

**COLORADO
DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISIONS
EISENHOWER/JOHNSON MEMORIAL TUNNELS
24.9kV SWITCHGEAR REPLACEMENT**

The 2011 Standard Specifications for Road and Bridge Construction, controls construction of this project. The following special provisions supplement or modify the Standard Specifications and take precedence over the Standard Specifications and plans.

PROJECT SPECIAL PROVISIONS

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**COLORADO
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STANDARD SPECIAL PROVISIONS

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NOTICE TO BIDDERS

The proposal guaranty shall be a certified check, cashier's check, or bid bond in the amount of 5 percent of the Contractor's total bid.

Pursuant to subsections 102.04 and 102.05, it is recommended that bidders on this project review the work site and plan details with an authorized Department representative. Prospective bidders shall contact one of the following listed authorized Department representatives at least 12 hours in advance of the time they wish to go over the project.

Acting Tunnel Superintendent:	Kenny Martinez
West Program Engineer:	Steve Harelson
Resident Engineer:	Jana Spiker, PE Office Phone: 720-497-6959 Cell Phone: 303-503-0978
Project Engineer:	(As determined by the Resident Engineer)

The above referenced individuals are the only representatives of the Department with authority to provide any information, clarification, or interpretation regarding the plans, specifications, and any other contract documents or requirements.

Questions received from bidders along with CDOT responses will be posted on the CDOT web site listed below as they become available.

<http://www.coloradodot.info/business/bidding/future-bidding-opportunities>

If the bidder has a question or requests clarification that involves the bidder's innovative or proprietary means and methods, phasing, scheduling, or other aspects of construction of the project, the Project Engineer will direct the bidder to contact the Resident Engineer directly to address the question or clarification. The Resident Engineer will keep the bidder's innovation confidential and will not share this information with other bidders.

The Resident Engineer will determine whether questions are innovative or proprietary in nature. If the Resident Engineer determines that a question does not warrant confidentiality, the bidder may withdraw the question. If the bidder withdraws the question, the Resident Engineer will not answer the question and the question will not be documented on the CDOT web site. If the bidder does not withdraw the question, the question will be answered, and both the question and CDOT answer will be posted on the web site. If the Resident Engineer agrees that a question warrants confidentiality, the Resident Engineer will answer the question, and keep both question and answer confidential. CDOT will keep a record of both question and answer in their confidential file.

All questions shall be directed to the CDOT contacts listed above no later than 7:00 A.M. Monday of the week of bid opening. Final questions and answers will be posted no later than Tuesday morning of bid opening week.

Questions and answers shall be used for reference only and shall not be considered part of the Contract.

COMMENCEMENT AND COMPLETION OF WORK

The Contractor shall select the date that work begins for this project. The Contractor shall notify the Engineer, in writing, at least 20 days before the proposed beginning date. The date that work begins shall be subject to the Region Transportation Director's approval. A different date may be authorized in writing by the Chief Engineer in the "Notice to Proceed."

The Contractor shall complete all work by July 1, 2016 in accordance with the "Notice to Proceed."

Stockpiling of materials before the beginning date is subject to the Engineer's approval. If such approval is given, stockpiled material will be paid for in accordance with Sections 109 and 626.

Section 108 of the Standard and Supplemental Specifications is hereby revised for this project as follows:

Subsection 108.03 shall include the following:

Salient features for this project are:

- (1) Submittal of shop drawings to CDOT
- (2) Release of Equipment for Manufacture
- (3) Fabrication of New Equipment
- (4) Installation of New Regulators and Temporary Switchgear in the West Building
- (5) Demolition of Existing Switchgear in the West Building
- (6) Installation of New Switchgear in West Building
- (7) Removal of Temporary Switchgear from West Building
- (8) Installation of New Regulators and Temporary Switchgear in the East Building
- (9) Demolition of Existing Switchgear in the East Building
- (10) Installation of New Switchgear in East Building
- (11) Removal of Temporary Switchgear from East Building
- (12) Final Test and Inspection
- (13) Demobilization

DISADVANTAGED BUSINESS ENTERPRISE (DBE) CONTRACT GOAL

This is a federally-assisted construction project. As described in the CDOT DBE Standard Special Provision, the Bidder shall make good faith efforts to meet the following contract goal:

XXX Percent DBE participation.

ON THE JOB TRAINING CONTRACT GOAL

The Department has determined that On the Job Training shall be provided to trainees with the goal of developing full journey workers in the types of trade or classification involved. The contract goal for On the Job Trainees working in an approved training plan in this Contract has been established as follows:

Minimum number of total On the Job Training **required ♦ hours**

**REVISION OF SECTION 102
PROJECT PLANS AND OTHER DATA**

Section 102 of the Standard Specifications is hereby revised for this project as follows:

Subsection 102.05 shall include the following:

After the proposals have been opened, the low responsible bidder may obtain from CDOT's Printing and Visual Communications Center, 4201 East Arkansas Avenue, Denver, Colorado 80222, at no cost: 10 sets of plans and special provisions; and if available for the project, one set of full-size cross sections, one set of full-size major structure plan sheets, and one set of computer output data. If the low bidder has not picked up the plans and other available data by 4:00 p.m. on the second Friday after bid opening, they will be sent to the Resident Engineer in charge of the project. Additional sets of plans and other available data may be purchased on a cash sale basis from CDOT's Visual Communication Center at current reproduction prices. Subcontractors and suppliers may obtain plans and other data from the successful bidder or they may purchase copies on a cash sale basis from the Visual Communication Center at current reproduction prices.

**REVISION OF SECTIONS 105
 CONTRACTOR SUBMITTALS**

Section 105 of the Standard Specifications is hereby revised for this project as follows:

In subsection 105.02 (c) add the following paragraph.

The Contractor shall submit shop drawings for all materials within 28 calendar days after Notice to Proceed.

In subsection 105.02, delete Table 105-1 and replace with the following:

**TABLE 105-1
 SUMMARY OF CONTRACTOR SUBMITTALS**

Section No.	Description	Type	Contractor P.E. Seal Required?*
210	Power Control Board Modifications	Shop Drawing	No
613	24.9kV Switchgear	Shop Drawing	No
613	Step Voltage Regulator	Shop Drawing	No
613	Regulator Bypass Switch	Shop Drawing	No
613	Hook-Operated Disconnect Switch	Shop Drawing	No
613	Temporary Switchgear	Shop Drawing	No
613	Construction Sequencing Plan	Shop Drawing	No
613	Wire and Cable	Shop Drawing	No
613	Cable Splices	Shop Drawing	No
613	Conduit	Shop Drawing	No
613	Conduit Fittings and Supports	Shop Drawing	No
613	Junction and Pull Boxes	Shop Drawing	No
613	Wire Terminations	Shop Drawing	No
613	Hanger Rods	Shop Drawing	No
613	Channels	Shop Drawing	No
613	Mounting Hardware	Shop Drawing	No
613	Grounding and Bonding Connectors	Shop Drawing	No
613	Conduit Expansion Fittings	Shop Drawing	No
613	Testing Procedure and Test Reports	Shop Drawing	No

*: A PE seal is required where the Contractor has provided the design for the item, or performed engineering to modify the details shown on the plans. The PE seal is not required where complete details are provided on the plans.

