



ARCHITECTURE
ENGINEERING

November 8, 2013

Re: **ADDENDUM FOUR - DELAWARE STATE POLICE - TROOP 3- BID PACK 1**
Dover, Delaware
2011116.00

ADDENDUM FOUR

The addendum forms a part of the contract documents and modifies the original bidding documents dated, October 9, 2013, modified by Addendum No. 1 dated 10-18-2013, Addendum No. 2 dated 10-25-2013, and Addendum No. 3 dated 10-31-2013, as noted below.

GENERAL

The bid period has been extended.

Sealed bids for OMB/DFM Contract No. MJ450600001 – Delaware State Police – New Troop 3 – Site Work will be received by the State of Delaware, Office of Management and Budget, Division of Facilities Management in the reception area of the Facilities Management Office in the Thomas Collins Building, 504 S. DuPont Highway, Suite 1 (Third Floor), Dover, DE 19901 until 2:00 pm local time on Wednesday, November 26, 2013, at which time they will be publicly opened and read aloud in the conference room. Bidder bears the risk of late delivery. Any bids received after the stated time will be returned unopened.

CLARIFICATION

The Class A Apprenticeship Program requirement, listed in Project Manual Section 004513 has been removed. See revised Section 004513 included with this addendum.

Electrical specification sections have been added to the Project Manual to address the previously discussed electrical scope of work at the proposed packaged grinder pump station, as discussed below and attached with this addendum.

PROJECT MANUAL

- 1. TABLE OF CONTENTS**
 - a. REVISE To reflect added specification sections, listed below.
- 2. SECTION 004100 BID FORM**
 - a. REVISE For Bids Due: Until 2:00 pm (local Time) November 26, 2013.
- 3. SECTION 004513 CONTRACTOR RESPONSIBILITY**
 - a. REVISE Removed the Class A Apprenticeship Program requirement.
- 4. SECTION 260519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND**

CABLES

- a. SECTION ADDED
- 5. SECTION 260526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**
 - a. SECTION ADDED
- 6. SECTION 260529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**
 - a. SECTION ADDED
- 7. SECTION 26 05 34 CONDUIT**
 - a. REVISE Conduit materials.
- 8. SECTION 260537 BOXES**
 - a. SECTION ADDED
- 9. SECTION 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS**
 - a. SECTION ADDED
- 10. SECTION 262200 LOW-VOLTAGE TRANSFORMERS**
 - a. SECTION ADDED
- 11. SECTION 262813 FUSES**
 - a. SECTION ADDED
- 12. SECTION 262818 ENCLOSED SWITCHES**
 - a. SECTION ADDED
- 13. 323113 CHAIN LINK FENCES AND GATES**
 - a. REVISE To reflect amended post size and materials, manufacturers, fence height, removal of barbed wire text, and slide gate specification.

BIDDER QUESTIONS & RESPONSES

- 1) *Please refer to number 14 on the Contractor Responsibility form. Does this apply to any subcontractor or just the subcontract categories determined at the pre-bid meeting? There will be additional subcontractors such as pavement markings, signage, jack & bores and turf establishment. Other bidders may even have more subcontract categories. We are not having any luck finding subcontractors that participate in a Class A Apprenticeship Program. Most local subcontractors are not willing to participate in a Class A Apprenticeship Program for various reasons. We request that you provide us with a list of subcontractors, for each category, that participate in a Class A Apprenticeship Program.*

The Class A Apprenticeship Program requirement, listed in Project Manual Section 004513 has been removed. See revised Section 004513 included with this addendum.

- 2) *I just wanted to clarify what I interpreted in Addendum #1. If the contractor does not currently have a Class A Apprenticeship Program in place they can not bid on this project? Dixie currently does not have one in place and I see George & Lynch does not have one either according to their question. The contractors have already had to go through pre-qualifications in order to bid this project and none of this was mentioned in the annual or supplemental pre-quals.*

The Class A Apprenticeship Program requirement, listed in Project Manual Section 004513 has been removed. See revised Section 004513 included with this addendum.

- 3) *Please clarify if possible: They are asking for 4" OD terminals. Is that for only the cantilever slide gate posts or do they mean all terminals posts which are end and corner posts? For 6' high, 4" corner posts are larger than usually specified. No where do they mention the size of the line posts (intermediate posts). Do they want 2-1/2" OD of if they are really going so heavy on the ends and corners, do they want 3" OD line posts? They are calling for Schedule #40 coated and no one does that because it is rough and the vinyl doesn't coat well. All of our state of Delaware jobs are smooth SS40 from Allied Tube and Conduit when the job requires it to be black vinyl coated. The gates described are round frame cantilever slide which is too heavy for a 30 foot and 40 foot opening and it will cause operator problems by too much drag. They should have used a square frame aluminum with enclosed rollers. The specs are really confusing because the three suppliers named are Allied Tube and Conduit – currently in business. Then they give Anchor Fence, Inc. (been out of business for 15 years) and Dominion Fence (out of business for years).*

End post, corner post and line post sizes and acceptable materials; slide gate specifications, fence height, removal of barbed wire and acceptable manufacturers have been amended in the revised specification, Section 323113, attached.

- 4) *Pertaining to the Alternate price- does the second slide gate get an operator as well?*

The slide gate does include a gate operator, if installed.

- 5) *Is there a specification for the downspout boots shown on the detail on drawing C-903?*

See specification Section 334100 Part 1.2.B.

- 6) *The drawings are saying 6' high fence and the spec's are saying 8' high! Also, spec's say Barb –wire and the drawings do not indicate. Can you please clarify??*

See RFI # 3 above.

- 7) *Is the masonry portion of the trash dumpster enclosure part of the sitework scope of work?*

Yes.

- 8) *Are individual water services being installed for the homeowners on Banning Rd where the Artesian Water line runs? If so, how many services are required and what size?*

No individual water services are to be installed along Banning Road.



ARCHITECTURE
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Attachments

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Section 260534 CONDUIT

Section 260537 BOXES

Section 260553 IDENTIFICATION FOR ELECTRICAL SYSTEMS

Section 262200 LOW-VOLTAGE TRANSFORMERS

Section 262813 FUSES

Section 262818 ENCLOSED SWITCHES

Section 323113 CHAIN LINK FENCES AND GATES

END OF ADDENDUM FOUR

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DELAWARE STATE POLICE NEW TROOP 3 – BID PACK I - SITEWORK
KENT COUNTY, DELAWARE
CONTRACT # MJ450600001

BID FORM

For Bids Due: Until 2:00 pm (Local Time) **To:** State of Delaware, Office of Management and Budget
November 26, 2013 Division of Facilities Management
540 S. DuPont Highway, Suite 1
Dover, Delaware 19901
Attn: Rich Glazeski

Name of Bidder: _____

Delaware Business License No.: _____ **Taxpayer ID No.:** _____

(Other License Nos.): _____

Phone No.: () _____ - _____ **Fax No.:** () _____ - _____

The undersigned, representing that he has read and understands the Bidding Documents and that this bid is made in accordance therewith, that he has visited the site and has familiarized himself with the local conditions under which the Work is to be performed, and that his bid is based upon the materials, systems and equipment described in the Bidding Documents without exception, hereby proposes and agrees to provide all labor, materials, plant, equipment, supplies, transport and other facilities required to execute the work described by the aforesaid documents for the lump sum itemized below:

\$ _____
(\$ _____)

ALTERNATES

Alternate prices conform to applicable project specification section. Refer to specifications for a complete description of the following Alternates. An “ADD” or “DEDUCT” amount is indicated by the crossed out part that does not apply.

ALTERNATE No. 1: Addition of second access road and associated construction. Refer to drawings for limits of scope.

Add/Deduct: _____
(\$ _____)

ALTERNATE No. 2: Increase in rear parking area and associated construction. Refer to drawings for limits of scope.

Add/Deduct: _____
(\$ _____)

ALTERNATE No. 3: Finish Grade, Top-soil and Seed, and revised fence layout in place of rough grade at proposed maintenance building. Refer to drawings for limits of scope.

