WEST PLAINS ENGINEERING, INC.

MECHANICAL ELECTRICAL PLUMBING POWER

AN ENGINEERING SOLUTION CENTER

Albertson Engineering Inc.

RESPEC

1250L Pump Room Rehabilitation
Lead, South Dakota

WPE # BR24011

July 25, 2025

SPECIFICATIONS

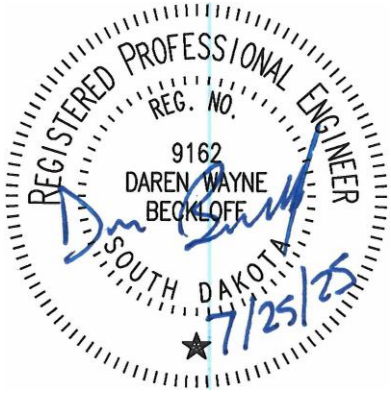
FOR

1250L Pump Room Rehabilitation
Lead, South Dakota

WPE # BR24011

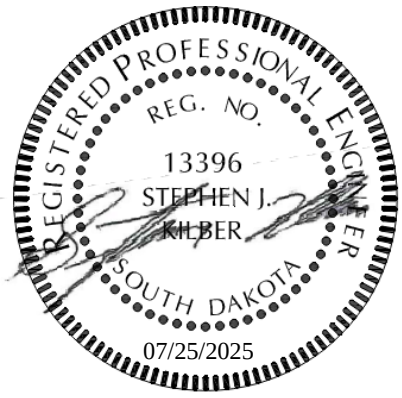
July 25, 2025

Daren W Beckloff, P.E.
Electrical Engineer

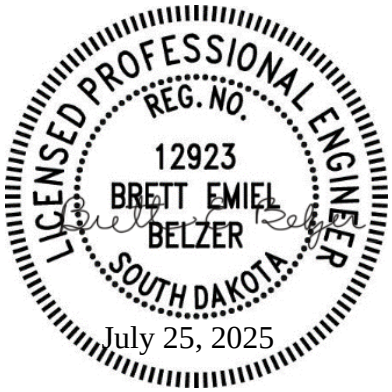


Michael S Heinrich, P.E.
Mechanical Engineer

Stephan Kilber, P.E.
Structural Engineer



Brett Belzer, P.E.
Geotechnical Engineer



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SECTION 03 2200

ROCK ANCHORS – 1250 LEVEL

PART 1: GENERAL

1.01 SCOPE

A. The contractor will install thrust block anchors in the 1250 Level Pump Room as indicated on drawings after the decommissioning and removal of existing pumproom infrastructure and after installation of new ground support. The contractor will be required to install anchors according to the construction drawings.

1.02 SUBMITTALS

A. Submittals should be provided to the owner (or representative) and the design engineer (or representative).

B. The Contractor shall prepare and submit to the Engineer for review a design submittal describing the rock anchor system or systems intended for use. The submittal shall be submitted a minimum of two (2) weeks prior to the commencement of the anchor installation work. Anchor installation cannot commence until the Engineer has reviewed the submittal. The design submittal shall include the following:
   1. Type and details of rock anchors, including manufacturer's recommendations for installation.
   2. Type and details of rock anchor accessories.
   3. Corrosion protection system(s) for rock anchors and accessories.
   4. Equipment and procedures for rock hole drilling.
   5. Adhesive type and manufacturer's recommended installation method.
   6. Manufacturer-published torque/load relationships.
   7. Design data for any and all other system components.
   8. Cement grout type and consistency for horizontal, vertical, and overhead use.

C. The Contractor shall submit to the Engineer for review the equipment to be used for load testing, including equipment calibration certificates. Testing cannot commence until the Engineer has reviewed the submittal.

D. The contractor shall submit daily field documentation of all drilling information for installation of the bolts including drill depth, the presence of moisture or flowing water, and the presence of fractures or voids present in the holes, including their depth and thickness.

E. The contractor shall submit field documentation of all pull testing information including location, photo record (before and after), displacement, and load.

1.03 INSPECTIONS

A. For the 1250-level pumproom thrust block installation, the following inspections are required:
   1. Visual inspection of thrust block anchors after installation by the design engineer (or representative) prior to Pumproom infrastructure installation.

1.04 REFERENCES

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel

B. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

E. ASTM C579 - Standard Test Method for Compressive Strength of Chemical- Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

F. ASTM F432 - Standard Specification for Roof and Rock Bolts and Accessories

G. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts

PART 2: PRODUCTS

2.01 THRUST BLOCK ANCHORS

A. Bar shall consist of No. 8 (nominal) high strength prestressing steel (minimum yield strength=75 ksi) all-thread bar in accordance with ASTM A615.

B. All accessories shall be compatible with 75 ksi all-thread bar in accordance with ASTM A563. Bearing plates shall be flat and in accordance with ASTM A36 or as noted on the Drawings.

C. Bars shall be mechanically cleaned and not acid washed.

D. Sufficient tail length of no less than 6 inches shall be provided beyond the end hardware to accommodate thrust block connection attachment as depicted on the Drawings.

2.02 PUMP EQUIPMENT PAD ANCHORS

A. Bar shall consist of No. 8 (nominal) high strength prestressing steel (minimum tensile strength=150 ksi) all-thread bar in accordance with ASTM A722.

B. All accessories shall be compatible with 150 ksi all-thread bar in accordance with ASTM A722. Bearing plates shall be flat and in accordance with ASTM A36 or as noted on the Drawings.

C. Bars shall be mechanically cleaned and not acid washed.

D. Sufficient tail length or no less than 6 inches shall be provided beyond the end hardware to accommodate thrust block connection attachment as depicted on the Drawings.

2.03 RESIN GROUT

A. Resin shall be unaffected by mild acids, mild alkalis, or by groundwater. Resin shall reach 80% of its ultimate strength within a time interval equal to five times the gel time. Strength of mixed and cured resin when tested in accordance with ASTM D695 shall be:
   1. Compressive Strength: 14,500 psi (100 MPa)
   2. Tensile Strength: 7,250 psi (50 MPa)
   3. Shear Strength: 4,640 psi (32 MPa)

B. Resin shall be supplied in cartridge form in conformance with ASTM F432.

C. Resin shall be high strength unsaturated polyester with a predominance of non-reactive inorganic filler.

D. Catalyst shall contain peroxide with a non-reactive inorganic filler.

E. Either slow or fast set resin may be used. Gel time of slow-set resin shall not exceed 20 to 30 minutes based on expected rock temperature.

F. The materials shall have thixotropic and viscous properties to permit adequate mixing of the materials by manipulation of the rock bolts and to prevent the mixture from running out of the hole after mixing.

G. Provide sufficient resin to meet encapsulation length criterion based on adopted drill hole diameter.

H. Provide resin cartridges with a shelf life of not less than 6 months as dated on the container and used within the stated shelf life.

I. Store resin under environmental conditions as recommended by the vendor’s product literature until use.

2.04 CEMENT GROUT

A. Cement grout shall be non-shrink grout and conform to ASTM C1107.

B. Accelerators and expansive admixtures shall not be permitted.

C. Compressive Strength of the grout when tested in accordance with ASTM C109 shall have a minimum strength of:
   1. 7,000 psi (48 MPa) at 7 day age
   2. 8,500 psi (59 MPa) at 28 day age

2.05 END HARDWARE FOR THRUST BLOCKS

A. Steel bearing plates shall conform to ASTM A36, be square and domed.

B. The stress-strain behavior of the plate shall be compatible with that of the bolt and have an equal (or greater) collapse load to that of the bolt ultimate tensile strength as tested under ASTM F432.

C. Steel washers shall be spherical, matched to the domed plate and bar size, and conform to ASTM F436 (flat washers) or ASTM A536 (beveled washers). A hardened flat washer may be placed between the spherical washer and nut for increased performance.

D. Nuts shall be hexagonal head, classified as heavy duty, capable of developing an ultimate strength not less than 125% of the minimum yield strength of the bar and meet the requirements of ASTM A563.

E. Ensure that the threads on rock bolts and nut are free of rust and burrs and are free running in the thread of the bar.

F. All exposed threaded rods and hardware shall be coated using an epoxy coating such as PC-591 from Gulf Coast Paint Manufacturing Inc., or approved product.

2.06 END HARDWARE FOR PUMP PAD ANCHORS

A. Steel bearing plates shall conform to ASTM A36, be square and domed.

B. The stress-strain behavior of the plate shall be compatible with that of the bolt and have an equal (or greater) collapse load to that of the bolt ultimate tensile strength as tested under ASTM F432.

C. Steel washers shall be spherical, matched to the domed plate and bar size, and conform to ASTM F436 (flat washers) or ASTM A536 (beveled washers). A hardened flat washer may be placed between the spherical washer and nut for increased performance.

D. Nuts shall be hexagonal head, classified as heavy duty, capable of developing an ultimate strength not less than 125% of the minimum yield strength of the bar and meet the requirements of ASTM A563.

E. Ensure that the threads on rock bolts and nut are free of rust and burrs and are free running in the thread of the bar.

F. All exposed threaded rods and hardware shall be coated using an epoxy coating such as PC-591 from Gulf Coast Paint Manufacturing Inc., or approved product.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install thrust block anchors in accordance with this Specification and as shown on the Drawings.

B. Install high-strength non-shrink grout to exposed rock surfaces to provide a level surface for connection of the steel base plate to rock anchors.

3.02 THRUST BLOCK ANCHORS

A. Install thrust block anchors in locations shown on the Drawings following completion of shaft excavation and ground support.

B. Position anchors in between standard bolt pattern.

C. Drill holes shall be drilled normal to the rock surface within a tolerance of 2% over the full hole length and the minimum hole diameter shall be 1 3/8 inches using a hollow drill bit, hammer drill, or diamond core drill. Survey drill holes to ensure they normal to the rock surface prior to installing the anchors.

D. Unless noted otherwise, drill holes for thrust block anchors in accordance with the Drawings.

E. A regular surface shall be provided to seat the face plate by trimming rock surfaces or forming pads of quick setting mortar grout with a maximum thickness of 6 inches, which should extend the width and length of the plate and taper at 45 degrees to the rock surface.

F. Just before setting the steel bolt, the bore hole must be cleaned using appropriate methods per the manufacturer's recommendation to assure it is free of dust and debris, inadequate hole cleaning could lead to poor load values.

G. Mark and set steel bolt to the required embedment depth until working time has elapsed.

H. The anchor bond length shall be no less than 50% of the total anchor length.

I. Install bearing plate, hardened washer(s), and hex nut perpendicular to bar.

J. Clean and protect the tail of the threaded rods.

K. The Contractor shall follow all manufacturer's installation procedures for bolt and epoxy installation.

3.03 PUMP PAD ROCK ANCHORS

A. Install thrust block anchors in locations shown on the Drawings following completion of shaft excavation and ground support.

B. Drill holes shall be drilled normal to the rock surface within a tolerance of 2% over the full hole length and the minimum hole diameter shall be 1 5/8 inches using a hollow drill bit, hammer drill, or diamond core drill. Survey drill holes to ensure they normal to the rock surface prior to installing the anchors.

C. Unless noted otherwise, drill holes for pump pad anchors in accordance with the Drawings.

D. Just before setting the steel bolt, the bore hole must be cleaned using appropriate methods per the manufacturer's recommendation to assure it is free of dust and debris, inadequate hole cleaning could lead to poor load values.

E. Mark and set steel bolt to the required embedment depth until working time has elapsed.

F. The anchor bond length shall be no less than 50% of the total anchor length.

G. Install bearing plate, hardened washer(s), and hex nut perpendicular to bar.

H. Pretension rock anchors to the torque listed on the design drawings.

I. Clean and protect the tail of the threaded rods.

J. The Contractor shall follow all manufacturer's installation procedures for bolt and epoxy installation.

3.04 PULL TESTING

A. The contractor shall perform non-destructive tests to verify the steel bolts anchor installation to resist design loads.

B. Non-Destructive Pull Tests

1. The contactor must pull test the rock anchors installed for thrust blocks and pump pad to a maximum load of 80% of the minimum yield strength (48 kips). The tests should be performed on a minimum of two anchors per anchorage type for the various thrust blocks and pump pad (10 pull tests). For the support frame rock anchors, the maximum load and load increments shall be reduced by 50% (maximum test load of 24 kips). For the pump pad rock anchors, maximum load and load increments shall be increased by 67% (maximum test load of 80 kips). Each test location should have a photo and notes taken before and after test.
2. The steel bolt should be installed using the same materials and procedures as stated on the construction drawings.
3. Pull testing equipment must be able to record pressure (load) and displacement. The pressure and displacement gauges must be calibrated in the last 90 days. Pressure gauge shall have an accuracy of 200 lbf and be graduated in 100 lbf increments. (The load may be measured in pressure units and converted to a force based on the area of the hydraulic cylinder). Displacement gauge shall have a minimum accuracy of 0.001 inches, be graduated in increments of 0.0005 inches or less, and have a minimum travel of 2 inches.
4. Apply an Alignment Load (AL) of 10% of the highest anticipated design load and record to displacement reading at the AL (or zero the gauge). This is to seat the test system and

keep it correctly positioned, 1000 lbf is sufficient. You may need to hold the pressure for a minute to seat the jack firmly against the liner.

5. Perform three loading and unloading cycles to check for pre-failure anchor movements. Apply the load with the hydraulic ram in cycles of 12, 24, and 36 kips.
6. After the third cycle, load the anchor in the same increments or in 500-lb increments, whichever is less, until 80% of the minimum yield strength is achieved, or the anchor fails. Under no circumstances shall the applied load exceed 80% of the yield stress of the anchor or 48 kips.
7. Failure is defined as a rapid increase in displacement with applied loading, or a total displacement exceeding ½ inch. If failure does occur, pull the anchor a minimum of ½ inch beyond the failure displacement while recording the load every 0.05 inches, then unload the anchor.
8. If failure does not occur (i.e. bolt is loaded to 80% of yield strength without failure), unload the anchor to the AL in equal decrements that match the loading increments, and record the displacement at each decrement

END OF SECTION 03 2200

SECTION 03 2300

THRUST BLOCK ANCHORS – SHAFT

PART 1: GENERAL

1.01 SCOPE

A. The contractor will install shaft thrust block anchors in the Ross Shaft at the 3650 level as indicated on drawings after the decommissioning and removal of existing infrastructure. The contractor will be required to install anchors according to the construction drawings.

1.02 SUBMITTALS

A. Submittals should be provided to the owner (or representative) and the design engineer (or representative).

B. The Contractor shall prepare and submit to the Engineer for review a design submittal describing the rock anchor system or systems intended for use. The submittal shall be submitted a minimum of two (2) weeks prior to the commencement of the anchor installation work. Anchor installation cannot commence until the Engineer has reviewed the submittal. The design submittal shall include the following:
   1. Type and details of rock anchors, including manufacturer's recommendations for installation.
   2. Type and details of rock anchor accessories.
   3. Corrosion protection system(s) for rock anchors and accessories.
   4. Equipment and procedures for rock hole drilling.
   5. Adhesive type and manufacturer's recommended installation method.
   6. Manufacturer-published torque/load relationships.
   7. Design data for any and all other system components.

C. The Contractor shall submit to the Engineer for review the equipment to be used for load testing, including equipment calibration certificates. Testing cannot commence until the Engineer has reviewed the submittal.

D. The contractor shall submit daily field documentation of all drilling information for installation of the bolts including drill depth, the presence of moisture or flowing water, and the presence of fractures or voids present in the holes, including their depth and thickness.

E. The contractor shall submit field documentation of all pull testing information including location, photo record (before and after), displacement, and load.

1.03 INSPECTIONS

A. For the pumproom thrust block installation, the following inspections are required:
   1. Test borings shall be completed, prior to drilling of anchors, along the periphery of the existing concrete block to identify voids within the concrete. If voids are encountered, the contractor shall:
      a. Photograph and document location, drilling depth and thickness of void.
      b. Notify SDSTA and design engineer.

B. Visual inspection of thrust block anchors after installation by the design engineer (or representative) prior to Pumproom infrastructure installation.

1.04 REFERENCES

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel

B. ASTM A123/A123M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Products

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

D. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

G. ASTM C579 - Standard Test Method for Compressive Strength of Chemical- Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes

H. ASTM F432 Standard Specification for Roof and Rock Bolts and Accessories

I. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts

PART 2: PRODUCTS

2.01 THRUST BLOCK ANCHORS

A. Thrust block anchors shall conform to Post-Tensioning Institute (4th ed.) Class I anchor type (e.g. Williams Form MCP II or equivalent).

B. Bar shall consist of high strength prestressing steel (minimum tensile strength=150 ksi) all thread bar in accordance with ASTM A722.

C. All accessories shall be compatible with 150 ksi all-thread bar as recommended by the vendor. Bearing plates shall be flat.

D. Bars and accessories shall be hot dipped galvanized in accordance with ASTM A123, coating grade 100.

E. Bars shall be mechanically cleaned and not acid washed.

F. Sufficient tail length shall be provided beyond the end hardware to accommodate thrust block connection attachment as depicted on the Drawings.

2.02 RESISTANT TO GROUT

A. Capable of withstanding handling and installation methods

B. Enable the anchor to elongate during testing and loading

2.03 RESIN

A. Resin shall be unaffected by mild acids, mild alkalis, or by groundwater. Resin shall reach 80% of its ultimate strength within a time interval equal to five times the gel time. Strength of mixed and cured resin when tested in accordance with ASTM C579 shall be:
   1. Compressive Strength: 14,500 psi (100 MPa)
   2. Tensile Strength: 7,250 psi (50 MPa)
   3. Shear Strength: 4,640 psi (32 MPa)

B. Resin shall be supplied in cartridge form.

C. Resin shall be high strength unsaturated polyester with a predominance of non-reactive inorganic filler.

D. Catalyst shall contain peroxide with a non-reactive inorganic filler.

E. Either slow or fast set resin may be used. Gel time of slow-set resin shall not exceed 20 to 30 minutes based on expected rock temperature.

F. The materials shall have thixotropic and viscous properties to permit adequate mixing of the materials by manipulation of the rock bolts and to prevent the mixture from running out of the hole after mixing.

G. Provide sufficient resin to meet encapsulation length criterion based on adopted drill hole diameter.

H. Provide resin cartridges with a shelf life of not less than 6 months as dated on the container and used within the stated shelf life.

I. Store resin under environmental conditions as recommended by the vendor’s product literature until use.

2.04 CEMENT GROUT

A. Cement grout shall be non-shrink grout and conform to ASTM C1107.

B. Accelerators and expansive admixtures shall not be permitted.

C. Compressive Strength of the grout when tested in accordance with ASTM C109 shall be:
   1. 7,000 psi (48 MPa) at 7 day age
   2. 8,500 psi (59 MPa) at 28 day age

D. Spacers shall be provided to centralize rock bolts and thrust block anchors in the hole.

E. Cement grout shall completely encapsulate the rock bolts without any air pockets.

2.05 END HARDWARE FOR THRUST BLOCKS

A. Steel bearing plates shall conform to ASTM A36.

B. The stress-strain behavior of the plate shall be compatible with that of the bolt and have an equal (or greater) collapse load to that of the bolt ultimate tensile strength as tested under ASTM F432.

C. Bearing plates shall be drilled to accommodate grout and breather tubes as required.

D. Steel washers shall be spherical, matched to the domed plate and bar size, and conform to ASTM F436. A hardened flat washer may be placed between the spherical washer and nut for increased performance.

E. Nuts shall be hexagonal head, classified as heavy duty, capable of developing an ultimate strength not less than 125% of the minimum yield strength of the bar and meet the requirements of ASTM A194 (Grade 2) or A563 (Grade C).

F. Ensure that the threads on rock bolts and nut are free of rust and burrs and are free running in the thread of the bar.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install rock bolts in accordance with this Specification and as shown on the Drawings.

B. Provide support to exposed rock surfaces that is adequate at all times to maintain safety of personnel and construction operations. Periodically inspect all exposed rock surfaces in the excavations, including previously excavated areas, and install additional support as required.

3.02 THRUST BLOCK ANCHORS

A. Install thrust block anchors in locations shown on the Drawings.

B. Drill holes shall be drilled normal to the rock surface within a tolerance of 2% over the full hole length and the minimum hole diameter shall be 1 3/8 inches using a hollow drill bit, hammer drill, or diamond core drill. Survey drill holes to ensure they normal to the rock surface prior to installing the anchors.

C. Unless noted otherwise, drill holes for thrust block anchors in accordance with the Drawings.

D. A regular surface shall be provided to seat the face plate by trimming rock surfaces or forming pads of quick setting mortar grout.

E. Install bearing plate, hardened washer(s), and hex nut perpendicular to bar. Clean and protect the tail which is to receive the future thrust block attachment.

F. The Contractor shall follow all manufacturer's installation procedures for bolt and epoxy installation.

G. Just before setting the steel bolt, the bore hole must be cleaned using appropriate methods per the manufacturer's recommendation to assure it is free of dust and debris, inadequate hole cleaning could lead to poor load values.

H. Mark and set steel rock anchor to the required embedment depth until working time has elapsed.

3.03 PULL TESTING

A. The contractor shall perform non-destructive tests to verify the steel bolts anchor installation to resist design loads.

B. Non-Destructive Pull Tests
   1. The contactor must pull test the steel bolts installed within the pumproom interval to 80% of the minimum yield strength (80 kips). The tests should be performed on one anchor per thrust block location. Each test location should have a photo and notes taken before and after test.
   2. The steel bolt should be installed using the same materials and procedures as stated on the construction drawings.
   3. Pull testing equipment must be able to record pressure (load) and displacement. The pressure and displacement gauges must be calibrated in the last 90 days. Pressure gauge shall have an accuracy of 200 lbf and be graduated in 100 lbf increments. (The load may be measured in pressure units and converted to a force based on the area of the hydraulic cylinder). Displacement gauge shall have a minimum accuracy of 0.001 inches, be graduated in increments of 0.0005 inches or less, and have a minimum travel of 2 inches.
   4. Apply an Alignment Load (AL) of 10% of the highest anticipated design load and record to displacement reading at the AL (or zero the gauge). This is to seat the test system and keep it correctly positioned, 1000 lbf is sufficient. You may need to hold the pressure for a minute to seat the jack firmly against the liner.
   5. Perform three loading and unloading cycles to check for pre-failure anchor movements. Apply the load with the hydraulic ram in cycles of 20, 40, and 60 kips.
   6. After the third cycle, load the anchor in the same increments or in 500-lb increments, whichever is less, until 80% of the minimum yield strength is achieved, or the anchor fails. Under no circumstances shall the applied load exceed 80% of the yield stress of the anchor (60 kips).
   7. Failure is defined as a rapid increase in displacement with applied loading, or a total displacement exceeding ½ inch. If failure does occur, pull the anchor a minimum of ½ inch beyond the failure displacement while recording the load every 0.05 inches, then unload the anchor.
   8. If failure does not occur (i.e. bolt is loaded to 80% of yield strength without failure), unload the anchor to the AL in equal decrements that match the loading increments, and record the displacement at each decrement

SECTION 03 3000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete formwork.

