.05 SPECIFIC PURPOSE OUTLET BOXES

A. As fabricated by manufacturers for mounting their equipment.

2.06 FINISHING COLLAR OR COMBINATION FINISHING COLLAR/OUTLET BOX (SURFACE MOUNTED EQUIPMENT USED WITH EXPOSED RACEWAY):

A. Finishing Collar: Same finish and peripheral dimensions as the equipment base, including provisions for mounting, slots to fit over raceway and of depth to cover outlet box and extend back to ceiling or wall.

B. Combination Finishing Collar/Outlet Box: Same finish and peripheral dimensions as the equipment base, gage or thickness of metal as required by National Electrical Code, including provisions for mounting, and knockouts or threaded bosses for entrance of raceway.

PART 3. EXECUTION

3.01 PREPARATION

A. Before proceeding with the installation of junction and pull boxes, check the locations with the Owner's Representative and have same approved.

3.02 INSTALLATION

A. Mounting Position of Wall Outlets for Wiring Devices: Unless otherwise indicated, install boxes so that the long axis of each wiring device will be vertical.

B. Height of Wall Outlets: Unless otherwise indicated, locate outlet boxes with their center lines at the following elevations above finished floor:

Lighting Fixtures	As Indicated on Drawings"
Lighting Fixtures in Stairway	As Indicated on Drawings"
Exit Lights	8'-0" where ceiling height allows a minimum of 6-inch clearance between ceiling and top of exit light. Otherwise mount exit light so that it's top is 6 inches below finished ceiling. Adjust height and clearances as required to suit installation over doors.
Switches	4'-0"
Single & Duplex Receptacles	1'-6"* or as indicated.
Water Cooler Receptacles	2'-0"
Range Receptacle	1'-6"
Special Purpose Receptacles	4'-0"
Thermostats	5'-0"
Manual Fire Alarm Boxes	4'-0"
Audible Notification Appliances	8'-0" where ceiling height allows a minimum of 6-inch clearance between ceiling and top of appliance. Otherwise mount appliance so that it's top is 6 inches below finished ceiling.
Visible Notification Appliances	Install outlet so that the bottom of the visible lens will be 6'-8" AFF.
Combination Audible/Visible Notification Appliances	Install outlet so that the bottom of the visual lens will be 6'-8" AFF, and the audible section will be above the visible section.
Telecommunications	2'-0"
Telephone	2'-0"

*In areas containing heating convectors, install outlets above convectors at height indicated on drawings.

C. Supplementary Junction and Pull Boxes: In addition to junction and pull boxes indicated on the drawings and required by NFPA 70, provide supplementary junction and pull boxes as follows:
   1. When required to facilitate installation of wiring.
   2. At every third 90 degree turn in conjunction with raceway sizes over 1 inch.
   3. At intervals not exceeding 100 feet in conjunction with raceway sizes over 1 inch.

3.03 OUTLET, JUNCTION, AND PULL BOX SCHEDULE

A. Boxes for Concealed Conduit System:
   1. Non-Fire Rated Construction:
      a. Depth: To suit job conditions and comply with NFPA 70 Article 370.
      b. For Lighting Fixtures: Use galvanized steel outlet boxes designed for the purpose.
         1) For Fixtures Weighing 50 lbs. or Less: Box marked "FOR FIXTURE SUPPORT".
         2) For Fixtures More Than 50 lbs: Box listed and marked with the weight of the fixture to be supported (or support fixture independent of the box).
      c. For Junction and Pull Boxes: Use galvanized steel boxes with flush covers.
      d. For Switches, Receptacles, Etc:
         1) Plaster or Cast-In-Place Concrete Walls: Use 4 inch or 4-11/16-inch galvanized steel boxes with device covers.

2) Walls Other Than Plaster or Cast-In-Place Concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.

2. Recessed Boxes in Fire Rated (2 hour maximum) Bearing and Nonbearing Wood or Steel Stud Walls (Gypsum Wallboard Facings):
   a. Use listed single and double gang metallic outlet and switch boxes. The surface area of individual outlet or switch boxes shall not exceed 16 square inches.
   b. The aggregate surface area of the boxes shall not exceed 100 square inches per 100 square feet of wall surface.
   c. Securely fasten boxes to the studs. Verify that the opening in the wallboard facing is cut so that the clearance between the box and the wallboard does not exceed 1/8 inch.
   d. Separate boxes located on opposite sides of walls or partitions by a minimum horizontal distance of 24 inches. This minimum separation distance may be reduced when wall opening protective materials are installed according to the requirements of their classification.
   e. Use wall opening protective material in conjunction with boxes installed on opposite sides of walls or partitions of staggered stud construction in accordance with the classification requirements for the protective material.
3. Other Fire Rated Construction: Use materials and methods to comply with the listing requirements for the classified construction.

B. Boxes for Exposed Conduit System:
   1. Dry and Damp Locations: Use zinc electroplate or hot dipped galvanized threaded type malleable iron or cast-iron alloy outlet, junction, and pullboxes or conduit bodies provided with a volume marking in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.
      a. Galvanized steel boxes may be used in conjunction with conduit sizes over 1 inch in non-hazardous dry and damp locations.
      b. Galvanized steel boxes may be used in conjunction with electrical metallic tubing where it is allowed (specified) to be installed exposed as branch circuit conduits at elevations over 10’-0” above finished floor.
   2. Wet Locations: Use threaded type malleable iron or cast-iron alloy outlet junction, and pullboxes or conduit bodies (provided with a volume marking) with hot dipped galvanized or other specified corrosion resistant coating in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.
      a. Use corrosion resistant boxes in conjunction with plastic coated rigid ferrous metal conduit.
      3. Finishing Collar or Combination Finishing Collar/Outlet Box (Surface Mounted Equipment Used with Exposed Raceway):
      a. Use finishing collar where surface mounted equipment is installed on an exposed raceway outlet box and the equipment base is larger than the outlet box.
      b. Use combination finishing collar/outlet box where surface mounted equipment is not indicated to be installed on an exposed raceway outlet box, but raceway cannot be run directly into equipment body due to equipment design.

C. Specific Purpose Outlet Boxes: Use to mount equipment when available and suitable for job conditions. Unless otherwise specified, use threaded type boxes with finish as specified for exposed conduit system, steel (painted) for surface metal raceway system and galvanized steel for recessed installations.

END OF SECTION 260533.1

SECTION 260533.13
CONDUIT FOR ELECTRICAL SYSTEMS

PART 1. GENERAL

1.01 REFERENCES

A. NEMA, ANSI, and UL.

1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

1.03 MAINTENANCE

A. Spare Parts: Furnish the following items in the manufacturer's original containers labeled with the names of the items and locations where the items would be used. Store them at the site where directed:
   1. Touch up coating compound for plastic coated rigid metal conduit (one spray type can and one non-spray can with brush top).

PART 2. PRODUCTS

2.01 RACEWAYS

A. Rigid Ferrous Metal Conduit: Steel, hot dipped galvanized on the outside and inside UL categorized as Rigid Ferrous Metal Conduit (identified on UL Listing Mark as Rigid Metal Conduit - Steel, or Rigid Steel Conduit), by Allied Tube & Conduit Corp., LTV Copperweld, or Wheatland Tube Co.

B. Liquid-tight Flexible Metal Conduit: UL categorized as liquid-tight flexible metal conduit (identified on UL Listing Mark as Liquid-Tight Flexible Metal Conduit, also specifically marked with temperature and environment application data), by AFC Cable Systems Inc., Anamet Electrical Inc., Electri-Flex Co., or Universal Metal Hose Co.

C. Plastic Coated Rigid Metal Conduit, Fittings, and Accessories: Rigid ferrous metal conduit, fittings and accessories coated with 40 mils thick polyvinylchloride coating; Ocal/T&B Corp.'s Ocal-Blue System, PCD Inc.'s KorKap, KorKap XL, or Robroy Industries' Plastibond or Perma-Cote System.

2.02 FITTINGS AND ACCESSORIES

A. Connectors and Couplings:
   1. Couplings (For Rigid Metal Conduit): Standard threaded couplings as furnished by conduit manufacturer.
   2. Watertight Conduit Hubs: Cooper/Crouse Hinds' Myers Hubs (stainless steel), OZ/Gedney Co.'s Type CH-T (hot dipped galvanized finish).
   3. Liquid-tight Flexible Metal Conduit Connectors: OZ/Gedney Co.'s 4Q-TG Series (hot-dip/mechanically galvanized), or Thomas & Betts Corp.'s 3322 Series (PVC coated).

B. Conduit Bodies (Threaded): Malleable iron or cast-iron alloy bodies and covers with hot dipped galvanized or other specified corrosion resistant finish; Cooper/Crouse-Hinds' Condulets (Corro-

free epoxy powder coat), Thomas & Betts Corp.'s Conduit Bodies (hot dipped galvanized), or OZ/Gedney Co.'s Conduit Bodies (hot dipped galvanized). Stainless steel cover screws, covers gasketed to suit application.

C. Expansion Fittings: Cooper/Crouse-Hinds XJG (Corro-free epoxy powder coat), OZ Gedney Co.'s AX, EXE (end type, hot dipped galvanized), or Thomas & Betts Corp.'s XJG (hot dipped galvanized).

D. Deflection Fittings: Ductile iron couplings with hot dipped galvanized finish, neoprene sleeve, and stainless-steel bands, Appleton Electric Co.'s CF; or bronze couplings, neoprene sleeve, and stainless-steel bands, OZ/Gedney Co.'s Type DX.

E. Sealing Fittings: Malleable iron body with hot dipped/mechanically galvanized finish, neoprene sleeve, and stainless-steel bands, Appleton electric Co.'s CF; or bronze couplings, neoprene sleeve, and stainless-steel bands, OZ/Gedney Co.'s Type DX.
   1. Horizontal: Cooper/Crouse-Hinds' EYS with Chico A sealing compound and Chico X filler, OZ/Gedney Co.'s EYD with EYC sealing compound and EYF damming fiber, or Thomas & Betts Corp.'s. EYS w/Chico A sealing compound and Chico X filler.
   2. Vertical (with Drain): Cooper/Crouse-Hinds with Chico A sealing compound and Chico X filler, OZ/Gedney Co.'s EY, EYA with EYC sealing compound and EYF damming fiber, or Thomas & Betts Corp.'s. w/Chico A sealing compound and Chico X filler.
   3. Other Type Fittings. As required to suit installation requirements, by Cooper/Crouse-Hinds, OZ/Gedney Co., or Thomas & Betts Corp. with hot dipped/mechanically galvanized finish or epoxy powder coat.

F. Conduit Clamps and Back Spacers: Malleable iron, hot dipped/mechanically galvanized finish; Cooper/Crouse-Hinds' 510 and CB1 Series, OZ/Gedney Co.'s 14-G and 141G Series, or Thomas & Betts Corp.'s 1275 and 1350 Series.

G. Drains and Breathers: Stainless steel; Appleton Electric Co.'s ECBD, Cooper/Crouse-Hinds' ECD, OZ/Gedney Co.'s Type DB, or Thomas & Betts Corp.'s Type ECD.

PART 3. EXECUTION

3.01 RACEWAY INSTALLATION - GENERAL

A. Number of Raceways: Do not change number of raceways to less than the number indicated on the drawings.
   1. Each raceway shall enclose one circuit unless otherwise indicated on the drawings.

B. Conduit Size: Not smaller than 1/2-inch electrical trade size. Where type THWN, THWN-2, XHHW, or XHHW-2 conductors are specified for use under Section 16121, the minimum allowable conduit size for new Work shall be based on Type THW conductors.