**REVISION OF SECTION 107
PERFORMANCE OF SAFETY CRITICAL WORK**

Section 107 of the Standard Specifications is hereby revised as follows:

Add subsection 107.061 immediately following subsection 107.06 as follows:

107.061 Performance of Safety Critical Work. The following work elements are considered safety critical work for this project:

- (1) Work requiring the use of cranes or other heavy lifting equipment to set a girder, to make overhead repairs, or includes special provisions for Removal of Bridge or Removal of Portion of Bridge. Also when construction materials are being lifted that may fall onto active traffic lanes.

The Contractor shall submit, for record purposes only, an initial detailed construction plan that addresses safe construction of each of the safety critical elements. When the specifications already require an erection plan, a bridge removal plan, or a removal of portion of bridge plan, it shall be included as a part of this plan. The detailed construction plan shall be submitted two weeks prior to the safety critical element conference described below. The construction plan shall be stamped "Approved for Construction" and signed by the Contractor. The construction plan will not be approved by the Engineer.

The Construction Plan shall include the following:

- (1) Safety Critical Element for which the plan is being prepared and submitted.
- (2) Contractor or subcontractor responsible for the plan preparation and the work.
- (3) Schedule, procedures, equipment, and sequence of operations, that comply with the working hour limitations
- (4) Temporary works required: falsework, bracing, shoring, etc.
- (5) Additional actions that will be taken to ensure that the work will be performed safely.
- (6) Names and qualifications of workers who will be in responsible charge of the work:
 - A. Years of experience performing similar work
 - B. Training taken in performing similar work
 - C. Certifications earned in performing similar work
- (7) Names and qualifications of workers operating cranes or other lifting equipment
 - A. Years of experience performing similar work
 - B. Training taken in performing similar work
 - C. Certifications earned in performing similar work
- (8) The construction plan shall address how the Contractor will handle contingencies such as:
 - A. Unplanned events (storms, traffic accidents, etc.)
 - B. Structural elements that don't fit or line up
 - C. Work that cannot be completed in time for the roadway to be reopened to traffic
 - D. Replacement of workers who don't perform the work safely
 - E. Equipment failure
 - F. Other potential difficulties inherent in the type of work being performed
- (9) Name and qualifications of Contractor's person designated to determine and notify the Engineer in writing when it is safe to open a route to traffic after it has been closed for safety critical work.

PERFORMANCE OF SAFETY CRITICAL WORK

- (10) Erection plan or bridge removal plan when submitted as required elsewhere by the specifications. Plan requirements that overlap with above requirements may be submitted only once.

A safety critical element conference shall be held two weeks prior to beginning construction on each safety critical element. The Engineer, the Contractor, the safety critical element subcontractors, and the Contractor's Engineer shall attend the conference. Required pre-erection conferences or bridge removal conferences may be included as a part of this conference.

After the safety critical element conference, and prior to beginning work on the safety critical element, the Contractor shall submit a final construction plan to the Engineer for record purposes only. The final construction plan shall be stamped "Approved for Construction" and signed by the Contractor.

The Contractor shall perform safety critical work only when the Engineer is on the project site. The Contractor's Engineer shall be on site to inspect and provide written approval of safety critical work for which he provided signed and sealed construction details. Unless otherwise directed or approved, the Contractor's Engineer need not be on site during the actual performance of safety critical work, but shall be present to conduct inspection for written approval of the safety critical work.

When ordered by the Engineer, the Contractor shall immediately stop safety critical work that is being performed in an unsafe manner or will result in an unsafe situation for the traveling public. Prior to stopping work, the Contractor shall make the situation safe for work stoppage. The Contractor shall submit an acceptable plan to correct the unsafe process before the Engineer will authorize resumption of the work.

When ordered by the Engineer, the Contractor shall remove workers from the project that are performing the safety critical work in a manner that creates an unsafe situation for the public in accordance with subsection 108.05.

Should an unplanned event occur or the safety critical operation deviate from the submitted plan, the Contractor shall immediately cease operations on the safety critical element, except for performing any work necessary to ensure worksite safety, and provide proper protection of the work and the traveling public. If the Contractor intends to modify the submitted plan, he shall submit a revised plan to the Engineer prior to resuming operations.

All costs associated with the preparation and implementation of each safety critical element construction plan will not be measured and paid for separately, but shall be included in the work.

Nothing in the section shall be construed to relieve the Contractor from ultimate liability for unsafe or negligent acts or to be a waiver of the Colorado Governmental Immunity Act on behalf of the Department.

**REVISION OF SECTION 202
REMOVAL OF ELECTRICAL EQUIPMENT**

Section 202 of the Standard Specifications is hereby revised for this project to include the following:

Subsection 202.01 shall include the following:

The work shall include the demolition and removal of the existing 24.9kV Switchgear, electrical equipment, feeders, conduit, and wire as shown on the plans.

Subsection 202.02 shall include the following:

The Contractor shall coordinate with CDOT EJMT Maintenance Staff and obtain the approval of the Engineer prior to disconnecting or de-energizing any existing feeder or circuit to ensure operational and safety control. All conduit ends shall be sealed to prevent the entrance of water.

Subsection 202.11 shall include the following:

Removal of Electrical Equipment will not be measured but shall be paid for as a single lump sum basis for all work, materials, and equipment required for removal of all electrical equipment required for the removal and replacement of the Switchgear as specified herein.

Removal of Electrical Equipment shall include the removal of switchgear, voltage regulators, conduit, electrical cable complete with associated items. This payment will include the removal, hauling and, disposal of all abandoned or non-used electrical items which in any way hinders or obstructs the installation of the new electrical equipment indicated on the plans. Included in the term "associated items" is all equipment required to perform the complete demolition of the electrical items as required for the tunnel facility. This payment will also include the relocation or rearrangement of all electrical items that are presently in use or energized which in any way hinders or obstructs the installation of the new electrical equipment indicated on the plans. All materials and equipment removed shall become the property of the Contractor.

Subsection 202.12 shall include the following:

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Removal of Electrical Equipment	Lump Sum

**REVISION OF SECTION 210
MODIFY POWER CONTROL BOARD**

Section 210 of the Standard Specifications is hereby revised for this project to include the following:

Subsection 210.01 shall include the following:

The work shall also include modifications to the existing Power Control Board located in the Control Room of the East Ventilation Building as shown in the plans.

Subsection 210.02 shall include the following:

Modifications to Existing Power Control Board shall be made in accordance with the requirements of the Revision of Section 613, 24.9kV Switchgear Assemblies.

Subsection 210.12 shall include the following:

Modify Power Control Board will be measured but will be paid for on a lump sum basis.

Subsection 210.13 shall include the following:

Payment for Modify Power Control Board will be the contract lump sum bid and will be full compensation for all equipment, labor and materials required to complete the item as specified herein.

Payment will be made under:

Pay Item	Pay Unit
Modify Power Control Board	Lump Sum

**REVISION OF SECTION 250
ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT**

Section 250 of the Standard Specifications is hereby revised for this project to include the following:

Subsection 250.01 shall include the following:

This work will also include inspections, assessment, removal and disposal of asbestos material encountered as a result of any drilling into the electrical room ceiling and at other locations required to complete the work as shown in the plans.