B. Concrete reinforcement.

C. Miscellaneous concrete elements, including equipment pads.

1.02 REFERENCE STANDARDS

A. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).

B. ACI 301 - Specifications for Structural Concrete; 2016.

C. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).

D. ACI 318 - Building Code Requirements for Structural Concrete; 2019, with Errata (2021).

E. ACI 347R - Guide to Formwork for Concrete; 2014, with Errata (2017).

F. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2020.

G. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2018.

H. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.

I. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2021b.

J. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.

K. ASTM C150/C150M - Standard Specification for Portland Cement; 2021.

L. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.

M. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).

N. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019.

O. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2017.

P. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2017.

Q. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2012.

1.03 SUBMITTALS

A. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.

B. Mix Design: Submit proposed product for the pre-bagged, pre-blended concrete mix.

C. Test Reports: Submit report for each test or series of tests specified.

D. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.

1.04 QUALITY ASSURANCE

A. Perform work of this section in accordance with ACI 301 and ACI 318.

PART 2 PRODUCTS

2.01 FORMWORK

A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.

B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
   1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
   2. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
   3. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches (38 mm) of concrete surface.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
   1. Type: Deformed billet-steel bars.
   2. Finish: Unfinished.

B. Reinforcement Accessories:
   1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch (1.29 mm).
   2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C595/C595M, Type IL.

B. Water: ASTM C1602/C1602M; clean, not potable, industrial use, and not detrimental to concrete.

2.04 ADMIXTURES

A. Air Entrainment Admixture: ASTM C260/C260M.

B. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.

C. Water Reducing Admixture: ASTM C494/C494M Type A.

2.05 ACCESSORY MATERIALS

A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
   1. Grout: Comply with ASTM C1107/C1107M.
   2. Pump Manufacturer to specify compressive strength.
   3. Products containing aluminum powder are not permitted.

2.06 CONCRETE MIX DESIGN

A. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.

B. Normal Weight Concrete from pre-blended, pre-bagged products.
   1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 pounds per square inch (27.6 MPa).
   2. Water-Cement Ratio per pre-bagged manufacturer’s requirements.
   3. Maximum Air Content: 3 percent, determined in accordance with ASTM C173/C173M.
   4. Slump Range: See construction documents.
   5. Maximum Aggregate Size: 5/8 inch (16 mm).

2.07 MIXING

A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.

B. Adding Water: Do not add water beyond the manufacturer's recommendations for the pre-blended, pre-bagged concrete mix.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.

B. Verify that forms are clean and free of rust before applying release agent.

C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.

B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.04 PLACING CONCRETE

A. Place concrete in accordance with ACI 304R.

B. Notify SDSTA not less than 24 hours prior to commencement of placement operations.

C. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

D. Ensure reinforcement, inserts, and embedded parts will not be disturbed during concrete placement.

E. Finish pump equipment pad to be level and flat per tolerances as specified by the pump manufacturer.

3.05 CONCRETE FINISHING

A. Repair surface defects, including tie holes, immediately after removing formwork.

B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.

C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch (6 mm) or more in height. Provide finish as follows:

3.06 CURING AND PROTECTION

A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
   1. Normal concrete: Not less than seven days.

C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

3.07 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified.

B. Provide free access to concrete operations at project site and cooperate with appointed firm.

C. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.

D. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every concrete placement.

E. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.08 DEFECTIVE CONCRETE

A. Test Results: The testing agency shall report test results in writing to SDSTA and Contractor within 24 hours of test.

B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.

C. Repair or replacement of defective concrete will be determined by the SDSTA. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of SDSTA for each individual area.

3.09 PROTECTION

A. Do not permit traffic or disturbance over unprotected concrete until fully cured.

END OF SECTION 03 3000

SECTION 05 1200

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural steel framing members.

B. Structural steel support members and struts.

C. Base plates.

1.02 REFERENCE STANDARDS

A. AISC (MAN) - Steel Construction Manual; 2017.

B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2016.

C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

G. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2014 (Reapproved 2020).

H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.

I. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.

J. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2015.

K. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2007 (Reapproved 2013).

L. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2020.

M. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments; 2019.

N. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry; 2018.

O. ASTM E709 - Standard Guide for Magnetic Particle Testing; 2021.

P. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2019.

Q. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2019, with Editorial Revision (2020).

R. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2012.

S. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2014 (Amended 2015).

T. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.

U. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2014, with Errata (2015).

V. SSPC-SP-1 – Solvent Cleaning; 2015, with Editorial Revision (2016)

W. SSPC-SP 3 – Power Tool Cleaning; 2018.

1.03 SUBMITTALS

A. Shop Drawings:
   1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
   2. Connections.

B. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.

C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.

D. Designer's Qualification Statement.

E. Fabricator's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."

B. Fabricator: Company specializing in performing the work of this section with minimum 3 years of documented experience.

C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

D. Erector: Company specializing in performing the work of this section with minimum 3 years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Angles and Plates: ASTM A36/A36M and ASTM A572, Grade 50.

B. Steel W Shapes and Tees: ASTM A992/A992M.

C. Rolled Steel Structural Shapes: ASTM A992/A992M.

D. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B or Grade C.

E. Pipe: ASTM A53/A53M, Grade B, Finish as indicated.

F. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.

G. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.

H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.

I. Shop and Touch-Up Primer: Fabricator’s standard.

J. Shop Paint: Fabricator’s standard.

2.02 FABRICATION

A. Shop fabricate to greatest extent possible.

2.03 FINISH

A. Prepare structural component surfaces in accordance with SSPC-SP 3.

B. Shop prime structural steel members. Do not prime surfaces that will be field welded. Apply primer in accordance with manufacturer’s requirements.

C. Shop paint structural steel members. Apply paint in accordance with manufacturer’s requirements.

D. Field touch-up steel members where the coating was damaged during installation or where field welding occurred. Prepare surfaces and apply paint in accordance with manufacturer’s requirements.

2.04 SOURCE QUALITY CONTROL

A. Welded Connections: Visually inspect all shop-welded connections.

B. See drawings for NDE inspection requirements. Any of the following may be used:
   1. Ultrasonic testing performed in accordance with ASTM E164.
   2. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
   3. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

A. Erect structural steel in compliance with AISC 303.

B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.

C. Field weld components indicated on shop drawings.

D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".

E. Do not field cut or alter structural members without approval of SDSTA.

F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1/8" inch.

3.04 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests.

B. Welded Connections: Visually inspect all field-welded connections.

C. See drawings for NDE inspection requirements. Any one of the following may be used:
   1. Ultrasonic testing performed in accordance with ASTM E164.
   2. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
   3. Magnetic particle inspection performed in accordance with ASTM E709.

END OF SECTION 05 1200

SECTION 23 0010

GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Quality Assurance
B. Methods of Request for Approval
C. Submittals
D. Job Conditions
E. Project Coordination
F. Additional General Provisions
G. Drawings and Measurements
H. Workmanship
I. Patching Materials
J. Equipment Housekeeping Pads
K. Equipment Clean-Up
L. Cutting and Patching
M. Project Conditions
N. Preparation
O. General Installation Requirements
P. Laying Out the Work
Q. Temporary Heating
R. Progress Cleaning
S. Protection of Installed Work
T. System Startup
U. Demonstration and Instruction
V. Adjusting
W. Final Cleaning
X. Closeout Procedures
Y. Project Record Documents
Z. Warranty and Bonds

1.02 DEFINITIONS

A. Contractor
   1. The term “Contractor” refers to the installation Contractor responsible for the furnishing and installation of all work indicated within this Specification.
B. Furnish
   1. The term “furnish” is used to mean “purchase, supply, provide and deliver to the Project site, protect and provide interim storage and be ready for unloading, unpacking, assembly, installation, and similar operations in accordance with Manufacturer’s specifications.”
C. Provide
   1. The terms “provide” means to “furnish and install, complete and ready for the intended use.”
D. Install

1. The term “install” is used to describe operations at project site including the actual “unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations”.

E. Installer
   1. The “Installer” is the Contractor, Subcontractor and/or supplier who uses their own employees for performance of all construction

F. If Applicable:
   1. The term “if applicable” will be that work which may be required for completed construction at applicable locations, but is not necessarily shown or described in the Contract Documents.

G. As Necessary
   1. The term “as necessary” will be that work which is required for completed construction, but is not necessarily shown or described in the Contract Documents.

H. As Required
   1. The term “as required” will be that work which is required for completed construction and is shown on the drawings or described in the project Specification.

I. Concealed
   1. The term “concealed” means hidden from sight, buried as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.

J. Exposed
   1. The term “exposed” means bare, open to the elements, out in the open, uncovered.

K. Product
   1. The term “product” will mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.

L. Substantial Completion
   1. “Substantial Completion” is deemed that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written Specification.

M. Words in the singular will also mean and include the plural, wherever the context so indicates, and words in the plural will mean the singular, wherever the context so indicates.

1.03 RELATED DOCUMENTS

A. The attached General Conditions, Supplementary General Conditions and Special Conditions or General Requirements are hereby incorporated into and shall become a part of all sections under DIVISION 23. In certain instances where the terms of this Division of the Specifications conflict with the terms of the General Conditions, or Special Conditions, this Division of the Specifications shall govern (or the more stringent requirement shall apply).

B. Where “Contractor” is referred to in this Specification it shall mean “Contractor, Sub-Contractor and/or Sub-Contractors under the Prime Contractor.”

1.04 DESCRIPTION OF WORK

A. The work shall include everything in this Division of the Specifications and everything indicated on the Drawings that is complementary to this Division of the Specifications. Refer to the Index of Drawings to determine what Drawings apply directly to this work.

1.05 QUALITY ASSURANCE

A. Codes and Standards:
   1. All work shall be executed in accordance with the Local, State and other attending rules and regulations applicable to the trade affected and be subject to the inspection of these departments.
   2. Materials and equipment shall be new and of best quality, of the type best suited for the purpose intended, and be made by nationally recognized and substantially established manufacturers. The type and weight of material used for each purpose shall be as herein

specified, and material shall conform with the requirements of the latest standard specifications of the “ASTM” for that particular material.

3. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
4. The following list of codes, technical societies, trade organizations and governing agencies shall set the standards by which all work shall be executed:
    a. State Fire Protection Laws and Statutes
    b. Underwriters Laboratories (UL)

B. Fees
1. All fees, permits, licenses, etc., necessary in order to complete the work of this section shall be obtained and paid by this Contractor.

C. Alternate Equipment
1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” do not follow the manufacturer’s names, only such specific items may be used in the base bid, except as hereinafter provided.
2. Items of equipment of the Contractor’s choice may be offered as alternates to such specified items, either in the spaces provided for same in the proposal form or if no space is provided, on the bidder’s letterhead attached to each copy of the proposal form.
3. Alternate proposal must be accompanied by full descriptive and technical data for item proposed, together with statement or amount of cost addition or deduction from the base bid if alternate is accepted. Substitutions proposed by the Contractor will not be considered in the award of the contract.
4. The Contractor must judge that such alternate equipment is of equal quality and character to the specified equipment, and it is physically adaptable for installation within the allotted space with all required service clearances. Unless otherwise specified with this Division, the Engineer will not approve or disapprove any alternate equipment or materials before the bids are opened.
5. The cost of any changes to other trades as a result of use of the alternate material or equipment must be borne by the Contractor submitting such material or equipment.

D. Equipment of Substitution:
1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” follow the manufacturer’s name, such items may be substituted until such time that the “Schedule of Materials and Equipment” is submitted to the Architect or Engineer. The base bid and any alternate shall be based on materials only as specified or approved.

E. Where work required by the drawings and specification is above the standard required by local regulations, it shall be done as shown and/or specified.

1.06 METHODS OF REQUEST FOR APPROVAL:

A. Prior to the award of the contract, interested parties may request approval of substitute materials. Such requests shall be made in writing and delivered to SDSTA no later than ten (10) days prior to the receipt of bids. Any substitutions that the SDSTA finds satisfactory will then be published in an addendum as “acceptable substitutions.”

B. The listing of any manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Division 23 Contractor to ensure that any price quotations received and submittals made are for products which meet or exceed the specifications included herein.

C. The Contractor must judge that such items of substitution are of equal quality and character to the specified items and it is physically adaptable for installation within the allotted space with all required service clearances. This includes the following:
1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same (or better) warranty for the substitution as for the specified product.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.
4. Waives claims for additional costs or time extensions which may subsequently become apparent.
5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities.

D. The cost of any changes to other trades as a result of use of the substitution material or equipment must be borne by the Contractor submitting such material or equipment.

E. After the award of the contract, any request for a substitution must be made in writing by the Contractor (not material supplier or Sub-Contractor). Such request shall state the name of the product specified, the name of the product proposed for substitution, the reason for requesting the substitution, and any change in contract amount resulting from the substitution. No such substitution shall be made until an appropriate Contract Modification has been issued and approved.

F. Manufactured materials hereinafter specified or shown on the Drawings shall be installed or applied in accordance with the directions of the manufacturer unless specifically designated otherwise in the Specifications or on the Drawings.

G. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

H. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

I. Substitution Submittal Procedure:
1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
3. The Architect will notify Contractor in writing of decision to accept or reject request.
4. Request shall be made in writing and be delivered to A/E no later than seven days prior to receipt of bids.

1.07 SUBMITTALS

A. Submittals for Review
1. When the following are specified in individual sections, submit them for review:
a. Product data.
b. Shop drawings.
c. Samples for selection.
d. Samples for verification.

B. Submittals for Information
1. When the following are specified in individual sections, submit them for information:
a. Design data.
b. Certificates.
c. Test reports.
d. Inspection reports.
e. Manufacturer's instructions.
f. Other types indicated.

C. Submittals for Project Closeout
1. When the following are specified in individual sections, submit them at project closeout:
a. Project record documents.
b. Operation and maintenance data.
c. Warranties.
d. Bonds.
e. Test and balance reports.

f. System certification as required.
g. Other types as indicated.

D. Submittal of Shop Drawings:
1. All hard copy submittals shall be compiled into an indexed three ring binder prior to submittal. Any loose leaf or stapled sheets will be rejected.
a. Documents for Review:
1) Small Size Sheets, Not Larger Than 8-1/2 x 11 inches (215 x 280 mm): Submit the number of copies that Contractor requires, plus three copies that will be retained by Architect.
2) Larger Sheets, Not Larger Than 36 x 48 inches (910 x 1220 mm): Submit the number of opaque reproductions that Contractor requires, plus three copies that will be retained by Architect. A minimum of eight submittals shall be submitted.
2. Electronic submittals shall be in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible or scanned files will be rejected.
a. Submittals shall be for specific equipment to be provided on the project and not an entire catalog.
3. The Contractor shall submit shop drawings per the requirements of Division 01.
4. Major components of the system shall be submitted at one time under a protective cover with each section indexed with visible file tabs. All equipment shall be labeled per the equipment tags on the drawings, ie. Equipment names, etc.
5. Shop drawings shall indicate manufacturer name, model number, dimensions, voltage and current characteristics, construction and rough-in connections of all materials to be used. Each shop drawing shall be certified as being checked and approved by the Contractor before submittal.
6. Shop drawings not indicated as being approved by the Contractor will be returned without review.
7. The Contractor shall provide approved shop drawings with the Operating and Maintenance Manual.
8. The following wording will appear on shop drawings reviewed by the Engineer. Contractors not wishing to comply with these conditions shall not submit a bid.
"Corrections or comments made on the shop drawings during this review do not relieve Contractor from compliance with requirements of the Drawings and Specifications. This check is only for review of general compliance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades and performing their work in a safe and satisfactory manner."
9. The Engineer is not an error checker. Where the Contractor is submitting shop drawings that differ from the specifications, the Contractor must itemize in writing, each variance from the specifications. Failure to do so will be considered an error on the Contractors part and the specified materials shall be furnished. Shop drawings submitted in error or with errors as compared to Specifications and Drawings will be the responsibility of the Contractor to correct such error later.
10. Shop drawings must only be those materials as specified or approved in published addendum. Others will be returned without review.
11. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.
12. When revised for resubmission, identify all changes made since previous submission.
13. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
14. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.

E. Guarantee:

1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.
2. Note that individual specification sections may indicate longer warranty periods on specific components or parts. In each case, the more stringent warranty period shall govern.
3. For equipment or component parts of equipment put into service during construction for use by Owner, submit documents within 10 days after acceptance.
4. Any requested use of the equipment or component parts of equipment by the contractor for the contractor, whether the General Contractor or any subcontractor, shall be the responsibility of the contractor. The equipment or components shall be cleaned to new condition prior to substantial completion. Warranty shall begin at time of the project's substantial completion.

F. Operating and Maintenance Instructions:
1. For Each Item of Equipment and Each System:
   a. Description of unit or system, and component parts.
   b. Identify function, normal operating characteristics, and limiting conditions.
   c. Include performance curves, with engineering data and tests.
   d. Complete nomenclature and model number of replaceable parts.
2. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
3. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
4. Provide servicing and lubrication schedule, and list of lubricants required.
5. Include manufacturer's printed operation and maintenance instructions for each component.
6. Include sequence of operation by controls manufacturer.
7. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
8. Provide control diagrams by controls manufacturer as installed. (Record Drawings)
9. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
10. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
11. Include test and balancing reports.
12. One copy of each shop drawing shall be included in the O&M Manuals but shall not serve in lieu of maintenance and operating instructions. Temperature control diagrams must include a description of the sequence of control.
13. The Contractor shall submit O&M Manuals to the Engineer, not the Owner, for review. The Engineer will forward the manuals to the Owner.
14. This Contractor shall also supervise the initial operation as required to acquaint him thoroughly with the best practice.
15. This Contractor shall furnish the Engineer with a written statement from the Owner indicating complete acceptance of the equipment data and instruction of the operator. The Engineer will not approve the request for final payment until such statement has been submitted.
16. Additional Requirements: As specified in individual product specification sections.
17. Assembly of Operation and Maintenance Manuals
   a. Assemble operation and maintenance data into an organized electronic document for Owner's personnel use.

1) Cover: Identify each document with title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify Contractor Name; identify Architect and Engineer Firms names; identify subject matter of contents.
2) Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
3) Tables of Contents: List every item separated by a title page, using the same identification as on the title page; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
4) Title pages: Provide title pages for each separate product and system; identify the contents on the title page; immediately following the title page include a description of product and major component parts of equipment. Where systems involve more than one specification section, provide separate title pages for each system.
5) Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
6) Drawings: Include drawings with text.
7) Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.

b. Prepare instructions and data by personnel experienced in maintenance and operation of described products. Prepare data in the form of an instructional manual.
c. Provide an electronic version of the O&M Manuals.

18. Additional Requirements: As specified in individual product specification sections.

G. Test Reports:
1. Work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently concealed.
2. Tests shall be made in the presence of the Engineer and the Owner, and shall meet with their approval. The Contractor shall notify the Engineer at a time sufficiently prior to the performance of any test to allow time for the Engineer to be present for the test.
3. Instruments for making tests shall be furnished by this Contractor.
4. The final test shall be performed as soon as possible after the work is entirely completed
5. Test reports submitted electronically shall be in standard PDF format or submitted with software to view the file. Refer to Division 1 Specifications for test results submittal requirements.

H. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

I. See Division 1 Specifications for any additional submittal information.

1.08 JOB CONDITIONS:

A. General:
1. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
2. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.

B. Fees and Service Charges:
1. Permits, licenses, fees and service charges required in connection with the work shall be secured and paid for by this Contractor, and upon completion of the work he shall furnish proof of acceptance from the proper Local and State Department having jurisdiction.

C. Mechanical Symbols and Abbreviations:
1. Symbols and abbreviations are as indicated in legends on the Drawings.

D. Correlation of Work:
1. This Contractor shall be responsible for close correlation of his work with that of other Contractors and shall organize his work so that it will not interfere with or delay the work of other Contractors.

2. Field verification of scale dimensions on Plans is directed since actual locations, distances and levels will be governed by actual field conditions.
3. The Division 23 Contractor shall check architectural, structural, plumbing, heating and ventilating plans to avert possible installation conflicts. Should drastic changes from original Plans be necessary to resolve such conflicts, the Sub-Contractor shall notify the Prime Contractor who in turn shall notify the Architect or Engineer and secure written approval and agreement on necessary adjustments before the installation is started.
4. Discrepancies shown on different Plans, or between Plans and actual field conditions, or between Plans and Specifications, shall promptly be brought to the attention of the Architect or Engineer for a decision.
5. Where a discrepancy exists between drawing and specifications or other disciplines the worst cost case shall be provided.
6. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate occupancy requirements.
7. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
8. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility to other installations, for maintenance, and for repairs.
9. Coordinate completion and clean-up of work of separate sections.
10. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

E. Final Inspection:
1. Refer to Division 1 Specifications for final inspection process.
2. The Contractor shall also submit the operating and maintenance manuals at this time. The Engineer will not schedule nor perform a final inspection without successful submittal of operating and maintenance manuals by the Contractor.
3. During the final observation, pre-final or follow-up final, the Contractor and all his Prime Sub-Contractors shall have the foreman of the project present.
4. Should the Contractor fail to complete items on the punch list within a timely manner, the Owner reserves the right to have the work completed by others and the cost deducted from the contract price, including change orders.
5. The Contractor shall notify in writing to the Architect and/or Engineer once all punch list items are corrected, that he is ready for a follow-up final. The written notice shall contain explanations for those known items not completed and a schedule for completing them.
6. The Architect and/or Engineer shall schedule a follow-up final to confirm completion. Repeated observation trips required of the Engineer by the Contractor’s inability to complete the project satisfactorily will require the Contractor to reimburse the Engineer for all incurred costs after the follow-up final observation.

1.09 PROJECT COORDINATION

A. Refer to Division 1 Specifications for definition of Superintendent."

B. This section applies to all work performed and specified under Division 23.

C. Cooperate with the Superintendent and Owner in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.

D. During construction, coordinate use of site and facilities through the Superintendent.

E. Comply with specified procedures for intra-project communications, submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

F. Comply with instructions of the Superintendent for use of temporary utilities and construction facilities.

G. Coordinate field engineering and layout work under instructions of the Superintendent.

H. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

I. Notify affected utility companies and comply with their requirements.

J. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

K. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

L. Coordinate installation of equipment, piping, etc. with electrical gear. Equipment shall not be located in front of panels. Piping shall not be routed above panels. Coordinate location of equipment equipment with Division 26.

M. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.