C. Conduit Bends: For 1/2- and 3/4-inch conduits, bends may be made with manual benders. For all conduit sizes larger than 3/4 inch, manufactured or field fabricated offsets or bends may be used. Make field fabricated offsets or bends with an approved hydraulic bender.

D. Conduit Exposed in Indoor Wet Locations: Install entire wiring system including conduit, boxes, and fittings so that there is a 1/4-inch air space between it and the wall or supporting surface.

E. Conduit in Hazardous Areas: Install Work in hazardous areas in accordance with NFPA 70. The hazardous areas and the degree of hazard for each area are indicated on the drawings.

3.02 RACEWAY SCHEDULE - TYPES & USE

A. Rigid Ferrous Metal Conduit: Install in all wet locations unless otherwise specified or indicated on the drawings.

B. Liquid-tight Flexible Metal Conduit: Install equipment grounding conductor in liquid-tight flexible metal conduit and bond at each box or equipment to which conduit is connected:
   1. Use 1 to 3 feet of liquid-tight flexible metal conduit (UL listed and marked for the installation's temperature and environmental conditions) for final conduit connection to:
      a. Motors with weather-protected or totally enclosed housings.
      b. Equipment subject to vibration.
      c. Equipment requiring flexible connection for adjustment or alignment.

C. Plastic Coated Rigid Metal Conduit: Use in all process areas.

3.03 FITTINGS AND ACCESSORIES SCHEDULE

A. General:
   1. Use malleable iron or cast-iron alloy fittings and accessories having hot dipped/mechanically galvanized finish or other specified corrosion resistant finish in conjunction with ferrous raceways unless otherwise specified or indicated on the drawings.
   2. Use caps or plugs to seal ends of conduits until wiring is installed (to exclude foreign material).
   3. Use expansion fittings:
      a. Where raceways cross expansion joints.
      b. At intervals not exceeding 75 feet in straight runs (outside installations).
      c. Between fixed equipment (outside installations).
   4. Use deflection fittings where raceways cross expansion joints that move in more than one plane.
   5. Use watertight hub on end of each conduit entering cabinets or boxes that are not constructed with integral threaded hubs.
   6. Use back spacers behind each conduit clamp to keep raceway off surface to which it is attached and arranged to allow raceway to move due to expansion and contraction (outside installations).
   7. Use drains in low points of the system to drain condensation, keeping interior of raceway system free of moisture. Also use breather at high point of the system for outside installations.

B. For Rigid Metal Conduit: Use threaded fittings.

C. For Liquid-tight Flexible Metal Conduit: Use liquid-tight connectors.

D. For Plastic Coated Rigid Metal Conduit: Use conduit manufacturer's PVC coated fittings and accessories.

END OF SECTION 260533.13

SECTION 260543
UNDERGROUND CONDUIT, DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1. GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: Section 310000.

B. Cast-In-Place Concrete: Section 033000.

1.02 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions.

PART 2. PRODUCTS

2.01 MATERIALS

A. Rigid Ferrous Metal Conduit: Steel, galvanized on the outside and inside (conduit enameled on the inside will not be accepted), UL categorized as Rigid Ferrous Metal Conduit (identified on UL Listing Mark as Rigid Metal Conduit-Steel or Rigid Steel Conduit), as manufactured by Allied Tube & Conduit Corp., LTV Steel Tubular Products Co., Triangle Wire & Cable Inc., or Wheatland Tube Co.

B. Rigid Nonmetallic Conduit and Fittings (Concrete Encased): Cantex, Inc.'s Schedule 40, Carlon Electrical Products Inc.'s Plus 40, CertainTeed Corp.'s Schedule 40, Omni/Opti-Com Manufacturing Network, Inc.'s Schedule 40 or Queen City Plastic Inc.'s Schedule 40.

C. Plastic Coated Rigid Metal Conduit, Fittings and Accessories: Rigid ferrous metal conduit, fittings and accessories coated with 40 mils thick polyvinylchloride coating; Occidental Coating Co.'s Ocal 40, Protective Coatings Developments Inc.'s Kor-Kap, or Robroy Industries' Plastibond System.

D. Conduit Spacers and Levelers: Commercially manufactured type to suit conduit, installation and spacing requirements.

E. Duct Seal: Appleton Electric Co.'s DUC Weatherproof Compound, Manville Corp.'s Duxseal, OZ/Gedney Co.'s DUX, or Thomas & Betts Corp.'s DX.

F. Drag Line: Minimum 1/8-inch polypropylene monofilament utility rope; American Synthetic Ropes' Flotorope, Greenlee Tool Co.'s 2 ply Rope 431, or Thomas Industries/Jet Line Products' Rope 232.

G. Thru Wall Sealing Bushings:
   1. For Walls Which Have or Will Have Membrane Waterproofing:
      a. Cast-In-Place Installations: OZ/Gedney Co.'s Type FSK thruwall seal and Type FSKA membrane clamp adapter.
      b. Core Drilled or Sleeved Installations: OZ/Gedney Co.'s Type CSM and Type CSMC with membrane clamp adapter.
   2. For Walls Which Will Not Have Membrane Waterproofing:
      a. Cast-In-Place Installations: OZ/Gedney Co.'s Type FSK.
      b. Core Drilled or Sleeved Installations: OZ/Gedney Co.'s Type CSM, or Thunderline Corp.'s Link-Seal.

H. End Bells:
   1. For Rigid Ferrous Metal Conduit: OZ/Gedney Co.'s Type TNS.
   2. For Rigid Nonmetallic Conduit: Conduit manufacturer's standard end bells.

I. Insulated Grounding Bushings: Appleton Electric Co.'s GIB-50 Series, Crouse Hinds GLL Series, OZ/Gedney Co.'s IBC-50L Series, Raco Inc.'s 1212 Series, or Thomas & Betts Corp.'s 3870 or BG Series.

PART 3. EXECUTION

3.01 PREPARATION

A. Before installing any Work, lay out the proposed course for the conduits, location of manholes, etc. and have same approved by the Owner's Representative.

3.02 INSTALLATION

A. Spacing:
   1. Arrangement for Power and Signal Service: Separate power system conduits from signal system conduits with minimum 6 inches thick concrete wall or 12 inches of earth.
   2. Conduit Bank: Separate individual conduits a minimum of 3 inches. Use spacers and levelers located no more than 8 feet apart.

B. Depth:
   1. Existing Grade to Remain: Unless otherwise indicated or directed, install conduit more than 18 inches below existing finished grade.
   2. Existing Grade to Be Altered: Unless otherwise indicated or directed, install conduit more than 18 inches below the existing grade where the finished grade is to be higher than the existing grade. Where the finished grade is to be lower than the existing grade, install conduit more than 18 inches below finished grade.
   3. Under Roads and Parking Lots:
      a. Rigid Ferrous Metal Conduit: Unless otherwise indicated or directed, install rigid ferrous metal conduit more than 24 inches below top surface of roads and parking lots.
      b. Rigid Nonmetallic Conduit (Concrete Encased): Unless otherwise indicated or directed, install concrete encased rigid nonmetallic conduit more than 30 inches below top surface of roads and parking lots.
   4. Crossing Obstructions: Use rigid ferrous metal conduit where top of conduit system is less than 18 inches below finished grade when crossing obstructions (heating tunnels, etc.).
   5. In Rock:
      a. Unless otherwise indicated on the drawings install rigid ferrous metal conduit or concrete encased rigid nonmetallic conduit at depths previously specified. Backfill with suitable material in accordance with SECTION 312000 – EARTH MOVING.
      b. Where conduit is indicated to be installed at lesser depths, use rigid ferrous metal conduit. Cover conduit with minimum 2 inches of concrete. In exposed rock area fill trench with concrete to surface level of rock. Where rock is not exposed, complete backfill in accordance with SECTION 312000 – EARTH MOVING.

C. Pitch:
   1. Pitch conduit away from buildings.
   2. Pitch conduit toward manhole a minimum of 12 inches per 100 feet. On runs where it is impossible to maintain the grade all one way, grade from center so that conduits pitch both directions down toward manholes.

D. Concrete Encasement for Rigid Non-Metallic Conduit Using Either of the Two Methods Indicated Below: (Concrete Encasement for Rigid Ferrous Metal Conduit is not Required):
   1. Single Pour Method.
   2. Two Pour Method:
      a. Lay rigid nonmetallic conduits on a continuous concrete footing not less than 3 inches thick and as wide as the encasement. Install footings straight and true both in line of run and transversely, and finished with an even surface. Incorporate anchoring devices into the footing for use in tying down the conduits. Grade footings so that conduits maintain required pitch. Before installing spacers, levelers, and conduits, let concrete footings harden as required to prevent damage to the footings.
         1) Where conduits enter building or manhole wall, reinforce footings for 10 feet with No. 4 rods, 4 inches on center.
         2) Footings are not required for rigid ferrous metal conduit.
      b. After rigid nonmetallic conduits have been laid on footing with spacers and levelers (located no more than 8 feet apart), tie conduits down to the footing, then surround the conduits by concrete not less than 2 inches thick on top and 2 inches on each side. Separate individual conduits a minimum of 3 inches so that each conduit is completely enveloped in concrete.
         1) Where conduits enter building or manhole walls, reinforce encasement for 10 feet with No. 4 rods, 4 inches on center.
         2) Encasement is not required for rigid ferrous metal conduit.
      c. Form sides of the concrete encasement. Exception: Earth cuts will be permitted as the form where trenches are neatly excavated in stable soils.

E. Jacking Conduits: Rigid ferrous metal conduit may be jacked under roads, parking lots, etc. Submit jacking details for approval.

F. Conduits in Filled Ground: Where indicated reinforce the footing and encasement for rigid nonmetallic conduits 10 feet beyond limits of fill. Reinforcement, footing or encasement is not required for rigid ferrous metal conduit.

G. Conduits Entering Buildings and Manholes:
   1. Seal conduit entrances into manholes watertight.
   2. Seal conduit entrances into building walls watertight. Exception: Seal is not required in below grade foundation walls associated with slab on grade construction.
   3. Install end bells at conduit entrances into manholes.
   4. Install end bells at conduit entrances into buildings. Exceptions:
      a. Install insulated grounding bushing on conduit entrance stub up associated with slab on grade construction.
      b. Install insulated grounding bushing and 2 locknuts on conduit where conduit is terminated in cabinet, junction or pull box.

H. Cleaning Conduits: Take precautions to prevent foreign matter from entering conduits during installation. After installation clean conduits with tools designed for the purpose.

I. Conduit for Future Use (Spare Conduit and Empty Conduit): Demonstrate to the Owner's Representative that conduits installed for future use are clear of obstructions (draw mandrel 1/2 inch less in diameter than conduit). Install a drag line in each conduit.

J. Sealing Ends of Conduits:
   1. Occupied Conduits: Seal ends of conduits to be used for Work of this contract until cables are to be installed. After cable installation, seal conduits at building entrances and first manhole outside building. Seal with duct seal.
   2. Conduits for Future Use: Seal the ends of spare and empty conduits at building entrances and manholes. Seal with plastic plugs or a contrasting color cement/sand mixture.

K. Using Existing Underground Conduits: Clean the conduits with tools designed for the purpose. The condition of conduits after cleaning may be determined with a mandrel 1/2 inch less in diameter than the conduit, with the sheath painted with black lacquer. Pull mandrel through conduit. Conduit is acceptable when there are no roller marks or scratches on the mandrel. Other methods may be used if approved. Report and demonstrate to the Owner’s Representative any defect found in the conduit system that cannot be eliminated. The Contractor is held responsible for any damage to cables resulting from imperfections in the conduit.