Subsection 250.09, first paragraph shall include the following:

- (5) Materials handling and stockpiling as required
- (6) Disposal of solid waste and hazardous waste

Subsection 250.09, delete the fifth paragraph and replace with the following:

Materials stockpiled under the requirements of this specification will not be measured and paid for separately but shall be included in the lump sum price for Environmental, Health and Safety Management. Disposal of solid waste and hazardous waste materials will not be measured and paid for separately but shall be included in the lump sum price for Environmental, Health and Safety Management.

Subsection 250.10, delete the fifth and sixth paragraphs and replace with the following:

Payment for Materials Handling (Stockpile) will not be made separately but shall be included in the contract lump sum price for Environmental, Health and Safety Management and shall include furnishing all materials, labor, equipment and incidentals necessary to complete this work, and all handling of the material prior to disposal. This also includes haul, stockpile, water collection, and security.

Payment for Solid Waste Disposal and Hazardous Waste Disposal will not be made separately but shall be included in the contract lump sum price for Environmental, Health and Safety Management and shall include furnishing all materials, labor, equipment, tools, storage containers for transport, containerization of material for up to 60 days, and incidentals necessary to complete this work. This also includes all handling of the material, loading for disposal, unloading for disposal, and all associated fees.

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REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.01 shall include the following:

The work shall also include furnishing, handling, storing and installing all conduit, wireway, hanger system, conduit fittings, sealing boots, wall penetrations, ceiling/roof penetrations, mounting hardware, and anchors, fasteners and supports for fastening conduit and equipment to the building structure.

Subsection 613.02(c) shall include the following:

- (c) *Conduit.* Unless otherwise noted in these specifications or shown on the plans, all conduits shall be metal Galvanized Rigid Conduit (GRC). GRC shall be mild steel, hot-dip galvanized conduit complying with ANSI C80.1 and FS WW-C-581 and shall be UL listed. All conduit material shall comply with the applicable standards of ASTM, NEMA, ICEA, and where applicable shall be UL listed.

Conduit shall be $\frac{3}{4}$ inch trade size or larger or as indicated on the plans, and shall be manufactured by National Electrical Products Company, Youngstown Steel and Tube Company, Republic Steel, Allied Steel Tube and Conduit Company, or approved equal.

Liquidtight flexible metal conduit shall be minimum $\frac{3}{4}$ -inch trade size and shall comply with UL-1 Listed, standard weight, flexible, galvanized steel conduit with a heavy wall neoprene or polyurethane jacket. Fittings shall be galvanized steel designed for use with liquidtight flexible metal conduit and comply with UL Standard 514.

Elbows, bends, and similar offsets shall be made of full weight materials complying with the above and shall be coated and threaded the same as conduit. Threads for conduit, couplings, and fittings shall be full depth and clean cut.

Material for Fittings shall comply with ANSI/NEMA FB-1.

Conduit Expansion Fittings shall be O-Z./Gedney type AX, EX, EXDS, TX, or EXE; Crouse Hinds type XJ; Appleton expansion fitting or approved equal.

Factory fabricated metal connectors of the size, rating material type, and class required for each service shall be provided.

Lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer.

The finish shall consist of a wash and phosphate undercoat and an ANSI 61 gray polyester powder finish. Hardware and latches are zinc plated with a yellow chromate finish.

- (j) A hanger system for the support of conduits and wireways shall be provided. Support shall be provided for conduits at 10 foot intervals and within 18 inches of terminations, in accordance with the requirements of the National Electrical Code. The materials for the hanger system shall conform to the following:

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**REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING**

- (1) Conduit Clamps shall be one hole or two-hole, cadmium plated or galvanized heavy gauge steel, or galvanized malleable iron.
- (2) Hanger Rod: Galvanized Steel or electro-galvanized and zinc chromate coated steel, 3/8-inch minimum.
- (3) Channels, Fittings, Hangers, Clamps, and Accessories: Unless otherwise indicated, all surface mounted supporting channels and associated fittings, clamps and accessories shall be galvanized steel. Channels shall be constructed of 12-gauge minimum, 1-5/8-inch deep by 1-5/8-inch wide minimum. Hangers shall be steel which is hot-dip galvanized after fabrication.
- (4) Nuts, bolts, and washers shall be Type 316 stainless steel.

Subsection 613.03 shall include the following:

All equipment and materials that are damaged during transport, and which the Engineer deems to be non-functional or unfit for use, will be repaired or replaced at the Contractor's expense.

Equipment shall be stored in a clean, dry space and protected from dirt, fumes, water, construction debris, and any physical damage.

Auxiliary heaters shall be provided for all equipment that would be damaged by moisture condensation.

The Contractor shall examine the areas and conditions under which electrical equipment is to be installed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the Work. Work shall not proceed until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

Supporting devices shall be installed as follows:

- (1) Provide anchors with sufficient strength to support four times the load imposed by the combined conduit and conductor weight. Anchors shall be seismic rated for Zone 3 requirements.
- (2) Hollow Masonry: Toggle bolt type expansion anchors.
- (3) Solid Masonry: Expansion anchors or preset inserts.
- (4) Metal Surfaces: Machine screws, bolts, or welded studs.
- (5) Wood Surfaces: Wood screws.
- (6) Concrete Surfaces: Concrete screw anchors, wedge anchors, or sleeve anchors or approved equal. Power driven (powder actuated) studs shall not be used.

Subsection 613.07 shall be deleted in its entirety and replaced with the following:

613.07 Conduit. Electrical conduit shall be installed in accordance with the applicable requirements described in the Department of Transportation's, *A Policy on the Accommodation of Utilities on Colorado Highways Rights-of-Way*, as amended, and the following:

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REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING

Conduit runs in structures are shown on the plans only for information. Locations will be established during construction by the Contractor with approval of the Engineer. Conduit and cable shall be so located as to avoid any interference with known present or known future construction installations. Existing conduit to be reused shall be

cleaned with a mandrel 1/2 inch smaller than conduit's inside diameter (ID) and a cylindrical wire brush of diameter equal to conduit's ID, followed by a swab of the same size as the conduit's ID.

The ends of all conduits, whether shop or field cut, shall be reamed to remove burrs and rough edges. Cuts shall be made square and true so that the ends will butt or come together for the full circumference thereof. Slip joints or running threads will not be permitted for coupling conduit. When a standard coupling cannot be used for coupling metal type conduit, an approved threaded union coupling shall be used. All threads on all ferrous metal conduit, not previously treated with a corrosion preventative, shall be painted with conducting rust preventive paint before couplings are made up. All couplings for metal type conduit shall be tightened until the ends of the conduit are brought together, providing a continuous electrical connection throughout the entire length of the conduit run. Where the coating on ferrous metal conduit has been damaged in handling or installing, such damaged places shall be painted with rust preventive paint.

All metal type conduit ends shall be threaded and shall be capped until wiring is started. When caps are removed, the threaded ends shall be provided with conduit bushings or transition fittings as applicable.

Liquidtight flexible metal conduit shall be used only when necessary as the final conduit connection to electrical equipment and other utilization devices. Connections to equipment subject to vibration, calibration, periodic removal, or where specifically indicated or noted on the plans shall be made with between 18 and 24 inches of Liquidtight flexible metal conduit.

It shall be the option of the Contractor, at no expense to the Department, to install pull boxes to facilitate the work.