N. Coordinate completion and clean-up of work of separate sections.

O. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

P. Make the following types of submittals to Engineer through the Superintendent.
   1. Requests for interpretation/information.
   2. Requests for substitution.
   3. Shop drawings, product data and samples.
   4. Test and inspection reports.
   5. Manufacturer's instructions and field reports.
   6. Applications for payment and change order requests.
   7. Progress schedules.
   8. Coordination drawings.
   9. Closeout submittals.
      a. Warranties
      b. Bonds
      c. System Certification
      d. Test and Balance Reports
   10. As-built Record Drawings.
   11. Operation and Maintenance Manuals.

1.10 DRAWINGS AND MEASUREMENTS

A. Contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement of equipment, ducts, conduits, piping and approximate sizes and locations of equipment and outlets.

B. Mechanical trades shall follow these drawings in laying out their work, consult general construction drawings to familiarize themselves with all conditions affecting their work, and shall verify spaces in which their work will be installed.

C. Coordinate work with other trades as job conditions reasonably require.

D. Where job conditions require reasonable changes in indicated locations and arrangement, make such changes without extra cost to Owner.

E. The drawings are not intended to be scaled for roughing in measurements nor to serve as shop drawings.

F. The Contractor shall consult the structural, mechanical, electrical, or equipment drawings for dimensions, obstructions, and location of equipment or other trades. Any discrepancies between structural, electrical, or equipment drawings and the work shown on these drawings shall be reported to the Engineers for adjustment.

G. The installation details, instructions, and recommendations of the manufacturer of the product used, or modified to obtain the best end result, shall be the basis of attaining installation of the products for usage on this project except where definite and specific instructions are set forth herein or details are shown on the plans.

1.11 WORKMANSHIP

A. The installation work included in this specification shall be performed in a neat workmanlike manner by people experienced and skilled in the trade. Only the best quality workmanship will be accepted. All exposed parts of the systems such as exposed piping, Equipment, etc., shall be square and true with the construction.

1.12 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

1.13 EQUIPMENT HOUSEKEEPING PADS

A. Provide reinforced concrete housekeeping pads for all floor mounted equipment (i.e. pumps and etc)

B. Provide anchor bolts, per equipment manufacturer's directions, to attach equipment to pads.

1.14 TRANSPORTATION AND HANDLING

A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

B. Transport and handle products in accordance with manufacturer's instructions.

C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

F. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

1.15 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

E. For exterior storage of fabricated products, place on sloped supports above ground.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Prevent contact with material that may cause corrosion, discoloration, or staining.

H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.16 EQUIPMENT CLEAN-UP

A. Special care must be taken for protection of air handling equipment, pumps, etc. All must be kept completely protected from weather elements, painting, etc. until the building is substantially completed. Damage from rust, paint, scratches, etc. shall be corrected as directed by the A/E.

B. Clean all equipment, etc., thoroughly, just prior to final inspection. Equipment shall be cleaned by an approved method.

1.17 CUTTING AND PATCHING

A. Execute cutting and patching to complete the work, to uncover work to install improperly sequenced work, to remove and replace defective or non-conforming work, to remove samples of installed work for testing when requested, to provide openings in the work for penetration of mechanical and electrical work, to execute patching to complement adjacent work, and to fit Products together to integrate with other work.

B. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing.

C. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

D. In existing construction, this Contractor shall perform all cutting required and all necessary patching after completion to restore the surface to its original condition, unless otherwise indicated.

E. Should the cutting of walls, floors, ceiling, partitions, etc., be required for proper installation of the work or apparatus of this Contractor, or be made necessary on account of his failure to give General Contractor proper information at the time required, such cutting shall be done at his own expense, restoring the work to its original condition.

F. All cutting and patching done by this Contractor shall be subject to the direction and approval of the A/E. This Contractor shall not endanger the stability of the structure by cutting, digging, or otherwise, and shall not at any time cut or alter work of any other contractor without A/E's consent.

1.18 PROJECT CONDITIONS

A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water.

C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

E. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

F. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.

G. Verify that demolition is complete in alterations areas and areas are ready for installation of new work.

H. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

I. Verity that utility services are available, of these of the correct characteristics, and in the correct location.

J. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work,

assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions. Protect work of other trades.

1.19 PREPARATION

A. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore at completion.

B. Remove unsuitable materials not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for furnished work.

C. Remove debris and abandoned items from area and from concealed spaces.

D. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate ducts and piping to prevent condensation in exposed areas.

E. Prepare surfaces and remove surface finishes to provide for proper installation of new work and finishes.

F. Clean substrate surfaces prior to applying next materials or substance.

G. Seal cracks or openings of substrate prior to applying next material or substance.

H. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

1.20 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections.

B. Make neat transitions. Patch work to match adjacent work in texture and appearance.

1.21 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect/Engineer of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly notify Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Utilize recognized engineering survey practices.

F. Establish elevations, lines and levels. Locate and layout by instrumentation and similar appropriate means.

G. Periodically verify layouts by same means.

H. Maintain a complete and accurate log of control and survey work as it progresses.

1.22 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition per OSHA standards.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

1.23 PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage. This includes the protection of the work of other trades.

C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

D. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

E. Prohibit traffic from landscaped area.

1.24 SYSTEM STARTUP

A. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

B. Verify that wiring and support components for equipment are complete and tested.

C. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.

D. Any irregularities, faulty equipment, etc. shall be repaired or replaced as required prior to acceptance.

E. All equipment shall be freshly oiled, filters charged with clean media and installation completely finished prior to acceptance.

1.25 DEMONSTRATION AND INSTRUCTION

A. Contractor shall complete all start-up and perform all intimal testing of each system prior to scheduling or requesting to schedule training. All systems shall be completely operational before training or demonstration will occur.

B. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.

C. Demonstrate operation and maintenance of Products to Owner's representative at a scheduled time with the Owner.

D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner Personnel.

F. Utilize operation and maintenance e manuals as basis for instruction. Review contents of manuals with Owner's personnel in detail to explain all aspects of operation and maintenance.

1.26 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.27 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

C. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

1.28 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.
   1. Provide copies to Architect.

B. Notify Architect when work is considered finally complete.

C. Complete items of work determined by Architect's final inspection.

1.29 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Changes made by Addenda and modifications.

E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   2. Field changes of dimension and detail.
   3. Details not on original Contract Documents.

F. At completion of project Contractor shall provide a minimum of two (2) sets of As-Built Record drawings. Additional sets shall be provided if required under General Requirements.

G. Refer to Division 1 Specifications for additional as-built drawing requirements.

1.30 WARRANTY AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Sub-Contractors, suppliers and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

F. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Sub-Contractor, Supplier, and Manufacturer, with name address, and telephone number of responsible principal.

G. Warranty:
   1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.
   2. Note that individual specification sections may indicate longer warranty periods on specific components or parts. In each case, the more stringent warranty period shall govern.
   3. For equipment or component parts of equipment put into service during construction for use by Owner, submit documents within 10 days after acceptance.

a. Any requested use of the equipment or component parts of equipment by the contractor for the contractor, whether the General Contractor or any subcontractor, shall be the responsibility of the contractor. The equipment or components shall be cleaned to new condition prior to substantial completion. Warranty shall begin at time of the project's substantial completion.

END OF SECTION 23 0010

SECTION 23 0510
MINOR MECHANICAL DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Mechanical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and ductwork arrangements are as shown on Drawings.

B. Verify that ductwork and equipment to be removed serve only abandoned facilities.

C. Demolition drawings are based on casual field observation .

D. Report discrepancies to Architect before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.02 PREPARATION

A. Coordinate service outages with Owner. Notify Owner 48 hours prior to any outage.

B. Provide temporary connections to maintain existing systems in service during construction.

3.03 DEMOLITION AND EXTENSION OF EXISTING MECHANICAL WORK

A. Remove, relocate, and extend existing installations to accommodate new construction.

B. Maintain access to existing mechanical installations which remain active. Modify installation or provide access panel as appropriate.

C. Extend existing installations using materials and methods as specified.

3.04 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

END OF SECTION 23 0510

SECTION 23 0553

IDENTIFICATION FOR MECHANICAL PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

1.02 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.

B. ASME B31.3 - Process Piping; 2020.

C. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

D. Ten States Standards for Wastewater Facilities.

E. Surf Design Standard Pipe Marking/Labels V1 March 30, 2021

1.03 SUBMITTALS

A. See Section 230010 - GENERAL PROVISIONS for submittal procedures.

B. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Automatic Controls: Tags. Key to control schematic.

B. Control Panels: Nameplates.

C. Piping: Tags.

D. Pumps: Nameplates.

E. Small-sized Equipment: Tags.

F. Valves: Tags.

2.02 MANUFACTURERS

A. Brimar

B. Brady Corporation

C. Champion America

D. Seton Identification Products

E. Substitutions: See Section 23 0010 GENERAL PROVISIONS.

2.03 NAMEPLATES

A. Letter Color: White.

B. Letter Height: 1/4 inch (6 mm).

C. Background Color: Black.

D. Plastic: Comply with ASTM D709.

2.04 TAGS

A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.

B. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

2.05 PIPE MARKERS

A. Color: Comply with ASME A13.1 and Surf Design Standard Pipe Marking/Labels.

B. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install tags with corrosion resistant chain.

C. Identify piping with plastic pipe markers. Use tags on piping 3/4 inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

D. Identify pumps with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
   1. Coordinate nameplate requirements with Owner. See example in drawings. Nameplates shall be approximately 5" x 2-1/2" in size.
   2. Minimum information to be noted shall include:
      a. Equipment tag - 1/2" letters. (ex. P-1)
      b. Equipment description - 3/16" letters. (ex. PUMP)

E. Identify control panels and major control components outside panels with plastic nameplates.
   1. Coordinate nameplate requirements with Owner. See example in drawings.
   2. Minimum information to be noted shall include:
      a. Equipment tag - 1/2" letters. (ex. P-1)
      b. Equipment description - 3/16" letters. (ex. PUMP)

END OF SECTION 23 0553

SECTION 23 2113
MECHANICAL PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dewatering system requirements.

B. Low Pressure Drain Piping

C. High pressure piping.

D. Equipment drains and overflows.

E. Pipe hangers and supports.

F. Unions, flanges, mechanical couplings, and dielectric connections.

G. Weld neck flange.

H. Valves:
   1. Ball valves.
   2. Butterfly valves.
   3. Swing check valves.
   4. Gate valves.
   5. High pressure manual pinch valve.
   6. Balancing valves.

I. Pressure gauges.

1.02 RELATED REQUIREMENTS

A. Section 23 0553 - Identification for Mechanical Piping and Equipment.

1.03 REFERENCE STANDARDS

A. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing and Fusing Operators; 2017.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

D. ASME B31.9 - Building Services Piping; 2014.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.

F. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2015.

G. ASTM A183 - Standard Specification for Carbon Steel Track Bolts and Nuts; 2014.

H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2018a.

I. ASTM B32 - Standard Specification for Solder Metal; 2008 (Reapproved 2014).

J. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2016.

K. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2016.

L. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992,with Editorial Revision (2018).

M. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2013).

N. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe; 2000.

O. AWWA C606 - Grooved and Shouldered Joints; 2015.

P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.04 SUBMITTALS

A. See Section 230010 - GENERAL PROVISIONS, for submittal procedures.

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.

C. Welder Qualifications: Certify in accordance with ASME BPVC-IX.
   1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 DEWATERING SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
   3. Grooved mechanical joints may be used in accessible locations only and on piping designated as drains or low pressure..
      a. Grooved mechanical connections and joints comply with AWWA C606.
         1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
         2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.
      b. Use rigid joints unless otherwise indicated.
      c. Use gaskets of molded synthetic rubber with central cavity, pressure-responsive configuration, and complying with ASTM D2000,
      d. Provide steel coupling nuts and bolts complying with ASTM A183.
   4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct weldedn or threaded connections.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch (20 mm) gate valves with cap; pipe to nearest floor drain.
   2. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.
   3. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.

4. For shut-off and to isolate parts of systems or vertical risers, use gate, ball, or butterfly valves.

2.02 LOW PRESSURE DRAIN PIPING

A. Steel Pipe: ASTM A53B, Schedule 40, black, using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
   3. FLANGE ADAPTERS ARE NOT ALLOWED ON LOW PRESSURE DRAIN PIPING. Piping connections from grooved to welded must be welded, or a flange adapter nipple may be used.
   4. Fittings shall be 300# rated fittings.

2.03 HIGH PRESSURE PIPING

A. Steel Pipe: ASTM A53B, Schedule 80, black, using one of the following joint types:
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.
   2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings. GROOVED JOINTS MUST BE HEAVY DUTY AND RIGID, VICTAULIC HP-70 OR EQUIVALENT.
   3. FLANGE ADAPTERS AND FLANGE ADAPTER NIPPLES ARE NOT ALLOWED ON HIGH PRESSURE PIPING. ALL PIPING CONNECTIONS SHALL BE WELD NECK RAISED FACE FLANGE.
   4. Fittings shall be rated for 740 psi.

2.04 EQUIPMENT DRAINS AND OVERFLOWS

A. Steel Pipe: ASTM A53/A53M, Schedule 40 galvanized; using one of the following joint types:
   1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn; using one of the following joint types:
   1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

2.05 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.
   1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
   2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches (13 to 38 mm): Malleable iron, adjustable swivel, split ring.
   3. Hangers for Pipe Sizes 2 to 4 Inches (50 to 100 mm): Rigid, 2 hole galvanized steel or stainless steel pipe straps.
   4. Hangers for Pipe Sizes 6 Inches (150 mm) and Greater: Rigid, 2 hole galvanized steel or stainless steel pipe straps.

B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

2.06 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches (50 mm, DN) and Less:
   1. Ferrous Piping: 150 psi (1034 kPa) malleable iron, threaded.
   2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches (50 mm, DN) and Greater:
   1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
   2. Copper Piping: Bronze.
   3. Gaskets: 1/16 inch (1.6 mm) thick, preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
   1. Dimensions and Testing: In accordance with AWWA C606.
   2. Mechanical Couplings: Comply with ASTM F1476.
   3. Housing Material: Ductile iron, galvanized complying with ASTM A536.
   4. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
   5. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
   6. When pipe is field grooved, provide coupling manufacturer's grooving tools.

2.07 WELD NECK FLANGE

A. Class 300.
   1. SCH 80/STD Bore.
   2. CWP Rating: 600 psi.
   3. Raised Face.
   4. 8 Bolt Holes.
   5. Carbon Steel.

2.08 BALL VALVES

A. Up To and Including 2 Inches (50 mm):
   1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

B. Over 2 Inches (50 mm):
   1. Cast steel body, chrome plated stainless steel ball, teflon or Virgin TFE seat and stuffing box seals, lever handle, flanged ends, rated to 800 psi (5515 kPa).

2.09 BUTTERFLY VALVES

A. Body: Cast or ductile iron with resilient replaceable EPDM seat, lug or grooved ends, extended neck.

B. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.

C. Operator: Infinite position lever handle with memory stop.

2.10 SWING CHECK VALVES

A. All sizes:
   1. Wafer style, carbon Steel body, Teflon seal, stainless steel, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged or grooved ends.

B. Chexter Model 1605-AC.

2.11 GATE VALVES

A. All sizes:
   1. Carbon Steel.
   2. Class 300.
   3. Body and Disc: ASTM A216/A216M.
   4. CWP Rating: 600 psi.
   5. Pressure and Temperature Rating: ASME B16.34.
   6. Bolted Bonnet: OS&Y; Rising Stem.
   7. End Connections: Flanged.

2.12 HIGH PRESSURE MANUAL PINCH VALVE

A. Size Range: 2" to 12" (DN50 to DN300)
   1. Pressure Rating: Up to 740 psi (51 bar) at ambient temperature (per ANSI Class 300)
   2. End Connections: ANSI B16.5 Class 300 flanges
   3. Actuation: Handwheel-operated; gear-assisted handwheel for sizes 6" and above

4. Body Design: Heavy-duty enclosed body with reinforced ribs and pressure-bearing structure
5. Mounting: Horizontal or vertical; lifting lugs standard on 6" and larger sizes
6. Body Material Options:
    a. 316 Stainless Steel (for corrosive or sanitary environments)
    b. Aluminum Bronze (optional for marine or specialty applications)
7. Sleeve (Pinch Tube):
    a. Neoprene, Viton, Butyl, or Silicone for chemical, temperature, or abrasion resistance
8. Stem and Hardware: Stainless Steel (304 or 316)
9. Coatings: Fusion-bonded epoxy or polyester powder coating for corrosion resistance
10. Seals and Gaskets: PTFE, Viton, or EPDM depending on media compatibility
11. Operating Temperature: -20°C to +120°C (material dependent)
12. Media Compatibility: Slurries, abrasive fluids, corrosive chemicals, powders, and viscous media
13. Flow Control: Capable of Throttling

B. Maintenance:
1. Sleeve replaceable in-line without removing valve from pipeline
2. Minimal moving parts reduce maintenance frequency
3. Cycle Life: 100,000+ cycles (sleeve dependent)
4. Leakage: Bubble-tight shutoff when fully closed
5. Torque Requirements: Gear assist recommended for 6" and larger due to Class 300 pressure sealing

2.13 BALANCING VALVES

A. Valve shall have ports for flow measurement. Valve shall be capable of shut-off.

B. Ductile Iron body and trim.

C. Pressure rating: Class 300.

D. Temperature Rating: ASME B16.34.

E. End connections: flanged.

2.14 PRESSURE GAUGES - GENERAL

A. Designed for demanding industrial applications with mechanical vibration or pulsation.

B. Stainless steel construction.

C. Key Specifications:
1. Case Diameter: 2-1/2 inches
2. Case Material: 304 Stainless Steel
3. Lens: Polycarbonate or tempered glass
4. Mounting: 1/4” MPT (Male Pipe Thread) Stainless Steel Lower Mount
5. Internal Components: 316 Stainless Steel (Bourdon tube, movement, socket)
6. Accuracy: ±1% of full scale (Grade 1A per ASME B40.1)
7. Pressure Range: 0–300 psi
8. Compliance: Meets or exceeds ASME B40.100 and EN 837-1 standards
9. Filling: Glycerin (typically 99.7% USP grade), factory filled
10. Operating Temperature Range: -40°F to 140°F
11. Dial: White aluminum with black and red markings for dual scale (psi/kPA)
12. Pointer: Black aluminum, micro-adjustable

D. Installation Notes:
1. Use wrench flats on the stem to tighten.
2. Avoid applying torque to the gauge case.
3. Use appropriate thread sealant compatible with stainless steel.

2.15 PRESSURE GAUGES - PUMP SUCTION

A. Designed for demanding industrial applications with mechanical vibration or pulsation.

B. Stainless steel construction.

C. Key Specifications:
   1. Case Diameter: 3-1/2 inches
   2. Case Material: 304 Stainless Steel
   3. Lens: Polycarbonate or tempered glass
   4. Mounting: 1/4” MPT (Male Pipe Thread) Stainless Steel Lower Mount
   5. Internal Components: 316 Stainless Steel (Bourdon tube, movement, socket)
   6. Accuracy: 1.5% of full scale (Grade A per ASME B40.1)
   7. Pressure Range: Negative 30 to 30 psi
   8. Compliance: Meets or exceeds ASME B40.100 and EN 837-1 standards
   9. Filling: Glycerin (typically 99.7% USP grade), factory filled
   10. Operating Temperature Range: -40°F to 140°F
   11. Dial: White aluminum with black and red markings for dual scale (psi/kPA)
   12. Pointer: Black aluminum, micro-adjustable

D. Installation Notes:
   1. Use wrench flats on the stem to tighten.
   2. Avoid applying torque to the gauge case.
   3. Use appropriate thread sealant compatible with stainless steel.

2.16 PRESSURE GAUGES - PUMP DISCHARGE

A. Designed for demanding industrial applications with mechanical vibration or pulsation.

B. Stainless steel construction.

C. Key Specifications:
   1. Case Diameter: 6 inches
   2. Case Material: 304 Stainless Steel
   3. Lens: Laminated safety glass
   4. Mounting: 1/4” MPT (Male Pipe Thread) Stainless Steel Bottom Mount
   5. Internal Components: 316 Stainless Steel (Bourdon tube, movement, socket)
   6. Accuracy: ±0.5% of full scale (ASME B40.1 Grade 2A)
   7. Pressure Range: 0–1000 psi
   8. Compliance: Meets or exceeds ASME B40.100 and EN 837-1 standards
   9. Filling: Glycerin (typically 99.7% USP grade), factory filled
   10. Operating Temperature Range: 32 °F to 150°F
   11. Dial: White aluminum with black and red markings for dual scale (psi/kPA)
   12. Pointer: Black aluminum, micro-adjustable
   13. Overpressure Protection:
      a. Withstands 300% of full scale without rupture
      b. Maintains accuracy after 130% overpressure
      c. Endures 15,000 pressure cycles from 10% to 90% full scale at 60 cycles/min

D. Installation Notes:
   1. Use wrench flats on the stem to tighten.
   2. Avoid applying torque to the gauge case.
   3. Use appropriate thread sealant compatible with stainless steel.

E. Manufacturers: Mcdaniel or approved equal.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. Pipe sizes shown on the drawings are nominal pipe sizes, not outside diameters.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install low pressure drain piping and high pressure piping piping to ASME B31.9 requirements.

C. Route piping in orderly manner, parallel to tunnel drifts and adjacent piping, and maintain gradient.

D. Install piping to conserve space and to avoid interference with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Grooved Joints:
   1. Install in accordance with the manufacturer's latest published installation instructions.
   2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

H. Pipe Hangers and Supports:
   1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
   2. Support horizontal piping as scheduled.
   3. Provide roller guides for piping installed on pipe supports.

I. Provide clearance in hangers and from structure and other equipment for access to valves and fittings.

J. Use eccentric reducers to maintain top of pipe level.

K. Install valves with stems upright or horizontal, not inverted.

L. The right is reserved to authorize minor changes in pipe location to avoid conflicts with other trades at no additional cost to the Owner.

M. Install isolating valves on all items subject to repair or replacement.

3.03 TESTING OF LOW PRESSURE DRAIN PIPING

A. Test pipe with 100 psig water pressure.

B. Hold test pressure for a minimum of 8 hours.

C. Test witnessed by Design Professional if requested by Owner's Representative.

3.04 TESTING OF HIGH PRESSURE PIPING

A. Test pipe with staged pressure at 100 psig, 350 psig, and 700 psig water pressure.

B. Hold test pressure for a minimum of 8 hours.

C. Test witnessed by Design Professional if requested by Owner's Representative.

3.05 FINAL RUN TEST

A. Pump shall run for 24 hours.

B. Contractor shall verify that no leaks are present at any of the fittings during or after the 24 hour test.

3.06 SCHEDULES

A. Hanger Spacing for Copper Tubing.
   1. 1/2 Inch (15 mm) and 3/4 inch (20 mm): Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6 mm).
   2. 1 Inch (25 mm): Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6 mm).
   3. 1-1/2 Inches (40 mm) and 2 Inches (50 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).