3.03 CONDUIT SCHEDULE - TYPES AND USE

A. Rigid Ferrous Metal Conduit: Install in all locations unless otherwise specified or indicated on the drawings.

B. Rigid Nonmetallic Conduit (Concrete Encased): May be installed in all locations except:
   1. Where conduit stubs up or rises through slab or finished grade.
   2. Where other type raceways are specified or indicated on the drawings.

C. Plastic Coated Rigid Metal Conduit: Use at locations indicated on drawings.

END OF SECTION 260543

SECTION 262416
PANELBOARDS

PART 1. GENERAL

1.01 REFERENCES

A. NEMA, UL.

1.02 SUBMITTALS

A. Submittal Packages: Submit the shop drawings, product data, and the quality control submittals specified below at the same time as a package.

B. Shop Drawings; include the following for each panelboard:
   1. Cabinet and gutter size.
   2. Voltage and current rating.
   3. Panelboard short circuit rating. Indicate if rating is Fully Rated Equipment Rating, or where acceptable, UL listed Integrated Equipment Short Circuit Rating.
   4. Circuit breaker enumeration (frame, ATE, poles, I.C.).
      a. Indicate if circuit breakers are suitable for the panelboards' Fully Rated Equipment Rating, or where acceptable, are series connected devices which have been test verified and listed with UL (include documentation proving the compatibility of the proposed circuit breaker combinations). Circuit breakers do not have to be listed as series connected devices when all of the circuit breaker interrupting ratings are equal to, or greater than, the short circuit rating of the panelboard.
   5. When indicated on the panelboard schedule, a coordinated selective scheme between the main circuit breaker and branch/feeder circuit breakers so that under fault conditions the branch/feeder circuit breaker clears the fault while the main circuit breaker remains closed.
   6. Accessories.

C. Product Data:
   1. Catalog sheets, specifications and installation instructions.
   2. Bill of materials.

D. Quality Control Submittals:
   1. List of Completed Installations: If brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations which can prove the proposed products have operated satisfactorily for one year.
   2. Company Field Advisor Data: Include:
      a. Name, business address and telephone number of Company Field Advisor secured for the required services.
      b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
      c. Services and each product for which authorization is given by the Company listed specifically for this project.

E. Contract Closeout Submittals:
   1. System acceptance test report.
   2. Certificate: Affidavit, signed by the Company Field Advisor.
   3. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Owner's Representative.

1.03 QUALITY ASSURANCE

A. Company Field Advisor: Secure the services of a Company Field Advisor from the manufacturer of the programmable solid state circuit breakers for a minimum of 8 working hours for the following:
   1. Render advice regarding final adjustment and programming of the circuit breakers.
   2. Witness final system test and then certify with an affidavit that the circuit breakers are installed in accordance with the contract documents and are operating properly.
   3. Train facility personnel on the operation and maintenance of the circuit breakers (minimum of two 1-hour sessions).
   4. Explain available service programs to facility supervisory personnel for their consideration.

PART 2. PRODUCTS

2.01 PANELBOARDS

A. As produced by Cutler-Hammer/Eaton Corp., Challenger Electrical Equipment Corp. General Electric Co., Siemens, or Square D Co., having:
   1. Flush or surface type cabinets as indicated on the drawings.
   2. Increased gutter space for gutter taps, sub-feed wiring, through-feed wiring, oversize lugs.
   3. UL label "SUITABLE FOR USE AS SERVICE EQUIPMENT" where used as service equipment.
      a. Where indicated, equip panelboards used as service equipment with secondary surge arresters; GE's Tranquell Series, Joslyn's Mfr. Co.'s Surge Tec Series, Intermatic Incorp.'s AG2401 or AG6503, Square D Co.'s SDSA 1175 or SDSA 3650, to suit system primary (transformer size, available current) and secondary characteristics.
   4. Door and one-piece trim. Door fastened to trim with butt or piano hinges. Trim fastened to cabinet with devices having provision for trim adjustment.
   5. Door lock. 2 keys with each lock (Exception: Not more than 7 keys, total).
   6. Solid tinned copper bus bars. Ampere rating of bus bars not less than frame size of main circuit breaker.
   7. Full capacity copper neutral bus in panelboards where neutrals are required.
   8. Copper equipment grounding bus in panelboards where equipment grounding conductors are required.
   9. Sections designated "space" or "provision for future breaker" equipped to accept future circuit breakers.
   10. Lock on devices for exit light, fire alarm, stair well circuits.
   11. Provisions for padlocking circuit breaker handle in OFF position where indicated.
   12. Directory.
   13. Short circuit rating not less than indicated on panelboard schedule. Furnish panelboards having Fully Rated Equipment Rating (the short circuit rating of the panelboard is equal to the lowest interrupting rating of any device installed in the panelboard). Exception:
   14. Molded case, bolt-on circuit breakers:
      a. Mounting: Individually mounted main circuit breaker (when MCB is required), and group mounted branch/feeder circuit breakers to accommodate the circuit breaker style and panelboard construction.
      b. Components: See panelboard schedule for specific components required for each circuit breaker. In addition to the specific components, equip each circuit breaker with additional components as required to achieve a coordinated selective scheme

between the main circuit breaker and the branch/feeder circuit breakers when indicated on the panelboard schedule that a coordinated selective scheme is required.

c. Single pole 15 ATE and 20 ATE circuit breakers marked SWD where used as switches.

d. Single pole and two pole 15, 20, and 30 ATE circuit breakers rated for high intensity discharge lighting loads when applicable.

2.02 NAMEPLATES

A. General: Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inch high.
   1. Phenolic: Two color laminated engravers stock, 1/16-inch minimum thickness, machine engraved to expose inner core color (black lettering on a white background).
   2. Materials for Outdoor Applications: As recommended by nameplate manufacturer to suit environmental conditions.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install panelboards in accordance with NEMA Publication No. PB1.1 "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less".
   1. Set/program the circuit breakers.

B. Flush Cabinets: Set flush cabinets so that edges will be flush with the finished wall line. Where space will not permit flush type cabinets to be set entirely in the wall, set cabinet as nearly flush as possible, and cover the protruding sides with the trim extending over the exposed sides of the cabinet and back to the finished wall line.

C. Directory: Indicate on typewritten directory the equipment controlled by each circuit breaker, and size of feeder servicing panelboard. For power panelboards also include ATE rating and feeder size for each breaker.

D. Identification:
   1. Provide nameplates corresponding to panelboard designations on the drawings, and electrical parameters (phase, wire, voltage).
   2. Install a nameplate on each panelboard which explains the means of identifying each ungrounded system conductor by phase and system. Examples of nameplate statements:
      a. Identification of 120/208 Volt Circuit Conductors:
         2 wire circuit - white*, black.
         3 wire circuit - white*, black, red.
         4 wire circuit - white*, black, red, blue.

         *White is used only as neutral. Where neutral is not required, black, red, or black, red, blue is used for phase-to-phase circuits.

      b. Identification of 277/480 Volt Circuit Conductors:
         2 wire circuit - natural gray**, brown.
         3 wire circuit - natural gray**, brown, yellow.
         4 wire circuit - natural gray**, brown, yellow, orange.

**Natural gray is used only as neutral. Where neutral is not required, brown, yellow, or brown, yellow, orange is used for phase-to-phase circuits.

3.02 FIELD QUALITY CONTROL

A. Preliminary System Test:
   1. Preparation: Have the Company Field Advisor adjust the completed circuit breakers and then operate them long enough to assure that they are performing properly.
   2. Run a preliminary test for the purpose of:
      a. Determining whether the circuit breakers are in a suitable condition to conduct an acceptance test.
      b. Checking instruments and equipment.
      c. Training facility personnel.

B. System Acceptance Test:
   1. Preparation: Notify the Owner's Representative at least 3 working days prior to the test so arrangements can be made prior to the test to have a Facility Representative witness the test.
   2. Make the following tests:
      a. Test circuit breakers which have ground fault protection in accordance with the approved information sheets and test form.
      b. Test programmable solid state trip devices in accordance with the manufacturer's recommendations.
   3. Supply all equipment necessary for system adjustment and testing.
   4. Submit written report of test results signed by the Company Field Advisor and the Owner's Representative. Mount a copy of the final report in a conspicuous location on, or inside, the panelboard door.

END OF SECTION 262416

SECTION 262417
CIRCUIT BREAKERS FOR EXISTING PANELBOARDS

PART 1. GENERAL

1.01 SUBMITTALS

A. Not required.

PART 2. PRODUCTS

2.01 CIRCUIT BREAKERS

A. Similar to existing circuit breakers.

B. Compatible with existing panelboard.

C. Number of poles and ampere trip rating as indicated on drawings.

D. Complete with accessories required for installation.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install new circuit breakers in existing panelboards where indicated.

B. Add new circuits equally across phases to prevent overloading any phase in the panelboard. After new and existing circuits are energized, take current reading on panelboard feeder during a heavy usage time period. If phases are substantially unbalanced, rearrange both new and existing circuits in panelboard to equally distribute load between all phases, and provide new typewritten directory indicating equipment controlled by each circuit breaker.

END OF SECTION 262417

SECTION 262726
WIRING DEVICES

PART 1. GENERAL

1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications, and installation instructions.

PART 2. PRODUCTS

2.01 SWITCHES

A. Local Switches, Single Pole:
   1. 15A, 120/277 V ac; Bryant's 4801, Crouse-Hinds/AH's 1891, General Electric's GE5931-1G, Hubbell's 1201/1101, Leviton's 1201/1101, Pass & Seymour's 15AC1, or Woodhead's 1891.
   2. 20A, 120/277 V ac; Bryant's 4901, Crouse-Hinds/AH's 1991, General Electric's GE 5951-1G, Hubbell's 1121/1221, Leviton's 1121/1221, Pass & Seymour's 20AC1, or Woodhead's 1991.
   3. 30A, 120/277 V ac; Bryant's 3001, Crouse-Hinds/AH's 3991, General Electric's GE 5991-1G, Hubbell's 3031, Leviton's 3031, or Pass & Seymour's 30AC1.

B. Local Switches, Double Pole:
   1. 15A, 120/277 V ac; Bryant's 4802, Crouse-Hinds/AH's 1892, General Electric's GE5932-1G; Hubbell's 1202/1102, Leviton's 1202/1102, Pass & Seymour's 15AC2, or Woodhead's 1892.
   2. 20A, 120/277 V ac; Bryant's 4902, Crouse-Hinds/AH's 1992, General Electric's GE5952-1G, Hubbell's 1222/1122, Leviton's 1222/1122, Pass & Seymour's 20AC2, or Woodhead's 1992.
   3. 30A, 120/277 V ac; Bryant's 3002, Crouse-Hinds/AH's 3992, General Electric's GE5992-1G, Leviton's 3032, or Pass & Seymour's 30AC2.

C. Local Switches, Three-Way:
   1. 15A, 120/277 V ac; Bryant's 4803, Crouse-Hinds/AH 1893, General Electric's GE5933-1, Hubbell's 1203/1103, Leviton's 1203/1103, Pass & Seymour's 15AC3, or Woodhead's 1893.
   2. 20A, 120/277 V ac; Bryant's 4903, Crouse-Hinds/AH's 1993, General Electric's GE5953-1G, Hubbell's 1223/1123, Leviton's 1223-2/1123-2, Pass & Seymour's 20AC3, or Woodhead's 1993.
   3. 30A, 120/277 V ac; Bryant's 3003, Crouse-Hinds/AH's 3993, General Electric's GE5993-1G, Leviton's 3033, or Pass & Seymour's 30AC3.