Add/Deduct: _____
(\$ _____)

DELAWARE STATE POLICE NEW TROOP 3 – BID PACK I - SITEWORK
KENT COUNTY, DELAWARE
CONTRACT # MJ450600001

BID FORM

UNIT PRICES

Unit prices conform to applicable project specification section. Refer to the specifications for a complete description of the following Unit Prices:

	<u>ADD</u>	<u>DEDUCT</u>
UNIT PRICE No. 1: <u>Removal / Replacement of Unsatisfactory Soils-</u> \$ / CY	\$ _____	\$ _____
UNIT PRICE No. 2: <u>1/2" Diameter Electrical Conduit -</u> \$ / LF	\$ _____	\$ _____
UNIT PRICE No. 3: <u>1" Diameter Electrical Conduit -</u> \$ / LF	\$ _____	\$ _____
UNIT PRICE No. 4: <u>4" Diameter Electrical Conduit -</u> \$ / LF	\$ _____	\$ _____
UNIT PRICE No. 5: <u>6" Diameter Electrical Conduit -</u> \$ / LF	\$ _____	\$ _____
UNIT PRICE No. 6: <u>Miscellaneous Concrete-</u> \$ / CY	\$ _____	\$ _____
UNIT PRICE No. 7: <u>Offsite Select Borrow Fill-</u> \$ / 750 CY	\$ _____	\$ _____

DELAWARE STATE POLICE NEW TROOP 3 – BID PACK I - SITEWORK
KENT COUNTY, DELAWARE
CONTRACT # MJ450600001

BID FORM

I/We acknowledge Addendums numbered _____ and the price(s) submitted include any cost/schedule impact they may have.

This bid shall remain valid and cannot be withdrawn for sixty (60) days from the date of opening of bids, and the undersigned shall abide by the Bid Security forfeiture provisions. Bid Security is attached to this Bid.

The Owner shall have the right to reject any or all bids, and to waive any informality or irregularity in any bid received.

This bid is based upon work being accomplished by the Sub-Contractors named on the list attached to this bid.

Should I/We be awarded this contract, I/We pledge to achieve substantial completion of all the work within _____ calendar days of the Notice to Proceed.

The undersigned represents and warrants that he has complied and shall comply with all requirements of local, state, and national laws; that no legal requirement has been or shall be violated in making or accepting this bid, in awarding the contract to him or in the prosecution of the work required; that the bid is legal and firm; that he has not, directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken action in restraint of free competitive bidding.

Upon receipt of written notice of the acceptance of this Bid, the Bidder shall, within twenty (20) calendar days, execute the agreement in the required form and deliver the Contract Bonds, and Insurance Certificates, required by the Contract Documents.

I am / We are an Individual / a Partnership / a Corporation

By _____ Trading as _____
(Individual's / General Partner's / Corporate Name)

(State of Corporation)

Business Address: _____

Witness: _____ **By:** _____
(SEAL) (Authorized Signature)

(Title)
Date: _____

ATTACHMENTS

- Sub-Contractor List
- Non-Collusion Statement
- Bid Security
- (Others as Required by Project Manuals)

DELAWARE STATE POLICE NEW TROOP 3 – BID PACK I – SITEWORK
KENT COUNTY, DELAWARE
CONTRACT # MJ4506000001

BID FORM

SUBCONTRACTOR LIST

In accordance with Title 29, Chapter 6962 (d)(10)b Delaware Code, the following sub-contractor listing must accompany the bid submittal. The name and address of the sub-contractor **must be listed for each category** where the bidder intends to use a sub-contractor to perform that category of work. In order to provide full disclosure and acceptance of the bid by the *Owner*, **it is required that bidders list themselves as being the sub-contractor for all categories where he/she is qualified and intends to perform such work.**

<u>Subcontractor Category</u>	<u>Subcontractor</u>	<u>Address (City & State)</u>	<u>Subcontractors tax payer ID # or Delaware Business license #</u>
1. Site Work	_____	_____	_____
2. Concrete	_____	_____	_____
3. Paving	_____	_____	_____
4. Landscaping	_____	_____	_____
5. Electrical	_____	_____	_____
6. Directional Drilling	_____	_____	_____
7. Fencing	_____	_____	_____

DELAWARE STATE POLICE NEW TROOP 3 – BID PACK I – SITEWORK
KENT COUNTY, DELAWARE
CONTRACT # MJ450600001

BID FORM
NON-COLLUSION STATEMENT

This is to certify that the undersigned bidder has neither directly nor indirectly, entered into any agreement, participated in any collusion or otherwise taken any action in restraint of free competitive bidding in connection with this proposal submitted this date (*to the Office of Management and Budget, Division of Facilities Management*).

All the terms and conditions of (*Project or Contract Number*) have been thoroughly examined and are understood.

NAME OF BIDDER: _____

AUTHORIZED REPRESENTATIVE (TYPED): _____

AUTHORIZED REPRESENTATIVE (SIGNATURE): _____

TITLE: _____

ADDRESS OF BIDDER: _____

E-MAIL: _____

PHONE NUMBER: _____

Sworn to and Subscribed before me this _____ day of _____ 20____.

My Commission expires _____. NOTARY PUBLIC _____.

THIS PAGE MUST BE SIGNED AND NOTARIZED FOR YOUR BID TO BE CONSIDERED.

CONTRACTOR RESPONSIBILITY

PROSPECTIVE BIDDERS NOTES:

1. **Contractor Responsibility Certification** forms are required to be submitted with the bid.

The Department is performing a pilot project for Contractor Responsibility requirements for one project located in Kent County. This project has been selected. The required forms are provided within this document along with the Bid forms. The Certification forms must be fully completed, initialed as indicated, signed, notarized, and submitted with your bid.

Contractor Responsibility Certification

Firm: _____

(Insert name, address and telephone number of firm submitting certification)

Project Name: _____

Project Number: _____

As a condition of performing work on a project for the OMB/DFM, a contractor submitting a bid shall execute this form and certify compliance with the responsible contractor qualification standards set forth below. Bids will not be accepted unless they are accompanied by a fully executed copy of this certification form.

This form must be completed by an employee or other person representing the submitting firm who has the authority to execute this form and has adequate knowledge to address all matters specified herein. **The person completing this form shall initial* each qualification standard listed below and execute the signature requirement at the end of this form in the presence of a notary.**

Contractor Qualification Standards

- (1) The firm meets the bonding requirements for the contract, as required by applicable law or contract specifications and any insurance requirements, as required by applicable law or contract specifications, including general liability insurance, workers compensation insurance and unemployment insurance. _____*
- (2) The firm has not been debarred or suspended by any federal, state or local government agency or authority in the past three years. _____*
- (3) The firm has not defaulted on any project in the past three years. _____*
- (4) The firm has not had any type of business, contracting or trade license, registration, or other certification revoked or suspended in the past three years. _____*

- (5) The firm and its owners have not been convicted of any crime relating to the contracting business in the past ten years. _____*
- (6) The firm has not within the past three years been found in violation of any law applicable to its contracting business, including, but not limited to, licensing laws, tax laws, prompt payment laws, wage and hour laws, prevailing wage laws, environmental laws or others, where the result of such violation was the payment of a fine, back pay damages or any other type of penalty in the amount of \$1,000 or more. _____*
- (7) The firm will pay all craft employees that it employs on the project the current wage rates and fringe benefits as required under applicable federal, state or local wage laws. _____*
- (8) All craft labor that will employed by the firm for the project have completed at least the OSHA 10 hour training course for safety established by the U.S. Department of Labor. Occupational Safety & Health Administration. _____*
- (9) The firm will employ craft employees in all classifications and individual trades required to successfully perform the work related to this project. _____*
- (10) The firm has all other technical qualifications and resources, including equipment, personnel and financial resources, to perform the referenced contract, or will obtain same through the use of qualified, responsible subcontractors. _____*
- (11) The firm will maintain all qualifications, resources and capabilities referenced in this certification throughout the duration of the project. _____*
- (12) The firm shall notify the OMB/DFM, within seven days of any material changes to all matters attested to in this certification. _____*
- (13) If the firm is identified as the lowest apparent bidder, it shall provide the OMB/DFM, within seven days, the Subcontractor Responsibility Certifications executed by the identified subcontracting firms which shall contain the same information set forth in this certification. _____*

CONTRACTOR RESPONSIBILITY

00 45 13-2

The undersigned attests that he or she has the authority to execute this form and has sufficient knowledge to address all matters specified herein and attests, under the penalty of perjury, that the information submitted is true, complete and accurate.