The Contractor shall route exposed conduit parallel and perpendicular to walls and adjacent piping.

The Contractor shall maintain a minimum 6-inch clearance between conduit and piping.

The Contractor shall arrange conduit supports to prevent distortion of alignment by wire pulling operations.

The Contractor shall group conduit in parallel runs where practical, and use conduit supports constructed of galvanized steel channel with conduit clamps, designed to provide the proper separation between the conduits.

The Contractor shall fasten conduit with approved malleable iron clamps before conductors are pulled. Do not use spring steel clips for conduit clamps. The Contractor shall remove all wire used for temporary conduit support during construction.

The Contractor shall support conduit at a maximum of 10 feet on center.

The Contractor shall install no more than the equivalent of three 90-degree bends between end points of any conduit run. Adequately sized boxes shall be installed to meet this requirement whether specifically shown or not in the Plans.

Conduit bodies shall not be used to make sharp changes in direction, as around beams or corners. All bends shall be via standard radius sweeps. LB fittings shall be a mogul cast fitting with a gasket and cover.

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REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING

The Contractor shall use hydraulic one-shot conduit bender or factory elbows for bends in conduit.

The Contractor shall avoid moisture traps where possible; where unavoidable, provide conduit body with drain fitting at conduit low point.

Conduit offsets shall be properly made and installed where required. Where two or more conduit offsets or bends are installed in parallel, they shall be symmetrically formed and arranged.

Conduit shall be supported on each side of conduit bends or fittings and not more than 2 feet away from any junction box or pull box, if utilized.

Conduit shall not be fastened to other conduits or pipes for support.

Conduits and conduit boxes shall be of such sizes and numbers and shall be so installed that the required number of conductors may be drawn in without injury or excessive strain. The Contractor will be permitted to increase the size of conduits and number of boxes, if he so desires, to facilitate a speedier and less complicated installation, however, such changes shall be at his expense.

Where fasteners are required in concrete floors, walls or ceilings, expansion anchors shall be used unless noted otherwise

- (1) The minimum allowable anchor working load for existing concrete strength $f'c = 3,000$ psi, shall be certified in writing for Tension = 6,800 lbs and Shear = 5,000 lbs.
- (2) The corresponding ultimate anchor capacity shall be certified in writing for Tension = 22,000 lbs and Shear = 18,000 lbs.
- (3) The concrete anchors and the Type 316 stainless steel bolts, nuts, and washers shall be supplied by one of the following manufacturer or an approved equal:
 - a. HILTI Corporation
 - b. Williams
 - c. Marine Fasteners
- (4) All anchors supplied shall be from one manufacturer.
- (5) The bolts shall be installed by first drilling holes into existing concrete and effectively cleaning any loose material from the drilled holes. The Contractor shall exercise care in locating and drilling the holes so as to avoid damage to existing reinforcing steel bars and concrete.
- (6) The Contractor shall follow the installation procedures recommended by the manufacturer, including, but not limited to, the size and depth of hole for the required bolt size, the type of drilling tools preferred, surface preparation.

Inserting wooden plugs in concrete or masonry will not be accepted as a base for conduit fastenings, nor will conduit or pipe straps be welded to steel structures.

Openings in floors, walls, ceilings or roofs required for the installation of the conduit shall be sealed and patched to match the existing area after the installation is complete.

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REVISION OF SECTION 613
ELECTRICAL CONDUIT AND WIRING

Rigid metallic conduits shall have expansion fittings installed at every expansion joint and as specified in the NEC. The expansion fittings shall provide for 4-inch conduit movement, 2-inches in either direction. A 14-inch bonding jumper, designed for use in conjunction with the expansion fitting shall be installed around every expansion fitting.

Subsection 613.08 shall be deleted in its entirety and replaced with the following:

613.08 Wiring. The material shall comply with the applicable standards of ASTM, NEMA, ICEA, and where applicable shall be UL listed.

600-volt wire and cable shall be copper, not less than 98% conductivity.

Insulation shall be type XHHW. Wire shall be stranded. All wire sizes shown are in American Wire Gauge sizes.

All power wire shall be color coded as follows:

<u>Conductor</u>	<u>120 Volt</u>	<u>277/480 Volt</u>
Ungrounded	Black-Red	Brown (Φ A)-Orange (Φ B)-Yellow (Φ C)
Grounded	White	Gray
Grounding	Green	Green

Factory fabricated metal connectors of the size, rating material type, and class required for each service shall be provided.

35kV cable shall be shielded, with a semi-conducting strand shield, ethylene propylene rubber insulation, semi-conducting insulation shield, copper tape shield, and polyvinyl chloride jacket. The insulation level shall be 100 percent. Terminations shall be made using stress cones, and the shields shall be grounded at the switchgear. The other end of the shield shall not be grounded.

Lubricants for assisting in the pulling of jacketed cables shall be those specifically recommended by the cable manufacturer.

Subsection 613.10 shall be deleted in its entirety and replaced with the following:

613.10 Testing. Prior to final acceptance, the Contractor shall demonstrate to the Engineer's satisfaction that electrical installations are in proper working condition, provide all instrumentation and labor required to perform all inspection and tests as described herein. All tests shall be performed in the presence of the Department personnel or Department's authorized Engineer. All test results shall be documented and submitted to the Engineer for approval.

Subsection 613.11 shall include the following:

Electrical Conduit of the specified diameter will not be measured and paid for separately but shall be included in the lump sum item, Conduit.

Wire and cable will not be measured and paid for separately but shall be included in the lump sum item, Wiring.

Conduit clamps, channels, associated accessories, hardware and hanger system described herein and the installation thereof shall not be measured separately, but shall be incidental to the work.

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ELECTRICAL CONDUIT AND WIRING

Subsection 613.12 shall include the following:

The accepted quantities will be paid for at the contract unit price for each of the pay items listed below that appear in the bid schedule.

Payment will be made under:

Pay Item	Pay Unit
Conduit	Lump Sum
Wiring	Lump Sum

Payment for conduit shall also include all conduit connections and terminations, pull and junction boxes, conduit fittings, hangers and supports, and identification materials.

Payment for Wiring shall also include all wire and cable splices, terminations, and identification tags.

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REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

Section 613 of the Standard Specifications is hereby revised for this project as follows:

DESCRIPTION

Add the following subsection:

613.13 This Section specifies the requirements for metal-enclosed, medium voltage metal-clad draw-out type vacuum-type circuit breaker switchgear. The general arrangement of the switchgear shall be as follows:

- (1) Main circuit breaker section A, with 1200 ampere frame circuit breaker with associated potential transformer compartment.
- (2) Main circuit breaker section B, with 1200 ampere frame circuit breaker with associated potential transformer compartment. One circuit breaker and potential transformer assembly shall be provided to insert in either one of the two main compartments. Each compartment shall be provided with a protective relay.
- (3) Blank section with through busing, to accommodate column in electrical room.
- (4) Tie circuit breaker section, with 1200 ampere frame circuit breaker unit and protective relay.
- (5) Feeder circuit breaker section for 2400V transformer no. 1B, with 1200 ampere frame circuit breaker unit and protective relay.
- (6) Feeder circuit breaker section for 480V transformer no. 2, with 1200 ampere frame circuit breaker unit and protective relay.
- (7) Blank section with through busing, to accommodate column in electrical room.
- (8) Feeder circuit breaker section for 2400V transformer no. 1A, with 1200 ampere frame circuit breaker unit and protective relay.
- (9) Feeder circuit breaker section for 480V transformer no. 1, with 1200 ampere frame circuit breaker unit and protective relay.