4. 2-1/2 Inches (65 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).
5. 3 Inches (80 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).

B. Hanger Spacing for Steel Piping.
1. 1/2 Inch (15 mm), 3/4 Inch (20 mm), and 1 Inch (25 mm): Maximum span, 7 feet (2100 mm); minimum rod size, 1/4 inch (6 mm).
2. 1-1/4 Inches (32 mm): Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9 mm).
3. 1-1/2 Inches (40 mm): Maximum span, 9 feet (2700 mm); minimum rod size, 3/8 inch (9 mm).
4. 2 Inches (50 mm): Maximum span, 10 feet (3.0 m); minimum rod size, 3/8 inch (9 mm).
5. 2-1/2 Inches (65 mm): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch (9 mm).
6. 3 Inches (80 mm): Maximum span, 12 feet (3.6 m); minimum rod size, 3/8 inch (9 mm).
7. 4 Inches (100 mm): Maximum span, 14 feet (4.3 m); minimum rod size, 1/2 inch (13 mm).
8. 6 Inches (150 mm): Maximum span, 17 feet (5.1 m); minimum rod size, 1/2 inch (13 mm).
9. 8 Inches (200 mm): Maximum span, 19 feet (5.8 m); minimum rod size, 5/8 inch (16 mm).
10. 12 Inches (300 mm): Maximum span, 23 feet (7.0 m); minimum rod size, 7/8 inch (22 mm).

END OF SECTION 23 2113

SECTION 26 0010

GENERAL PROVISIONS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Quality Assurance
B. Methods of Request for Approval
C. Submittals
D. Job Conditions
E. Project Coordination
F. Progress Meetings
G. Definitions
H. Drawings and Measurements
I. Workmanship
J. Patching Materials
K. Equipment Housekeeping Pads
L. Equipment Clean-Up
M. Sealing of Penetrations
N. Project Conditions
O. Preparation
P. General Installation Requirements
Q. Existing Utilities
R. Laying Out the Work
S. Temporary Lighting and Power
T. Progress Cleaning
U. Protection of Installed Work
V. Demonstration and Instruction
W. Adjusting
X. Project Record Documents
Y. Warranty and Bonds

1.02 RELATED DOCUMENTS

A. The attached General Conditions, Supplementary General Conditions and Special Conditions or General Requirements are hereby incorporated into and shall become a part of all sections under DIVISION 26 and 27 – ELECTRICAL. In certain instances where the terms of this Division of the Specifications conflict with the terms of the General Conditions, or Special Conditions, this Division of the Specifications shall govern (or the more stringent requirement shall apply).

B. Where “Contractor” is referred to in this Specification it shall mean “Contractor, Sub-Contractor and/or Sub-Contractors under the Prime Contractor.”

1.03 DESCRIPTION OF WORK

A. The work shall include everything in this Division of the Specifications and everything indicated on the Drawings that is complementary to this Division of the Specifications. Refer to the Index of Drawings to determine what Drawings apply directly to this work.

1.04 QUALITY ASSURANCE

A. Codes and Standards:

1. Work, materials and manner of placing material shall conform in every respect with the latest provisions of Local, State and National Codes.
2. Materials and equipment shall be new and of best quality, of the type best suited for the purpose intended, and be made by nationally recognized and substantially established manufacturers. The type and weight of material used for each purpose shall be as herein specified, and material shall conform with the requirements of the latest standard specifications of the “ASTM” for that particular material.
3. Electrical materials used in this work shall be listed by the Underwriters Laboratories, Inc. where testing is provided and shall bear their label.
4. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
5. Where the notation of NEMA is indicated the equipment shall conform to National Electrical Manufacturers Association Standard.
6. The following list of codes, technical societies, trade organizations and governing agencies shall set the standards by which all work shall be executed:
    a. City Electrical Ordinances
    b. State Electrical Laws and Statutes
    c. National Electrical Code (NEC) Current Edition
    d. National Board of Fire Underwriters (NBFU)
    e. National Electrical Manufacturers Association (NEMA)
    f. Underwriters Laboratories (UL)
    g. Electrical Testing Laboratory (ETL)
    h. International Building Code (IBC)
    i. International Fire Code (IFC)

B. Fees
1. All fees, permits, licenses, etc., necessary in order to complete the work of this section shall be obtained and paid by this Contractor.

C. Alternate Equipment
1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” do not follow the manufacturer’s names, only such specific items may be used in the base bid, except as hereinafter provided.
2. Items of equipment of the Contractor’s choice may be offered as alternates to such specified items, either in the spaces provided for same in the proposal form or if no space is provided, on the bidder’s letterhead attached to each copy of the proposal form.
3. Alternate proposal must be accompanied by full descriptive and technical data for item proposed, together with statement or amount of cost addition or deduction from the base bid if alternate is accepted. Substitutions proposed by the Contractor will not be considered in the award of the contract.
4. The Contractor must judge that such alternate equipment is of equal quality and character to the specified equipment, and it is physically adaptable for installation within the allotted space with all required service clearances. Unless otherwise specified with this Division, the Engineer will not approve or disapprove any alternate equipment or materials before the bids are opened.
5. The cost of any changes to other trades as a result of use of the alternate material or equipment must be borne by the Contractor submitting such material or equipment.

D. Equipment of Substitution:
1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” follow the manufacturer’s name, such items may be substituted until such time that the “Schedule of Materials and Equipment” is submitted to the Architect or Engineer. The base bid and any alternate shall be based on materials only as specified or approved

1.05 METHODS OF REQUEST FOR APPROVAL:

A. Prior to the award of the contract, interested parties may request approval of substitute materials. Such requests shall be made in writing and delivered to SDSTA no later than ten (10) days prior to the receipt of bids. Any substitutions that the SDSTA finds satisfactory will then be published in an addendum as “acceptable substitutions.”

B. Should the Contractor wish to use materials other than those specified or listed in Addenda they shall do so in compliance with the method as specified under “Alternate Equipment.”

C. The listing of any manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Electrical Contractor to ensure that any price quotations received and submittals made are for products which meet or exceed the specifications included herein.

D. The Contractor must judge that such items of substitution are of equal quality and character to the specified items and it is physically adaptable for installation within the allotted space with all required service clearances. This includes the following:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same (or better) warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.
   4. Waives claims for additional costs or time extensions which may subsequently become apparent.
   5. ill reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities.

E. The cost of any changes to other trades as a result of use of the substitution material or equipment must be borne by the Contractor submitting such material or equipment.

F. After the award of the contract, any request for a substitution must be made in writing by the Contractor (not material supplier or Sub-Contractor). Such request shall state the name of the product specified, the name of the product proposed for substitution, the reason for requesting the substitution, and any change in contract amount resulting from the substitution. No such substitution shall be made until an appropriate Contract Modification has been issued and approved.

G. Manufactured materials hereinafter specified or shown on the Drawings shall be installed or applied in accordance with the directions of the manufacturer unless specifically designated otherwise in the Specifications or on the Drawings.

H. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

1.06 SUBMITTALS

A. Schedule of Materials:
   1. This Contractor shall submit for review, a complete schedule of materials and equipment, listing names of manufacturers, catalog numbers, or identifying description of all equipment of substitution as defined in Specification section Alternate Equipment and Equipment of Substitution. The schedule shall also include a list of Sub-Contractors.
   2. The schedule shall be submitted within fourteen (14) days after the award of contract and before ordering any materials. Items shall be listed in conformance with the numerical order of the articles in the Specification. Upon receipt of approval of the schedule the Contractor may place orders with suppliers to start the shop drawing process.
   3. The review of the schedule of materials and equipment by the Architect or Engineer shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications unless such deviation has been called to the attention of the Architect or Engineer at the time of submission.
   4. If a list of material is not submitted within fourteen (14) days after the award of the contract, is will be assumed that the Contractor has waived his option of selecting

equipment and materials in favor of the Owner, but shall not waive his contract requirements to provide shop drawings.

B. Submittal of Shop Drawings:
   1. The Contractor shall submit seven (7) hard copies or one (1) electronic copy in either standard “researchable” (no scans will be accepted) PDF format or with software to view file of all shop drawings to the Architect or Engineer.
   2. Major components of the system shall be submitted at one time under a protective cover with each section indexed with visible file tabs. All equipment shall be labeled per the equipment tags on the drawings, ie. Motor names, fixture types, etc.
   3. Shop drawings shall indicate catalog number, dimensions, voltage and current characteristics, wire sizes, construction and rough-in data of all materials to be used. Each shop drawing shall be certified as being checked and approved by the Contractor before submittal.
   4. Shop drawings not indicated as being approved by the Contractor will be returned without review.
   5. The Contractor shall provide three (3) copies of approved shop drawings to be submitted with the Operating and Maintenance Manual.
   6. The following wording will appear on shop drawings reviewed by the Engineer. Contractors not wishing to comply with these conditions shall not submit a bid.
      "Corrections or comments made on the shop drawings during this review do not relieve Contractor from compliance with requirements of the Drawings and Specifications. This check is only for review of general compliance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades and performing their work in a safe and satisfactory manner.”
   7. The Engineer is not an error checker. Where the Contractor is submitting shop drawings that differ from the specifications, the Contractor must itemize in writing, each variance from the specifications. Failure to do so will be considered an error on the Contractors part and the specified materials shall be furnished. Shop drawings submitted in error or with errors as compared to Specifications and Drawings will be the responsibility of the Contractor to correct such error later.
   8. Shop drawings must only be those materials as specified or approved in published addendum. Others will be returned without review.
   9. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.
   10. When revised for resubmission, identify all changes made since previous submission.
   11. Contractor shall also prepare all submittal documents in digital format for posting on a document exchange site such as Submittal Exchange. This shall be provided at not additional cost to the contract.

C. Guarantee:
   1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.

D. Operating and Maintenance Instructions:
   1. This Contractor shall furnish copies of complete catalog data, manufacturer's literature and detailed manuals covering the operating, maintenance of equipment and parts list specified under this Division of the Specifications. Submit the O&M manuals per the requirements of Division 01.
   2. One copy of each shop drawing shall be included in the notebooks but shall not serve in lieu of maintenance and operating instructions. Temperature control diagrams must include a description of the sequence of control.

3. The Contractor shall submit O&M Manuals to the Engineer, not the Owner, for review. The Engineer will forward the manuals to the Owner.
4. This Contractor shall also supervise the initial operation as required to acquaint him thoroughly with the best practice.
5. This Contractor shall furnish the Engineer with a written statement from the Owner indicating complete acceptance of the equipment data and instruction of the operator. The Engineer will not approve the request for final payment until such statement has been submitted.
6. Provide an electronic copy of the above.

E. Test Reports:
1. Work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently concealed.
2. Tests shall be made in the presence of the Engineer and the Owner, and shall meet with their approval. The Contractor shall notify the Engineer at a time sufficiently prior to the performance of any test to allow time for the Engineer to be present for the test.
3. The entire system shall be subject to a test at full operating and under normal usage conditions. This shall include voltage and current checks, resistance measurements and equipment operation. Defects in the work or workmanship which appear during these tests shall be properly remedied and a test again applied and continued to a satisfactory conclusion.
4. Electricity or other energy necessary for use in testing and adjusting and or the operation period will be supplied by the Owner.
5. Instruments for making tests shall be furnished by this Contractor.
6. After testing the apparatus, the entire system shall be operated for one week under normal conditions.
7. The final test shall be performed as soon as possible after the work is entirely completed
8. Test reports submitted electronically shall be in standard PDF format or submitted with software to view the file. Refer to Division 1 Specifications for test results submittal requirements.

1.07 JOB CONDITIONS:

A. Fees and Service Charges:
1. Permits, licenses, fees and service charges required in connection with the work shall be secured and paid for by this Contractor, and upon completion of the work he shall furnish proof of acceptance from the proper Local and State Department having jurisdiction.

B. Electrical Symbols and Abbreviations:
1. Symbols and abbreviations are as indicated in legends on the Drawings.

C. Correlation of Work:
1. This Contractor shall be responsible for close correlation of his work with that of other Contractors and shall organize his work so that it will not interfere with or delay the work of other Contractors.
2. Field verification of scale dimensions on Plans is directed since actual locations, distances and levels will be governed by actual field conditions.
3. The Electrical Sub-Contractor shall check architectural, structural, plumbing, heating and ventilating plans to avert possible installation conflicts. Should drastic changes from original Plans be necessary to resolve such conflicts, the Sub-Contractor shall notify the Prime Contractor who in turn shall notify the Architect or Engineer and secure written approval and agreement on necessary adjustments before the installation is started.
4. Discrepancies shown on different Plans, or between Plans and actual field conditions, or between Plans and Specifications, shall promptly be brought to the attention of the Architect or Engineer for a decision.
5. Where a discrepancy exists between drawing and specifications or other disciplines the worst cost case shall be provided.
6. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate occupancy requirements.

7. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
8. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility to other installations, for maintenance, and for repairs.
9. Coordinate completion and clean-up of work of separate sections.
10. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

D. Final Inspection:
1. Refer to division 1 specifications for final inspection process. The Contractor shall also submit the operating and maintenance manuals at this time. The Engineer will not schedule nor perform a final inspection without successful submittal of operating and maintenance manuals by the Contractor.
2. During the final observation, pre-final or follow-up final, the Contractor and all his Prime Sub-Contractors shall have the foreman of the project present.
3. The Contractor shall comply completely with all the listed requirements within a negotiated number of days of receipt of list. Should the Contractor fail to complete items on the list within a timely maner, the Owner reserves the right to have the work completed by others and the cost deducted from the contract price, including change orders.
4. The Contractor shall notify in writing to the Architect and/or Engineer once all punch list items are corrected, that he is ready for a follow-up final. The written notice shall contain explanations for those known items not completed and a schedule for completing them.
5. The Architect and/or Engineer shall schedule a follow-up final to confirm completion. Repeated observation trips required of the Engineer by the Contractor’s inability to complete the project satisfactorily will require the Contractor to reimburse the Engineer for all incurred costs after the follow-up final observation.

1.08 PROJECT COORDINATION

A. Refer to division 1 specifications for definition of superintendent.

B. This section applies to all work performed and specified under Divisions 26, and 27.

C. Cooperate with the Superintendent and Owner in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.

D. During construction, coordinate use of site and facilities through the Superintendent

E. Comply with specified procedures for intra-project communications, submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

F. Comply with instructions of the Superintendent for use of temporary utilities and construction facilities.

G. Coordinate field engineering and layout work under instructions of the Superintendent.

H. Make the following types of submittals to Architect/Engineer through the Superintendent.
1. Requests for interpretation/information.
2. Requests for substitution.
3. Shop drawings, product data and samples.
4. Test and inspection reports.
5. Manufacturer's instructions and field reports.
6. Applications for payment and change order requests.
7. Progress schedules.
8. Coordination drawings.
9. Closeout submittals.

10. As-built Record Drawings.
11. Operation and Maintenance Manuals.

1.09 PROGRESS MEETINGS

A. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.

1.10 DEFINITIONS

A. Contractor
   1. The term “Contractor” refers to the installation Contractor responsible for the furnishing and installation of all work indicated within this Specification.

B. Furnish
   1. The term “furnish” is used to mean “purchase, supply, provide and deliver to the Project site, protect and provide interim storage and be ready for unloading, unpacking, assembly, installation, and similar operations in accordance with Manufacturer’s specifications.”

C. Provide
   1. The terms “provide” means to “furnish and install, complete and ready for the intended use.”

D. Install
   1. The term “install” is used to describe operations at project site including the actual “unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations”.

E. Installer
   1. The “Installer” is the Contractor, Subcontractor and/or supplier who uses their own employees for performance of all construction

F. If Applicable:
   1. The term “if applicable” will be that work which may be required for completed construction at applicable locations, but is not necessarily shown or described in the Contract Documents.

G. As Necessary
   1. The term “as necessary” will be that work which is required for completed construction, but is not necessarily show or described in the Contract Documents.

H. As Required
   1. The term “as required” will be that work which is required for completed construction and is shown on the drawings or described in the project Specification.

I. Concealed
   1. The term “concealed” means hidden from sight, buried as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.

J. Exposed
   1. The term “exposed” means bare, open to the elements, out in the open, uncovered.

K. Product
   1. The term “product” will mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.

L. Substantial Completion
   1. “Substantial Completion” is deemed that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written Specification.

M. Words in the singular will also mean and include the plural, wherever the context so indicates, and words in the plural will mean the singular, wherever the context so indicates.

1.11 DRAWINGS AND MEASUREMENTS

A. The extent of the system of equipment, materials, panels, conduits, wire, fixtures and connections as shown are in general diagrammatic and not for exact locations, except in certain cases, the drawings may include details giving exact location and arrangements.

B. The drawings are not intended to be scaled for roughing in measurements nor to serve as shop drawings.

C. The Contractor shall consult the architectural, structural, mechanical, or equipment drawings for dimensions, obstructions, and location of equipment or other trades. Any discrepancies between architectural, structural, mechanical, or equipment drawings and the electrical work shown on these drawings shall be reported to the Engineers for adjustment.

D. The installation details, instructions, and recommendations of the manufacturer of the product used, or modified to obtain the best end result, shall be the basis of attaining installation of the products for usage on this project except where definite and specific instructions are set forth herein or details are shown on the plans.

E. Outlet devices, switches, panels, cabinets, fixtures and special equipment are shown on the drawings only in a schematic manner and not necessarily in their specific location. The Contractor shall be responsible for exact locations of the outlets to form a functional and aesthetic installation either by careful review of all architectural elevations, tile patterns, surface finishes, and equipment arrangements or by consultation with the Engineers and other trades involved.

F. This contractor’s bid shall allow a minimum of 10 feet variance in location of each electrical outlet, light fixture, panelboard, motor, appliance, etc. shown on the plans.

1.12 WORKMANSHIP

A. The installation work included in this specification shall be performed in a neat workmanlike manner by people experienced and skilled in the Electrical trade. Only the best quality workmanship will be accepted. All exposed parts of the electrical wiring systems such as exposed conduits, flush plates, cabinet trim, fixtures, etc., shall be square and true with the building construction.

1.13 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

1.14 EQUIPMENT HOUSEKEEPING PADS

A. Fixed concrete bases for electrical equipment will be provided under Division 03. The Electrical Contractor shall inform Division 03 Contractor before bid time of all required pads so that the cost for these pads are included in the Division 03 bid. If this is not coordinated the Electrical Contractor is responsible for all costs associated with the installation of these pads.

B. Coordinate with Division 03 Contractor to assure that all the outside corners are beveled, anchor bolts are provided per equipment manufactures recommendations, and that the pad horizontal dimensions are 3" larger than the footprint of the equipment on all sides.

C. Provide reinforced concrete housekeeping pads for all floor mounted electrical equipment (i.e. motor control centers, distribution panels, step-down transformers, standby generators, etc.)

D. Provide anchor bolts, per equipment manufacturer's directions, to attach equipment to pads.

1.15 EQUIPMENT CLEAN-UP

A. Special care must be taken for protection of panels, switches, etc. All must be kept completely protected from weather elements, painting, etc. until the building is substantially completed. Damage from rust, paint, scratches, etc. shall be corrected as directed by the A/E.

B. Clean all light fixtures and lamps thoroughly, just prior to final inspection. Fixture globes, enclosures, shielding, etc. shall be cleaned by an approved method.

C. Protection of electrical equipment during painting of the building shall be the responsibility of the Painting Contractor. This shall not relieve the Electrical Contractor of the responsibility for checking to assure that adequate protection is being provided.

1.16 SEALING OF PENETRATIONS

A. All penetrations for raceway, wire, etc. furnished under Division 26, 27, 28 of these specifications which penetrate fire and/or smoke walls and full height partitions (including chase walls), shall be sealed with a UL System specifically approved for the application.

1.17 PROJECT CONDITIONS

A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water.

C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

E. Erosion and Sediment Control: Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

G. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.

H. Verify that demolition is complete in alterations areas and areas are ready for installation of new work.

I. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

J. Verity that utility services are available, of these of the correct characteristics, and in the correct location.

K. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions. Protect work of other trades.

1.18 PREPARATION

A. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore at completion.

B. Remove unsuitable materials not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for furnished work.

C. Remove debris and abandoned items from area and from concealed spaces.

D. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate ducts and piping to prevent condensation in exposed areas.

E. Prepare surfaces and remove surface finishes to provide for proper installation of new work and finishes.

F. Clean substrate surfaces prior to applying next materials or substance.

G. Seal cracks or openings of substrate prior to applying next material or substance.

H. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

1.19 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections.

B. Make neat transitions. Patch work to match adjacent work in texture and appearance.

C. All ceiling mounted devices (i.e. smoke detectors, speakers, light fixtures, etc.) shall be installed centered in ceiling tiles (unless otherwise noted). Coordinate with ceiling installer.

1.20 EXISTING UTILITIES

A. The plans indicate as accurately as possible the location , type and sizes of existing underground utilities at the site. It is the Contractor's responsibility to have all utilities located prior to starting work. Contractor shall contact appropriate utility company and One Call for locating utilities prior to commencement of any work. The Owner also has underground conduit and other systems in place. Contractor shall contact the Owner prior to excavation in any area to determine any items that may be impacted by excavation.

B. This Contactor shall protect all utilities and Owner items affected by his work, and shall repair any damage caused by his forces at no additional cost to the Owner.

C. The Owner and the Owners' of all underground facilities shall be notified at least 5 business days prior to excavation.

1.21 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect/Engineer of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly notify Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and layout by instrumentation and similar appropriate means.
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

1.22 TEMPORARY LIGHTING AND POWER

A. Provide all temporary facilities required to supply construction power and light. Install and maintain facilities in a manner that will protect the public and workmen. Comply with all applicable laws and regulations.

B. Upon completion of work, remove all temporary facilities from the project site.

C. The Electrical Contractor shall provide power and lighting for construction as outlined in the General Requirements and/or Special Conditions. Where required to be separately metered the Electrical Contractor shall supply all materials for metering. Electrical Contractor shall coordinate with the Construction Manager/General Contractor to ensure all costs for temporary

power and all electrical usage is paid for as part of this contract. The Contractors are responsible for any charges related to temporary power and its usage.

D. When the Electrical Utility is needed for specific power outages the Electrical Contractor will be responsible for paying any costs associated with utility shut downs and shall pay the Utility Company for any charges incurred.

1.23 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition per OSHA standards.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

1.24 PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.

C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

D. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

E. Prohibit traffic from landscaped area.

1.25 DEMONSTRATION AND INSTRUCTION

A. Contractor shall complete all start-up and perform all initial testing of each system prior to scheduling or requesting to schedule training. All systems shall be completely operational before training or demonstration will occur.

B. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.

C. Demonstrate operation and maintenance of Products to Owner's representative at a scheduled time with the Owner.

D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner Personnel.

F. Utilize operation and maintenance e manuals as basis for instruction. Review contents of manuals with Owner's personnel in detail to explain all aspects of operation and maintenance.

1.26 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.27 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.

6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Changes made by Addenda and modifications.

E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   2. Field changes of dimension and detail.
   3. Details not on original Contract Documents.

F. At completion of project Contractor shall provide a minimum of two (2) sets of As-Built Record drawings. Additional sets shall be provided if required under General Requirements.

G. Refer to Division 1 Specifications for additional as-built drawing requirements.

1.28 WARRANTY AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Sub-Contractors, suppliers and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

F. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Sub-Contractor, Supplier, and Manufacturer, with name address, and telephone number of responsible principal.

END OF SECTION 26 0010

SECTION 26 0132

PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Quality Assurance
B. Methods of Request for Approval
C. Submittals
D. Job Conditions
E. Project Coordination
F. Progress Meetings
G. Definitions
H. Drawings and Measurements
I. Workmanship
J. Patching Materials
K. Equipment Housekeeping Pads
L. Equipment Clean-Up
M. Sealing of Penetrations
N. Project Conditions
O. Preparation
P. General Installation Requirements
Q. Existing Utilities
R. Laying Out the Work
S. Progress Cleaning
T. Protection of Installed Work
U. Commissioning
V. Demonstration and Instruction
W. Adjusting
X. Project Record Documents
Y. Warranty and Bonds

1.02 RELATED DOCUMENTS

A. The attached General Conditions, Supplementary General Conditions and Special Conditions or General Requirements are hereby incorporated into and shall become a part of all sections under DIVISION 26 and 27 – ELECTRICAL. In certain instances where the terms of this Division of the Specifications conflict with the terms of the General Conditions, or Special Conditions, this Division of the Specifications shall govern (or the more stringent requirement shall apply).

B. Where “Contractor” is referred to in this Specification it shall mean “Contractor, Sub-Contractor and/or Sub-Contractors under the Prime Contractor.”

1.03 DESCRIPTION OF WORK

A. The work shall include everything in this Division of the Specifications and everything indicated on the Drawings that is complementary to this Division of the Specifications. Refer to the Index of Drawings to determine what Drawings apply directly to this work.

1.04 QUALITY ASSURANCE

A. Codes and Standards:

1. Work, materials and manner of placing material shall conform in every respect with the latest provisions of Local, State and National Codes.
2. Materials and equipment shall be new and of best quality, of the type best suited for the purpose intended, and be made by nationally recognized and substantially established manufacturers. The type and weight of material used for each purpose shall be as herein specified, and material shall conform with the requirements of the latest standard specifications of the “ASTM” for that particular material.
3. Electrical materials used in this work shall be listed by the Underwriters Laboratories, Inc. where testing is provided and shall bear their label.
4. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
5. Where the notation of NEMA is indicated the equipment shall conform to National Electrical Manufacturers Association Standard.
6. The following list of codes, technical societies, trade organizations and governing agencies shall set the standards by which all work shall be executed:
    a. City Electrical Ordinances
    b. State Electrical Laws and Statutes
    c. National Electrical Code (NEC) Current Edition
    d. National Board of Fire Underwriters (NBFU)
    e. National Electrical Manufacturers Association (NEMA)
    f. Underwriters Laboratories (UL)
    g. Electrical Testing Laboratory (ETL)
    h. International Building Code (IBC)
    i. International Fire Code (IFC)

B. Fees
1. All fees, permits, licenses, etc., necessary in order to complete the work of this section shall be obtained and paid by this Contractor.

C. Alternate Equipment
1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” do not follow the manufacturer’s names, only such specific items may be used in the base bid, except as hereinafter provided.
2. Items of equipment of the Contractor’s choice may be offered as alternates to such specified items, either in the spaces provided for same in the proposal form or if no space is provided, on the bidder’s letterhead attached to each copy of the proposal form.
3. Alternate proposal must be accompanied by full descriptive and technical data for item proposed, together with statement or amount of cost addition or deduction from the base bid if alternate is accepted. Substitutions proposed by the Contractor will not be considered in the award of the contract.
4. The Contractor must judge that such alternate equipment is of equal quality and character to the specified equipment, and it is physically adaptable for installation within the allotted space with all required service clearances. Unless otherwise specified with this Division, the Engineer will not approve or disapprove any alternate equipment or materials before the bids are opened.
5. The cost of any changes to other trades as a result of use of the alternate material or equipment must be borne by the Contractor submitting such material or equipment.

D. Equipment of Substitution:
1. Where items of equipment and materials are specifically identified herein by a single manufacturer’s name, or as many as three manufacturer’s names, model or catalog numbers, and the words “or equal and approved” follow the manufacturer’s name, such items may be substituted until such time that the “Schedule of Materials and Equipment” is submitted to the Architect or Engineer. The base bid and any alternate shall be based on materials only as specified or approved

1.05 METHODS OF REQUEST FOR APPROVAL:

A. Prior to the award of the contract, interested parties may request approval of substitute materials. Such requests shall be made in writing and delivered to the Architect or Engineer no later than ten (10) days prior to the receipt of bids. Any substitutions that the Architect or Engineer finds satisfactory will then be published in an addendum as “acceptable substitutions.”

B. Should the Contractor wish to use materials other than those specified or listed in Addenda they shall do so in compliance with the method as specified under “Alternate Equipment.”

C. The listing of any manufacturer as “acceptable” does not imply automatic approval. It is the sole responsibility of the Electrical Contractor to ensure that any price quotations received and submittals made are for products which meet or exceed the specifications included herein.

D. The Contractor must judge that such items of substitution are of equal quality and character to the specified items and it is physically adaptable for installation within the allotted space with all required service clearances. This includes the following:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same (or better) warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to the Owner.
   4. Waives claims for additional costs or time extensions which may subsequently become apparent.
   5. ill reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities.

E. The cost of any changes to other trades as a result of use of the substitution material or equipment must be borne by the Contractor submitting such material or equipment.

F. After the award of the contract, any request for a substitution must be made in writing by the Contractor (not material supplier or Sub-Contractor). Such request shall state the name of the product specified, the name of the product proposed for substitution, the reason for requesting the substitution, and any change in contract amount resulting from the substitution. No such substitution shall be made until an appropriate Contract Modification has been issued and approved.

G. Manufactured materials hereinafter specified or shown on the Drawings shall be installed or applied in accordance with the directions of the manufacturer unless specifically designated otherwise in the Specifications or on the Drawings.

H. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

1.06 SUBMITTALS

A. Schedule of Materials:
   1. This Contractor shall submit for review, a complete schedule of materials and equipment, listing names of manufacturers, catalog numbers, or identifying description of all equipment of substitution as defined in Specification section Alternate Equipment and Equipment of Substitution. The schedule shall also include a list of Sub-Contractors.
   2. The schedule shall be submitted within fourteen (14) days after the award of contract and before ordering any materials. Items shall be listed in conformance with the numerical order of the articles in the Specification. Upon receipt of approval of the schedule the Contractor may place orders with suppliers to start the shop drawing process.
   3. The review of the schedule of materials and equipment by the Architect or Engineer shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications unless such deviation has been called to the attention of the Architect or Engineer at the time of submission.
   4. If a list of material is not submitted within fourteen (14) days after the award of the contract, is will be assumed that the Contractor has waived his option of selecting

equipment and materials in favor of the Owner, but shall not waive his contract requirements to provide shop drawings.

B. Submittal of Shop Drawings:
   1. The Contractor shall submit seven (7) hard copies or one (1) electronic copy in either standard “searchable” (no scans will be accepted) PDF format or with software to view file of all shop drawings to the Architect or Engineer.
   2. Major components of the system shall be submitted at one time under a protective cover with each section indexed with visible file tabs. All equipment shall be labeled per the equipment tags on the drawings, ie. Motor names, fixture types, etc.
   3. Shop drawings shall indicate catalog number, dimensions, voltage and current characteristics, wire sizes, construction and rough-in data of all materials to be used. Each shop drawing shall be certified as being checked and approved by the Contractor before submittal.
   4. Shop drawings not indicated as being approved by the Contractor will be returned without review.
   5. The Contractor shall provide three (3) copies of approved shop drawings to be submitted with the Operating and Maintenance Manual.
   6. The following wording will appear on shop drawings reviewed by the Engineer. Contractors not wishing to comply with these conditions shall not submit a bid.
      "Corrections or comments made on the shop drawings during this review do not relieve Contractor from compliance with requirements of the Drawings and Specifications. This check is only for review of general compliance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades and performing their work in a safe and satisfactory manner.”
   7. The Engineer is not an error checker. Where the Contractor is submitting shop drawings that differ from the specifications, the Contractor must itemize in writing, each variance from the specifications. Failure to do so will be considered an error on the Contractors part and the specified materials shall be furnished. Shop drawings submitted in error or with errors as compared to Specifications and Drawings will be the responsibility of the Contractor to correct such error later.
   8. Shop drawings must only be those materials as specified or approved in published addendum. Others will be returned without review.
   9. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of the completed Work.
   10. When revised for resubmission, identify all changes made since previous submission.
   11. Contractor shall also prepare all submittal documents in digital format for posting on a document exchange site such as Submittal Exchange. This shall be provided at not additional cost to the contract.

C. Guarantee:
   1. The Contractor shall assume responsibility for any defects which may develop in any part of his work caused by faulty workmanship, material or equipment, and agrees to replace, repair or alter, at his expense, any such faulty workmanship, material or equipment that has been brought to his attention during a period of one year from the date of the final certificate for payment. Acceptance of the work shall not waive this guarantee.

D. Operating and Maintenance Instructions:
   1. This Contractor shall furnish three (3) copies of complete catalog data, manufacturer’s literature and detailed manuals covering the operating, maintenance of equipment and parts list specified under this Division of the Specification. All such literature shall be bound in three new, standard 3-ring notebooks and shall be submitted to the Engineer. The lubrication instructions in the manufacturer’s literature shall be underlined.
   2. One copy of each shop drawing shall be included in the notebooks but shall not serve in lieu of maintenance and operating instructions. Temperature control diagrams must include a description of the sequence of control.

3. The Contractor shall submit O&M Manuals to the Engineer, not the owner, for review. The Engineer will forward the manuals to the Owner.
4. This Contractor shall also supervise the initial operation as required to acquaint him thoroughly with the best practice.
5. This Contractor shall furnish the Engineer with a written statement from the Owner indicating complete acceptance of the equipment data and instruction of the operator. The Engineer will not approve the request for final payment until such statement has been submitted.
6. Provide an electronic copy of the above.

E. Test Reports:
1. Work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently concealed.
2. Tests shall be made in the presence of the Engineer and the Owner, and shall meet with their approval. The Contractor shall notify the Engineer at a time sufficiently prior to the performance of any test to allow time for the Engineer to be present for the test.
3. The entire system shall be subject to a test at full operating and under normal usage conditions. This shall include voltage and current checks, resistance measurements and equipment operation. Defects in the work or workmanship which appear during these tests shall be properly remedied and a test again applied and continued to a satisfactory conclusion.
4. Electricity or other energy necessary for use in testing and adjusting and or the operation period will be supplied by the Owner.
5. Instruments for making tests shall be furnished by this Contractor.
6. After testing the apparatus, the entire system shall be operated for one week under normal conditions.
7. The final test shall be performed as soon as possible after the work is entirely completed
8. Test reports submitted electronically shall be in standard PDF format or submitted with software to view the file.

1.07 JOB CONDITIONS:

A. Fees and Service Charges:
1. Permits, licenses, fees and service charges required in connection with the work shall be secured and paid for by this Contractor, and upon completion of the work he shall furnish proof of acceptance from the proper Local and State Department having jurisdiction.

B. Electrical Symbols and Abbreviations:
1. Symbols and abbreviations are as indicated in legends on the Drawings.

C. Correlation of Work:
1. This Contractor shall be responsible for close correlation of his work with that of other Contractors and shall organize his work so that it will not interfere with or delay the work of other Contractors.
2. Field verification of scale dimensions on Plans is directed since actual locations, distances and levels will be governed by actual field conditions.
3. The Electrical Sub-Contractor shall check architectural, structural, plumbing, heating and ventilating plans to avert possible installation conflicts. Should drastic changes from original Plans be necessary to resolve such conflicts, the Sub-Contractor shall notify the Prime Contractor who in turn shall notify the Architect or Engineer and secure written approval and agreement on necessary adjustments before the installation is started.
4. Discrepancies shown on different Plans, or between Plans and actual field conditions, or between Plans and Specifications, shall promptly be brought to the attention of the Architect or Engineer for a decision.
5. Where a discrepancy exists between drawing and specifications or other disciplines the worst cost case shall be provided.
6. Coordinate work of alterations and renovations to expedite completion sequentially and to accommodate occupancy requirements.

7. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
8. Coordinate space requirements, supports, and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility to other installations, for maintenance, and for repairs.
9. Coordinate completion and clean-up of work of separate sections.
10. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

D. Final Inspection:
1. Upon completion of work, the Contractor shall notify the Architect or Engineer in writing and make arrangements for a final observation. The Contractor shall also submit the operating and maintenance manuals at this time. The Engineer will not schedule nor perform a final inspection without successful submittal of operating and maintenance manuals by the Contractor.
2. During the final observation, pre-final or follow-up final, the Contractor and all his Prime Sub-Contractors shall have the foreman of the project present.
3. After the final observation is made, the Contractor will receive a list of items requiring adjustment, correction, replacement, or completion.
4. The Contractor shall comply completely with all the listed requirements within a negotiated number of days of receipt of list. Should the Contractor fail to complete items on the list within this time limit, the Owner reserves the right to have the work completed by others and the cost deducted from the contract price, including change orders.
5. The Contractor shall notify in writing to the Architect and/or Engineer once all punch list items are corrected, that he is ready for a follow-up final. The written notice shall contain explanations for those known items not completed and a schedule for completing them.
6. The Architect and/or Engineer shall schedule a follow-up final to confirm completion. Repeated observation trips required of the Engineer by the Contractor’s inability to complete the project satisfactorily will require the Contractor to reimburse the Engineer for all incurred costs after the follow-up final observation.

1.08 PROJECT COORDINATION

A. Project Coordinator: Construction Manager/General Contractor.

B. This section applies to all work performed and specified under Divisions 26 and 27.

C. Cooperate with the Construction manager/General Contractor and Owner in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.

D. During construction, coordinate use of site and facilities through the Construction Manager/ General Contractor

E. Comply with specified procedures for intra-project communications, submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.

F. Comply with instructions of the Construction Manager / General Contractor for use of temporary utilities and construction facilities.

G. Coordinate field engineering and layout work under instructions of the Construction Manager/General Contractor.

H. Make the following types of submittals to Architect/Engineer through the Construction Manager/General Contractor.
1. Requests for interpretation/information.
2. Requests for substitution.
3. Shop drawings, product data and samples.

4. Test and inspection reports.
5. Manufacturer's instructions and field reports.
6. Applications for payment and change order requests.
7. Progress schedules.
8. Coordination drawings.
9. Closeout submittals.
10. As-built Record Drawings.
11. Operation and Maintenance Manuals.

1.09 PROGRESS MEETINGS

A. Attendance Required: Job superintendent, major Subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.

1.10 DEFINITIONS

A. Contractor
   1. The term “Contractor” refers to the installation Contractor responsible for the furnishing and installation of all work indicated within this Specification.

B. Furnish
   1. The term “furnish” is used to mean “purchase, supply, provide and deliver to the Project site, protect and provide interim storage and be ready for unloading, unpacking, assembly, installation, and similar operations in accordance with Manufacturer’s specifications.”

C. Provide
   1. The terms “provide” means to “furnish and install, complete and ready for the intended use.”

D. Install
   1. The term “install” is used to describe operations at project site including the actual “unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations”.

E. Installer
   1. The “Installer” is the Contractor, Subcontractor and/or supplier who uses their own employees for performance of all construction

F. If Applicable:
   1. The term “if applicable” will be that work which may be required for completed construction at applicable locations, but is not necessarily shown or described in the Contract Documents.

G. As Necessary
   1. The term “as necessary” will be that work which is required for completed construction, but is not necessarily show or described in the Contract Documents.

H. As Required
   1. The term “as required” will be that work which is required for completed construction and is shown on the drawings or described in the project Specification.

I. Concealed
   1. The term “concealed” means hidden from sight, buried as in chases, furred spaces, shafts, fixed ceiling or embedded in construction.

J. Exposed
   1. The term “exposed” means bare, open to the elements, out in the open, uncovered.

K. Product
   1. The term “product” will mean any item of equipment, material, fixture, apparatus, appliance or accessory installed under this Division.

L. Substantial Completion
   1. “Substantial Completion” is deemed that the project is sufficiently complete to be utilized for its intended use as stated in the body of this written Specification.

M. Words in the singular will also mean and include the plural, wherever the context so indicates, and words in the plural will mean the singular, wherever the context so indicates.

1.11 DRAWINGS AND MEASUREMENTS

A. The extent of the system of equipment, materials, panels, conduits, wire, fixtures and connections as shown are in general diagrammatic and not for exact locations, except in certain cases, the drawings may include details giving exact location and arrangements.

B. The drawings are not intended to be scaled for roughing in measurements nor to serve as shop drawings.

C. The Contractor shall consult the architectural, structural, mechanical, or equipment drawings for dimensions, obstructions, and location of equipment or other trades. Any discrepancies between architectural, structural, mechanical, or equipment drawings and the electrical work shown on these drawings shall be reported to the Engineers for adjustment.

D. The installation details, instructions, and recommendations of the manufacturer of the product used, or modified to obtain the best end result, shall be the basis of attaining installation of the products for usage on this project except where definite and specific instructions are set forth herein or details are shown on the plans.

E. Outlet devices, switches, panels, cabinets, fixtures and special equipment are shown on the drawings only in a schematic manner and not necessarily in their specific location. The Contractor shall be responsible for exact locations of the outlets to form a functional and aesthetic installation either by careful review of all architectural elevations, tile patterns, surface finishes, and equipment arrangements or by consultation with the Engineers and other trades involved.

F. This contractor’s bid shall allow a minimum of 10 feet variance in location of each electrical outlet, light fixture, panelboard, motor, appliance, etc. shown on the plans.

1.12 WORKMANSHIP

A. The installation work included in this specification shall be performed in a neat workmanlike manner by people experienced and skilled in the Electrical trade. Only the best quality workmanship will be accepted. All exposed parts of the electrical wiring systems such as exposed conduits, flush plates, cabinet trim, fixtures, etc., shall be square and true with the building construction.

1.13 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

1.14 EQUIPMENT HOUSEKEEPING PADS

A. Fixed concrete bases for electrical equipment will be provided under Division 03. The Electrical Contractor shall inform Division 03 Contractor before bid time of all required pads so that the cost for these pads are included in the Division 03 bid. If this is not coordinated the Electrical Contractor is responsible for all costs associated with the installation of these pads.

B. Coordinate with Division 03 Contractor to assure that all the outside corners are beveled, anchor bolts are provided per equipment manufactures recommendations, and that the pad horizontal dimensions are 3" larger than the footprint of the equipment on all sides.

C. Provide reinforced concrete housekeeping pads for all floor mounted electrical equipment (i.e. motor control centers, distribution panels, step-down transformers, standby generators, etc.)

D. Provide anchor bolts, per equipment manufacturer's directions, to attach equipment to pads.

1.15 EQUIPMENT CLEAN-UP

A. Special care must be taken for protection of panels, switches, etc. All must be kept completely protected from weather elements, painting, etc. until the building is substantially completed. Damage from rust, paint, scratches, etc. shall be corrected as directed by the A/E.

B. Clean all light fixtures and lamps thoroughly, just prior to final inspection. Fixture globes, enclosures, shielding, etc. shall be cleaned by an approved method.

C. Protection of electrical equipment during painting of the building shall be the responsibility of the Painting Contractor. This shall not relieve the Electrical Contractor of the responsibility for checking to assure that adequate protection is being provided.

1.16 SEALING OF PENETRATIONS

A. All penetrations for raceway, wire, etc. furnished under Division 26, 27, 28 of these specifications which penetrate fire and/or smoke walls and full height partitions (including chase walls), shall be sealed with a UL System specifically approved for the application.

1.17 PROJECT CONDITIONS

A. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water.

C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

E. Erosion and Sediment Control: Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
   1. Minimize amount of bare soil exposed at one time.
   2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
   3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
   4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

F. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

G. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.

H. Verify that demolition is complete in alterations areas and areas are ready for installation of new work.

I. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

J. Verity that utility services are available, of these of the correct characteristics, and in the correct location.

K. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions. Protect work of other trades.

1.18 PREPARATION

A. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore at completion.

B. Remove unsuitable materials not marked for salvage, such as rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for furnished work.

C. Remove debris and abandoned items from area and from concealed spaces.

D. Close openings in exterior surfaces to protect existing work and salvage items from weather and extremes of temperature and humidity. Insulate ducts and piping to prevent condensation in exposed areas.

E. Prepare surfaces and remove surface finishes to provide for proper installation of new work and finishes.

F. Clean substrate surfaces prior to applying next materials or substance.

G. Seal cracks or openings of substrate prior to applying next material or substance.

H. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

1.19 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections.

B. Make neat transitions. Patch work to match adjacent work in texture and appearance.

C. All ceiling mounted devices (i.e. smoke detectors, speakers, light fixtures, etc.) shall be installed centered in ceiling tiles (unless otherwise noted). Coordinate with ceiling installer.

1.20 EXISTING UTILITES

A. The plans indicate as accurately as possible the location , type and sizes of existing underground utilities at the site. It is the Contractor's responsibility to have all utilities located prior to starting work. Contractor shall contact appropriate utility company and One Call for locating utilities prior to commencement of any work. The Owner also has underground conduit and other systems in place. Contractor shall contact the Owner prior to excavation in any area to determine any items that may be impacted by excavation.

B. This Contactor shall protect all utilities and Owner items affected by his work, and shall repair any damage caused by his forces at no additional cost to the Owner.

C. The Owner and the Owners' of all underground facilities shall be notified at least 5 business days prior to excavation.

1.21 LAYING OUT THE WORK

A. Verify locations of survey control points prior to starting work.

B. Promptly notify Architect/Engineer of any discrepancies discovered.

C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

D. Promptly notify Architect/Engineer the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

F. Utilize recognized engineering survey practices.

G. Establish elevations, lines and levels. Locate and layout by instrumentation and similar appropriate means.
   1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   2. Grid or axis for structures.
   3. Building foundation, column locations, ground floor elevations.

H. Periodically verify layouts by same means.

I. Maintain a complete and accurate log of control and survey work as it progresses.

1.22 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition per OSHA standards.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site.