Print and Sign Name

Title

Name of Firm

Date

Subscribed and sworn to before me this _____ day

Of _____, 20____

Notary Public

My Commission Expires: _____

SECTION 260519**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Wire and cable for 600 volts and less.
- C. Wiring connectors.
- D. Electrical tape.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2001 (Reapproved 2007).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010.
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2009).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- I. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- J. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- K. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- L. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- M. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- N. 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 DEDC, LLC of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. 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. Conform to requirements of NFPA 70.

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, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify DEDC, LLC 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. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.
- H. Exterior Locations: Use only building wire with Type THWN-2 insulation in raceway.
- I. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- J. Use stranded conductors for control circuits.
- K. Use conductor not smaller than 12 AWG for power and lighting circuits.
- L. Use conductor not smaller than 14 AWG for control circuits.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- 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. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- H. Conductor Material:
 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787787M unless otherwise indicated.
 3. Tinned Copper Conductors: Comply with ASTM B33.
- I. Minimum Conductor Size:
 1. Branch Circuits: 12 AWG.
 - J. 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:
 - 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. 240/120 V, 1 Phase, 3 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Neutral/Grounded: White.
 - c. Equipment Ground, All Systems: Green.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com.
 - b. Encore Wire Corporation: www.encorewire.com.
 - c. Southwire Company: www.southwire.com.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.
- F. Conductor: Copper.
- G. Insulation Voltage Rating: 600 volts.
- H. Insulation: NFPA 70, Type THHN/THWN.
- I. Insulation: Thermoplastic material rated 75 degrees C.

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. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. 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.
- D. Wiring Connectors for Terminations:
 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
 - c. NSI Industries LLC: www.nsiindustries.com.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilsco.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.05 WIRING ACCESSORIES

- A. Electrical Tape:
 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com.
 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. American Polywater Corporation: www.polywater.com.
 - c. Ideal Industries, Inc: www.idealindustries.com.

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 raceway installation is complete and supported.
- E. Verify that field measurements are as shown on the drawings.
- F. 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. Arrange circuiting to minimize splices.
 - 2. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.
 - a. Increase size of conductors as required to account for ampacity derating.
 - 3. 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. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- D. 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.
- E. 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.
- F. Install conductors with a minimum of 12 inches of slack at each outlet.
- G. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- H. 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. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- I. 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.
- J. Insulate ends of spare conductors using vinyl insulating electrical tape.

- K. 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.
- L. Identify conductors and cables in accordance with Section 26 05 53.
- M. Color Code Legend: Provide identification label identifying color code for ungrounded conductors 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.
- N. 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.
- O. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
- P. 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.
- Q. Use wiring methods indicated.
- R. Pull all conductors into raceway at same time.
- S. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- T. Protect exposed cable from damage.
- U. Use suitable cable fittings and connectors.
- V. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- W. Clean conductor surfaces before installing lugs and connectors.
- X. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- Y. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- Z. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- AA. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA STD ATS, except Section 4.
- B. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- C. Correct deficiencies and replace damaged or defective conductors and cables.
- D. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION

SECTION 260526
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 rod electrodes.
- E. Grounding and bonding components.
- F. Provide all components necessary to complete the grounding system(s) consisting of:
 - 1. Existing metal underground water pipe.
 - 2. Metal underground water pipe.
 - 3. Metal frame of the building.
 - 4. Rod electrodes.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. IEEE 81 - Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System; 1983.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; National Electrical Manufacturers Association; 2007.
- D. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04 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 DEDC, LLC of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.05 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms.

1.06 SUBMITTALS

- A. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

1.07 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS**2.01 GROUNDING AND BONDING REQUIREMENTS**

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. 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.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding System Resistance:
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by DEDC, LLC. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System: Not greater than 5 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 according to IEEE 81 using "point-to-point" methods.
- E. 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.
 - 2. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
- F. 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.

2.02 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.

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 05 19:
 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).
- 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.
 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
- D. Ground Rod Electrodes:
 1. Comply with NEMA GR 1.
 2. Material: Copper-bonded (copper-clad) steel.
 3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.
 4. Manufacturers:
 - a. Erico International Corporation: www.erico.com.
 - b. Galvan Industries, Inc: www.galvanelectrical.com.
 - c. Harger Lightning & Grounding: www.harger.com.

2.03 MANUFACTURERS

- A. Cooper Power Systems, a division of Cooper Industries: www.cooperindustries.com.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ELECTRODES

- A. Manufacturers:
 1. Cooper Power Systems, a division of Cooper Industries: www.cooperindustries.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Rod Electrodes: Copper-clad steel.
 1. Diameter: 3/4 inch.
 2. Length: 10 feet.

2.05 CONNECTORS AND ACCESSORIES

- A. Mechanical Connectors: Bronze.

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 shown on the drawings.
- 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. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.

- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.
 - 1. Outdoor Installations: Unless otherwise indicated, install with top of rod flush with finished grade.
- D. 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.
- E. Identify grounding and bonding system components in accordance with Section 26 05 53.
- F. Install ground electrodes at locations indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- G. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing where indicated. Bond steel together.
- H. Provide bonding to meet requirements described in Quality Assurance.
- I. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.03 FIELD QUALITY CONTROL

- A. Perform inspection in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA STD ATS except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.13.
- D. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- E. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

END OF SECTION

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 34 - Conduit: Additional support and attachment requirements for conduits.
- B. Conduit and equipment supports.
- C. Anchors and fasteners.

1.03 REFERENCE STANDARDS

- A. MFMA-4 - Metal Framing Standards Publication; Metal Framing Manufacturers Association; 2004.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. 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 DEDC, LLC of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- C. 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.

1.06 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.

- C. Installer Qualifications for Powder-Actuated Fasteners (when specified): Certified by fastener system manufacturer with current operator's license.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 - 2. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated, where applicable.
 - 3. 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 2. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Outdoor and Damp or Wet Indoor Locations: Use stainless steel unless otherwise indicated.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 - 1. Conduit Clamps: Bolted type unless otherwise indicated.
 - 2. Manufacturers:
 - a. Cooper Crouse-Hinds, a division of Cooper Industries: www.cooperindustries.com.
 - b. Erico International Corporation: www.erico.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
- C. 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 304 Stainless Steel.
 - 4. Minimum Channel Thickness: 12 gauge.
 - 5. Minimum Channel Dimensions: 1-5/8 inch width by 1-5/8 inch height.
 - 6. Manufacturers:
 - a. Cooper B-Line, a division of Cooper Industries: www.cooperindustries.com.
 - b. Thomas & Betts Corporation: www.tnb.com.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
 - d. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
 - 1) All associated fittings, accessories, and hardware shall be Stainless Steel.
- D. 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 expansion anchors.

3. Solid or Grout-Filled Masonry: Use expansion anchors.
4. Manufacturers - Mechanical Anchors:
 - a. Hilti, Inc: www.us.hilti.com.

2.02 MATERIALS

- A. Hangers, Supports, Anchors, and Fasteners - General: Corrosion-resistant materials of size and type adequate to carry the loads of equipment and conduit, including weight of wire in conduit.
- B. Anchors and Fasteners:
 1. Refer to the attached table:

Drop-in Sleeve Anchors
Expansion Machine Bolt Anchors
Lag Shield Anchors
Nail-in Anchors
Toggle Bolts
Hollow Wall Anchors
Power Driven Studs
BrickXXXXX
ConcreteXXXXX
Concrete BlockXXXX
Cinder BlockXXX
StoneXXXX
MarbleXX
Building TileXXX
Ceramic TileXX
TerrazzoXX
Terra CottaXXX
PlasterXX
DrywallXX
SlateXX
SteelX

ANCHOR HARDWARE TABLE
- C. Formed Steel Channel:
 1. Product: Steel "U" shaped with in-turned clamping ridges manufactured by Unitstrut, Power Wtrut, B-Line Strut or Kindorf.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that mounting surfaces are ready to receive support and attachment components.
- B. 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 support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by DEDC, LLC, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by DEDC, LLC, do not provide support from roof deck.

- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. 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) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- H. Conduit Support and Attachment: Also comply with Section 26 05 34.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Correct deficiencies and replace damaged or defective support and attachment components.
- D. 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 fasten supports to pipes, ducts, mechanical equipment, or conduit.
 - 2. Do not drill or cut structural members.
- E. 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.
- F. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- G. In wet and damp locations use steel channel supports to stand cabinets and panelboards 1-5/8" off wall.
- H. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

END OF SECTION

SECTION 260534
CONDUIT

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Galvanized steel rigid metal conduit (RMC).
- B. Liquidtight flexible metal conduit (LFMC).
- C. Rigid polyvinyl chloride (PVC) conduit.
- D. Conduit fittings.
- E. Accessories.
- F. Conduit, fittings and conduit bodies.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- B. Section 26 05 37 - Boxes.

1.03 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); National Electrical Contractors Association; 2006.
- D. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; National Electrical Manufacturers Association; 2003.
- E. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; National Electrical Manufacturers Association; 2004.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- H. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- I. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- J. UL 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify DEDC, LLC of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- B. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 1" trade size and larger.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and shown.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 PRODUCTS**2.01 CONDUIT APPLICATIONS**

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 - 1. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit, PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
 - 2. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 - 3. Where rigid polyvinyl (PVC) conduit larger than 3/4" trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
 - 4. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.
- D. Connections to Vibrating Equipment:
 - 1. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
 - 2. Maximum Length: 3 feet unless otherwise indicated.
 - 3. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.02 CONDUIT REQUIREMENTS

- A. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- B. Provide products listed, classified, and labeled by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
- C. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Underground, Exterior: 1 inch (27 mm) trade size.
- D. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit: www.alliedeg.com.
 - 2. Republic Conduit: www.republic-conduit.com.
 - 3. Wheatland Tube Company: www.wheatland.com.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - 2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 4. Material: Use steel or malleable iron.
 - 5. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, Inc: www.afcweb.com.
 - 2. Electri-Flex Company: www.electriflex.com.
 - 3. International Metal Hose: www.metalthose.com.
- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 - 1. Manufacturers:
 - a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
- D. Description: Interlocked steel construction with PVC jacket.
- E. Fittings: NEMA FB 1.

2.05 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 - 1. Cantex Inc: www.cantexinc.com.
 - 2. Carlon, a brand of Thomas & Betts Corporation: www.carlon.com.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.06 ACCESSORIES

- A. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- B. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
- C. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that field measurements are as shown on drawings.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- E. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
- F. Conduit Support:
 - 1. Secure and support conduits in accordance with NFPA 70 and Section 26 05 29 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- G. Connections and Terminations:
 - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 - 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 - 3. Use suitable adapters where required to transition from one type of conduit to another.
 - 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 - 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 - 6. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
 - 7. Secure joints and connections to provide maximum mechanical strength and electrical continuity.
- H. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
 - 1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 - 2. Where conduits are subject to earth movement by settlement or frost.

- I. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
 - 1. Where conduits pass from outdoors into conditioned interior spaces.
 - 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- J. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- K. Provide grounding and bonding in accordance with Section 26 05 26.

3.03 FIELD QUALITY CONTROL

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Correct deficiencies and replace damaged or defective conduits.

3.04 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.
- B. Install conduit securely, in a neat and workmanlike manner, as specified in NECA 1.
- C. Install steel conduit as specified in NECA 101.
- D. Arrange supports to prevent misalignment during wiring installation.
- E. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- F. Group related conduits; support using conduit rack. Construct rack using steel channel.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
- H. Route conduit in and under slab from point-to-point.
- I. Cut conduit square using saw or pipecutter; de-burr cut ends.
- J. Bring conduit to shoulder of fittings; fasten securely.
- K. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one shot bender to fabricate bends in metal conduit larger than 2 inch size.
- L. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic.
- M. Provide suitable pull string in each empty conduit except sleeves and nipples.
- N. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- O. Ground and bond conduit under provisions of Section 26 05 26.
- P. Identify conduit under provisions of Section 26 05 53.

END OF SECTION

SECTION 260537
BOXES

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Underground boxes/enclosures.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 34 - Conduit:
 - 1. Conduit bodies and other fittings.
- D. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2008.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. SCTE 77 - Specification for Underground Enclosure Integrity; Society of Cable Telecommunications Engineers; 2010 (ANSI/SCTE 77).
- E. 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 DEDC, LLC of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground handhole enclosures.
 - 1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.

- B. 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.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Products: Provide products listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

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 by Underwriter's Laboratories Inc. (UL) or testing firm acceptable to authority having jurisdiction as suitable for the purpose indicated.
 - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- B. Underground Boxes/Enclosures:
 - 1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel cover bolts.
 - 2. Size: As indicated on drawings.
 - 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
 - 4. Applications:
 - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 8 load rating.
 - b. Parking Lots, in Areas Subject Only To Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77, Tier 15 load rating.
 - c. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
 - 5. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Manufacturers:
 - 1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 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. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- E. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 31 00 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
- F. Install boxes plumb and level.
- G. Install boxes as required to preserve insulation integrity.
- H. Underground Boxes/Enclosures:
 - 1. Install enclosure on gravel base, minimum 18 inches deep.
 - 2. Flush-mount enclosures located in concrete or paved areas.
 - 3. Mount enclosures located in landscaped areas with top at flush with finished grade.
 - 4. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- I. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- J. Install boxes securely, in a neat and workmanlike manner, as specified in NECA 1.
- K. Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and as required by NFPA 70.

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

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Electrical identification requirements.
- B. Large Device Identification.
- C. Nameplates and Labels.
- D. Wire and cable markers.
- E. Voltage markers.
- F. Underground warning tape.
- G. Warning signs and labels.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

1.03 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2007.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2007.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.
 - 2. Do not install identification products until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- C. Samples:
 - 1. Identification Nameplates: One of each type and color specified.
 - 2. Warning Signs and Labels: One of each type and legend specified.
- 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.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.07 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. 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.
 - b. Enclosed Fused Switches:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify fuse type, and ampere rating.
- B. Identification for Conductors and Cables:
 - 1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 05 19.
 - 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.

2.02 MANUFACTURERS

- A. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 LARGE DEVICE IDENTIFICATION

- A. Identify all disconnect switches, pull boxes, junction boxes (larger than 4" X 4") finished with black engraved lamicaid self-adhesive labels, 1" X 4". The label shall state the power feed, circuit or section number, and the equipment identification number that the large device serves.

2.04 IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates:
 - 1. Manufacturers:
 - a. Brimar Industries, Inc: www.brimar.com.
 - b. Seton Identification Products: www.seton.com.
 - 2. Materials:
 - a. Outdoor Locations: Use plastic or stainless steel nameplates suitable for exterior use.
 - 3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
 - 4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
 - 5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.
- B. Format for Equipment Identification:
 - 1. Minimum Size: 1 inch by 2.5 inches.
 - 2. Legend:
 - a. Equipment designation or other approved description.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height:
 - a. Equipment Designation: 1/2 inch.
 - 5. Color:
 - a. Normal Power System: Black text on white background.

- b. Emergency Power System: White text on red background.

2.05 WIRE AND CABLE MARKERS

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com.
 - 2. Panduit Corp: www.panduit.com.
- B. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- C. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- D. Legend: Power source and circuit number or other designation indicated.
- E. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- F. Minimum Text Height: 1/8 inch.
- G. Color: Black text on white background unless otherwise indicated.
- H. Locations: Each conductor at pull boxes, junction boxes, and Termination or connection points including each load connection.
- I. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.