MATERIALS

Add the following subsections:

613.14 Design and Performance. Design and performance of components and methods specified herein shall comply with all applicable Federal, State, and Local laws, ordinances, regulations and codes, and the latest industry standards including, but not limited to the entities listed below.

- (1) American National Standards Institute (ANSI)
- (2) National Electrical Manufacturers Association (NEMA)
- (3) National Fire Protection Association (NFPA)

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(4) Underwriters Laboratories (UL)

The switchgear shall be designed, manufactured, and tested in accordance with the latest revision of the applicable ANSI, NEMA, and UL Standards. Where a discrepancy exists between the various standards, the most stringent requirements shall apply.

The tunnel is located at an elevation of approximately 11,000 ft. above sea level. The equipment to be provided shall be fully rated for the various parameters in this Specification at that altitude.

613.15 Quality Assurance. Switchgear and all components of types and sizes required shall have been satisfactorily used for purposes similar to those intended herein for not less than three years.

Entities manufacturing equipment shall have experience on at least two projects involving complexities similar to those required under this Contract.

The switchgear and circuit breakers shall be suitable for and certified to meet all applicable seismic requirements of Uniform Building Code (UBC) for Zone 1 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, UBC: a peak of 0.09g, and a Zero Period Acceleration (ZPA) of 0.075g. The tests shall fully envelope this response spectrum for all equipment natural frequencies up to at least 35 Hz.

613.16 Submittals. See Section 105 for general submittal requirements. The switchgear submittal shall include the following information:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line diagram
6. Schematic diagram
7. Nameplate schedule
8. Component list
9. Conduit entry/exit locations
10. Assembly ratings including:
 - a. Switchgear assembly short-circuit withstand rating
 - b. Enclosure internal arc short circuit rating
 - c. Voltage
 - d. Continuous current
 - e. Basic impulse level
11. Major component ratings including:

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- a. Voltage
 - b. Continuous current
 - c. Interrupting ratings
15. Cable terminal sizes
16. Product data sheets
17. Connection details between close-coupled assemblies
18. Composite floor plan of close-coupled assemblies
19. Key interlock scheme drawing and sequence of operations
20. Descriptive bulletins
21. Certification that the equipment is suitable for installation and operation at an elevation of 11,000 feet above sea level
22. The following information shall be submitted for record purposes:
- a. Final as-built drawings and information for items listed in paragraph 1.04
 - b. Wiring diagrams
 - c. Certified production test reports
 - d. Installation information including equipment anchorage provisions
 - e. Seismic certification

613.17 Spare Parts And Special Tools.

A complete set of the following indicated spare parts shall be furnished for each of the two switchgear assemblies.

Furnish one spare circuit breaker for each switchgear assembly.

Furnish one ground and test device for each switchgear assembly for each switchgear assembly.

A minimum of six (6) spare fuses of each size and type used in the switchgear shall be furnished for each switchgear assembly.

Furnish one set of all special tools required for the erection, operation, and maintenance of all equipment furnished for each switchgear assembly.

Furnish a minimum of three (3) half-pint containers of paint matching the exterior finish of the enclosure for each switchgear assembly.

Furnish six (6) spare indicating lamps of each type installed for each switchgear assembly.

Furnish one (1) container of contact lubricant for each switchgear assembly.

Furnish one (1) portable breaker lifting device for each switchgear assembly.

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613.18 Manufacturers. Medium voltage switchgear shall be manufactured by General Electric Company, Square D Company, Cutler Hammer, Siemens or an approved equal.

613.19 Ratings. The switchgear shall have the following ratings, as shown on the Contract Drawings:

1. Nominal System Voltage: 24.9/14.4 kV, 3 phase, 3 wire, solidly grounded neutral
2. Rated Maximum Voltage: 27kV
3. Rated Frequency: 60 Hertz
4. Rated Insulation Level: 125kV
5. Rated Continuous Current: 1200 Amperes
6. Rated Short-Circuit Current: 22kA
7. Rated Short Circuit MVA: 1000MVA
8. Short Circuit Current Bus Bracing: 22kA
9. Control Voltage: 125V DC

613.20 Construction Features. Switchgear shall be factory assembled, suitable for indoor use, dead front, metal enclosed, free standing, arc-flash resistant, and completely equipped with removable medium voltage vacuum circuit breakers, fuses, instrument transformers, relays, metering, switches, and associated devices as described herein and as shown on the Contract Drawings and conforming to ANSI C37.20.2, C37.55, C37.100, and NEMA SG 5.

Provisions shall be made for extension of the switchgear in both directions. Circuit breakers shall be removable, drawout type.

All breakers shall be arranged as shown on the Contract Drawings.

No polyvinyl chloride (PVC) materials, insulation or products shall be used in switchgear, except for removable insulating boots on bus work.

613.21 Construction. The switchgear assembly shall consist of individual vertical sections housing various combinations of circuit breakers and auxiliaries, bolted to form a rigid metal-clad switchgear assembly. Metal side sheets shall provide grounded barriers between adjacent structures and solid removable metal barriers shall isolate the major primary sections of each circuit. The 27 kV switchgear structures shall be provided with one full height hinged rear cover.

The construction of the switchgear shall permit the addition of new circuit breaker sections at the end of the lineup.

The stationary primary contacts shall be silver-plated and recessed within insulating tubes. A steel shutter shall automatically cover the stationary primary disconnecting contacts when the breaker is in the disconnected position or out of the cell. Provide rails to allow withdrawal of each 27 kV circuit breaker for inspection and maintenance without the use of a separate lifting device.

The switchgear assembly shall be of arc resistant construction that provides Type-2 accessibility around the perimeter (front, sides, and rear) of the line-up in accordance with IEEE C37.20.7.

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Each individual vertical section of the switchgear shall include integral and top mounted pressure release flaps to facilitate a controlled upward release of arc created overpressures, smoke, and gasses. Individual vertical sections shall be of a unitized design to allow removal of a damaged vertical section after a fault incident, without requiring the removal of the adjacent vertical sections.

The main bus shall be copper with fluidized bed epoxy flame-retardant and track-resistant insulation. The bus supports between units shall be flame-retardant, track-resistant, cycloaliphatic epoxy. The switchgear shall be constructed so that all buses, bus supports and connections shall withstand stresses that would be produced by currents equal to the momentary ratings of the circuit breakers. Main bus shall be rated 1200 amperes. Insulated copper main bus shall be provided and have provisions for future extension. All bus joints shall be plated, bolted and insulated with easily installed boots. The bus shall be braced to withstand fault currents equal to the close and latch rating of the breakers. The temperature rise of the bus and connections shall be in accordance with ANSI standards and documented by design tests.

A copper ground bus shall extend the entire length of the switchgear.

The switchgear manufacturer shall provide suitable terminal blocks for secondary wire terminations and a minimum of 10% spare terminals shall be provided. One control circuit cutout device shall be provided in each circuit breaker housing. Switchgear secondary wire shall be #12 AWG, type SIS rated 600 volt, 90 degrees C, furnished with wire markers at each termination. Wires shall terminate on terminal blocks with marker strips numbered in agreement with detailed connection diagrams.