1.23 PROTECTION OF INSTALLED WORK

A. Protect installed work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed Products. Control activity in immediate work area to prevent damage.

C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

D. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

E. Prohibit traffic from landscaped area.

1.24 COMMISSIONING

A. This project is being commissioned. A Commissioning Agent has been hired by the Owner. Each Contractor and Sub-Contractor shall be responsible for assisting in the commissioning of the systems they have installed as outlined in the individual specifications and in the Commissioning Requirements specification sections. It is each Contractors and Sub-Contractors responsibility to understand these requirements and perform the work as outlined.

1.25 DEMONSTRATION AND INSTRUCTION

A. Contractor shall complete all start-up and perform all intimal testing of each system prior to scheduling or requesting to schedule training. All systems shall be completely operational before training or demonstration will occur.

B. Demonstrate operation and maintenance of Products to Owner's personnel prior to date of final inspection.

C. Demonstrate operation and maintenance of Products to Owner's representative at a scheduled time with the Owner.

D. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner Personnel.

F. Utilize operation and maintenance e manuals as basis for instruction. Review contents of manuals with Owner's personnel in detail to explain all aspects of operation and maintenance.

1.26 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.27 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed shop drawings, product data, and samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
2. Changes made by Addenda and modifications.

E. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
2. Field changes of dimension and detail.
3. Details not on original Contract Documents.

F. At completion of project Contractor shall provide a minimum of two (2) sets of As-Built Record drawings. Additional sets shall be provided if required under General Requirements.

1.28 WARRANTY AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Sub-Contractors, suppliers and manufacturers, within ten days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

E. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.

F. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Sub-Contractor, Supplier, and Manufacturer, with name address, and telephone number of responsible principal.

END OF SECTION 26 0132

SECTION 26 0505
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical demolition.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections and drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated on contract documents.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Architect/Engineer before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

F. An attempt has been made to show all devices and branch circuits. The electrical contractor shall visit the site to verify devices not shown, extent of conduit, boxes etc, & routings. All devices need to be removed in the demolition area unless noted on the drawings.

G. It is mandatory that the existing building remain in continuous and non-interrupted operation during remodeling/altering of the existing bldg. The specific area(s) being remodeled/altered at any scheduled time are obviously exclusive of the statement. Services to existing building shall be kept on continuous operation including power, lighting, telephone, fire alarm, etc. Any absolutely necessary interruption of these services to accomplish project construction shall be held to a minimum, arranged with the Owner through the general contractor two (2) weeks in advance. Temporary services shall be furnished and installed where necessary to accomplish this purpose. Temporary systems shall be removed only after new permanent services are installed, fully operational, tested and compliant.

H. Electrical Contractor shall refer to architectural drawings to familiarize himself with extent of alteration/remodeling work and more specifically note where new partitioning is being installed, where existing partitioning is being removed, where ceilings are being removed and or replaced, etc.

I. If existing devices to be reused, provide all necessary conduit, wire, and terminations between devices and head end panels i.e. new fire alarm devices (smoke detectors, heat detectors, pull stations, alarm horns, remote annunciators, etc.) and new fire alarm panel. Any existing switches or receptacles that are relocated shall be replaced by new.

J. If existing conduit is allowed to be reused it shall be supported per NEC and these specifications. Field verify the existing conditions prior to bidding.

3.02 PREPARATION

A. Owner personnel will identify any existing conduit and electrical equipment that is to remain in place. Coordinate with Owner personnel.

B. Services to areas not within the demolition/remodel areas shall be maintained.

C. Disconnect electrical systems in walls, floors, and ceilings to be removed.

D. Coordinate utility service outages with utility company.

E. Coordinate service outages with Owner. Temporary connections of power, telephone, and data to external buildings must be completed before modifications of those systems occur.

F. All required service and utility outages shall be scheduled in advance, and approved by SDSTA in writing in advance.

G. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

H. Existing Electrical Services: Maintain existing systems in service.

I. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
   1. Obtain permission from Owner at least 168 hours before partially or completely disabling system.

J. Existing Telephone, Data, and Television Systems: Maintain existing systems in service.

3.03 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
   1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
   2. PCB- and DEHP-containing lighting ballasts.
   3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Systems to be relocated, extended, or modified include, but are not limited to (not all may apply) telephone, data, fire alarm, P/A, intercom, security, nurse call, etc. All systems shall be re-tested to ensure functionality. Testing shall be by vendors for proper certifications of operation.

D. Remove abandoned wiring to source of supply.

E. If existing systems supporting/mounting methods are removed support/remount as required to meet the specifications for new.

F. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

G. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

H. Disconnect and remove abandoned panelboards and distribution equipment.

I. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

J. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

K. Repair adjacent construction and finishes damaged during demolition and extension work.

L. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

M. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate. For instance, if new hard ceilings are installed relocate junction boxes as required to maintain accessibility or provide access panels. Contractor shall field verify existing conditions, this shall include: conduit routing, junction box locations, surface/recessed applications, vertical height of components, seal-offs, etc. Documents will not indicate all the details of the electrical system, only main components & devices.

N. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

O. Except where otherwise shown or noted on drawing - "to be retained, relocated" or hereinafter noted, all existing electrical equipment and material in areas to be remodeled/altered shall be removed where they interfere with proposed new construction and or interfere with proposed usage of space by Owner as follows:
   1. Remove any conduits protruding above finished floor, cap and finish over with floor material to match existing.
   2. Remove all light fixtures, receptacles, switches, etc., as indicated, and associated wiring.

P. Remove all surface mounted conduit/boxes and their associated wiring. Remove all concealed raceways, boxes and wiring from partitions being demolished. Remove all existing wiring/cabling from all existing concealed raceways in partitions that are to remain relating to demolished devices.

Q. In remodeled/altered areas any feeders, conduits, branch circuits, signal and telephone circuits, etc. Passing through the remodeled areas to serve (or be served from) existing adjacent, remote, or surrounding areas that are to remain, shall be retained and kept operational and shall be rerouted in all cases where they interfere with any new work or usage to be accomplished in the remodeled area.

R. Where devices are omitted from present branch circuits, the remaining devices shall be re-wired, if needed and as required, to remain on their respective circuits and in operating condition. Re feed from nearest panel or replacement panel. Where possible, electrical contractor may use existing branch circuit conduit, but new circuit wiring will need to be pulled. If existing circuiting is not available in the area of the electrical load, provide a new circuit from the panelboard servicing the area. Where practical, contractor will be allowed to reuse existing wiring, provided that it matches required color code. If contractor elects to exercise this option, he shall warrant used wire as new

S. All wiring (power, lighting) not reused for remodeling areas, shall be completely removed back to associated panels. Empty boxes and conduits shall be removed beyond remodeled area (above ceiling).

T. EXISTING SHARED NEUTRALS: Existing wiring being reused that is sharing neutrals shall be replaced back to panel and new wiring with a dedicated neutral shall be installed. The use of handle ties is not allowed unless specifically noted.

U. Extend existing installations using existing materials where practical, and providing new materials and methods compatible with existing electrical installations. Refer to specific notes on the drawings.

3.04 SALVAGE ITEMS

A. Salvage items to be returned to Owner shall include, but are not limited to, fire alarm equipment, clocks, clock equipment, dimmers, dimming equipment (not reused), panelboards, circuit breakers, hand dryers, and door closers.

B. The Owner shall have salvage rights for existing equipment and wire removed and not reused. If Owner does not wish to keep this equipment, it shall become Contractor's property and be removed from the site, unless otherwise specified or shown.

C. Disposal of all electrical items (fluorescent lamps, fluorescent ballasts, HID lamps, HID ballasts, transformers, etc.) shall be done in full compliance with all applicable local, county, state, and federal requirements. This Contractor shall bear all costs (fees, permits, etc.) associated with these disposal requirements.

D. Check with Owner prior to removal of all items.

E. Items shall not be damaged during removal.

F. Deliver to the Owner all salvage items to be retained by owner. Deliver to owner determined site within the city limits.

G. The Owner shall have the first choice to accept existing devices being removed. Do not relocate existing devices - provide new unless otherwise noted.

H. Salvage items to be returned to Owner shall be as specifically noted on the drawings.

I. All demolition materials not scheduled to be salvaged shall become the Contractor's property, and shall be removed from the site and legally disposed of by or through the contractor.

3.05 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment that remain or that are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

D. Electrical contractor shall be responsible for his own demolition, removal, capping, storing, abandoning, disconnecting, relocating and reconnection of existing electrical equipment and material. All cutting, patching, repairing, replacement and refinishing, shall match the existing construction as nearly as possible.

END OF SECTION 26 0505

SECTION 26 0513
MEDIUM-VOLTAGE CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Medium voltage cable.

B. Cable accessories.

C. This specification describes single conductor EPR (Ethylene-propylene-rubber) insulated, shielded power cables for use in grounded neutral circuits not exceeding 15,000 volts phase-to-phase at conductor temperatures of 90 degrees Centigrade for continuous normal operation, 130 degrees Centigrade for emergency overload conditions, and 250 degrees Centigrade for short-circuit conditions. Cables shall be type MV-105 for CT use in applications covered by the NEC. Otherwise, they are intended for general purpose power cable applications in wet or dry locations, including conduit, cable tray, duct, direct burial, and aerial installation.

1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code; 2017.

B. IEEE 48 - IEEE Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV; 2009.

C. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2009.

D. NEMA WC 71 - Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy; 2014.

E. NEMA WC 74 - 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy; 2012.

F. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 26 0010 - GENERAL PROVISIONS, for submittal procedures.

B. Product Data: Provide for cable, terminations, and accessories.

C. Test Reports: Indicate results of cable test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30 second intervals at maximum voltage.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual sizes and locations of cables.

F. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

G. Maintenance Data: Include instructions for testing and cleaning cable and accessories.

1.05 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.

C. Installer Qualifications: Authorized installer of specified manufacturer with service facilities within 100 miles (160 km) of Project.

D. Products: Listed, classified, and labeled as suitable for the purpose intended.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MEDIUM-VOLTAGE CABLE

A. Manufacturers:
1. General Cable Technologies Corporation: www.generalcable.com.
2. Okonite: www.okonite.com.
3. Southwire Company: www.southwire.com.
4. Kerite; www.kerite.com
5. Prysmian; www.prysmiangroup.com
6. Aetna Insulated Wire; www.aetnawire.com
7. Omni Cable.
8. Substitutions: See Section 260010 - GENERAL PROVISIONS.

B. Medium Voltage Cable: NEMA WC 70 [EPR] insulated cable with copper tape shield.
1. Voltage: 5/15 kV, grounded.
2. Conductor: Copper, stranded, with semi-conducting conductor shield.
3. Construction: Single conductor with metal 5 mil copper tape. Bare copper helically applied with 25% overlap tape shield.
4. Insulation: EPR, 220 mils (6 mm) minimum thickness. 133% insulation level.
5. Armor Material: steel or aluminum.
6. Color Code: Red outer jacket.
   a. 12470V, 3 Phase, 3 Wire System:
      1) Phase A: Red.
      2) Phase B: Orange.
      3) Phase C: Black.
7. Color Code: Yellow outer jacket
   a. 4160V, 3 Phase, 3 Wire System:
      1) Phase A: Red.
      2) Phase B: Black.
      3) Phase C: Blue.
8.

2.02 CABLE ACCESSORIES

A. Manufacturers:
1. 3M: www.3m.com.
2. TE Connectivity; Raychem Products: www.te.com.
3. Cooper Power; www.cooperindustries.com
4. Substitutions: See Section 260010 - GENERAL PROVISIONS.

B. Cast Epoxy Cable Terminations: IEEE 48, Class 1 cast epoxy cable termination in kit form with stress cone, shield ground connection, wet porcelain rain shield for outdoor units, epoxy resin molding material, and accessories and molds required for proper application.

C. Splices:
1. Splices shall only be permitted with Owner's approval prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify routing and termination locations of cable bank prior to rough-in.

C. Cable routing is shown in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

A. Avoid abrasion and other damage to cables during installation.

B. Use suitable lubricants and pulling equipment.

C. Sustain cable pulling tensions and bending radii below recommended limits.

D. Ground cable shield at each termination and splice.

E. Install cables in manholes along wall providing longest route.

F. Arrange cable in manholes to avoid interference with duct entrances.

G. Fireproof cables in manholes using fireproofing tape in half-lapped wrapping. Extend fireproofing 1 inch (25 mm) into duct.

H. Circuit ID: In each cabinet, install permanent identification tags on each cable to clearly designate the circuit phase and voltage. Position the tags so they will be easy to read after the fireproofing tape is installed.

I. Maintain and verify maximum bend radius on all cable for pulling into raceways, boxes, or equipment.

3.03 FIELD QUALITY CONTROL

A. See Section 26 0010 - GENERAL PROVISIONS, for additional requirements.

B. Inspect exposed cable sections for physical damage.

C. Inspect cable for proper connections as indicated.

D. Inspect shield grounding, cable supports, and terminations for proper installation.

3.04 FIELD TESTING

A. Subject each to dielectric-absorption tests after the installation of high-voltage power cables has been completed, including splices, joints, and terminations, and before the cable is energized.

B. Completely isolate each power-cable installation from extraneous electrical connections at cable terminations and joints. Observe safety precautions.

C. First give each power cable a full dielectric-absorption test with 5000-volt insulation-resistance test set. Apply test for a long enough time to fully charge the cable. Record readings every 15 seconds during the first 3 minutes of test and at 1 minute intervals thereafter. Continue test until three equal readings, 1 minute apart, are obtained. Minimum reading is 200 megohms at an ambient temperature of 68 degrees F. Correct readings taken at other than 68 degrees F ambient temperatures.

D. Upon successful completion of the dielectric absorption tests, subject the cable to a direct-current high-potential test for 5 minutes with test voltages applied in accordance with IEEE 400.2 for ethylene propylene rubber-insulated cable.

E. Record leakage current readings every 30 seconds during the first 2 minutes and every minute thereafter for the remainder of the test. When the leakage current continues to increase after the first minute, immediately terminate the test and take steps to find and correct the fault. When a second test becomes necessary, repeat this test procedure.

F. Upon satisfactory completion of the high-potential test, give the cable a second dielectric-absorption test as before.

G. Provide results of the second dielectric-absorption test that agree with the first test and that indicate no evidence of permanent injury to the cable caused by the high-potential test.

H. Record test data and include identification of cable and location, megohm readings versus time, leakage current readings versus time, and cable temperature versus time.

I. Final acceptance depends upon the satisfactory performance of the cable under test. Do not energize cable until recorded test data has been approved by the Engineer. Provide final test reports to the Engineer. Provide reports with a cover letter sheet clearly marked with the System name, Date, and the words "Final Test Report".

3.05 FIREPROOFING INSTALLATION

A. After the cable has been installed, spliced, tested, and inspected, fireproof all exposed cables in cabinets.

B. Cable surfaces to be fireproofed shall be clean and dry.

C. All primary feeder cable (consisting of 3-single-conductor cables) shall be grouped together and wrapped as one (1) assembly with fireproofing tape.

D. The fireproofing shall be applied in the following sequence of steps:
   1. Wrap cable with 3-inch wide x .055 inch thick fireproofing tape. Tape shall be heat resistant organic fabric, one side coated with flame retarding self-extinguishing elastomer. Tape shall withstand fault arc temperature of 20,000 degrees Fahrenheit for 200 cycles. Install either 2 layer butt lapped or 1 layer half lapped.
   2. Install glass cloth, 1/2 inch wide x 0.007 inch thick tape at three foot intervals and at each end of the fireproofing tape. The tape shall be applied in bands with two complete wraps.

3.06 PROTECTION

A. Protect installed cables from entrance of moisture.

END OF SECTION 26 0513

SECTION 26 0519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Armored cable.

B. Metal-clad cable.

C. Wiring connectors.

D. Electrical tape.

E. Oxide inhibiting compound.

F. Cable ties.

1.02 RELATED REQUIREMENTS

A. Section 26 0505 - Selective Demolition for Electrical: Disconnection, removal, and/or extension of existing electrical conductors and cables.

B. Section 26 0513 - Medium-Voltage Cables: Cables and terminations for systems 601 V through 35,000 V.

C. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011 (Reapproved 2017).

C. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).

D. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

F. NECA 104 - Recommended Practice for Installing Aluminum Building Wire and Cable; 2012.

G. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.

H. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2009.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

K. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

L. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

M. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

N. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

O. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 26 0010 - General Provisions, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Furnish products listed and classified by Underwriters Laboratories inc. as suitable for the purpose specified and indicated.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Metal-clad cable is permited and/or non-metal-clad cables.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

D. Comply with NEMA WC 70.

E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

F. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

G. Conductor Material:
1. Provide copper conductors except where aluminum conductors are specifically indicated or permitted for substitution. Conductor sizes indicated are based on copper unless specifically indicated as aluminum. Conductors designated with the abbreviation "AL" indicate aluminum.
2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.

H. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
a. Exceptions:

1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.
2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.
3) 20 A, 277 V circuits longer than 150 feet (46 m): 10 AWG, for voltage drop.
4) Feeders conductors shall be sized for a maximum voltage drop of 3% at design load.
5) Branch circuit conductors shall be sized for a maximum voltage drop of 5% at design load.
6) This contractor shall derated conductor ampacity in areas of high ambient temperature per the NEC.
7) Provide a separate neutral for each phase wire - NO SHARED NEUTRALS. This applies to single phase circuits only.
8) Provide additional derating per NEC tables 310-16 through 310-31 note 8 for all home runs with more than 3 current carrying conductors in a reaceway.

2. Control Circuits: Only use 16 AWG for all external control circuit wiring.

I. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
2. Color Coding Method: Integrally colored insulation.
3. Color Code: Black outer jacket.
a. 480Y/277 V, 3 Phase, 4 Wire System:
1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.
4) Neutral/Grounded: Gray.
b. 208Y/120 V, 3 Phase, 4 Wire System:
1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.
4) Neutral/Grounded: White.
c. Equipment Ground, All Systems: Green.
d. Travelers for 3-Way and 4-Way Switching: Pink.
e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
f. For control circuits, comply with manufacturer's recommended color code.

2.03 METAL-CLAD CABLE

A. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

B. Conductor Stranding:
1. Size 10 AWG and Smaller: Solid.
2. Size 8 AWG and Larger: Stranded.

C. Insulation Voltage Rating: 600 V.

D. Insulation: Type THWN.

E. Grounding: Full-size integral equipment grounding conductor.

F. Armor: Steel, interlocked tape.

2.04 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Wiring Connectors for Splices and Taps:
1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.

2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
3. Connectors for Aluminum Conductors: Use compression connectors.

C. Wiring Connectors for Terminations:
1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
6. Aluminum Conductors: Use compression connectors for all connections.
7. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
8. Conductors for Control Circuits: Use crimped terminals for all connections.

D. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.

E. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.

F. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

G. Mechanical Connectors: Provide bolted type or set-screw type.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. For the connection to any of the following: utility transformer, exterior transformer, transition cabinet, or padmount transformer, provide long barrel, 2 hole NEMA spaced, tin plated copper compression connectors with hot dipped galvanized or stainless steel hardware consisting of 1/2 inch bolts, washers, lock washers, and nuts.
2. Engineer to witness installation - schedule accordingly. With engineer approval photographs may be provided in lieu of engineer oversight. Coordinate required photos with engineer.

2.05 WIRING ACCESSORIES

A. Electrical Tape:
1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
3. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil (2.3 mm).

B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
1. Provide for ALL aluminum conductor terminations, splices, etc.

C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

D. All permanent splices shall be made with compression type connectors. Split bolts shall not be permitted except for temporary wiring.

E. Solderless Pressure Connectors:
   1. Scotch lok brand not acceptable.

F. Splices and taps shall be approved by owner & engineer prior to installation. When allowed for conductor sizes No. 6 and larger splicing shall be compression with heat shrink insulation.

G. Where a circuit passes through an outlet box and is tapped, all leads should be pigtailed out to the wiring device, including the equipment ground wire. This prevents loss of neutral or ground during maintenance work.

H. All underground splices shall be waterproof/watertight.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03 INSTALLATION

A. Circuiting Requirements:
   1. Unless dimensioned, circuit routing indicated is diagrammatic.
   2. When circuit destination is indicated without specific routing, determine exact routing required.
   3. Arrange circuiting to minimize splices.
   4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.
   5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
   6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
   7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
      a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
      b. Increase size of conductors as required to account for ampacity derating.
      c. Size raceways, boxes, etc. to accommodate conductors.
   8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install aluminum conductors in accordance with NECA 104.

E. Install metal-clad cable (Type MC) in accordance with NECA 120.

F. Installation in Raceway:
   1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
   2. Pull all conductors and cables together into raceway at same time.
   3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
   4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
   1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
   2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.

I. Terminate cables using suitable fittings.
   1. Metal-Clad Cable (Type MC):
      a. Use listed fittings.
      b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

J. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.

K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

M. Make wiring connections using specified wiring connectors.
   1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
   2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
   3. Do not remove conductor strands to facilitate insertion into connector.
   4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
   5. Connections for Aluminum Conductors: Fill connectors with oxide inhibiting compound where not pre-filled by manufacturer.
   6. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   7. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

O. Insulate ends of spare conductors using vinyl insulating electrical tape.

P. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

Q. Identify conductors and cables in accordance with Section 26 0553.

R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 26 0010.

S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

T. Route wire and cable as required to meet project conditions.
   1. Wire and cable routing indicated is approximate unless dimensioned.
   2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
   3. Include wire and cable of lengths required to install connected devices within 10 ft of location shown.

U. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

3.04 FIELD QUALITY CONTROL

A. See Section 26 0010 - General Provisions, for additional requirements.

B. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION 26 0519

SECTION 26 0526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
   1. Includes oxide inhibiting compound.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 99 - Health Care Facilities Code; 2018.

E. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 PERFORMANCE REQUIREMENTS

A. Grounding system Resistance: 25 ohms maximum.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Verify exact locations of underground metal water service pipe entrances to building.
   2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
   3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.06 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

C. Shop Drawings:
   1. Indicate proposed arrangement for signal reference grids. Include locations of items to be bonded and methods of connection.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Field quality control test reports.

F. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.07 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications for Signal Reference Grids: Company with minimum five years documented experience with high frequency grounding systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

F. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:
   1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect. Precipitation within the previous 48 hours does not constitute normally dry conditions.
   2. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
   3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Grounding Electrode System:
   1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
      a. Provide continuous grounding electrode conductors without splice or joint.
      b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
   2. Metal Underground Water Pipe(s):
      a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.
      b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.

c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Metal In-Ground Support Structure:
   a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
4. Concrete-Encased Electrode:
   a. Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
5. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
   a. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.
6. Ground Riser: Provide common grounding electrode conductor not less than 3/0 AWG for tap connections to multiple separately derived systems as permitted in NFPA 70.