2.06 VOLTAGE MARKERS

- A. Minimum Size:
- B. Legend:
- C. Color: Black text on orange background unless otherwise indicated.
- D. Location: Furnish markers for each conduit longer than 6 feet.
- E. Spacing: 20 feet on center.

2.07 UNDERGROUND WARNING TAPE

- A. Manufacturers:
 - 1. Brady Corporation: www.bradyid.com.
 - 2. Seton Identification Products: www.seton.com.
- B. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- C. Foil-backed Detectable Type Tape: 6 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- D. Legend: Type of service, continuously repeated over full length of tape.
- E. Color:
 - 1. Tape for Buried Power Lines: Black text on red background.
 - 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.08 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 - 1. Materials:
 - 2. Minimum Size: 7 by 10 inches 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 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. Interior Components: Legible from the point of access.
 6. Conductors and Cables: Legible from the point of access.
- 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. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.
- G. Secure rigid signs using stainless steel screws.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 260519**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Wire and cable for 600 volts and less.
- C. Wiring connectors.
- D. Electrical tape.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- B. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.

1.03 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2001 (Reapproved 2007).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010.
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2009).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- I. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- J. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- K. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- L. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- M. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- N. 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 DEDC, LLC of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. 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. Conform to requirements of NFPA 70.

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, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify DEDC, LLC 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. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.
- H. Exterior Locations: Use only building wire with Type THWN-2 insulation in raceway.
- I. Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- J. Use stranded conductors for control circuits.
- K. Use conductor not smaller than 12 AWG for power and lighting circuits.
- L. Use conductor not smaller than 14 AWG for control circuits.

2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- 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. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 05 26.
- H. Conductor Material:
 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787787M unless otherwise indicated.
 3. Tinned Copper Conductors: Comply with ASTM B33.
- I. Minimum Conductor Size:
 1. Branch Circuits: 12 AWG.
 - J. 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:
 - 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. 240/120 V, 1 Phase, 3 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Neutral/Grounded: White.
 - c. Equipment Ground, All Systems: Green.

2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com.
 - b. Encore Wire Corporation: www.encorewire.com.
 - c. Southwire Company: www.southwire.com.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Size 4 AWG and Larger: Type XHHW-2.
 - b. Installed Underground: Type XHHW-2.
- F. Conductor: Copper.
- G. Insulation Voltage Rating: 600 volts.
- H. Insulation: NFPA 70, Type THHN/THWN.
- I. Insulation: Thermoplastic material rated 75 degrees C.

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. Connectors for Grounding and Bonding: Comply with Section 26 05 26.
- C. 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.
- D. Wiring Connectors for Terminations:
 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
 - c. NSI Industries LLC: www.nsiindustries.com.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilsco.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.

2.05 WIRING ACCESSORIES

- A. Electrical Tape:
 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com.
 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
- B. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
 1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
- C. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
 1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. American Polywater Corporation: www.polywater.com.
 - c. Ideal Industries, Inc: www.idealindustries.com.

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 raceway installation is complete and supported.
- E. Verify that field measurements are as shown on the drawings.
- F. 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. Arrange circuiting to minimize splices.
 - 2. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is not permitted.
 - a. Increase size of conductors as required to account for ampacity derating.
 - 3. 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. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- D. 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.
- E. 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.
- F. Install conductors with a minimum of 12 inches of slack at each outlet.
- G. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- H. 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. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- I. 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.
- J. Insulate ends of spare conductors using vinyl insulating electrical tape.

- K. 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.
- L. Identify conductors and cables in accordance with Section 26 05 53.
- M. Color Code Legend: Provide identification label identifying color code for ungrounded conductors 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.
- N. 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.
- O. Install wire and cable securely, in a neat and workmanlike manner, as specified in NECA 1.
- P. 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.
- Q. Use wiring methods indicated.
- R. Pull all conductors into raceway at same time.
- S. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- T. Protect exposed cable from damage.
- U. Use suitable cable fittings and connectors.
- V. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- W. Clean conductor surfaces before installing lugs and connectors.
- X. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- Y. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- Z. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- AA. Identify and color code wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

3.04 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA STD ATS, except Section 4.
- B. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- C. Correct deficiencies and replace damaged or defective conductors and cables.
- D. Perform inspections and tests listed in NETA STD ATS, Section 7.3.2.

END OF SECTION

SECTION 262813
FUSES

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Fuses.

1.02 RELATED REQUIREMENTS

- A. Section 26 28 18 - Enclosed Switches: Fusible switches.

1.03 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2002 (R2007).
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - a. Fusible Enclosed Switches: See Section 26 28 18.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify DEDC, LLC of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Cooper Bussmann, a division of Cooper Industries: www.cooperindustries.com.
- B. Mersen (formerly Ferraz Shawmut): ferrazshawmut.mersen.com.
- C. Littelfuse, Inc: www.littelfuse.com.

2.02 APPLICATIONS

- A. General Purpose Branch Circuits: Class RK1, fast-acting, non-time-delay.

2.03 FUSES

- A. Provide products listed and classified by Underwriters Laboratories Inc. as suitable for the purpose indicated.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
 - 1. Class RK1, Fast-Acting, Non-Time-Delay Fuses:
 - a. Products:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 262818
ENCLOSED SWITCHES

PART 1 GENERAL**1.01 SECTION INCLUDES**

- A. Enclosed safety switches.
- B. Fusible switches.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding for Electrical Systems.
- B. Section 26 05 29 - Hangers and Supports for Electrical Systems.
- C. Section 26 05 53 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 28 13 - Fuses.

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2008.
- C. NEMA FU 1 - Low Voltage Cartridge Fuses; National Electrical Manufacturers Association; 2002 (R2007).
- D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2001 (R2006).
- E. NETA STD ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems; International Electrical Testing Association; 2009.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within 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. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify DEDC, LLC of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.06 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Schneider Electric; Square D Products; Model Class 3110, Catalog # H362DS: www.schneider-electric.us.

2.02 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break, enclosed safety switches complying with NEMA KS 1, type HD (heavy duty), and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed and labeled by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. Minimum Ratings:
 - a. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- J. Enclosures: Comply with NEMA KS 1 and 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. Outdoor Locations: Type 4X, stainless steel.
- K. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- L. Heavy Duty Switches:
 - 1. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

2. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

2.03 COMPONENTS

- A. Fusible Switch Assemblies: NEMA KS 1, Type HD enclosed load interrupter knife switch.
 1. Externally operable handle interlocked to prevent opening front cover with switch in ON position.
 2. Handle lockable in OFF position.
 3. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses. Provide rejection clips to reject all other than Class R fuses.
 4. Fuse extenders where indicated on contract drawings.
- B. Enclosures: NEMA KS 1.
 1. Exterior Locations: Type NEMA 4X Stainless Steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- B. Verify that mounting surfaces are ready to receive enclosed safety switches.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install enclosed switches in accordance with manufacturer's instructions.
- B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 05 29.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 05 26.
- H. Provide identification nameplate for each enclosed switch in accordance with Section 26 05 53.
- I. Install fuses in fusible disconnect switches.
- J. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection in accordance with Section 01 40 00.
- B. Inspect and test in accordance with NETA STD ATS, except Section 4.
- C. Perform inspections and tests listed in NETA STD ATS, Section 7.5.1.1.
- D. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 323113 - SECURITY FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Vinyl coated galvanized steel chain-link fabric.
 - 2. Vinyl coated galvanized steel framework.
 - 3. Motor Operated Cantilever Linear Gates.
 - 4. Swing Gates.
- B. Division 31 Section "Earth Moving" for filling and grading work.
- C. Division 03 Section "Cast-in-Place Concrete" for concrete for post footings.
- D. Grounding requirements for fence and gates are specified in Section 16452 "Grounding."