D. Local Switches, Four-Way:
   1. 15A, 120/277 V ac; Bryant's 4804, Crouse-Hinds/AH's 1894, General Electric's GE5934-1G, Hubbell's 1204/1104, Leviton's 1204-2/1104-2, Pass & Seymour's 15AC4, or Woodhead's 1894.
   2. 20A, 120/277 V ac; Bryant's 4904, Crouse-Hinds/AH's 1994, General Electric's GE5954-1G, Hubbell's 1224/1124, Leviton's 1224-2/1124-2, Pass & Seymour's 20AC4, or Woodhead's 1994.
   3. 30A, 120/277 V ac; Crouse-Hinds/AH's 3994, or General Electric's GE5994-1G.

E. Local Switches, Key-Operated:
   1. Similar to toggle type local switches except operated by removable key instead of lever. Furnish 2 keys with each switch.

F. Motor Switch:
   1. Toggle type, fractional hp Manual Starter with Melting Alloy Type Thermal Overload Relay, 115/230 V, 16A, Square D Class 2510 or approved equivalent.

2.02 RECEPTACLES

A. Specification Grade Receptacles:
   1. Single receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Bryant's 5251, Crouse-Hinds/AH's 5251, General Electric's 5251-1, Hubbell's 5251, Leviton's 5251, or Pass & Seymour's 5251.
   2. Duplex receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Bryant's 5252/5242, Crouse-Hinds/AH's 5252/5242, General Electric's GEN5252-1, Hubbell's 5252/5242, Leviton's 5252/5242, Pass & Seymour's 5252/5242.
   3. Single receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5361/5351, Crouse-Hinds/AH's 5361/5351, General Electric's GE4103-1, Hubbell's 5361/5351, Leviton's 5361/5351, or Pass & Seymour's 5351.
   4. Duplex receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Bryant's 5362, Crouse-Hinds/AH's 5352/5342, General Electric's GE5352-1, Hubbell's 5352, Leviton's 5352, or Pass & Seymour's 5352.

B. Ground Fault Interrupter Receptacles:
   1. Duplex receptacle rated 15A (NEMA 5-15R), circuit-ampacity 20A; Bryant's GFR52FT, Crouse-Hinds/AH's GF5242, General Electric's GF5242, Hubbell's GF5252, Leviton's 6599, Pass & Seymour's 1591S, or Daniel Woodheads 5252GF.
   2. Duplex receptacle rated 20A (NEMA 5-20R), circuit ampacity 20A; Bryant's GFR53FT, Crouse-Hind/AH's GF5342, General Electric's GF5342, Hubbell's GF 5352, Leviton's 6899, Pass & Seymour's 2091S, or Daniel Woodheads 5352GF.

C. Isolated Ground Receptacles:
   1. Single receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Hubbell's IG5261, Leviton's 5261-IG, Cooper Wiring Devices IG5261.
   2. Duplex receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W); Hubbell's IG-5262, Leviton's 5262-IG, Cooper Wiring Devices IG5262.
   3. Single receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Hubbell's IG5361, Cooper Wiring Devices IG5361.
   4. Duplex receptacle, NEMA 5-20R (20A, 125 V, 2P, 3W); Hubbell's IG5362, Leviton's 5362-IG, Cooper Wiring Devices IG5362.

D. Corrosion Resistant Receptacles:
   1. Duplex receptacle, NEMA 5-15R (15A, 125 V, 2P, 3W): Bryant's 5262-CR, Crouse-Hinds/AH's 5262CR, General Electric's GE5262-C, Hubbell's 5262-ILH or Pass & Seymour's CR6200.

E. Special Purpose Receptacles: Furnish matching nylon, polycarbonate or armored plug with each receptacle as specified as follows or on the drawing.
   1. Dryer Outlet: NEMA 10-30R (3P, 3W, 30A, 125/250 V); Bryant's 9303, Crouse-Hinds/AH's 9344N, General Electric's GE4132-3, Hubbell's 9350, Leviton's 5207, or Pass & Seymour's 3860.
   2. Range Outlet: NEMA 10-50R (3P, 3W, 50A, 125/250 V); Bryant's 9306, Crouse-Hinds/AH's 7985N, General Electric's GE4152-3, Hubbell's 7962, Leviton's 5206GR, or Pass & Seymour's 3890.
   3. Other Types: As produced by Bryant, Crouse-Hinds/AH, General Electric, Hubbell, or Pass & Seymour. NEMA configuration and ratings to suit requirements.

2.03 WALL PLATES

A. Stainless Steel Wall Plates: Type 302 stainless steel with satin finish; Hubbell's 97000 Series, Leviton's 84000 Series, or Cooper Wiring Devices 93000 Series.

B. Covers for Threaded Type Boxes: Stamped sheet steel, gasketed device covers as produced by Crouse-Hinds Co., or OZ/Gedney Co.

2.04 EMERGENCY SHUTDOWN SWITCHES

A. Emergency Shutdown Pushbutton Switch: Square D. Co.'s Class 9001, Type K, pushbutton operator with the following:
   1. Red mushroom button.
   2. Transformer type red pilot light.
   3. Legend red plate with words "Emerg. Stop".
   4. NEMA 13 oil tight enclosure with cover riveted to boy.

2.05 NAMEPLATES

A. Phenolic Type: Standard white phenolic nameplates with 3/16-inch minimum size black lettering engraved thereon.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install wiring devices in outlet boxes.

B. Local Switches:
   1. Install local switches rated 15A, 120/277 V ac for switches unless otherwise shown on the drawings or specified.
   2. Install switches indicated Sa, Sb, Sc, etc, for control of outlets or fixtures with corresponding letters on the same circuit.
   3. Where more than one switch occurs at same location in a 120-volt system, arrange switches in gangs and cover with one face plate.
   4. Install switches in a 277-volt system in separate single boxes if voltage between exposed live metal parts of adjacent switches exceeds 300 volts.

5. Install single and double pole switches so that switch handle is up when switch is in the "On" position.

C. Receptacles:
   1. Install Specification Grade receptacles, NEMA 5-15R, 15A, 125 V, 2P, 3W, for duplex receptacles and single receptacles unless otherwise shown on the drawings or specified.
   2. Install receptacles with ground pole in the down position.

D. Wall Plates:
   1. Install wall plates on all wiring devices in dry locations, with finish to match hardware in each area.
   2. Install blank wall plates on outlet boxes which are for future equipment except telephone outlets.
   3. Install 5/8-inch bushed wall plates on telephone outlets.

E. Weatherproof Covers: Install weatherproof covers on wiring devices in damp and wet locations.

F. Nameplates: Provide phenolic or embossed aluminum nameplate for each special purpose receptacle indicating phase, ampere and voltage rating of the circuit. Attach nameplate with rivets or tamperproof fasteners to wall plate or to wall above receptacle. Wall plates may be engraved with required data in lieu of separate nameplates.

G. Mats: Where flush plates are required over outlet boxes that cannot be set deep enough for the plates to fit closely over the finished wall surfaces, provide oak mats to fill the space between the finished wall surface and the plate.

END OF SECTION 262726

SECTION 262813
FUSES

PART 1. GENERAL

1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications, and installation instructions.

1.02 MAINTENANCE

A. Spare Parts:
   1. Six spare fuses of each size and category, including any accessories required for a complete installation.
   2. Special tools if required for installation or removal of fuses.

PART 2. PRODUCTS

2.01 FUSEHOLDERS

A. Equipment provided shall be furnished with fuseholders to accommodate the fuses specified.

2.02 FUSES RATED 600V OR LESS

A. Fuses for Safety Switches (Motor Circuits) and Service Disconnects:
   1. Cartridge Type (250 Volts, 600 Amperes or Less): Dual element time-delay, UL Class RK-5, 200,000 amperes R.M.S. symmetrical interrupting capacity:
      a. Cooper Industries Inc.'s/Bussman Div. Type FRN-R.
      b. Gould Inc.'s/Circuit Protection Div. (Shawmut) Type TR-R.
      c. Littlefuse Inc.'s Type FLN-R.
   2. Cartridge Type (600 Volts, 600 Amperes or Less): Dual element time-delay, UL Class RK-5, 200,000 amperes R.M.S. symmetrical interrupting capacity:
      a. Cooper Industries Inc.'s/Bussmann Div. Type FRS-R.
      b. Gould Inc.'s/Circuit Protection Div. (Shawmut) Type TRS-R.
      c. Littlefuse Inc.'s Type FLS-R.
   3. Cartridge Type (600 Volts or Less - Above 600 Amperes): Current limiting, UL Class L, 200,000 amperes R.M.S. symmetrical interrupting capacity:
      a. Cooper Industries Inc.'s/Bussmann Div. Type KTU.
      b. Gould Inc.'s Circuit Protection Div. (Shawmut) Type A4BY.
      c. Littlefuse Inc.'s Type KLP-C.

B. Fuses for Safety Switches (Lighting and Heating Circuits):
   1. Cartridge Type (250 Volts): Single element, UL Class RK-1, 200,000 amperes R.M.S. symmetrical interrupting capacity:
      a. Cooper Industries Inc.'s/Bussmann Div., Type KTN-R.
      b. Gould Inc.'s/Circuit Protection Div. (Shawmut) Type A2K-R.
      c. Littlefuse Inc.'s Type KLN-R.
   2. Cartridge Type (600 Volts): Single element, UL Class RK-1, 200,000 amperes R.M.S. symmetrical interrupting capacity:
      a. Cooper Industries Inc.'s/Bussmann Div. Type KTS-R.

b. Gould Inc.'s/Circuit Protection Div. (Shawmut) Type A6K-R.
c. Littlefuse Inc.'s Type KLS-R.

2.03 FUSES RATED OVER 600V

A. Fuses for Metal Enclosed Interrupter Switchgear:
   1. Current Limiting, Silver-Sand Type: General Electric Co.'s Type EJ.
   2. Boric-Acid Type: S & C Electric Co.'s Type SM with snuffler, or Westinghouse Elec. Corp.'s Type RBA with condenser.

B. Fuses for Fused Load Break Interrupter Switches: General Electric Co. Type EJ, or S & C Electric Co.'s Type SM.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install fuses in respective equipment.

END OF SECTION 262813

SECTION 262816
ENCLOSED CIRCUIT BREAKERS

PART 1. GENERAL

1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications, and installation instructions.

PART 2. PRODUCTS

2.01 MATERIALS

A. Enclosed Circuit Breakers: As produced by Square D Co., General Electric Co., or Westinghouse/Cutler Hammer Corp. having:
   1. NEMA 1 enclosure unless otherwise indicated on the drawings.
   2. Solid neutral.
   3. Voltage rating, current rating, symmetrical current interrupt rating as indicated on drawing and number of poles as indicated on the drawings.
   4. Circuit breakers to suit requirements.
   5. Under 50 ampere trip element, enclosure has means to lock circuit breaker position on or off using standard padlock.
   6. Ampere trip elements 50 and above have industrial type enclosure with door and side handle. Handle position is lockable using standard padlock.

2.02 NAMEPLATES

A. Phenolic: Engraved plates, minimum 3/4" wide and length as required by inscription: Seton Name Plate Corp.

B. Stamped Metal: Standard stamped or embossed aluminum tags, minimum 3/4" wide and length as required by inscription: Tech Products, Inc.; Seton Name Plate Corp.

PART 3. EXECUTION

3.01 INSTALLATION

A. Mount enclosed circuit breakers on wall so that maximum height above the floor to the center of operating handle does not exceed 6-1/2'.