G. Service-Supplied System Grounding:
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
   a. Transformers (except autotransformers such as buck-boost transformers).
   b. Uninterruptible power supplies (UPS), when configured as separately derived systems.
   c. Generators, when neutral is switched in the transfer switch.
2. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
3. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
4. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
5. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

I. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.

3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
    a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
    b. Metal gas piping.
    c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.
10. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.
11. Provide bonding and equipment grounding for pools and fountains and associated equipment in accordance with NFPA 70.
12. Provide redundant grounding and bonding for patient care areas of health care facilities in accordance with NFPA 70 and NFPA 99.

J. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.
    a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.
    b. Raceway Size: 3/4 inch (21 mm) trade size unless otherwise indicated or required.
    c. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
    d. Ground Bar Mounting Height: 18 inches (450 mm) above finished floor unless otherwise indicated.

2.02 GROUNDING AND BONDING COMPONENTS

A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
1. Use insulated copper conductors unless otherwise indicated.
    a. Exceptions:
        1) Use bare copper conductors where installed underground in direct contact with earth.
        2) Use bare copper conductors where directly encased in concrete (not in raceway).
2. Factory Pre-fabricated Bonding Jumpers: Furnished with factory-installed ferrules; size braided cables to provide equivalent gauge of specified conductors.

C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
    a. Exceptions:

1) Use mechanical connectors for connections to electrodes at ground access wells.

3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
   a. Exceptions:
      1) Use exothermic welded connections for connections to metal building frame.

D. Oxide Inhibiting Compound: Comply with Section 26 0519.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Verify existing conditions prior to beginning work.

E. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Make grounding and bonding connections using specified connectors.
   1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
   2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
   3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
   4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
   5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

D. Identify grounding and bonding system components in accordance with Section 26 0553.

E. Bond together each metallic raceway (2" and larger) , pipe, duct and other metal object entering equipment enclosures. Use 2 AWG bare copper conductor per NEC.

F. General: Install electrical grounding systems where shown, in accordance with applicable portions of NEC, with NECA's “Standard of Installation”, and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
   1. Neutral conductors, cable shields, metallic conduits, cable terminations, junction boxes, and other non-current-carrying metallic parts of equipment shall be grounded.
   2. Equipment frames of metal-enclosed equipment, medium-voltage cable shields at cable joints and terminations, metal splice boxes, and other non-current-carrying metal items, shall be grounded unless otherwise indicated. Connections to earth shall be made in the same manner as required for neutral grounding. Equipment operating at more than 750 volts to ground shall be provided with grounds separate from secondary neutral grounds.
   3. Coordinate with other electrical work as necessary to interface installation of electrical grounding system with other work.
   4. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

G. Provide electrical service and distribution grounding system as indicated in drawings and outlined in this specification and as required by NEC.

H. Install ground electrodes at locations as required. Install additional rod electrodes as required to achieve specified resistance to ground.

I. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing.

J. Provide bonding to meet requirements described in Quality Assurance.

K. A new electrical service and distribution will be provided as part of this project. Contractor to not only provide new grounding system as indicated on drawings but Contractor to also provide bonding of existing grounding system to new grounding system. Contractor to ensure all items requiring bonding by NEC, including existing and new, shall be properly bonded.

L. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit. Terminate each end on suitable lug, bus, or bushing.

M. Equipment Grounding Conductor: Provide separate, insulated copper equipment grounding conductor in all of the following runs listed below. Terminate each end on suitable lug, bus, or bushing. Where ground conductors are specified or required, conduit sizes shall be increased as necessary to meet the NEC conduit fill requirements.
   1. All new feeders.
   2. All new feeders run in existing raceways.
   3. All raceways for receptacle circuits, including special power receptacles.
   4. All surface raceways and multi-outlet assemblies containing power receptacle devices (i.e. Wiremold).
   5. All feeds to light fixtures.
   6. All motor feeders and branch circuits.
   7. All flexible metal conduit.
   8. All non-metallic raceways containing power conductors.

N. Terminate each end of equipment ground conductors in an approved lug or bus or bushing.

O. In general, equipment ground conductors are not indicated on the plans. Where ground conductors are required, conduit sizes shall be increased as required to comply with NEC conduit fill requirements.

P. Where a pad mounted transformer is installed, the ground network shall consist of four (4) ground rods, one at each corner of the transformer pad, and interconnect with #1/0 bare copper conductor. Extend separate ground conductors to the primary and secondary side of the transformer. All ground connections below grade shall be of the exothermic weld type. Ground all conduits in the transformer enclosure using grounding bushings. Ground stress cones, lightning arrestors, transformer housings, and all non current carrying metal parts to the ground network. Provide a grounding jumper, provided by the manufacturer, between the grounding network and the transformer neutral.

3.03 FIELD QUALITY CONTROL

A. See Section 01 4500 Quality Control for construction.

B. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

C. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

D. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION 26 0526

SECTION 26 0529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

B. Conduit and equipment supports.

C. Anchors and fasteners.

1.02 RELATED REQUIREMENTS

A. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

B. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

1.03 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2015.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Comply with applicable building code.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:
   1. Comply with the following. Where requirements differ, comply with most stringent.
      a. NFPA 70.
      b. Requirements of authorities having jurisdiction.

2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 25%. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    c. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Steel Spring Clips:
1. Product: Caddy or equivalent.
2. Use only in concealed locations (i.e. above ceilings, within walls, etc.)

D. Supports: Fabricated of structural steel or formed steel members; galvanized or painted, as required.

E. Roof conduit supports: Provide approved conduit supports on roof – equal to Caddy pyramid or Cooper durablock.

F. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.

G. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
3. Channel Material:
    a. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
5. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
6. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
    b. Thomas & Betts Corporation: www.tnb.com.
    c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
    d. Substitutions: See Section 260010 - GENERAL PROVISIONS.

H. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
    a. Equipment Supports: 1/2 inch (13 mm) diameter.
    b. Busway Supports: 1/2 inch (13 mm) diameter.
    c. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch (6 mm) diameter.
    d. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch (10 mm) diameter.
    e. Trapeze Support for Multiple Conduits: 3/8 inch (10 mm) diameter.
    f. Outlet Boxes: 1/4 inch (6 mm) diameter.
    g. Luminaires: 1/4 inch (6 mm) diameter.

I. Anchors and Fasteners:
   1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
   2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
   3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
   4. Hollow Masonry: Use toggle bolts.
   5. Hollow Stud Walls: Use toggle bolts.
   6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
   7. Sheet Metal: Use sheet metal screws.
   8. Wood: Use wood screws.
   9. Plastic and lead anchors are not permitted.
   10. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
      a. Comply with MFMA-4.
      b. Channel Material: Use galvanized steel.
      c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install hangers and supports as required to adequately and securely support electrical system components, in a neat and workmanlike manner, as specified in NECA 1.
   1. Do not drill or cut structural members, unless specifically approved in writing by Structural Engineer.

D. Rigidly weld support members or use hexagon-head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

E. Install surface-mounted cabinets and panelboards with minimum of four anchors.

F. In wet and damp locations, use steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.

G. All supports shall be securely positioned to the structure, not equipment or ceiling tile supports. Coordinate structure load capabilities with General Contractor.

H. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

I. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

J. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

K. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

L. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

M. Equipment Support and Attachment:
   1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
   2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
   3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
   4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

N. Box Support and Attachment: Also comply with Section 26 0533.16.

O. Interior Luminaire Support and Attachment: Also comply with Section 26 5100.

P. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

Q. Secure fasteners according to manufacturer's recommended torque settings.

R. Remove temporary supports.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4500 - Quality Control for Construction.

B. Inspect support and attachment components for damage and defects.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 26 0529

SECTION 26 0533.16
BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).

C. Pull and junction boxes.

1.02 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 2726 - Wiring Devices:
   1. Wall plates.
   2. Floor box service fittings.
   3. Poke-through assemblies.
   4. Access floor boxes.
   5. Additional requirements for locating boxes for wiring devices.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. SCTE 77 - Specification for Underground Enclosure Integrity; 2017.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 508A - Industrial Control Panels; 2013.

I. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
   2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
   3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
   4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
   5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
   6. Coordinate the work with other trades to preserve insulation integrity.

7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 26 0010 - General Provisions, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.

C. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.01 BOXES

A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
1. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
2. Do not use "through-wall" boxes designed for access from both sides of wall.
3. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
4. Wall Plates: Comply with Section 26 2726.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
2. NEMA 250 Environment Type, Unless Otherwise Indicated:
   a. NEMA 4.
3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
   a. Provide hinged-cover enclosures unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:
   1. Unless dimensioned, box locations indicated are approximate.
      a. Adjust box locations up to 10 feet (3m) if required to accommodate intended purpose without adjustment in contract amount.
   2. Locate boxes as required for devices installed under other sections or by others.
      a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
      b. Communications Systems Outlets: Comply with Section 27 1000.
   3. Locate boxes so that wall plates do not span different building finishes.
   4. Locate boxes so that wall plates do not cross masonry joints.
   5. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
   6. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
   7. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.
   8. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
   9. Install in locations as shown on Drawings and approved by owner, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA70.
   10. Set wall mounted boxes at elevations to accommodate mounting heights as indicated.
   11. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
   12. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

I. Box Supports:
   1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
   2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

J. Install boxes plumb and level.

K. Install boxes as required to preserve insulation integrity.

L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

M. Close unused box openings.

N. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

O. Provide grounding and bonding in accordance with Section 26 0526.

P. Identify boxes in accordance with Section 26 0553.

Q. Orient boxes to accommodate wiring devices oriented as specified in Section 26 2726.

R. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

S. Set floor boxes level.

3.03 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.04 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

B. Clean exposed surfaces and restore finish.

END OF SECTION 26 0533.16

SECTION 26 0553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Warning signs and labels.

1.02 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

B. Section 26 2416 Panelboards

C. Section 26 1116 - Secondary Unit Substations

D. Section 26 1839 - Medium Voltage Motor Controllers

1.03 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70E - Standard for Electrical Safety in the Workplace; 2018.

E. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.05 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01 IDENTIFICATION REQUIREMENTS

A. Identification for Equipment:
   1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
      a. Switchgear:
         1) Identify power source and circuit number. Include location when not within sight of equipment.
         2) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      b. Panelboards:
         1) Identify power source and circuit number. Include location when not within sight of equipment.
         2) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
         3) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
      c. Transformers:
         1) Identify kVA rating.
         2) Identify voltage and phase for primary and secondary.

3) Identify power source and circuit number. Include location when not within sight of equipment.
4) Identify load(s) served. Include location when not within sight of equipment.

d. Enclosed switches, circuit breakers, and motor controllers:
1) Identify voltage and phase.
2) Identify power source and circuit number. Include location when not within sight of equipment.
3) Identify load(s) served. Include location when not within sight of equipment.

2. Service Equipment:
a. Use identification nameplate to identify each service disconnecting means.
b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
c. Use identification label at each piece of service equipment to identify the available fault current and the date calculations were performed.

3. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
4. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
5. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
6. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70, including but not limited to the following.
a. Service equipment.
b. Industrial control panels.
c. Motor control centers.
d. Elevator control panels.
e. Industrial machinery.

7. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
a. Minimum Size: 4 by 4 inches (_____ by _____ mm).
b. Legend: Include orange header that reads "WARNING", followed by the word message "Arc Flash and Shock Hazard; Appropriate PPE Required; Do not operate controls or open covers without appropriate personal protection equipment; Failure to comply may result in injury or death; Refer to NFPA 70E for minimum PPE requirements" or approved equivalent.
c. Service Equipment: Include the following information in accordance with NFPA 70.
1) Nominal system voltage.
2) Available fault current.
3) Arc Flash Label - clearing time of overcurrent protective device option not allowed.
4) Date label applied.

8. Use warning signs to identify electrical hazards for entrances to all buildings, vaults, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or

branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.

C. Identification for Boxes:
   1. Use voltage markers or color coded boxes to identify systems other than normal power system.
      a. For exposed boxes in public areas, do not color code.
   2. Use identification labels or handwritten text using indelible marker to identify circuits enclosed. Boxes containing sound, fire alarm, voice, intercom, clock system, data, etc. shall be labeled as such.
      a. For exposed boxes in public areas, use only identification labels.

D. Identification for Devices:
   1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
   2. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
      a. For receptacles in public areas or in areas as directed by Architect, provide identification on inside surface of wallplate.
   3. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

2.02 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:
   1. Materials:
      a. Indoor Clean, Dry Locations: Use plastic nameplates.
      b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
   2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
   3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
   4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
   5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

B. Identification Labels:
   1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
   2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:
   1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
   2. Legend:
      a. System designation where applicable:
         1) Fire Alarm System: Identify with text "FIRE ALARM".
      b. Equipment designation or other approved description.
   3. Text: All capitalized unless otherwise indicated.
   4. Minimum Text Height:
      a. System Designation: 1 inch (25 mm).
      b. Equipment Designation: 1/2 inch (13 mm).
   5. Color:
      a. Normal Power System: White text on black background.
      b. Emergency Power System: White text on red background.

2.03 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:
   1. Materials:
      a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
   2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
   3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.

C. Warning Labels:
   1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
   2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
   3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

B. Degrease and clean surfaces to receive nameplates and labels.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
   1. Surface-Mounted Equipment: Enclosure front.
   2. Flush-Mounted Equipment: Inside of equipment door.
   3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
   4. Elevated Equipment: Legible from the floor or working platform.
   5. Branch Devices: Adjacent to device.
   6. Interior Components: Legible from the point of access.
   7. Boxes: Outside face of cover.
   8. Conductors and Cables: Legible from the point of access.
   9. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Secure rigid signs using stainless steel screws.

G. Mark all handwritten text, where permitted, to be neat and legible.

3.03 FIELD QUALITY CONTROL

A. See Section 26 0010 - General Provisions, for additional requirements.

B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION 26 0553

SECTION 26 0573
POWER SYSTEM STUDIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Short-circuit study.

B. Protective device coordination study.

C. Arc flash and shock risk assessment.
   1. Includes arc flash hazard warning labels.

D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.02 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

B. Section 26 1116 - Secondary Unit Substations.

C. Section 26 1839 - Medium-Voltage Motor Controllers.

D. Section 26 2416 - Panelboards.

1.03 REFERENCE STANDARDS

A. IEEE 141 - IEEE Recommended Practice for Electrical Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).

B. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).

C. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.

D. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.

E. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).

F. NEMA MG 1 - Motors and Generators; 2017.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 70E - Standard for Electrical Safety in the Workplace; 2018.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
   2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Submit study reports prior to or concurrent with product submittals.
   2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.

1.05 SUBMITTALS

A. See Section 26 0010 - GENERAL PROVISIONS, for submittal procedures.

B. Study reports, stamped or sealed and signed by study preparer.

C. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.

1.06 POWER SYSTEM STUDIES

A. Scope of Studies:
   1. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
   2. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.

B. General Study Requirements:
   1. Comply with NFPA 70.
   2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.

C. Data Collection:
   1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
      a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
         1) Obtain up-to-date information from Black Hills Energy.
      b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
      c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
      d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
      e. Protective Devices:
         1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
         2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
      f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
      g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.

D. Short-Circuit Study:
   1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
   2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
      a. Maximum utility fault currents.
      b. Maximum motor contribution.
      c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
   3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.

E. Protective Device Coordination Study:
   1. Comply with applicable portions of IEEE 242 and IEEE 399.
   2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

3. Analyze protective devices and associated settings for suitable margins between time-current curves to provide adequate protection for equipment and conductors while achieving full selective coordination.

F. Arc Flash and Shock Risk Assessment:
   1. Comply with NFPA 70E.
   2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
   3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
      a. Maximum and minimum utility fault currents.
      b. Maximum and minimum motor contribution.
      c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).

G. Study Reports:
   1. General Requirements:
      a. Identify date of study and study preparer.
      b. Identify study methodology and software product(s) used.
      c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
      d. Identify base used for per unit values.
      e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
      f. Include conclusions and recommendations.
   2. Short-Circuit Study:
      a. For each scenario, identify at each bus location:
         1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
         2) Fault point X/R ratio.
         3) Associated equipment short circuit current ratings.
      b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
   3. Protective Device Coordination Study:
      a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
      b. For each graph include (where applicable):
         1) Partial single-line diagram identifying the portion of the system illustrated.
         2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
         3) Conductors: Damage curves.
         4) Transformers: Inrush points and damage curves.
         5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
         6) Motors: Full load current, starting curves, and damage curves.
         7) Capacitors: Full load current and damage curves.
      c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
         1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
         2) Include ground fault pickup and delay.
         3) Include fuse ratings.
         4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.

d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.

4. Arc Flash and Shock Risk Assessment:
   a. For the worst case for each scenario, identify at each bus location:
      1) Calculated incident energy and associated working distance.
      2) Calculated arc flash boundary.
      3) Bolted fault current.
      4) Arcing fault current.
      5) Clearing time.
      6) Arc gap distance.
   b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

1.07 QUALITY ASSURANCE

A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.

B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
   1. Products:
      a. SKM Systems Analysis, Inc: www.skm.com/#sle.

END OF SECTION 26 0573

SECTION 26 1116
SECONDARY UNIT SUBSTATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Unit substation.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Pads for substation support.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.03 REFERENCE STANDARDS

A. IEEE C37.20.2 - IEEE Standard for Metal-Clad Switchgear; 2015 with Addendum (2020).

B. IEEE C37.20.3 - IEEE Standard for Metal-Enclosed Interrupter Switchgear (1 kV-38 kV); 2013.

C. IEEE C57.12.01 - IEEE Standard for General Requirements for Dry-Type Distribution and Power Transformers; 2020.

D. IEEE C57.12.28 - IEEE Standard for Pad-Mounted Equipment -- Enclosure Integrity; 2014.

E. IEEE C57.12.91 - IEEE Standard Test Code for Dry-Type Distribution and Power Transformers; 2020.

F. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.

G. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

H. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.

I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate electrical characteristics and connection requirements, outline dimensions, connection and support points, weight, specified ratings and materials.

C. Manufacturer's equipment seismic qualification certification.

D. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.

E. Manufacturer's Installation Instructions.

F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

G. Manufacturer's Field Reports: Indicate activities on site, final adjustments and overcurrent protective device coordination curves, adverse findings, and recommendations.

H. Project Record Documents: Include copy of manufacturer's certified drawings.

I. Operation Data: Include operating instructions for manually and electrically opening and closing circuit breakers.

J. Maintenance Data: Include maintenance instructions for cleaning methods; cleaning materials recommended; instructions for circuit breaker removal, replacement, testing and adjustment, and lubrication; procedures for sampling and maintaining fluid.

K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 9300 - Operation and Maintenance Data.
   2. Extra Fuses: Two of each type and size.
   3. Tools: Two each of every special tool required to operate and maintain unit substation.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect products from weather and moisture by covering with heavy plastic or canvas and by maintaining heating within enclosure in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Atlas Electric.

B. Substitutions: See Section 26 0010 - GENERAL PROVISIONS.

2.02 UNIT SUBSTATIONS

A. Description: Secondary unit substation comprising air terminal primary section, transformer section, and medium-voltage switchgear secondary section.

B. Configuration: Mine power center skid mount style.

2.03 SERVICE CONDITIONS

A. Meet requirements for usual service conditions and for the specified unusual service conditions.

B. Maximum Ambient Temperature: 100 degrees F (38 degrees C).

2.04 PRIMARY SWITCH RATINGS

A. Voltage and Insulation Levels: Comply with IEEE C37.20.1.

B. Momentary Current Rating: To IEEE C37.20.1.

C. See drawings for voltage and current ratings.

2.05 TRANSFORMER RATINGS

A. Taps: Standard primary taps.

B. Impedance: 5.75 percent.

C. See drawings for voltage and kVA ratings.

2.06 INCOMING SECTION EQUIPMENT

A. Air terminal compartment.

B. Fused Air Interrupter Switch: IEEE C37.20.3, two position.

C. Metal-Clad Switchgear: IEEE C37.20.2.

D. Surge arrestors rated for voltage.

2.07 DRY TYPE TRANSFORMERS

A. Dry-Type Transformers: Three phase, pad-mounted, self-cooled transformer unit with solid-cast windings.

B. Cooling and Temperature Rise: IEEE C57.12.01; Class AA. 220 degree C insulation class with 150 degree C rise over 40 degree C ambient.

2.08 OUTGOING SECTION EQUIPMENT

A. Bus Material: Copper.

B. Bus Connections: Bolted, accessible from front for maintenance.

2.09 ACCESSORIES

A. Surge Arrestors: Station class, rated per drawing kV; mount in incoming line compartment.

B. 300 kVA unit to have 120/240V distribution panel with 10kVA transformer.

2.10 FABRICATION

A. Enclosure: Comply with requirements of IEEE C57.12.28.

B. Construction: Mining skid mount painted yellow.. NEMA 4 rated.

C. Main Bus: Copper.

2.11 FACTORY FINISHES

A. Clean surfaces before applying paint.

B. Apply corrosion-resisting primer to all surfaces.

C. Apply finish coat of baked enamel paint to 2 mils (0.5 mm) thick.

2.12 SOURCE QUALITY CONTROL

A. Provide factory tests to IEEE C57.12.91 and IEEE C57.12.01. Include the routine tests as defined in the standards and the following other tests:

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with IEEE C57.94.

B. Provide required support and attachment in accordance with Section 26 0529.

C. Install substation plumb and level and with each section aligned properly.

D. Make electrical connections between equipment sections using connectors furnished by manufacturer.

3.02 FIELD QUALITY CONTROL

A. See Section 26 0010 - GENERAL PROVISIONS, for additional requirements.

B. Inspect and test in accordance with NETA ATS, except Section 4.

END OF SECTION 26 1116

SECTION 26 1323

MEDIUM-VOLTAGE METAL-ENCLOSED SWITCHGEAR

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Medium-voltage, metal-enclosed switchgear with load interrupter switches.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

1.03 DEFINITIONS

A. Switchgear may also be identified as load interrupter fusible switchgear, MV fused switch, or MV SWGR.

1.04 REFERENCE STANDARDS

A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

B. IEEE C37.20.3 - IEEE Standard for Metal-Enclosed Interrupter Switchgear (1 kV-38 kV); 2013.

C. IEEE C37.20.4 - IEEE Standard for Indoor AC Switches (1 kV to 38 kV) for Use in Metal-Enclosed Switchgear; 2013.

D. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).

E. ISO 14001 - Environmental Management Systems — Requirements with Guidance for Use; 2015.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. NFPA 70E - Standard for Electrical Safety in the Workplace; 2018.

1.05 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures, for submittal procedures.