1.2 REFERENCES

- A. American Society for Testing and Materials
 - 1. A90/A90M - Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - 2. A653/A653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 3. A924/A924M - Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 4. B6 - Specification for Zinc.
 - 5. B117 - Practice for Operating Salt Spray (Fog) Apparatus.
 - 6. D1499 - Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics.
 - 7. D3359 - Test Methods for Measuring Adhesion by Tape Test.
 - 8. E8/E8M - Test Methods for Tension Testing of Metallic Materials.
 - 9. F567 - Practice for Installation of Chain-Link Fence. F626 - Specification for Fence Fittings.
 - 10. F668 - Specification for Poly (Vinyl Chloride) (PVC)- Coated Steel Chain-Link Fence Fabric.
 - 11. F900 - Specification for Industrial and Commercial Swing Gates.
 - 12. F934 - Specification for Standard Colors for Polymer-Coated Chain Link Fence Materials.
 - 13. F969 - Practice for Construction of Chain-Link Tennis Court Fence.
 - 14. F1043 - Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.
 - 15. F1184 - Specification for Industrial and Commercial Horizontal Slide Gates. F1665 - 08(2013) F1665 - 08(2013) Poly(Vinyl Chloride) (PVC)
 - 16. A 121: Zinc-Coated (Galvanized) Steel Barbed Wire
 - 17. A 123: Specifications for Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip.
 - 18. A 392: Zinc-Coated Steel Chain-Link Fence Fabric
 - 19. B 117: Standard Test Method of Salt Spray (Fog) Testing
 - 20. F 1083: Standard Specifications for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures.
- B. Federal Specifications (FS)

1. RR-F-191: Fencing, Wire and Post, Metal (and Gates, Chain-Link Fabric, and Accessories)

1.3 DEFINITIONS

- A. CLFMI: Chain Link Fence Manufacturers Institute.
- B. Zn-5-Al-MM Alloy: Zinc-5 percent aluminum-mischmetal alloy.

1.4 SUBMITTALS

- A. Product Data: Material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:
 1. Fence and gate posts, rails, tension wire and fittings.
 2. Black vinyl fence post and fence fabric color samples.
 3. Chain-link fabric, reinforcements, and attachments.
 4. Gates and hardware.
 5. Gate operators, including operating instructions.
 6. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Show locations of fence, each gate, posts, rails, and tension wires and details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage, footings and attachment and bracing.
 1. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 2. Wiring Diagrams: Power and control wiring and access control features. Differentiate between manufacturer-installed and field-installed wiring and between components provided by gate operator manufacturer and those provided by others.
- C. Product Certificates: Signed by manufacturers of chain-link fences and gates certifying that products furnished comply with requirements.
- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Field Test Reports: Indicate and interpret test results for compliance of chain-link fence and gate grounding and bonding with performance requirements.
- F. Maintenance Data: For the following to include in maintenance manuals specified in Section 01782, "Operation and Maintenance Manual Data":
 1. Gate operator and motor.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed chain-link fences and gates similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- B. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies, to supervise on-site testing specified in Part 3.
- C. Source Limitations for Chain-Link Fences and Gates: Obtain chain-link fences and primary personnel gates, including accessories, fittings and fastenings from a single source.
- D. Source Limitations for Gate Operators: Obtain primary vehicle gates, gate operators, accessories, fittings, fastenings and installation services for primary vehicle gates and operators from a single source.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. UL Standard: Provide gate operators that comply with UL 325 “Standards for Safety for Drapery, Gate, Louver and Window Operators.”
- G. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators serving as a required means of access.

1.6 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Contracting Owner not less than 2 working days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Owner's written permission.
- B. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to actual field conditions and existing structures and utilities. Verify dimensions by field measurements.

1.7 MISCELLANEOUS REQUIREMENTS

- A. Deliver, store, uncrate, handle and install in manner to prevent damage to equipment.
- B. Remove promptly from site all debris resulting from installation of materials and equipment specified herein.
- C. Finish of all materials and equipment shall be appropriate for exterior locations.

PART 2 - PRODUCTS

2.1 General

- A. All fences and gates shall be purchased from UL listed manufacturers.

2.2 CHAIN-LINK FENCE FABRIC

- A. Steel Chain-Link Fence Fabric: Height indicated on Drawings. Provide fabric fabricated in one-piece widths for fencing, not less than 72 inches high with 2-inch No. 9-gage (0.1483-inch diameter) wire.
1. Zinc-Coated Fabric: Comply with ASTM A 392 Class 2 and F 1083 and FS: RR-R-191, Type I, with zinc coating applied to steel wire before weaving with the following minimum coating weight:
 - a. Not less than 1.2 oz./sq. ft. of uncoated wire surface.
 2. Coat selvage ends of fabric that is metallic coated during the weaving process with manufacturer's standard clear protective coating.
 3. The vinyl coating is thermally bonded to a thermoset bonding layer over a galvanized steel wire. This process ensures a tightly adherent and impervious coating free of voids, as well as a smooth and lustrous surface appearance.
 4. Vinyl coating thickness, galvanized coating weight, and wire tensile strength conform to ASTM F668 Class 2b, Federal specification RR-F-191/1E Type IV, AASHTO M-181 Type IV, Class B
 5. Only plasticized poly(vinyl chloride) (PVC) with a low temperature (-20 C ; -4 C) plasticizer and no extenders or extraneous matter other than the necessary stabilizers and pigments, shall be used.
 6. The PVC coated wire shall pass the test for adhesion contained in ASTM F668 for Class 2b chain link fabric.
- B. Selvage: Twisted and barbed finish at top and knuckled at bottom selvage.
- C. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
1. Allied Tube and Conduit Corp.
 2. Approved Equal.

2.3 INDUSTRIAL FENCE FRAMING

- A. Round Steel Pipe: Standard weight, Schedule 40, vinyl coated, galvanized steel pipe complying with ASTM F 1083 and RR-F-191 for Class F steel fence.
1. External and Internal Coating Type A consisting of not less than 1.8 oz/sq. ft. zinc.
- B. SS40 pipe produced by Allied Tube shall be an acceptable alternative to SCH 40.
- C. Terminal Posts at all motorized gates: Standard weight, 4.00-inch O.D. galvanized steel pipe of material listed in this specification.
- D. Terminal Posts: Standard weight, 3.00-inch O.D. galvanized steel pipe of material listed in this specification.
- E. Line posts: Standard weight, 2.50-inch O.D. galvanized steel pipe of material listed in this specification.
- F. Post Brace Rails: Provide brace rail with truss rod assembly for each gate, end, and pull post. Provide two brace rails extending in opposing directions, each with truss rod assembly, for each corner post and for pull posts. Provide rail ends and clamps for attaching rails to posts.
1. Minimum 1.660 inches OD pipe.
- G. Vinyl Coating: All framing and appurtenances shall:

1. Have a Vinyl coating fused and adhered to the exterior zinc coating of the galvanized pipe in accordance with ASTM F1043.
2. The minimum thickness of the PVC (Vinyl) coating shall be 10-mils (0.254 mm). Color to match fabric, black, per ASTM F934.

2.4 GATES, GENERAL

- A. Gates for Class F Fence: Conform to FS-RR-F-191.
- B. Gate Frame: The entire frame and support members shall be manufactured with the same aluminum material, alloy and temper 6061-T6 (ASTM 1184). Fabricate chain link cantilever slide gates in accordance with ASTM F-1184, Type II, Class 2, using 2 inch square aluminum outside vertical members (1.10 lb/ft). Members are welded together with a continuous top track (3.83 lb/ft) and bottom rail to form a rigid one piece frame. Vertical interior support uprights will be positioned equally throughout the frame structure.

Standard Opening	Overall Gate	Length Bays
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15 ft. to 18 ft.	26' 3"	4
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19 ft. to 22 ft.	31' 3"	5
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- C. For 15 ft. – 22 ft. opening gates, the vertical interior support uprights will be 1.5 inch square aluminum (6061-T6) tubing (0.809 lb/ft). The bottom rail shall be a continuous one-piece 2 inch square aluminum (6061-T6) tube (1.10 lb/ft).