Incoming line and feeder cable lugs shall be 2-hole mounting, long barrel, copper compression lugs. Feeders shall be for conduit and cable. Cable entry shall be from either the top or the bottom of the enclosure, as indicated on the Drawings.

613.22 Circuit Breakers. The circuit breakers shall be horizontal drawout type, capable of being withdrawn on rails. The breakers shall be operated by a motor-charged stored energy spring mechanism, charged normally by a universal electric motor and in an emergency by a manual handle. The primary disconnecting contacts shall be silver-plated copper.

Each circuit breaker shall contain three vacuum interrupters separately mounted in a self-contained, self-aligning pole unit, which can be removed easily. The vacuum interrupter pole unit shall be mounted on cycloaliphatic epoxy supports. A contact wear gap indicator for each vacuum interrupter, which requires no tools to indicate available contact life, shall be easily visible when the breaker is removed from its compartment. The current transfer from the vacuum interrupter moving stem to the breaker main conductor shall be a non-sliding design. The breaker front panel shall be removable when the breaker is withdrawn for ease of inspection and maintenance.

The secondary contacts shall be silver-plated and shall automatically engage in the breaker operating position, which can be manually engaged in the breaker test position.

Interlocks shall be provided to prevent closing of a breaker between operating and test positions, to trip breakers upon insertion or removal from housing and to discharge stored energy mechanisms upon insertion or removal from the housing. The breaker shall be secured positively in the housing between and including the operating and test positions.

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The circuit breaker compartment door shall be mechanically interlocked with the breaker levering mechanism to prevent opening of the door unless the breaker is first opened and withdrawn to Test/Disconnected position with the door closed.

The design shall allow normal circuit breaker functions to be carried out with the door closed. Those functions include: manual open and close, manual levering to and from connected position, and manual charging of the circuit breaker closing springs. Shatter proof viewing windows shall be provided on the door to enable viewing of circuit breaker position inside the compartment, circuit breaker contact status (open/closed), and spring charged/discharged indication.

When a remote operable electrical levering device is specified under the accessories, the design shall allow levering of the circuit breaker using such a device with the door closed.

The breakers shall be electrically operated by the following control voltages: 125-volt DC close and 125 volt DC trip. Each breaker shall be complete with control switch and red and green indicating lights to indicate breaker contact position.

DC control voltage shall be supplied by from existing battery/charger system.

613.23 Protective Relays. The switchgear manufacturer shall furnish and install, in the metal-clad switchgear, the quantity, type and rating of protection relays as indicated on the drawings and described hereafter in this specification. Relays shall be mounted in a separate area metal barriered from medium voltage.

Relays shall be Microprocessor-Based Protective Relays. For incoming line circuit breakers: Cutler-Hammer FP-5000, or equivalent by General Electric Multilin or Basler or other equal microprocessor-based multi-function protective relay, with ANSI device functions 51/50, 54/50N, 46, 59, 27, 32, 67, 46, 55, 81O, 81U, 47, and 50BF. The relay shall also includes metering functions. For tie and transformer feeder circuit breakers: Cutler-Hammer DT 3000, or equivalent by General Electric Multilin or Basler or other equal microprocessor-based multi-function overcurrent relay, with ANSI device functions 51/50, 51/50N, or 51/50G, and 86.

613.24 Auxiliary Devices. Ring type current transformers shall be furnished as indicated on the contract drawings. The thermal and mechanical ratings of the current transformers shall be coordinated with the circuit breakers. Their accuracy rating shall be equal to or higher than ANSI standard requirements. The standard location for the current transformers on the bus side and line side of the breaker units shall be front accessible to permit adding or changing current transformers without removing high-voltage insulation connections. Shorting terminal blocks shall be furnished on the secondary of all the current transformers.

Voltage or potential transformers shall be supplied. Voltage transformers shall be mounted in drawout drawers contained in an enclosed auxiliary compartment. Rails shall be provided for auxiliary drawers to permit easy inspection, testing and fuse replacement. Shutters shall isolate primary bus stabs when drawers are withdrawn. Voltage transformers for each assembly shall consist of three 14.4kV to 120 volt transformers with primary and secondary fuses.

Lightning/Surge Arresters shall be intermediate class, rated for 18kV.

613.25 Enclosures. Indoor switchgear shall be provided with a NEMA 1 enclosure.

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The switchgear shall be installed inside an electrical room. Arc exhaust shall be discharged into the space above the switchgear.

613.26 Nameplates. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, white characters on black background, and secured with screws. Characters shall be 3/16-inch high, minimum. Furnish master nameplate for each switchgear lineup giving information in accordance with IEEE Std C37.20.2-1999, section 7.4.1 and IEEE C37.20.7, section 6.3. Circuit nameplates shall be provided with circuit designations as shown on purchaser's single-line diagrams.

Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

613.27 Finish. The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.

613.28 Accessories. The switchgear manufacturer shall furnish accessories for test, inspection, maintenance, and operation. Two sets of accessories shall be furnished, one set for each of the two switchgear locations. Each accessory set shall include:

1. One – Maintenance tool for manually charging the breaker closing spring and manually opening the shutter
2. One – Levering crank for moving the breaker between test and connected positions
3. One – Test jumper for electrically operating the breaker while out of its compartment
4. One – Breaker lifting yoke used for attachment to breaker for lifting breaker on or off compartment rails, when applicable
5. One – Set of rail extensions, when applicable
6. One – Portable lifting device for lifting the breaker on or off the rails
7. One – Ramp for rolling breaker mounted in lower compartment directly onto the floor
8. One – Test cabinet for testing electrically operated breakers outside housing
9. One – "Dockable" transport dolly for moving breaker about outside its compartment
10. One – Universal Remote Power Racking Device

613.29 Corona-Free Design. The switchgear shall be corona free by design and shall be tested for partial discharges in accordance with EEMAC standard G11-1. The corona discharges measured during the tests shall be less than 100 picocoulombs.

613.30 Partial Discharge Sensing Equipment. The switchgear shall be equipped with factory installed partial discharge (PD) sensors and relay for continuous monitoring of the partial discharges under normal operation. The partial discharge sensing shall identify potential insulation problems (insulation degradation) by trending of PD data over time so that corrective actions can be planned and implemented before permanent insulation deterioration develops.

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The PD sensing and monitoring system shall consist of sensors and relay(s) specifically developed for such applications. One sensor shall be installed over floating stress shields of specially designed bus or line side primary bushings, at every two vertical section for detection of partial discharges within the switchgear compartments. An sensor shall also be provided for installation around ground shields of the incoming and outgoing power cable terminations for detection of PD activity in the cables up to 100 feet from the switchgear. Output signals from each shall be factory wired to PD monitoring relay for continuous monitoring.

613.31 Bills of Material. The metal-clad switchgear auxiliary section for control and instrumentation shall include the following:

1. Three – Line-to-ground voltage transformers
2. Three – Current transformers

The metal-clad switchgear main circuit breaker section for control of a main circuit breaker shall include the following:

1. One – Drawout power circuit breaker
2. Three – Current transformers, single secondary
3. One – Circuit breaker control switch with red and green indicating lights
4. One – Microprocessor-based three-phase and ground overcurrent relay, ANSI device numbers 27 Undervoltage, 46 Current Balance, 47 Phase Voltage Reversal, 51/50/N Instantaneous and Time Overcurrent
5. One – Nameplate
6. One – Set of cable lugs.
7. Three – Lightning/Surge Arresters, intermediate class, rated 18kV.