B. Shop Drawings: Indicate outline dimensions, enclosure construction, shipping splits, lifting and supporting points, electrical single-line diagram, and equipment electrical ratings.
   1. Include wiring diagrams detailing power, signal, and control systems; differentiate between manufacturer- and field-installed wiring, and between components provided by manufacturer and others.

C. Operation and Maintenance Data:
   1. Provide detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

D. Executed warranty.

E. Project Record Documents:
   1. Configured settings/parameters for adjustable components updated to as-installed and commissioned state, noted if different from factory default.

1.06 QUALITY ASSURANCE

A. Comply with the following:
   1. NFPA 70.
   2. Requirements of local authorities having jurisdiction.
   3. Applicable local codes.

B. Manufacturer Qualifications:
   1. Firm engaged in manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for minimum of 10 years.
   2. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.

3. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.
4. Certified in accordance with ISO 14001, with product environmental profiles (PEPs) for specified products.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.

B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.

C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.

D. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Engineer.

1.08 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

A. See Section 01 9300 - Operation and Maintenance Data for additional requirements.

B. Manufacturer Warranty: Provide manufacturer warranty for defects in material and workmanship for 12 months from date of commissioning or 18 months from date of shipment, whichever comes first. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric; Square D HVL; www.se.com/#sle.

B. S&C Electric Company; www.sandc.com.

C. Source Limitations: Furnish products produced by manufacturer of other electrical distribution equipment for project and obtained from single supplier.

D. Substitutions: See Section 26 0010 - General Provisions.

2.02 MEDIUM-VOLTAGE METAL-ENCLOSED SWITCHGEAR

A. Basis of Design: Schneider Electric; Square D HVL; www.se.com/#sle.

B. Switchgear Ratings/Configurations: As indicated on drawings.

C. Switchgear Assemblies:
1. Comply with IEEE C37.20.3 and IEEE C37.20.4.
2. Sections: Separately constructed cubicle assembled to form rigid freestanding unit, braced to prevent distortion.
3. Bolt sections together to form integrated rigid structure.
4. Capable of withstanding effects of closing, carrying, and interrupting currents up to maximum short circuit rating.

D. Impulse Withstand (Basic Impulse Level):
1. 60 kV for maximum design voltage of 5.5 kV.

E. Power Frequency Withstand:
1. 19 kV for maximum design voltage of 5.5 kV.

F. Short Time Current (Two Second): 25 kA.

G. Integrated Short Circuit Rating: 25kA RMS symmetrical.

H. Main Bus:
   1. Bus Material: Tin-plated copper, noninsulated.
   2. Support from top of enclosure on NEMA Class A-20 fiberglass reinforced polyester standoff insulators.

I. Ground:
   1. Single Bays: Provide ground pad lug.
   2. Multiple Bay Lineups: Provide continuous ground bus through switchgear assembly, securely connected to steel frame of each cubicle.

J. Enclosures:
   1. Construction: Steel, 11 gauge, 0.120 inch (3.04 mm) minimum.
   2. Enviroment Type: Outdoor, non-walk-in.
   3. Outdoor Enclosures:
      a. Roof: Sloped, drip-proof.
      b. Cubicles: Provide door-in-door construction.
      c. Front Outer Door: Bulkhead type with three-point latching and vault-type handle with provisions for padlocking.
      d. NEMA 4.
   4. Provide removable rear covers to assist installation and maintenance of bus and cables.
   5. Finish:
      a. Provide zinc plating for non-painted steel parts.
      b. Prior to paint application, clean steel parts (except for galvanized) and apply pre-treatment of zinc phosphate for outdoor equipment or iron phosphate for indoor equipment.
      c. Paint: TGIC polyester powder, applied electrostatically through air.
      d. Color: ANSI-61 (light gray).
      e. Following paint application, bake parts to produce hard, durable finish uniform in color and free from blisters, sags, flaking, and peeling.
      f. Dry Film Thickness: 2.0 mil (0.050 mm), minimum.

K. Load Interrupter Switch:
   1. Description: 600 A continuous and interrupting, fixed mounted on fiberglass reinforced polyester standoff insulators, quick-make, quick-break with speed of operation independent of operator.
   2. Operating Mechanism: Stored energy.
      a. Operation: Manual via close/open lever.
      b. Provide separate opening and closing springs.
      c. Equip with FuseLogic rated 120 VAC.
   3. Utilize main current carrying paths and arcing interruption path type poles.
   4. Operating Handle:
      a. Permanently attach to front exterior of switchgear for immediate use, except for outdoor applications where switchgear is covered by full-height solid door.
      b. Operate with switch closed with handle in up position, and switch open with handle in down position.
      c. Include provisions for padlocking switch in open or closed position.
   5. Voltage and Short Circuit Ratings: Match ratings specified for integrated assembly.
   6. Momentary Rating: 40 kA, RMS asymmetrical.
   7. Fault Closing: 40 kA, RMS asymmetrical.
   8. Provide viewing window in switch enclosure for visible verification of switch blade position and blown fuse indicators from outside.

L. Accessories:
   1. Incoming Cable Termination: Cable lug. Bolted.
   2. Provide double clamping lugs for terminating cables on switchgear terminal pads.

M. Markings and Labeling:
   1. Provide identification and warning labels/nameplates exterior to equipment resistant to weather, UV, and intended installation environment.
   2. Provide engraved nameplates identifying project-specific equipment tag and service description, cubicles, and enclosure-mounted control and pilot devices.
   3. Provide warning labels/nameplates complying with ANSI Z535.4 at access locations to advise personnel of possible hazards in accordance with listing, NFPA 70, NFPA 70E, and other applicable standards.

N. Interlocks:
   1. Mechanical Interlocks:
      a. Provide interlock to prevent opening of high voltage compartment door with load interrupter switch in closed position.

2.03 SOURCE QUALITY CONTROL

A. See Section 01 4500 - Quality Control for Construction

B. Inspect and test switchgear assemblies at factory prior to shipment.

C. Split large line-ups to permit normal shipping and handling, as well as for ease of rejoining at job site.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer’s written instructions.

B. Unless otherwise indicated, install and anchor switchgear on raised concrete pad 6 inches high; see Section 03 3000.

3.02 FIELD QUALITY CONTROL

A. See Section 01 4500 - Quality Control for Construction for additional requirements.

B. Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
   1. Include necessary material, equipment, labor, and technical supervision.
   2. Replace damaged or malfunctioning equipment and report discrepancies or installation issues.
   3. Identify switchgear with label indicating inspection/testing agency and date of service.

C. Operational Readiness Testing:
   1. Inspect and test equipment and associated systems for conformance to Contract Documents, including equipment manufacturer’s recommendations, and readiness for operation.
      a. Visually inspect for physical damage and proper installation.
      b. Perform tests in accordance with manufacturer's instructions.
      c. Perform tests to verify compliance with Contract Documents.
      d. Perform tests to verify equipment is ready for operation.
      e. Touch-up paint chips and scratches with manufacturer-supplied paint.

3.03 PROTECTION

A. Protect installed switchgear from subsequent construction operations.

3.04 MAINTENANCE

A. See Section 01 9300 - Operation and Maintenance for additional information.

END OF SECTION 26 1323

SECTION 26 1839
MEDIUM-VOLTAGE MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Medium-voltage motor controllers.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete pads and foundations.

1.03 REFERENCE STANDARDS

A. IEEE C37.46 - IEEE Standard Specifications for High-Voltage (>1000 V) Expulsion and Current-Limiting Power Class Fuses and Fuse Disconnecting Switches; 2010.

B. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures, for submittal procedures.

B. Shop Drawings: Indicate outline dimensions, enclosure construction, lifting and supporting points, electrical single line diagram, and equipment electrical ratings.

C. Product Data: Provide data for components and accessories.

D. Test Reports: Indicate findings of field quality control procedures.

E. Manufacturer's Installation Instructions.

F. Operation Data: Manufacturer's instructions for operating products.

G. Maintenance Data: Manufacturer's instructions for repair and maintenance of products.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 9300 - Operation and Maintenance Data, and Section 26 0132 - Product Requirements.
   2. Extra Fuses: One of each size and rating.
   3. Fuse Pulling Tools: One, with insulated-handle, complying with IEEE C37.46.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles (160 km) of Project.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect products from weather and moisture by covering with heavy plastic or canvas and by maintaining heating within enclosure in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Benshaw: Type MVSS. Part #: CFMVFMX-0800-4160-04-00000XX.

2.02 COMPONENTS

A. Medium Voltage Motor Controllers: NEMA ICS 2, Class E2.

1. System Voltage: 4.16 kV, three phase, 60 Hz.
2. Rated Insulation Voltage: 5000 volts.
3. Motor Type and Size: Induction motor, rated 800 hp. horsepower rating shown on drawings.
4. Motor Starting Method: Reduce Voltage Solid State.

B. Contactor: NEMA ICS 2, Fixed type, size H2.

C. Medium Voltage Fuse: IEEE C37.46, Ratings shown on Drawings.
1. Fuse Voltage: 5.08 kV, maximum.
2. Fuse Interrupting Rating: 40,000 amperes rms symmetrical.

D. Thermal Overload Relays: Inductive type, selected by manufacturer to protect motors.

E. Enclosure: NEMA 4, factory-fabricated and finished.
1. Clean surfaces before applying paint.
2. Apply corrosion-resisting primer to all surfaces.
3. Apply finish coat of manufacturer's standard baked enamel paint to 2 mils (0.5 mm) thick.
4. Finish Color: Manufacturer's standard.

2.03 ACCESSORIES

A. Incoming Cable Terminations: Clamp-type, with adequate space for stress cone installation.

B. Auxiliary Contacts: NEMA ICS 2, 2 each normally open contacts in addition to seal-in contact.

C. Pushbuttons: NEMA ICS 2, START/STOP in front cover, with unguarded type operator.

D. Indicating Lights: NEMA ICS 2, RUN: green in front cover.

E. Selector Switches: NEMA ICS 2, HAND/OFF/AUTO, , in front cover.

F. Control Relays: NEMA ICS 2, Class A300 with Form Z contacts rated A150 and 120 volts, 60 Hz, AC operating coil.

G. Control Power Transformer: 120 volt secondary, 500 VA minimum.

H. Emergency Stop Mushroom head pushbutton.

I. Reset pushbutton.

J. Local HMI screen to display fault codes and running parameters and status.

K. RTD remote monitor SPR-100P with (8) RTD inputs.

L. Communications for digital IO status and remote run with Modbus TCP or Ethernet IP protocol.
1. Digital IO points:
a. Digital Input: Pump Run Command
b. Digital Input: Starter Fault Remote Reset
c. Digital Output: Fault Status
d. Digital Output: Starter HOA Status
e. Digital Output: Starter Ready Status
f. Digital Output: Pump Running Status
g. Digital Output: Pump in Lockout Status

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Test to NEMA ICS 2.

END OF SECTION 26 1839

SECTION 26 2416
PANELBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Lighting and appliance panelboards.

B. Overcurrent protective devices for panelboards.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

D. Section 26 0529 - Hangers and Supports for Electrical Systems.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 4300 - Surge Protective Devices.

1.03 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e (Amended 2017).

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

E. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

F. NEMA PB 1 - Panelboards; 2011.

G. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

K. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

L. UL 67 - Panelboards; Current Edition, Including All Revisions.

M. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

N. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

O. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

P. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

Q. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures, for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
1. Include wiring diagrams showing all factory and field connections.
2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

D. Supplier of Switchgear, Panelboards and Fusible Disconnect Switches shall provide a coordination study for short circuit to ensure compliance with NEC requirements. Supplier shall also provide coordination of breaker and fused/shunt trip elevator disconnect to ensure power to the elevator is also coordinated. The Supplier to assume infinite short circuit available at the bus on high side of utility transformer or Supplier shall coordinate directly with Utility Company for actual fault available.

E. Supplier of Switchgear, Panelboards and Fusible Disconnect Switches shall provide an arc flash study in accordance with NFPA 70 and 70E. Contractor shall also provide arc flash labeling of Switchgear, Panelboards and Fusible Disconnect Switches to ensure compliance with NFPA 70 and 70E requirements.

F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 26 0010 - GENERAL PROVISIONS, for additional provisions.
2. Panelboard Keys: Two of each different key.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB/GE: www.geindustrial.com/#sle.

B. Eaton Corporation: www.eaton.com.

C. Schneider Electric; Square D Products: www.schneider-electric.us.

D. Siemens Industry, Inc: www.usa.siemens.com.

E. Substitutions: See Section 260010 - GENERAL PROVISIONS. Not permitted.

2.02 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
   1. Altitude: Less than 6,600 feet (2,000 m).
   2. Ambient Temperature:
      a. Panelboards Containing Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

C. Short Circuit Current Rating:
   1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
   2. Listed series ratings are not acceptable.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.
   1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
   2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
   1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
      a. NEMA 4.
   2. Boxes: Galvanized steel unless otherwise indicated.
      a. Provide wiring gutters sized to accommodate the conductors to be installed.
   3. Fronts:
      a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
      b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
   4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.

L. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
   1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

N. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

O. Load centers are not acceptable.

P. Provide the following features and accessories where indicated or where required to complete installation:
   1. Feed-through lugs.
   2. Sub-feed lugs.

2.03 LIGHTING AND APPLIANCE PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:
   1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   2. Main and Neutral Lug Type: Mechanical.

C. Bussing:
   1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
   2. Phase and Neutral Bus Material: Copper.
   3. Ground Bus Material: Copper.

D. Circuit Breakers: Thermal magnetic bolt-on type, with common trip handle for all poles; UL listed unless otherwise indicated.

E. Minimum Integrated Short Circuit Rating:
   1. 208 Volt Panelboards: Minimum 22,000 amperes rms symmetrical.
   2. 480 Volt Panelboards: 25,000 amperes rms symmetrical.

F. Enclosures:
   1. Provide surface-mounted or flush-mounted enclosures as indicated.
   2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
   3. Provide clear plastic circuit directory holder mounted on inside of door.

G. Where scheduled, provide integral Surge Protection (SPD), as specified in Section 26 4300.

H. All panels shall have spare space and spare circuit breakers as identified on the drawings or of not identified on the plans provide a minimum, 25% spare circuit breakers & 25% space for future circuit breakers.

2.04 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:
   1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
   2. Interrupting Capacity:
      a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated.
      b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
   3. Conductor Terminations:
      a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
   4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
   5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
   6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
   7. Provide the following circuit breaker types where indicated:

a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
c. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
d. For equipment with GFCI requirements provide GFCI breaker protection for all equipment that is not readily accessible per NEC and local Authority Having Jurisdiction.

8. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
9. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
10. Do not use tandem circuit breakers.
11. Do not use handle ties in lieu of multi-pole circuit breakers.
12. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
13. Provide the following features and accessories where indicated or where required to complete installation:
    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.05 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install panelboards plumb.

G. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.

H. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.

I. Mount floor-mounted power distribution panelboards on properly sized 6 inches high concrete pad constructed in accordance with Section 03 3000.

J. Provide minimum of six spare 1 inch (27 mm) trade size conduits out of each flush-mounted (recessed) panelboard stubbed into accessible space above ceiling. Identify each as SPARE.

K. Provide grounding and bonding in accordance with Section 26 0526.
1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.

L. Install all field-installed branch devices, components, and accessories.

M. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.

N. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

O. Provide filler plates to cover unused spaces in panelboards.

P. Identify panelboards in accordance with Section 26 0553.
1. Provide identification nameplate for each power distribution panelboard branch device in accordance with Section 26 0553, clearly and specifically indicating the loads served.

Q. Provide typed circuit directory for each lighting and appliance panelboard and each power distribution panelboard provided with a door, clearly and specifically indicating the loads served. Identify spares and spaces. Revise directory to reflect circuiting changes required to balance phase loads. Hand written directories are not acceptable. Replace existing directories with new updated versions in renovation situations. Directory shall include room numbers.

R. The Electrical Contractor shall be responsible to provide and install the Arc Fault and SCCR labels to the equipment required by the NEC. This includes, but is not limited to Switchboards, Panelboards, Motor Control Centers, elevators, industrial control panels and industrial machinery. This calculation must be done by a qualified person with experience doing these calculations and must be documented and available to the Engineer for review, if requested.

S. Provide arc flash warning labels in accordance with NFPA 70.

T. Ground and bond panelboard enclosure according to Section 26 0526.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 200 amperes. Tests listed as optional are not required.

C. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

D. Test GFCI circuit breakers to verify proper operation.

E. Test shunt trips to verify proper operation.

F. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2416

SECTION 26 2726
WIRING DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Wall plates and covers.

1.02 RELATED REQUIREMENTS

A. Section 26 0533.16 - Boxes for Electrical Systems.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

A. FS W-C-596 .- Connector, Electrical, Power, General Specification for; Revision G, 2001

B. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2017h.

C. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); 2017g.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

E. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

F. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2015).

G. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2016.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

J. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

K. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

L. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
   2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
   3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
   4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
   5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
   6. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:
   1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

A. See Section 01 3300 - Submittal Procedures and Section 26 0010 - General Provisions, for submittal procedures.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Shop Drawings: Required.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

B. Products listed and classified by Underwriters Laboratories Inc.as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 WIRING DEVICE APPLICATIONS

A. Provide wiring devices suitable for intended use and with ratings adequate for load served.

B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.

C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.

D. Unless otherwise noted, do not use combination switch/receptacle devices.

2.02 MANUFACTURERS

A. Hubbell: www.hubbell.com.

B. Cooper/Arrow Hart: www.cooperindustries.com.

C. Legrand - Pass & Seymour

D. Leviton: www.leviton.com.

E. Substitutions: See Section 26 0010 - GENERAL PROVISIONS.

2.03 WIRING DEVICE FINISHES

A. Provide wiring device finishes as described below unless otherwise indicated.

B. Wiring Devices, Unless Otherwise Indicated: Black with stainless steel wall plate.

2.04 WALL SWITCHES

A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
   1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

2.05 RECEPTACLES

A. Manufacturers:
   1. Hubbell Incorporated: www.hubbell.com/#sle.
   2. Leviton Manufacturing Company, Inc: www.leviton.com.
   3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
   4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
   5. Substitutions: See Section 260010 - GENERAL PROVISIONS.

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.
3. Provide labeling of receptacles as outlined in Section 26 0553.

C. GFCI Receptacles:
1. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

D. Special purpose receptacles, as noted or shown on drawings.

2.06 WALL PLATES

A. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard.
3. Screws: Metal with slotted heads finished to match wall plate finish.

B. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

C. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

D. In-Use Weatherproof Cover Plates: Self-closing and weatherproof with cord and plug inserted into device. Product Hubbell WP26MH or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
1. Mounting Heights: Unless otherwise indicated, as follows:
a. Receptacles: 18 inches (450 mm) above finished floor or 6 inches (150 mm) above counter.
2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Connect wiring device grounding terminal to outlet box with bonding jumper, except where equipment grounding conductor is present.

H. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

I. For isolated ground receptacles, connect wiring device grounding terminal only to identified branch circuit isolated equipment grounding conductor. Do not connect grounding terminal to outlet box or normal branch circuit equipment grounding conductor.

J. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

K. Install securely, in a neat and workmanlike manner, as specified in NECA 1.

L. Install wiring devices plumb and level with mounting yoke held rigidly in place.

M. Install wall switches with OFF position down.

N. Mount grouped devices in a single continuous gang box. Use partitions where voltage between exposed live parts of adjacent switched may exceed 300 volts.

O. Provide single coverplate for multi-gang boxes for switches shown grouped on the drawings.

P. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

Q. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

R. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

S. Identify wiring devices in accordance with Section 26 0553.

T. For equipment with GFCI requirements provide GFCI breaker protection for all equipment that is not readily accessible per NEC and local Authority Having Jurisdiction.

U. equipment that is not readily accessible per NEC and local Authority Having Jurisdiction.

V. Install receptacles with grounding pole oriented to the top.

W. Install suspended outlet assembly in accordance with detail shown on drawings.

X. Use jumbo size plates for outlets installed in masonry walls.

Y. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

Z. Install protective rings on active flush cover service fittings.

AA. Biocontainment areas: All coverplates, covers, etc. that penetrate the biocontainment barriers shall be silicone sealed (or similar) with bright white caulk around the plate/cover to eliminate air leakage.

3.04 FIELD QUALITY CONTROL

A. See Section 26 0010 - GENERAL PROVISIONS, for additional requirements.

B. Inspect each wiring device for damage and defects.

C. Perform field inspection in accordance with Quality Requirements.

D. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.

E. Verify that each receptacle device is energized.

F. Test each receptacle to verify operation and proper polarity.

G. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

H. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust devices and boxes as required to assure that device coverplates seat firmly to wal surface.

3.06 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 2726

SECTION 26 4300
SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surge protective devices for branch panelboard locations.

1.02 ABBREVIATIONS AND ACRONYMS

A. SPD: Surge Protective Device.

1.03 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2018.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

B. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

C. Certificates: Manufacturer's documentation of listing for compliance with the following standards:
   1. UL 1449.

D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

G. Project Record Documents: Record actual connections and locations of surge protective devices.

1.05 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.06 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.07 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

A. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

B. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Field-installed, Externally Mounted Surge Protective Devices:
   1. Current Technology; a brand of Thomas & Betts Power Solutions: www.tnbpowersolutions.com.
   2. EATON, SPD Max Series; : www.eaton.com/us/en-us.
   3. Switchboard/Panelboard Manufacturer.

B. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

C. Substitutions: See Section 26 0010 - General Provisions.

2.02 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated .

B. Unless otherwise indicated, provide field-installed, externally-mounted SPDs.

C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D. Protected Modes:
   1. Wye Systems: L-N, L-G, N-G, L-L.

E. UL 1449 Voltage Protection Ratings (VPRs):
   1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
   2. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.

F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
   1. Outdoor locations: Type 3R.

H. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:
   1. Provide surface-mounted SPD where mounted in non-public areas or adjacent to surface-mounted equipment.

2.03 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Surge Protective Device:
   1. Protection Circuits: Field-replaceable modular or non-modular.
   2. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.
   3. UL 1449 Nominal Discharge Current (I-n): 20 kA.
   4. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
   5. Diagnostics:
      a. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
      b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.

B. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

C. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

D. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

E. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03 FIELD QUALITY CONTROL

A. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.04 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 4300

SECTION 26 5100

INTERIOR LIGHTING

PART 2 PRODUCTS

1.01 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

END OF SECTION 26 5100

SECTION 27 1000
STRUCTURED CABLING

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0533.16 - Boxes for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products.

D. Section 26 2726 - Wiring Devices.

1.02 REFERENCE STANDARDS

A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2017c.

C. TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2019d.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
   1. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
   2. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F (0 to 60 degrees C) at relative humidity of 0 to 95 percent, noncondensing.
   3. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.

B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
   1. Locate main distribution frame as indicated on the drawings.

C. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.02 IDENTIFICATION PRODUCTS

A. Comply with TIA-606.

END OF SECTION 27 1000