Standard Opening	Overall Gate	Length Bays
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23 ft. to 26 ft.	37' 3"	6
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27 ft. to 30 ft.	42' 3"	7
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- D. For 23 ft. – 30 ft. opening gates, the vertical interior support uprights will be 2 inch square aluminum (6061-T6) tubing (1.10 lb/ft). The bottom rail shall be a continuous one-piece 2 inch by 4 inch rectangular tube (1.69 lb/ft). An additional 2 inch square support rail shall be welded adjacent to the top track horizontal rail.
- E. The cantilever overhang will be 40% or greater for any given opening size.
- F. There will be two truck assemblies (secured to the guide posts) which operate inside the top track. They shall be swivel type zinc die cast with 4 sealed and lubricated ball bearing rollers (2" dia., 9/16" width) and two side rollers (front and back) to assure alignment in the top track.
- G. The top track and rail is an enclosed combination one piece aluminum (6061-T6) extrusion weighing 3.83 lb/ft. Top track to withstand a 2,000 lb. reaction load.
- H. Chain link fabric shall be installed over the entire gate length (UL-325) which will create a universal design (gate can be used for right or left hand applications). Fabric will be attached securely with tension bars that are attached on either frame end by tension bands.
- I. High tensile wire will provide additional fabric support across the top and bottom of the gate structure.
- J. Diagonal bracing shall be 1"x2" aluminum (6061-T6) tubing (0.809 lb/ft) welded to the uprights to form a rigid bracing system that does not require field adjustment.

- K. Bottom guide wheel assemblies have two 3” dia. rubber wheels (with protective covers – UL325) straddling the bottom horizontal gate rail. One assembly shall be attached to each guide post.
- L. Gate post brackets, latch, and keepers are galvanized steel.
- M. Motor Operated Gate posts shall be 4” OD schedule 40 or SS40 pipe (9.1 lb/ft). Two support posts and 1 latch post shall be installed.
- N. Primary personnel gates shall be manually operated, with provisions for “Best Lock” padlocks.
- O. Double Swing gates shall include a lockable center post socket in concrete at grade.
- P. Primary vehicle gates shall be power operated and activated by an electronic access control system. Vehicle gate shall be tied into security system in the building which will be constructed under a separate contract.
- Q. Cantilever Linear Vehicle Gates shall operate at a minimum speed of two (2) feet per second.
- R. Vehicle Gates shall be capable of opening to provide full clearance from end posts as identified in the contract drawings.
- S. Motor Operator shall be installed under this contract and capable of receiving:
 - 1. Control signals from ground loops and electronic eye equipment.
 - 2. Control signals from building security system.
 - 3. Control signals from future identity card swipe terminal, to be constructed under a separate contract.
 - 4. Control signals from fire department emergency access panel.
- T. Frames and Bracing: Fabricate from round galvanized steel tubing with outside dimension and weight according to ASTM F 1184 for the following gate fabric height:
 - 1. Gate fabric height by opening Width: 6 feet tall and widths as indicated on the contract drawings.

2.5 FITTINGS

- A. General: Provide fittings for a complete fence installation, including special fittings for corners. Fittings shall have coatings matching in material, color, product standards of adjoining fence fabric and framing.
- B. For steel fences, stretcher bar and tension wire bands or clamps shall be 11-gage (0.1205-inch diameter) minimum thickness galvanized pressed steel bands; ties for attaching fabric to line posts shall be equal to 6-gage (0.0162 inch diameter) galvanized steel wire; ties for attaching fabric to top and brace rails shall be equal to 9-gage (0.1483 inch diameter) galvanized steel wire; and hog rings shall be equal to 9-gage (0.143-inch diameter) galvanized steel wire, except that stretcher bar clamps, ties and hog rings may be of aluminum conforming to the requirements of FS – RR-F-191.
- C. Post and Line Caps: Hot-dip galvanized pressed steel or hot-dip galvanized cast iron. Provide weathertight closure cap for each post.
 - 1. Provide line post caps with loop to receive tension wire.
- D. Stretcher Bars: Fabricate one piece lengths equal to full height of fabric with a minimum cross section of 1/4-inch by 3/4-inch. Provide one stretcher bar of each gate, end post, and two for each corner or pull post.
- E. Stretcher Bar Bands: Heavy pressed steel, spaced not over 14 inches on center to secure stretcher bars to end, corner, pull and gate posts. Bands shall be within 4 inches of the top and bottom of fence fabric.

- F. Taut reinforcing wires shall be 9-gage installed and interwoven with or affixed with 9-gage fabric ties spaced uniformly between the top and bottom of the fence fabric.
- G. Tie Wires, Clips, and Fasteners: Provide the following types:
 - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
 - a. Hot-Dip Galvanized Steel: Nine-gage wire; galvanized coating thickness matching coating thickness of chain-link fence fabric. Spaced at 14 inches o.c.
- H. Pipe Sleeves: For posts set into concrete, provide preset hot-dip galvanized steel pipe sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch more than outside dimension of post, and flat steel plate forming bottom closure.

2.6 GATE OPERATOR

- A. General: Provide motor operation system for gate openings specified in contract drawings, of size and capacity and with features, characteristics, and accessories suitable for project conditions, recommended and provided by gate manufacturer complete with electric motor and factory-prewired motor controls, remote-control stations, control devices, power disconnect switch, obstruction detection device, weather resistant cover protecting controls, operating parts and accessories required for proper operation. The operator chassis and housing shall be fabricated from stainless steel or equal material.
 - 1. All electrical components shall be tested by a nationally recognized testing laboratory (NRTL) and bear the UL/ETL label.
 - 2. Provide electronic components with built-in troubleshooting diagnostic feature.
- B. Comply with NFPA 70.
- C. The gate operator shall be rugged, solid-state design, approved for use by a nationally recognized testing laboratory (NRTL) in accordance with the requirements of UL-325, fourth edition, and UL991, second edition.
- D. Install a manual disconnect switch and fully wired into the main motor/control leads to protect operating and maintenance personnel from injury during service.
- E. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70, Class 2 control circuit, maximum 24-V ac.
- F. Electrical Requirements: Provide the following:
 - 1. Power shall be supplied by a transformer which steps down the incoming voltage to the proper levels. Transformer shall be pre-set with jumpers to accommodate many voltages to compensate for low voltage at the installation site. A jumper diagram shall be located on the transformer in sight of maintenance personnel, to confirm proper voltage levels and jumper installation.
 - 2. The controller shall not utilize plug-in type timers and/or relays to accomplish control of the gate system. The controller shall be designed as a two-board set so that installation and maintenance routines may be centralized at one location for ease of use. All setup and maintenance operations shall be performed on the programming/diagnostics/ maintenance (PDM) board and all logic and input/output terminations shall be made on the motherboard.
 - 3. A programmable maximum run timer shall be adjustable from 0 to 600 seconds via software programming. Plug-in timers shall not be accepted. A line voltage disconnect shall be standard.
 - 4. Wiring shall terminate on clearly labeled, pressure-type terminal blocks and shall be color-coded for clarity.
 - 5. Field-wire run size recommendations shall be made by the manufacturer of the gate operators to suit the specific application.