B. Provide phenolic or stamped metal nameplates on cover of each enclosed circuit breaker indicating purpose or load served by the circuit breaker.

END OF SECTION 262816

SECTION 262816.1
SAFETY SWITCHES

PART 1. GENERAL

1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications, and installation instructions.

PART 2. PRODUCTS

2.01 SAFETY SWITCHES (SINGLE THROW)

A. NEMA 1, 3R, 4 (Stainless Steel), 12: Challenger's Heavy-Duty Series, Cutler-Hammer Inc.'s DH, General Electric Co.'s Type TH, or Square D Co.'s Heavy Duty Series, having:
   1. Fuses, or unfused as indicated on drawings.
   2. Fused switches equipped with fuseholders to accept only the fuses specified in Section 16416 (UL Class RK-1, RK-5, L).
   3. NEMA 1 enclosure unless otherwise indicated on drawing.
   4. 240V rating for 120V, 208V, or 240V, circuits.
   5. 600V rating for 277V, or 480V circuits.
   6. Solid neutral bus when neutral conductor is included with circuit.
   7. Ground bus.
   8. Current rating and number of poles as indicated on drawings.

B. NEMA 4X: Crouse-Hinds Co.'s NST, or Square D Co.'s Special Application Safety Switches; having:
   1. Fuses, or unfused as indicated on drawings.
   2. Fused switches equipped with fuseholders to accept only the fuses specified in Section 16416 (UL Class RK-1, RK-5, L).
   3. Molded fiberglass-reinforced polyester NEMA 4X enclosure.
   4. 240V rating for 120V, 208V, or 240V, circuits.
   5. 600V rating for 277V, or 480V circuits.
   6. Solid neutral bus when neutral conductor is included with circuit.
   7. Ground bus.
   8. Current rating and number of poles as indicated on drawings.

2.02 NAMEPLATES

A. General: Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inch high.
   1. Phenolic: Two color laminated engravers stock, 1/16-inch minimum thickness, machine engraved to expose inner core color (white).
   2. Aluminum: Standard aluminum alloy plate stock, minimum .032 inches thick, engraved areas enamel filled or background enameled with natural aluminum engraved characters.
   3. Materials for Outdoor Applications: As recommended by nameplate manufacturer to suit environmental conditions.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install switches so that the maximum height above the floor to the center of the operating handle does not exceed 6'-6".

B. Identify each safety switch, indicating purpose or load served:
   1. NEMA 1 Enclosures: Rivet or bolt nameplate to the cover.
   2. NEMA 12 Enclosures: Rivet or bolt and gasket nameplate to the cover.
   3. NEMA 3R, 4, 4X Enclosures: Attach nameplate to the cover using adhesive specifically designed for the purpose, or mount nameplate on wall or other conspicuous location adjacent to switch. Do not penetrate enclosure with fasteners.

END OF SECTION 262816.1

SECTION 263213
ELECTRICAL GENERATOR SET

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Automatic Transfer Switch: Section 263214.

1.02 SYSTEM DESCRIPTION

A. Design Criteria: The natural gas-alternator units are intended to:
1. Supply power on an emergency basis for short periods of time, less than 1000 hours annually or less than 10,000 hours during the initial 10 years of operation.
2. Operate 5000 hours without major repairs or overhauls, and be rebuildable at least once.
3. Operate in coordination with Automatic Transfer Switch.

B. Description of System:
1. The natural gas -alternator emergency system powers emergency feeders in the event of failure of the normal power source.
2. In normal operating condition, the mechanism of the transfer switch is in the normal position and the natural gas -alternator unit shut down. Sequence of transfer operation occurs as follows:
   a. Upon signal from the Automatic Transfer Switch, the natural gas-alternator unit automatically starts.
   b. Complete transition from onset of normal feeder failure to emergency feeder transfer shall not exceed 10 seconds.
   c. The natural gas-alternator unit continues to run until the automatic transfer switch signals for the unit to shut down.

1.03 SUBMITTALS

A. Submittals Package: Submit the product data, shop drawings, and quality control submittals specified below at the same time as a package.

B. Shop Drawings:
1. Manufacturer's drawings showing the construction (outline) of the natural gas-alternator unit, sound attenuating enclosure and accessories.
2. Installation details.
3. Housing details including layout of equipment, raceways, piping, etc.

C. Product Data:
1. Catalog sheets, specifications and installation instructions.
2. Bill of materials.
3. Detailed sequence of operations (format similar to SYSTEM DESCRIPTION).
4. Company's data indicating fuel consumption with the unit operating at 1/2, 3/4 and full load.
5. Name, address and telephone number of nearest fully equipped service organization.

D. Quality Control Submittals:
   1. Design Data:
      a. Company's data indicating hp, kW and kVA ratings with proof that the unit will meet the full load test without exceeding NEMA temperature rise specified.
      b. Certified data from the Company proving that the unit will meet the requirements of 1.02 A. Design Criteria.
      c. Torsional stress compatibility analysis for the proposed natural gas / alternator combination proving that the torsional stress will not exceed the specified limit.
      d. Ampere requirements of the starting system (at the batteries' specified minimum ambient temperature) during cranking.
         1) Include engine manufacturer's recommended battery ampere-hour capacity at the minimum ambient temperature condition for the specified duration and number of crank cycles.
         2) Include battery manufacturer's data proving that the batteries will meet the ampere-hour requirements at the batteries minimum ambient temperature.
         3) Include details of battery charger and battery rack recommended by battery manufacturer.
   2. Company Field Advisor Data: Include:
      a. Name, business address and telephone number of Company Field Advisor secured for the required services.
      b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
      c. Services and each product for which authorization is given by the Company, listed specifically for this project.
   3. Completed Installation Lists.

E. Contract Closeout Submittals:
   1. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Owner's Representative. Include name, address and telephone number of nearest fully equipped service organization.
   2. Test Report: System acceptance test report.
   3. Certificate: Affidavit, signed by the Company Field Advisor, certifying that the system meets the contract requirements and is operating properly.

1.04 QUALITY ASSURANCE

A. Source Quality Control: The Company producing the natural gas-alternator unit shall have test facilities available which can demonstrate that the proposed system meets contract requirements.
   1. If brand names other than those specified are proposed for use, pay all costs, including travel expenses to the test facility for the Owner's Representative to witness test demonstration.

B. List of Completed Installations:

1. Natural gas -Alternator Unit: If brand names other than those specified are proposed for use, furnish the name, address and telephone number of at least 5 comparable installations which can prove the proposed products have operated satisfactorily for 3 years.
2. Other Products: If brand names other than those specified are proposed for use, furnish the name, address and telephone number of a least 5 comparable installations which can prove the proposed products have operated satisfactorily for 3 years.

C. Company Field Advisor: Secure the services of a Company Field Advisor for a minimum of 16 working hours for the following:
1. Render advice regarding installation and final adjustment of the system.
2. Witness final system test and then certify with an affidavit that the system is installed in accordance with the contract documents and is operating properly.
3. Train facility personnel on the operation and maintenance of the system (minimum of two 2 hour sessions).
4. Explain available service programs to facility supervisory personnel for their consideration.

D. Service Availability: A fully equipped service organization capable of guaranteeing response time within 8 hours to service calls shall be available 24 hours a day, 7 days a week to service the completed Work.

1.05 PROJECT CONDITIONS

A. The natural gas-alternator unit shall meet all requirements at the following elevation and ambient temperatures (actual site conditions):
1. Elevation Above Sea Level: 500 feet.
2. Maximum Ambient Temperature: 110 degrees F.
3. Minimum Ambient Temperature: -20 degrees F.

1.06 MAINTENANCE

A. Spare Parts:
1. Two sets of gaskets for routine engine maintenance.
2. Two spare heating elements for water jacket heater. Furnish spare water jacket heater if elements are not replaceable.
3. Set of belts.
4. Set of oil filter elements.
5. Set of fuel filter elements.
6. Set of air cleaner elements.
7. Hydrometer for testing anti-freeze solution.
8. Test kit for checking chemical condition of coolant.
9. One year supply of coolant conditioner.
10. Special tools if required for the regular maintenance and minor repairs of the unit.

PART 2 PRODUCTS

2.01 NATURAL GAS-ALTERNATOR UNITS

A. Rating:
1. 250 kW, 0.80 pf, 120/208V, 3phase, 60 Hz.

B. Acceptable Companies: Caterpillar Tractor Co., Cummins/Onan Corp., Detroit Diesel Allison, Generac, or Kohler Co.

C. Base:
1. Rigid, electrically welded structural steel base with natural gas-alternator mounted directly thereon complete with spring type vibration isolators, provisions for foundation bolts and provisions for lifting entire unit.

D. Engine:
1. Industrial type natural gas engine, water cooled, pressure lubricated, medium speed (1800 rpm maximum)l.
2. Torsional stress of the engine crankshaft and alternator rotor shaft shall not exceed 5000 pounds per square inch when operating as an assembled unit at rated speed and power output.
3. Maximum average fuel consumption: $32m^3$ per hour at rated full load.
4. Engine Accessories: Equip engine with the Company's standard accessories. Exception: In addition to, or in lieu of the Company's standard accessories for the following, equip engine with:
   a. Electric starting system, 24 vdc minimum.
   b. Fuel filters, full flow (redundant) spin on type.
   c. Dry type air cleaner (replaceable element).
   d. Lubricating oil filters, full flow (with by-pass valve), spin-on type.
   e. Oil dipstick system that allows lubricating oil level to be checked while engine is running and stopped.
   f. Governor which maintain speed at precise isochronous control for 60 Hz operation. The frequency at any constant load (including no load) shall remain within a steady state band width of $\pm$ 0.25 percent of rated frequency. Frequency modulation (defined as the number of times per second that the frequency varies from the average frequency in cyclic manner) shall not exceed one cycle per second.

E. Engine Control and Instrumentation:
1. Timer for selective number of cranking cycles.
2. Circuit for bypassing oil pressure protective device during starting.
3. Selector switch for stop, automatic and manual positions.
4. Indicating Instruments and Safety Devices:
   a. Audible alarm to sound when any safety device operates.
   b. High water temperature cutout and indicating light.
   c. Low lube oil pressure cutout and indicating light.
   d. Overspeed shutdown and indicating light.
   e. Overcranking cutout and indicating light.
   f. Alarm system reset.

g. Lamp test switch.
h. Lubricating oil pressure gage.
i. Jacket water temperature gage.
j. Running time meter.
k. Sensor and warning device to indicate jacket water temperature below 70 degrees F.
l. Weak battery (alarm).

5. Auxiliary contacts or relays to control opening and closing of motorized dampers.
6. 16 Point Remote Annunciator Panel.
7. Include five auxiliary dry contacts for remote monitoring of generator to include:
   a. Low Fuel
   b. Generator Running
   c. Generator Failed to Start
   d. Low Battery
   e. General Fault
8. Engine gages and control switches may be installed directly on an engine mounted panel or on instrument panel of an engine starting control panel.
   a. Locate panel so that it may be observed conveniently by Facility operating personnel.