The metal-clad switchgear tie breaker section for control of a tie breaker shall include the following:

1. One – Drawout power circuit breaker
2. Three – Current transformers, single secondary
3. One – Circuit breaker control switch with red and green indicating lights
4. One – Microprocessor-based three-phase and ground overcurrent relay, ANSI device number 51/50/N
5. One – Set of cable lugs
6. One – Nameplate
7. Tie circuit breaker shall be provided with a key interlock on the rear door of the compartment, interlocked with the tie circuit breaker in the switchgear in the other ventilation building.
8. Three – Lightning/Surge Arresters, intermediate class, rated 18kV.

Each metal-clad switchgear feeder breaker section for control of a feeder circuit breaker shall include the following:

1. One – Drawout power circuit breaker
2. Three – Current transformers, single secondary
3. One – Circuit breaker control switch with red and green indicating lights

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4. One – Microprocessor-based 3-phase and ground relay, ANSI device number 51/50/N
5. One – Nameplate
6. One – Set of cable lugs.

613.32 Relays, Control Switches and Fuses. Protective relays shall conform to ANSI C 37.90 and be of the semiflush mounted, removable type, with built-in test facilities. Current transformer secondaries shall be automatically short circuited when the relay is removed from its case. Auxiliary relays shall be surface mounted and front connected.

In addition, the main and tie circuit breakers shall be provided with electro-mechanical lockout relays, with manual reset, that shall be engaged when the breakers are tripped on overcurrent.

Control, transfer, and instrument switches shall be of the heavy duty rotary, multi-position, cam operated, multi-stage type, with dust cover, rated 600VAC, with silver to silver contacts rated for continuous current of 20 amperes. Each circuit breaker control switch shall have red and green target. Each switch shall be equipped with engraved plastic escutcheon or nameplate identifying its function and position. Handle styles shall be pistol grip for control, and oval for instrument or transfer switches.

Each Circuit Breaker shall be provided with a control switch on the door of each circuit breaker cubicle for performing breaker close and open operations. Mechanical red/green targets shall be incorporated in the switch to indicate breaker “Closed/Open” position. A spring-return mechanism shall return the switch handle to the normal vertical position.

613.33 Indicating Lamps. Indicating lamps shall be light emitting diodes (LED) of the low voltage, low burden series resistor type, with lens colors as approved by the Engineer. Lamps shall be replaceable from the front of the panel.

613.34 Terminal Blocks. Terminal blocks for all external control connections shall be 600 volt, barrier type, having a minimum rating of 20 amperes with identifying marker strips. Terminal strips in each cubicle, shall have at least 20 percent spare terminals and shall be in accordance with NEMA ICS 4. Terminal blocks for current transformer secondary connections shall be of the short circuiting type.

613.35 Nameplates and Mimic Bus. Nameplates shall be provided for each switchgear, for each cubicle, and for all externally and internally mounted devices, including, but not limited to, instruments, meters, control switches, and relays to identify its function, and where applicable, its position.

Nameplates shall consist of letters and numbers back engraved on a laminated thermosetting plastic material, providing white letters and numbers on a black background. Size of letters and figures shall be approximately 1/8 inch for device nameplates and 7/16 inch for cubicle nameplates, and 1 inch for switchgear designations.

Nameplates shall be fastened with two oval-head stainless steel machine screws.

Number, location and designation of nameplates shall be as approved by the Engineer.

Mimic bus shall be provided on the face of the switchgear representing actual bus arrangements within the switchgear assembly. Circuit breaker control switches and indicating lights shall be located in the proper position on the mimic bus. The mimic bus shall be 1/8 x 3/4 inch, high strength thermosetting plastic material, secured every twelve (12) inches with self tapping screws.

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613.36 Interlocking. New control switches with key interlocking shall be provided for the Power Control Board located in the Control Room in the East Ventilation Building. See paragraph 613.49. See paragraph 613.31 for additional interlocking requirements.

613.37 Additional Grounding Requirements. The switchgear shall be provided with a solderless copper ground lug attached to a non-painted surface in each section of the switchgear. The lugs shall have the capacity for connection of two No. 4/0 wires.

613.38 Shop Painting. Prior to assembly and before shop painting, all surfaces of the switchgear enclosure shall be thoroughly cleaned of rust, oil, grease, dirt and mill scale and receive a phosphatizing treatment, and then be primed with one coat of rust-inhibitor for a dry film thickness of 1-2 mils.

The exterior and interior of the switchgear shall be given two or more finish coats of corrosion resistant paint for a final dry film thickness of at least 2-4 mils. The color of the finish on the switchgear shall be ANSI number 61 light gray.

Alternative painting process, such as electrostatically applied paint, can be utilized, subject to the approval of the Engineer.

613.39 Factory Testing. The following standard factory tests shall be performed on the circuit breaker element provided under this section. All tests shall be in accordance with the latest version of ANSI standards.

1. Alignment test with master cell to verify all interfaces and interchangeability
2. Circuit breakers operated over the range of minimum to maximum control voltage
3. Factory setting of contact gap
4. One-minute dielectric test per ANSI standards
5. Final inspections and quality checks

The following production test shall be performed on each breaker housing:

1. Alignment test with master breaker to verify interfaces
2. One-minute dielectric test per ANSI standards on primary and secondary circuits
3. Partial discharge tests, when applicable.
4. Operation of wiring, relays and other devices verified by an operational sequence test
5. Final inspection and quality check.

The manufacturer shall provide three (3) certified copies of factory test reports.

The owner's representative will witness factory tests as outlined above.

1. The manufacturer shall notify the owner two (2) weeks prior to the date the tests are to be performed.

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CONSTRUCTION REQUIREMENTS

Add the following subsections:

613.40 Delivery, Storage, and Handling. Prior to shipment, the switchgear assembly shall be cleaned by wiping with a clean, dry cloth.

Oil and grease marks shall be removed and wiped dry. All insulation shall be cleaned thoroughly. Dirt, soot, grease, or paint shall be removed from the circuit breaker contacts and surface of the entire current carrying structures.

All relays and instruments shall be firmly blocked to prevent damage during shipment.

The overall dimensions and weight of each shipping section shall be limited to the maximum allowable by applicable state and local codes governing shipment of materials over public roads or construction site handling limitations, whichever is less. Each shipping section shall have a label indicating dimensions and weight.

All equipment and materials shall be suitably wrapped, crated, boxed, or otherwise prepared for shipment to prevent damage during handling and shipping. All openings shall be properly protected to prevent the entrance of any dirt or debris. All parts not constructed to be normally exposed to the weather shall be suitably weatherproofed.

Each box or crate shall be equipped with suitable lifting devices to facilitate unloading and shall contain a detailed packing list.

Packaging shall be labeled and numbered so that each section or assembly may be identified before being uncrated. Any items not fully assembled to the switchgear structure shall be packaged separately. Removable circuit breaker units shall be packaged and shipped separately.