6. Enclosure, properly sized to accommodate the electrical equipment of the gate operator, shall be installed inside the gate operator. The enclosure shall swing out to permit access to the internal mechanical components of the operator.
 7. Enclosure shall be UL approved and be of galvanized construction for maximum corrosion resistance.
- G. Electromechanical Operation: Provide unit designed for concrete base/pad mounting; consisting of electric motor and factory-rewired motor controls and starter.
- H. Operation Cycle Requirements: Design gate operator to operate for not less than the following duty and cycles. One cycle equals one gate opening plus one gate closing.
1. Heavy Duty, High Cycle.
- I. Gate Operation Speed: 2 feet per second opening and closing speed.
- J. Gate Operator shall operate gates of size and length as shown on the contract drawings.
- K. Fasteners, except structural bolts, shall be stainless steel, or other non-corrosive material.
- L. Provide thermostatically controlled heater in gate operator.
- M. Electric Motors: High-starting torque, continuous-duty, insulated electric motors, complying with NEMA MG 1 and shall be available in all voltage and phases to suite the installation requirements of the site.
1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 2. Motors 1/3 hp and Larger: Motor horsepower as recommended by operator manufacturer.
 3. Motors shall have built-in overload protection and re-settable with a sealed pushbutton reset.
- N. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA ICS 6, Type 1 enclosure for pedestal mounting, and with space for additional optional equipment. Provide the following remote-control device(s):
1. Vehicle Loop Detector System: System including automatic closing timer with adjustable time delay before closing and loop detector designed to hold gate open until traffic clears. Provide electronic detector, with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement as recommended in writing by detection system manufacturer for function indicated.
 - a. Loop: Wire, in size indicated for field assembly, and sealant; style for saw-cut installation.
- O. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
1. Action: Reverse gate in both opening and closing cycles and hold until clear of obstruction.
- P. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.
1. Gate travel shall be controlled by NEMA 4 capacity proximity limit switches rates for harsh duty. The switch housings shall be one-piece and shall be corrosion resistant thermoplastic polyester.
 2. The limit switches shall have SPDT relay outputs with current carrying capacity. Maximum switched power rating shall be 180 watts. Maximum switched current ratings shall be 6 amps.

3. Limit switches shall be rated for operations from minus 40 deg. C. to 70 deg. C.
4. Provide built-in LED trip indicator light encapsulated inside the switch and visible to indicate activation.
5. Limit switch shall be readily accessible and replaceable with normal hand tools.
6. Limit switches shall provide ability to remotely monitor the gate position when in the fully closed and fully open positions.

Q. Emergency Release Mechanism: Quick disconnect release of operator drive system of the following type of mechanism, permitting manual operation if operator fails. Design system so control circuit power is disconnected during manual operation.

1. Type: Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge.
2. Type: Mechanical device, key, or crank-activated release.

R. Operating Features: Include the following:

1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features with capability of monitoring and auditing gate activity. Provide unit that is isolated from voltage spikes and surges.
2. Fully Systems Compatible: With controlling circuit board capable of accepting any type of input from external devices.
3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
4. Automatic Closing Timer: With adjustable time delay before closing and timer cut-off switch.
5. Open Override Circuit: Designed to override closing commands.
6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
8. Clock Timer: 24-hour, Seven-day programmable for regular events.

S. Housing Construction: Provide the following:

1. Housing shall be fabricated from 3/16-inch hot rolled stainless steel. Material shall meet and be certified to ASTM A240 specifications. The housing is to be formed to provide a strong configuration without welding. The housing is to be factory tested under a 1,200-pound draw load with no deformation to the related components.
2. All drilling and welding is to be completed prior to painting to ensure a continuously unbroken paint surface. Prior to painting all components are to be sand blasted to provide a clean surface for primer.
3. Prime the surface immediately after blasting. Priming is to be accomplished by a two-part, self-etching zinc chromate primer.
4. Automotive grade acrylic enamel finish paint is to be applied to all primed surfaces.
5. The housing cover must swing open to allow access to the internal components. The hinge is to be of stainless steel construction and of suitable size to allow years of trouble-free operation.
6. The housing cover must be able to accept a padlock. The cover lock is to automatically engage on cover closure.
7. All operator cover locks are to be keyed alike.

2.7 CAST-IN-PLACE CONCRETE

- A. General: Comply with ACI 301 for cast-in-place concrete.
- B. Materials: Portland cement complying with ASTM C 150, aggregates complying with ASTM C 33, and potable water.

1. Concrete Mixes: Normal-weight concrete, air entrained with not less than 4000-psi compressive strength (28 days), 3-inch slump, and 1-inch maximum size aggregate.

C. Refer to Section 03300 “Cast-In-Place Concrete.”

2.8 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for a verified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance.
 1. Do not begin installation before final grading is completed, unless otherwise permitted by OWNER.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION, GENERAL

- A. General: Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.
 1. Install fencing on established boundary lines inside property line, or as indicated on the Drawings.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed or compacted soil.
 1. Drill holes for post footings in firm, undisturbed or compacted soil. Holes shall have a diameter equal to 4 times the diameter of the post except where otherwise indicate don the drawings.
 2. Excavate hold depths approximately 3 inches deeper than post bottom with bottom of lineposts set not less than 48 inches in concrete base.

- C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil. Set terminal, line and gate operator-mounting posts in concrete footing. Protect portion of posts aboveground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Using mechanical devices to set line posts per ASTM F 567 is permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured.
1. Maximum spacing between line posts is 10 feet.
 2. Set keepers, stops, sleeves, and other accessories into concrete as required.
 3. All posts shall be able to pass a pull test when a force of 48 pounds is applied perpendicular to the fence at the top of the post. The post should not deflect more than 1 inch at the location where the force is applied.
 4. Post tops shall be riveted or shall be spot-welded. No loose or rattling fittings will be allowed.
 5. Concealed Concrete Footings: Stop footings 2 inches below grade to allow covering with surface material.

3.4 CHAIN-LINK FENCE INSTALLATION

- A. Terminal Posts: Locate terminal end, corner, and gate posts and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more.
- B. Post Bracing Assemblies: Install according to FS RR-F-191, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at two-thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
1. Anchor posts shall be set at approximately 500-foot intervals and braced to the adjacent line posts. Posts shall be braced before the wire fencing is placed.
- C. Tension Wire: Install according to FS RR-F-191, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric.
1. Top Tension Wire: Install tension wire through post cap loops.
 2. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same gage and type of wire.
- D. Top Rail: Install according to FS RR-F-191, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended by fencing manufacturer.
- E. Brace Rails: Install in one piece at post-height center span, spanning between posts, using fittings, special offset fittings, and accessories.
- F. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave a maximum of 2 inches between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- G. Tension or Stretcher Bars: Provide two stretcher bars for each pull post. Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 14 inches o.c.

- H. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric. Bend ends of wire to minimize hazard to individuals and clothing.
 - 1. Maximum Spacing: Tie fabric to line posts 12 inches o.c. and to braces 24 inches o.c.
- I. Fasteners: Install nuts for tension bands and carriage bolts on the side of the fence opposite the fabric side.

NOTE: All nuts for tension bands and carriage bolts shall be “tack welded” after final installation as per Owner direction and observation.

3.5 GATE INSTALLATION

- A. General: Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GATE OPERATOR INSTALLATION

- A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation for Concrete Bases/Pads: Hand-excavate holes for bases/pads, in firm, undisturbed or compacted soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated on Drawings.
- C. Concrete Bases/Pads: Cast-in-place or precast concrete, made of not less than 4000-psi compressive strength (28 days), depth not less than 12 inches, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings. Concrete pad shall include #4 rebar placed each way per manufacture's instructions.
- D. Vehicle Loop Detector System: Cut grooves in pavement and bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.
- E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.7 GROUNDING

- A. Refer to Section 16452, “Grounding.”

3.8 FIELD QUALITY CONTROL

- A. Ground-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure ground resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Perform tests by two-point method according to IEEE 81.
- B. Desired Maximum Grounding Resistance Value: 25 ohms.

- C. Excessive Ground Resistance: If resistance to ground exceeds desired value, notify OWNER promptly. Include recommendations to reduce ground resistance and proposal to accomplish recommended work.
- D. Report: Prepare test reports, certified by testing agency, of ground resistance at each test location. Include observations of weather and other phenomena that may affect test results.

3.9 ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Automatic Gate Operator: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, and limit switches.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Test controls and safeties. Remove damaged and malfunctioning units, replace with new units, and retest.
- C. Lubricate hardware, gate operator and other moving parts.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Government's personnel to adjust, operate, and maintain gates.
 - 1. Test and adjust operators and controls hardware, and other operable components. Replace damaged or malfunctioning operable components.
 - 2. Train Government personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 3. Review data in maintenance manuals. Refer to Section 01782, "Operation and Maintenance Data."
 - 4. Schedule training with Owner with at least seven days' advance notice.

END OF SECTION 323113