F. Engine Cooling and Heating Equipment:
1. Unit mounted radiator:
   a. Cooling core mounted vertically.
   b. Factory test pressure of 20 pounds per square inch, operating pressure as required by the engine manufacturer.
   c. Maximum operating temperature of 250 degrees F.
   d. Cooling core guard.
   e. OSHA approved fan guard.
   f. Surge tank as recommended by radiator manufacturer.
   g. Sight glass for coolant level indication.
2. Water cooled exhaust manifold or other suitable means (insulating blankets, etc.) to protect personnel from hot exhaust parts, to prevent excessive heat rejection to the room from the exhaust manifold and to prevent excessive heat build-up in engine and accessories due to lack of cooling air flow over engine and accessories.
3. Permanent type anti-freeze (ethylene glycol) for the cooling system; Dow Chemical Co.'s Dow Therm SR-1. Coolant mixture suitable for use to minus 50 degrees F.
4. Engine mounted radiator system and pusher type fan designed to cool the jacket water and lubricating oil.
5. Radiator flange for duct connection.
6. Permanent type anti-freeze (ethylene glycol) for the cooling system as manufactured by Dow Chemical Co. or Union Carbide. Coolant mixture suitable for use to minus 50 degrees F.
7. Coolant conditioner corrosion prohibitive chemical additive which controls acidity, softens water and leaves protective film on cooling passages. Type and method of application as recommended by engine manufacturer.
8. Thermostatically controlled electric water jacket heater in the cooling system to maintain engine temperature at minimum 70 degrees F.

9. Lube oil cooler.

G. Engine Exhaust Equipment:
   1. Silencer: Suitable for critical noise areas; Burgess-Manning's BEO, Donaldson Co. Inc.'s TCU, Riley-Beaird Inc.'s Maxim Model M51, or Universal Silencer's EN5 with:
      a. Flanges.
      b. Hangers and supports (vibration isolation type).
   2. Exhaust Pipe: Schedule 40 black steel pipe with:
      a. Corrugated (bellows) stainless steel flexible section for connection between exhaust manifold and exhaust pipe.
      b. Hangers and supports.
      c. Rain cap (vertical pipe).
   3. Insulation: 3 inch thick calcium silicate pipe insulation; Manville's Thermo-12, or Owens-Corning's Kaylo with Type 304 stainless steel metal jacketing, 0.010 inch thick, held in place with snap-in locking joints and stainless steel bands with snap straps.

H. Alternator and Accessories: Multipole, revolving field alternator meeting NEMA Standards, having:
   1. Brushless solid state permanent magnet (PMG) exciter system.
   2. Temperature compensated solid state voltage regulator. Voltage regulation within plus or minus 2 percent of rated voltage from no load to full load. Transient voltage dip not greater than 20 percent of rated voltage when full load at rated power factor is applied to the alternator.
   3. Stable alternator operating conditions reestablished within 2 seconds following any change in load between no load and full load or between full load and no load.
   4. Temperature rise in accordance with NEMA MG1-22.40, determined by resistance method, rated on standby duty basis, reference ambient temperature 40 degrees C (Class F insulation system 130 degrees C maximum rise; Class H insulation system 150 degrees C maximum rise).
   5. Rheostat for plus or minus 5 percent voltage adjustment.
   6. Amortisseur windings, suitable for paralleling.
   7. Alternator directly connected to engine and driven through a semi-flexible driving flange.
   8. Main circuit breaker mounted on unit, or on mounting frame adjacent to unit. Circuit breaker shall meet the requirements of Section 262816 - Enclosed Circuit Breakers. Breaker shall be rated 65,000AIC
   9. Instruments in panel, shock mounted on the unit:
      a. Frequency meter.
      b. Rheostat Control.
      c. AC voltmeter.
      d. AC ammeter.
      e. Individual or combination type selector switches for the voltmeter and ammeter.
      f. Panel lights and switch.

2.02 BATTERIES AND ACCESSORIES

A. Lead Acid batteries; with:
1. Number of cell units as required for voltage of starting system (Cell voltage shall be based on l.2 volts per cell).
2. Plastic cell containers.
3. Ampere-hour capacity as recommended by engine manufacturer for a minimum of 3 consecutive starting attempts of 15 seconds each.
4. Ampere-hour capacity as recommended by engine manufacturer for 60 seconds of continuous cranking. Note: Engine overcrank device shall terminate cranking with enough reserve power to permit additional cranking after an investigation to find the reason for a failure to start.
5. Full ampere-hour capacity delivered at ambient temperature of 32 degrees F.

B. Battery Charger: Constant voltage, current limiting type as recommended by the battery manufacturer, having:
1. Fully automatic, 2 rate (float and high-rate/equalize) charging control.
2. DC ammeter.
3. DC voltmeter.
4. High-rate indicator light.
5. Common audible alarm and individual indicating lights (with provision for connection to remote annunciator) for:
   a. Ground fault (if ungrounded type dc system).
   b. AC input failure.
   c. Low dc voltage.
   d. High dc voltage.
   e. No dc voltage at batteries.
6. Remote annunciator panel with common audible alarm and individual indicating lights for:
   a. Ground fault (if ungrounded type dc system).
   b. AC input failure.
   c. Low dc voltage.
   d. High dc voltage.
   e. No dc voltage at batteries.
7. Common audible alarm and individual indicating lights for:
   a. Ground fault (if ungrounded type dc system).
   b. AC input failure.
   c. Low dc voltage.
   d. High dc voltage.
   e. No dc voltage at batteries.

B. Battery Rack: As recommended by battery manufacturer.

2.03 HOUSING

A. All units shall be provided with a factory weatherproof level 1sound attenuated housing

to completely enclose unit, having:

1. All equipment and devices installed within the housing (except muffler) including main circuit breaker, batteries, etc. connected and ready for use as complete package.

    a. Sound attenuation shall be as follows:
        1. 75 dBA at 23 feet
2. Base:
    a. Minimum 6 inch channel iron with minimum 4 inch, 11 gage formed crossmembers.
    b. Painted with black epoxy
    c. Lifting hooks.
    d. Grounding lugs.
    e. Rodentproof skirt.
3. Walls and Roof:
    a. Minimum 16 gauge steel exterior pan for 14 gauge Color of exterior white.
    b. Acoustic composite foam insulation (R value 19.8).
    c. Minimum 50 pounds per sq. ft. snow loading for roof.
    d. Zinc plated or stainless steel fasteners
5. Insulated exterior door Doors equipped with key lock exterior latch handle.
6. All doors hinged. Hinges constructed of brass or stainless steel.
7. Exterior Emergency stop button.
8. Oil and coolant piped to outer perimeter of engine.
9. Crankcase breather and day tank vented to outside of housing.
10. Exhaust silencer with tail pipe and bird screen, mounted internally in housing.
11. All wiring from auxiliary equipment (water jacket heater, battery pad heater, alternator strip heater, etc.) to diesel-alternator designated control terminal strip. Contractor shall supply 120/208 volt 40 amp circuit for accessory power.

2.04 REMOTE ANNUNCIATOR

A. Provide remote alarm annunciator to meet NFPA 99.

PART 3 EXECUTION

3.01 INSTALLATION

A. Connections: Make all connections to unit with flexible connections designed for the specific purpose.

B. Natural Gas:
    1. Provide natural gas connection to generator before commencing the preliminary system test.

C. Phase Relationship: Correctly phase emergency and normal service so that motor rotation will not reverse upon transfer from normal to emergency feeder.

3.02 FIELD QUALITY CONTROL

A. Preliminary System Test:
1. Preparation: Have the Company Field Advisor adjust the completed system (with the contract automatic transfer switch connected). Coordinate with automatic transfer switch company field advisor switch/system test requirements. Operate it long enough to assure that it is performing properly.
2. Run a preliminary test for the purpose of:
   a. Determining whether the system is in a suitable condition to conduct an acceptance test.
   b. Checking and adjusting equipment.
   c. Training facility personnel.

B. System Acceptance Test:
1. Preparation: Coordinate test with automatic transfer switch manufacturer and notify the Owner's Representative at least 3 working days prior to the test so arrangements can be made to have a Facility Representative witness the test.
2. Make the following tests:
   a. Test each system function step by step as summarized under SYSTEM DESCRIPTION.
   b. Test starting system and battery capacity. Crank engine for the required time and number of consecutive starting attempts.
   c. Load test at unity (l.0) power factor and rated voltage in the following sequence (run each test segment continuously):
      1) One hour at half load.
      2) One hour at three-quarters load.
      3) Four hours at full load.
      4) During the test period take voltage, current, frequency and all engine instrument readings and record results at the beginning and end of test and at fifteen minute intervals during test.
   d. Measure fuel consumption during the full load test period.
3. Supply an adjustable resistive load bank or other approved apparatus to load unit for variations of test loads.
4. Supply equipment necessary for system adjustment and testing.
5. Submit written report of test results signed by Company Field Advisor and the Owner's Representative.

3.03 TRAINING

A. The engine manufacturer’s local representative shall provide eight hours of on-site training for appropriate site personnel. Training shall include maintenance, parts ordering, safety, operation, troubleshooting, and a complete review of operation and service manuals.

PART 4 WARRANTY AND SERVICE

4.01 GENERATOR WARRANTY

A. Generator shall be supplied with a two years part, labor and mileage warranty covering the generator set and all accessories.

B. Warranty period shall commence after the generator has been successfully acceptance tested.

4.02 SERVICE CONTRACT

A. A service contract shall be included with the purchase of the Generator. The service contract shall cover all factory recommended service and maintenance. Minimum service shall include annual inspection and maintenance as well as all repairs and service recommended as a result of said annual inspection.

B. The service contract shall cover a period of two years after the unit has successfully completed on-site acceptance testing.

END OF SECTION

SECTION 263214
AUTOMATIC TRANSFER SWITCH

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Electrical Generator Set: Section 263213.

1.02 REFERENCES

A. UL 1008 listed, CSA certified.

B. NFPA 70- National Electric Code

C. NFPA 110.

D. NEMA Standard ICS2-447-AC Transfer Switches.

E. IEEE Standard 446.

F. NEC Articles 700,701, 702

G. ISO 9001.

1.03 TRANSFER SWITCH OPERATING DESCRIPTION

A. Design Criteria: The transfer switch is required to:
1. Transmit signals to the natural gas-alternator indicating when the unit should start and stop.
2. The automatic transfer switch shall have provisions to transfer supply to emergency loads in the facility between the normal source (utility feed) and the standby source (natural gas generator package). In phase voltage monitoring shall be provided to control switch operation between two energized sources.
3. The automatic transfer switch shall have provisions to test the natural gas-alternator unit under load and unloaded. A selector switch shall be provided for "TEST UNDER LOAD" and "TEST UNLOADED".
4. The automatic transfer switch shall have provisions to automatically test the natural gas-alternator unit on a scheduled basis, as well as to manually initiate a test. A "MANUAL/OFF/AUTOMATIC" Test selector switch as well as "PUSH TO START TEST" and "PUSH TO STOP TEST" pushbuttons shall be provided.
5. Provisions shall be provided to select the frequency (daily/weekly/monthly) and the day of the month/week and time of day that the automatic testing is initiated.
6. Indication shall be provided for availability of both the "Normal" and "Emergency" sources.
7. Indication shall be provided for the switch position – "Normal" or "Emergency".
8. Provide remote alarm and indication capability.
9. Controls using touch screen controller are acceptable, if not provided then physical switches and buttons will be required.

B. Description of Operation – Automatic Operation:
1. The transfer switch monitors electrical parameters of normal and emergency feeders.
2. In normal operating condition, the mechanism of the transfer switch is in the normal position and the natural gas alternator (Section 263213) unit shut down. Sequence of transfer operation occurs as follows:
   a. The voltage on any phase of the normal feeder drops below 85 percent of normal, initiating in the transfer switch after an adjustable time delay (set at 2 seconds) to ride through voltage fluctuations and momentary outages.
   b. At the end of the adjustable time delay, the natural gas-alternator unit is signaled to automatically start.
   c. A voltage-frequency device in the transfer switch prevents transfer until the emergency feeder voltage rises to 90 percent of normal and the frequency reaches 95% nominal.
   d. The transfer switch transfers load to the emergency feeder.
   e. Complete transition from onset of normal feeder failure to emergency feeder transfer shall not exceed 10 seconds.
   f. When voltage on all phases of the normal feeder is restored to 90 percent voltage, transfer from emergency to normal feeder is initiated after an adjustable time delay (set at 30 minutes) in the transfer switch.
   g. The transfer switch transfers load to the normal feeder at the end of the time delay provided that the in phase monitor is satisfied. Exception: If the emergency power source should fail and the normal power source has been restored, retransfer to the normal source of power shall be immediate, by passing the retransfer delay timer.
   h. The unit continues to run unloaded 5 minutes, after which the control equipment shuts down the engine and resets the system.
   i. Permanently attached manual operating handle(s) allow for safe manual transfer under load. The switch operating speed is the same operated electrically or manually.

C. Description of Operation – Generator/Transfer Switch Test:
1. Automatic Test:
   a. With the Test Selector Switch in the “AUTOMATIC” position the generator shall be exercised as follows on a scheduled basis.
      1. When the time specified on the test scheduler occurs the natural gas-alternator unit is signaled to automatically start.
      2. With the load selector switch in the “TEST UNLOADED” position the generator runs unloaded for the length of time established above for retransferring load to the Normal Source (set at 30 minutes) after which the generator shuts down.
      3. With the load selector switch in the “TEST UNDER LOAD” position an auxiliary device (in-phase monitoring or programmed transition) in the transfer switch assures the normal and emergency power sources are synchronized.
      4. The transfer switch transfers load to the emergency generator.

5. Complete transition from onset of normal feeder failure to emergency feeder transfer shall not exceed 10 seconds.
6. The generator carries the load for 30 minutes (as described above), after which the generator synchronizes with the normal (utility) source and the transfer switch operates to connect the load to the utility.
7. The generator continues to run unloaded in the cool down mode for 5 minutes after the load is transferred to the normal source before the transfer switch sends a command to shut down the engine.

2. Manually Initiated Test:
   a. With the Test Selector Switch in the “MANUAL” position the generator shall be exercised as follows:
      1. When the “PUSH TO START TEST” button is pressed the natural gas-alternator unit is signaled to start.
      2. With the load selector switch in the “TEST UNLOADED” position the generator runs unloaded for the length of time established above for retransferring load to the Normal Source (set at 30 minutes) after which the generator shuts down.
      3. With the load selector switch in the “TEST UNDER LOAD” position an auxiliary device (in-phase monitoring or programmed transition) in the transfer switch assures the normal and emergency power sources are synchronized.
      4. The transfer switch transfers load to the emergency generator.
      5. Complete transition from onset of normal feeder failure to emergency feeder transfer shall not exceed 10 seconds.
      6. The generator carries the load until the “PUSH TO STOP TEST” pushbutton is pressed, after which the generator synchronizes with the normal (utility) source and the transfer switch operates to reconnect the load to the utility.
      7. The generator continues to run unloaded in the cool down mode for 5 minutes after the load is transferred to the normal source before the transfer switch sends a command to shut down the engine.

1.04 SUBMITTALS

A. Submittals Package: Submit the product data, shop drawings, and quality control submittals specified below at the same time as a package.

B. Shop Drawings:
   1. Installation details (coordination with connected equipment).

C. Product Data:
   1. Catalog sheets, specifications and installation instructions.
   2. Bill of materials.
   3. Detailed sequence of operations (format similar to TRANSFER SWITCH OPERATING DESCRIPTION).
   4. Company's data indicating maintenance schedule.

5. Name, address and telephone number of nearest fully equipped service organization.

D. Quality Control Submittals:
   1. Design Data:
      a. Company's data indicating the switch will meet the requirements of 1.03 B.
      b. Certified data from the Company proving that the switch will meet the requirements of 1.03 A. Design Criteria.
   2. Company Field Advisor Data: Include:
      a. Name, business address and telephone number of Company Field Advisor secured for the required services.
      b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
      c. Services and each product for which authorization is given by the Company, listed specifically for this project.
   3. Completed Installation List.

E. Contract Closeout Submittals:
   1. Operation and Maintenance Data: Deliver 2 copies, covering the installed product, to the Owner's Representative. Include name, address and telephone number of nearest fully equipped service organization.
   2. Test Report: Switch/System acceptance test report.
   3. Certificate: Affidavit, signed by the Company Field Advisor, certifying that the switch operation with the related equipment meets the contract requirements and is operating properly.

1.05 QUALITY ASSURANCE

A. List of Completed Installations: If brand names other than those specified are proposed for use, furnish the name, address and telephone number of a least 5 comparable installations which can prove the proposed products have operated satisfactorily for 3 years.

B. Company Field Advisor: Secure the services of a Company Field Advisor for a minimum of 8 working hours for the following:
   1. Render advice regarding installation and final adjustment of the switch.
   2. Witness final switch/system test and then certify with an affidavit that the switch is installed in accordance with the contract documents and is operating properly.
   3. Train facility personnel on the operation and maintenance of the switch (minimum of one 2 hour session).
   4. Explain available service programs to facility supervisory personnel for their consideration.

C. Service Availability: A fully equipped service organization capable of guaranteeing response time within 8 hours to service calls shall be available 24 hours a day, 7 days a week to service the completed Work.

1.06 MAINTENANCE

A. Spare Parts:
1. Special tools if required for the regular maintenance and minor repairs of the switch.

1.07 WITHSTAND AND CLOSE RATINGS:

A. The ATS shall be rated to close on and withstand the available rms symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans. WCR ATS ratings as be as follows when used with specific circuit breakers:

ATS Size	**Withstand & Closing Rating MCCB**	**W/CURRENT LIMTING FUSES**
30	22,000A	100,000
70 - 200	22,000A	200,000
230	22,000A	100,000
260 – 400	42,000A	200,000
600 – 1200	65,000A	200,000
1600 – 2000	85,000A	200,000
2600 – 3000	100,000A	200,000

PART 2 PRODUCTS

2.01 AUTOMATIC TRANSFER SWITCH

A. Automatic Switch Co.'s ASCO 300 Series with Group G Controller, Russelectric Inc.'s, Model RMT, or Zenith Controls Inc.'s ZTS, with:
1. Double throw construction.
2. Ratings as indicated on drawings.
3. Accessories to perform the functions specified in TRANSFER SWITCH OPERATING DESCRIPTION.
4. NEMA 1 enclosure.
5. Electrically operated and mechanically held.
6. Adjustable time delay, 0-6 seconds, to override momentary outages before initiating engine starting. Once engine is signaled to start it must run for at least the duration of the time delay before engine shut down.
7. Adjustable time delay, 0-30 minutes, on retransfer to normal feeder with bypass of time delay in event of emergency feeder failure.
8. Adjustable time delay, 0-10 minutes, on engine cool down.
9. Adjustable time delay, 0-5 seconds, on transfer to emergency feeder.
10. Test switch, momentary type, (permanent type are acceptable when accompanied by flashing red lights at the transfer switch and generator set to indicate switch is not in automatic mode), to simulate normal feeder failure (unit to start and transfer to emergency feeder).

11. In-phase Monitor, or Programmed Transition (Programmed transition adjustable 0-6 second time delay, factory set at 2 seconds).
12. Presignal transfer time delay contact closure (time adjustable, factory set at 15 seconds).
13. Two identified pilot lights to indicate switch position (green normal, red emergency).
14. Start contacts, silver plated.
15. Auxiliary contact on main shaft (closed on normal).
16. Auxiliary contact on main shaft (closed on emergency).
17. Automatic exerciser for exercising the referenced natural gas-alternator engine (no transfer to emergency feeder), minimum 30 minutes every 168 hours (7 days).
18. Equipment ground lug.
19. Communications interface to work with the Remote Annunciator.
20. Include auxiliary dry contacts for remote monitoring to include:
    a. General ATS fault
    b. Failed to Transfer
    c. On Backup Power
21. Live parts shielded from personnel when door is open.

2.03 NAMEPLATES

A. General: Precision engrave letters and numbers with uniform margins, character size minimum 3/16 inch high as indicated on the One Line Diagram.
   1. Phenolic: Two color laminated engravers stock, 1/16 inch minimum thickness, machine engraved to expose inner core color (black letters on white background).

PART 3 EXECUTION

3.01 INSTALLATION

A. Install all required engine starting signal circuitry from switches to engine start conductor junction box. Engine start signal shall be transmitted automatically upon loss of normal source voltage. The start signal shall prevent dry cranking of the generator by requiring the generator to reach proper output and run for at least the duration of the cool-down timer.

B. Install switch so that the maximum height above the floor to the center of the operating handle does not exceed 6'-0".

C. Identify switch, indicating designation, load served and normal feeder designation, by riveting or bolting nameplate to cover.

D. Install Remote Annunciator panel at location indicated.

3.02 FIELD QUALITY CONTROL

A. Preliminary Switch/System Test:
   1. Preparation: Have the Company Field Advisor adjust the switch for the completed system (including the related equipment) and then operate it long enough to assure that it is performing properly.
   2. Run a preliminary test for the purpose of:
      a. Determining whether the switch is in a suitable condition to conduct an acceptance test.
      b. Checking and adjusting equipment.
      c. Training facility personnel.

B. Switch/System Acceptance Test:
   1. Preparation: Coordinate test with related equipment manufacturer and notify the Owner's Representative at least 3 working days prior to the test so arrangements can be made to have a Facility Representative witness the test.
   2. Make the following tests:
      a. Test each switch function step by step as summarized under TRANSFER SWITCH OPERATING DESCRIPTION.
   3. Submit written report of test results signed by Company Field Advisor and the Owner's Representative. Give a copy of the final report to the Owner's Representative.

END OF SECTION

SECTION 265119
LIGHT-EMITTING DIODE (LED) FIXTURES

PART 1. GENERAL

1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications and installation instructions, including:
   1. Technical information for each fixture that proves that it meets specified requirements. Include data which proves proposed lamp and ballast combinations do not exceed specified total harmonic distortion.
   2. Candlepower distribution curves for each type fixture if different from Company or catalog number specified.

B. Samples: One of each product if requested.

C. Quality Control Submittals:
   1. List of Installations for LED fixtures: If brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations which can prove the proposed products have operated satisfactorily for 1 year. The installations shall present a grand total of at least 5000 ballasts.

1.02 QUALITY ASSURANCE

A. Equipment Qualifications for Products Other Than Those Specified:
   1. At the time of submission provide written notice to the Owner's Representative of the intent to propose and “or equal” for products other than those specified. Make the “or equal” submission in a timely manner to allow the Owner's Representative sufficient time to review the proposed product, perform inspections and witness test demonstrations.
   2. If products other than those specified are proposed for use furnish the name, address, and telephone numbers of at least 5 comparable installations that can prove the proposed products have performed satisfactorily for 3 years. Certify in writing that the owners of the 5 comparable installations will allow inspection of their installation by the Owner's Representative and the Company Field Advisor.
      a. Make arrangements with the owners of 2 installations (selected by the Owner's Representative) for inspection of the installations by the Owner's Representative. Also obtain the services of the Company Field Advisor for the proposed products to be present. Notify the Owner's Representative a minimum of 3 weeks prior to the availability of the installations for the inspection, and provide at least one alternative date for each inspection.
      b. Only references from the actual owner or owner's representative (Security Supervisor, Maintenance Supervisor, etc.) will be accepted. References from dealers, system installers or others, who are not the actual owners of the proposed products, are not acceptable.
         1) Verify the accuracy of all references submitted prior to submission and certify in writing that the accuracy of the information has been confirmed.

3. The product manufacturer shall have test facilities available that can demonstrate that the proposed products meet the contract requirements.
    a. Make arrangements with the test facility for the Owner's Representative to witness test demonstrations. Also obtain the services of the Company Field Advisor for the proposed product to be present at the test facility. Notify the Owner's Representative a minimum of 3 weeks prior to the availability of the test facility, and provide at least one alternative date for the testing.
4. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.

PART 2. PRODUCTS

2.01 LUMINAIRES

A. Type High Bay LED: Full metal fixture liner inside reinforced fiberglass housing: Cooper Metalux LHB LED:
    1. Lamp Type: LED.
    2. Luminaire to operate at 120 - 277V and connected for operation on 120V circuit, unless otherwise indicated on drawing.
    3. Mounting:
        a. Suspended
    4. Fixture is suitable for operation from -20 degrees C to 25 degrees c ambient conditions.
    5. Damp location Listed.
    6. 5-year warranty.

B. Type Area Site Luminaire LED McGraw Edison
    1. Lamp Type LED.
    2. Luminaire to operate at 120V circuit, unless otherwise indicated on drawing.
    4. Mounting:
        a. Pole Mounted
    6. Glass lens, reflective backing plates
    7. Fixture is suitable for operation from -40 degrees C to 40 degrees c ambient conditions.
    9. IP66, ISO 9001
    10. LED lamp listed UL 8750

C. Type Wall Mount Luminaire. LED McGraw Edison
    1. Lamp Type: Solid State LED.
    2. Luminaire to operate at 120 - 277V and connected for operation on 120V circuit, unless otherwise indicated on drawing.
    3. Mounting:
        a. Wall mounted.
    4. Housing:
        a. Five stage super TGIC polyester powder coat paint aluminum housing.
    5. Fixture is suitable for operation from -40 degrees C to 40 degrees c ambient conditions.
    6. Wet location Listed.
    7. IP66
    8. LED lamp listed UL 8750, LM79, LM80, ISO 9001

D. Type LED suspended, suspended. Pendant Mount Portfolio LSMP.
   1. Lamp Type: LED.
   2. Luminaire to operate at 120V circuit, unless otherwise indicated on drawing.
   3. Mounting:
      a. Suspended by pendant.
   4. Housing:
      a. extruded aluminum and die-formed 20 gauge
   5. Direct/indirect light
   6. Damp location Listed.
   7. LM79/LM90
   8. LED lamp listed UL 1598

E. Type LED Strip Light Metalux 4SNX.
   1. Lamp Type: LED.
   2. Luminaire to operate at 120V circuit, unless otherwise indicated on drawing.
   3. Mounting:
      a. Suspended by aircraft cable.
   4. Housing:
      a. extruded aluminum and die-formed 20 gauge
   5. Direct/indirect light
   6. Damp location Listed.
   7. LM79/LM90
   8. LED lamp listed UL 1598

F. Type LED Wall Sconce by Shaper
   1. Lamp Type: LED
   2. Luminaire to operate at 120V circuit, unless otherwise indicated on drawing.
   3. Mounting:
      a. wall.
   4. Housing:
      a. extruded aluminum and die-formed 20 gauge
   5. Direct/indirect light
   6. Damp location Listed.
   7. LM79/LM90

G. Type LED grid ceiling 2’x4’ troffer housing constructed form code guage prime cold rolled steel. Metalux Cruze SB
   1. Lamp Type: LED
   2. Luminaire to operate at 120V circuit, unless otherwise indicated on drawing.
   3. Mounting:
      a. 4 grid clips per fixture.
   4. Housing:
      a. extruded aluminum and die-formed 20 gauge
   5. Direct/indirect light
   6. Damp location Listed.
   7. LM79/LM90
   8. LED lamp listed UL 1598

H. Type LED RLM fixture.
   1. Lamp Type: LED
   2. Luminaire to operate at 120V circuit, unless otherwise indicated on drawing.
   3. Mounting:
      a. Arm Mount.
   4. Housing:
      a. extruded aluminum and die-formed 20 gauge
   5. Direct/indirect light
   6. Wet location Listed.
   7. LM79/LM90
   8. LED lamp listed UL 1598

I. Type down light. Halo HC
   1. Lamp Type: LED
   2. Luminaire to operate at 120V circuit, unless otherwise indicated on drawing.
   3. Mounting:
      a. recessed ceiling.
   4. Housing:
      a. 6” extruded aluminum and die-formed 20 gauge
   5. Direct/indirect light
   6. Damp location Listed.
   7. LM79/LM90
   8. LED lamp listed UL 1598

J. Type Exterior LED Wall Sconce by Invue
   1. Lamp Type: LED
   2. Luminaire to operate at 120V circuit, unless otherwise indicated on drawing.
   3. Mounting:
      a. wall.
   4. Housing:
      a. extruded aluminum and die-formed 20 gauge
   5. Direct/indirect light
   6. Wet location Listed.
   7. LM79/LM90

2.02 LIGHTING CONTROLS AND COMMUNICATION

A. Summary – The lighting in the firehouse shall be controlled by dimmer switches, and occupancy sensors as shown on the drawings. Each controller shall be configured to power and dim lights in the associated space.

B. Lighting Controllers - LMRC
   1. Dimming room controller On/Off/0-10V
   2. Single Phase 120VAC 60Hz input.
   3. Three-relay room controller
   4. Each relay rated for 120V, 20A.
   5. Class 2 output to DLM local network:24VDC, up to 250mA across 4 RJ45 ports.

6. UL and cUL listed
7. Five-year warranty
8. Wattstopper LMRC-210 Series model number LMRC-213 or engineer approved equal.

C. Control Switches – LMSW:
   1. Input voltage – 24VDC from DLM network
   2. Current consumption 5mA
   3. Connection to DLM network through two RJ45 ports
   4. UL listed
   5. Five-year warranty
   6. Control Switches shall be Wattstopper LMSW-100 Series
      a. LMSW-KIT-101 1 button kit
      b. LMSW-KIT-102 2 button kit.
      c. LMSW-KIT-103 3 button kit
      d. LMSW-KIT-104 4 button kit
      e. LMSW-KIT-108 8 button kit

PART 3. EXECUTION

3.01 INSTALLATION

A. General: Install fixtures at locations indicated on the drawings.

B. Finishing Collar or Combination Finishing Collar/Outlet Box (Surface Mounted Fixture Used with Exposed Raceway):
   1. Provide finishing collar where surface mounted fixture is installed on an exposed raceway outlet box and the fixture base is larger than the outlet box.
   2. Provide combination finishing collar/outlet box where surface mounted fixture is not indicated to be installed on an exposed raceway outlet box, but raceway cannot be run directly into fixture body due to fixture design.

END OF SECTION 265119

SECTION 265213.13
EMERGENCY LIGHTING – UNIT EQUIPMENT

PART 1. GENERAL

1.01 SUBMITTALS

A. Submittal Package: Submit the product data items specified below at the same time as a package.

B. Product Data:
   1. Catalog sheets, specifications and installation instructions.
   2. Battery warranty.
   3. Name, address and telephone number of nearest fully equipped service organization.

C. Project Closeout Submittals:
   1. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Owner's Representative. Include name, address and telephone number of the nearest fully equipped service organization.

1.02 QUALITY ASSURANCE

A. List of Completed Installations: If brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations which can prove the proposed products have operated satisfactorily for 3 years.

B. Service Availability: A fully equipped service organization shall be available to service the completed Work.

PART 2. PRODUCTS

2.01 EMERGENCY LIGHTING UNITS

A. Refer to the Lighting Fixture Schedule on the drawings for emergency fixtures required for the project.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer's printed instructions.

B. Insert a copy of the battery warranty in each unit and mark on batteries the date placed in service.

END OF SECTION 265213.13

SECTION 265213.16
EXIT LIGHT FIXTURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Product Data: Catalog sheets, specifications, and installation instructions.

B. Samples: One of each product if different from Company or catalog number specified.

1.02 QUALITY ASSURANCE

A. List of Installations: If brand names other than those specified are proposed for use, furnish the name, address, and telephone number of at least 5 comparable installations which can prove the proposed products have operated satisfactorily for one year.

PART 2 PRODUCTS

2.01 EXIT LIGHT FIXTURES

A. Refer to the Lighting Fixture Schedule on the drawings for description of Exit Fixtures required for the project.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer's printed instructions.

END OF SECTION 265213.16

SECTION 266216
TRANSFORMERS – DRY TYPE, UNDER 600V

PART 1. GENERAL

1.01 REFERENCES

A. NEMA, ANSI, IEEE, and UL.

1.02 SUBMITTALS

A. Submittals Package:
   1. For Transformers Rated 75KVA and Below: Submit the product data, and quality control submittals specified below all at the same time as a package.

B. Product Data: Catalog sheets, specifications and installation instructions.

C. Quality Control Submittals:
   1. Transformers Rated 75KVA and Below: Submit certified report of the Company's routine commercial NEMA tests for each type transformer.

D. Contract Closeout Submittals:
   1. Operation and Maintenance Data: Deliver 2 copies, covering the installed products, to the Owner's Representative.
   2. Energy Efficiency Rebate Documentation:
      a. Deliver 2 copies of documentation to the Owner's Representative showing the costs associated with purchase of any Energy Star labeled transformers.
         1) Submittal of confidential or proprietary documentation may be accommodated thru the rebate organization's legal declarations.
      b. The documentation will be forwarded to Facility supervisory personnel for their use in pursuing energy efficiency rebate incentive funds that may be, or may become, available during the course of this Contract thru organizations such as:
         1) New York State Energy Research and Development Authority (NYSERDA): New York Energy Smart program (518) 862-1090, www.nyserda.org.

1.03 DELIVERY, STORAGE AND HANDLING

A. Storage of Transformers: Provide supplemental heating devices, such as incandescent lamps or low wattage heaters within the enclosure or under a protective covering to control dampness. Maintain this protection from the time equipment is delivered to the site until it is energized.

PART 2. PRODUCTS

2.01 DRY TYPE TRANSFORMERS

A. By Acme Electric Corp. Power Products Div., Cutler-Hammer Inc., General Electric Co., Jefferson Electric Inc., Niagara Transformer Corp., Sola/Hevi-Duty Unit of General Signal, or Square D Co.:
   1. Two winding insulating type construction.
   2. Labeled for EPA Energy Star Program (based on NEMA TP1 Guide for Determining Energy Efficiency for Distribution Transformers), except where a specific type of dry type transformer is indicated on the drawings.

3. Enclosures for Transformers Installed in Dry Protected Locations (unless otherwise indicated):
   a. Ventilated enclosure for transformers rated over 10KVA.
   b. Enclosures for transformers rated 10KVA and under may be ventilated or non-ventilated.
4. Enclosure for Transformers in Damp Locations (unless otherwise indicated):
   a. Outdoor/ventilated enclosure equipped with weathershields for transformers rated over 10KVA.
   b. Enclosures for transformers rated 10KVA and under may be ventilated enclosure equipped with weathershields or non-ventilated.
5. Primary Taps (minimum of): 3-15KVA two-5 percent FCBN, over 15 KVA four 2-1/2 percent FCBN and two 2-1/2 percent FCAN.
6. Mounting accessories.

PART 3. EXECUTION

3.01 INSTALLATION

A. Install dry type transformers where indicated on the drawings.

END OF SECTION 266216