Adequate means shall be provided for lifting by fork lifts and cranes and for moving the equipment on rollers. Lift points shall be marked on each crate.

Indoor switchgear that cannot be installed immediately shall be stored in a dry, clean location within a heated building. During storage, the switchgear shall be placed on a level surface.

613.41 Field Supervision. Provide the services of a qualified, factory-trained switchgear manufacturer's representative to provide technical field support in the installation and start-up of the equipment specified in this Section. The manufacturer's representative shall provide technical direction and assistance in general assembly of the equipment, connections, calibrations, adjustments, and testing of the assembly and components contained therein.

613.42 Field Tests. Field tests shall be performed in accordance with the manufacturer's recommendations, International Electrical Testing Association (NETA), NEMA, UL, ANSI, and as required in this Section and/or as directed by the Engineer. Tests shall be performed only after the equipment has been thoroughly cleaned.

All Work shall be performed with due regard for the protection of personnel and equipment.

Test shall be performed only after the equipment has been thoroughly cleaned.

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All field tests shall be conducted in the presence of the Engineer or his designee for the purpose of demonstrating that the equipment and systems comply with the requirements of this Section to assure the Engineer that the entire installation meets applicable codes and standards requirements, and that all systems will function as designed.

All controls shall be checked individually prior to operational tests. Wiring diagrams and manufacturer's drawings shall be marked during checkout. Checked items shall be marked in yellow; discrepancies shall be corrected, and modifications shall be recorded in red. Marked wiring diagrams and manufacturer's drawings shall be submitted to the Engineer.

Record all test values, settings, and calibrations and furnish the Engineer with copies of test reports after completion of each individual test. These reports shall include a description of the test procedures. All test data for each test required in this Section shall be recorded on test forms.

The Engineer shall be advised, in writing, upon failure of any equipment or material to pass the tests performed or to properly function as intended.

Integrity Tests: The switchgear shall successfully complete the following tests as recommended by NETA and listed under the "Switchgear and Switchboard Assemblies" Section:

1. Visual and Mechanical Inspection
 - a. Inspect for physical, electrical, and mechanical condition.
 - b. Compare equipment nameplate information with latest one-line diagram and report discrepancies.
 - c. Check for proper anchorage, required clearances, physical damage, and proper alignment.
 - d. Inspect all doors, panels, and sections for paint, debris, scratches, fit, and missing hardware.
 - e. Verify that fuse and/or circuit breaker sizes and types correspond to the Contract Drawings.
 - f. Verify that current and voltage transformer ratios correspond to the Contract Drawings.
 - g. Inspect all bus connections for high resistance. Use low-resistance ohmmeter, or check tightness of bolted bus joints by using a calibrated torque wrench. Refer to manufacturer's instructions for proper torque levels.
 - h. Test all electrical and mechanical interlock systems for proper operation and sequencing.
 - i. Closure attempt shall be made on locked open devices.
 - ii. Opening attempt shall be made on locked close devices.
 - iii. Key exchange shall be made with devices operating in off-normal positions.
 - i. Clean entire switchgear using manufacturer's approved methods and materials.
 - j. Inspect insulation's for evidence of physical damage or contaminated surfaces.
 - k. Verify proper barrier and shutter installation and operation.
- l. Lubrication
 - i. Verify appropriate contact lubricant on moving current carrying parts.
 - ii. Verify appropriate lubrication on moving and sliding surfaces.

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- m. Exercise all active components.
 - n. Inspect all mechanical indicating devices for proper operation.
2. Electrical Tests
- a. Perform tests on all instrument transformers in accordance with NETA published values.
 - b. Perform ground-resistance tests in accordance with NETA published values.
 - c. Perform insulation-resistance tests on each bus section, phase-to-phase, and phase-to-ground for one (1) minute. Test voltages and minimum resistances shall be in accordance with NETA published values.
 - d. Perform an overpotential test on each bus section, each phase-to-ground, for one (1) minute at values recommended by the manufacturer.
 - e. Perform insulation-resistance test on shipping split control wiring. Do not perform this test on wiring connected to solid-state components.
 - f. Perform control wiring performance test. Use the elementary diagrams of the switchgear to identify each remote control and protective device. Conduct tests to verify satisfactory performance of each control feature.
 - g. Perform secondary voltage energization test on all control power circuits and voltage tests as detailed below in paragraph k, and l. Check voltage levels at each point on terminal boards and at each terminal device.
 - h. Perform current injection test on entire current circuit in each section of switchgear.
 - i. Perform current tests by primary injection, where possible, with magnitudes such that a minimum of 1.0 ampere flows in the secondary circuit.
 - ii. Where primary injection is impractical, utilize secondary injection with a minimum of 1.0 ampere.
 - iii. Test current at each device.
 - i. Determine accuracy of all meters and calibrate watt-hour meters per NETA recommendations.
 - j. Perform phasing check on double ended switchgear to ensure proper bus phasing from each source.
 - k. Potential Transformer Circuits
 - i. Perform secondary wiring integrity test. Disconnect transformer at secondary terminals and connect secondary wiring to proper secondary voltage. Check voltage at all devices.
 - ii. Verify secondary voltage by energizing primary winding with system voltage. Measure secondary voltage with the secondary wiring disconnected.

613.43 Records of Tests. Types of Records: Maintain complete and accurate records of all tests. These records shall include the following:

1. Description of test equipment used, including serial numbers.
2. Equipment or circuit identification, description, and location.
3. Complete nameplate data, including serial number.
4. Readings and measurements taken, including temperature and humidity.
5. Description of test, including date and tester's signature.

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- 6. Test results (written description as required).
- 7. Other observable data applicable to equipment tests.
- 8. Description of any necessary corrective actions.
- 9. Certification of satisfactory completion of wiring and installation in accordance with applicable items of this Section.

613.44 Training. Provide at the construction site training sessions for Authority personnel, for two (2) - eight (8) hour days.

The training sessions shall be conducted by a manufacturer’s qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers, and major components within the assembly.

613.45 Step Voltage Regulators. Voltage regulators shall comply IEEE C57.15 and shall be of the outdoor, self-cooled, 55/65 degrees C temperature rise, single-phase type. Windings and the load-tap-changing mechanism shall be mineral-oil-immersed. When operating under load, a regulator shall provide plus and minus 10 percent automatic voltage regulation in approximately 5/8 percent steps, with 16 steps above and 16 steps below rated voltage. Automatic control equipment shall provide Class 1 accuracy. Bypass surge arresters shall be suitable for a grounded system and for the associated regulator voltage. Distribution class surge arresters shall be mounted next to each incoming line bushing on a regulator tank-mounted bracket and connected to a surge arrester ground pad-mounted on the regulator tank.

Ratings:

Ratings at 60 Hz shall be

Maximum voltage	14.4kV
Basic Insulation Level (BIL)	150
Current	200A

613.46 Regulator Bypass Switches. Switches shall be of the outdoor, hookstick-operated, single-pole, single-throw, vertical-break type suitable for the indicated mounting. Switches shall be of a type designed to provide bypass of a single-phase regulator circuit by an integral sequence which always occurs when each switch is opened or closed. Each opening sequence shall initially bypass the single-phase regulator circuit, then open the input and output circuits, and finally interrupt the exciting current. Opening any single-phase regulator circuit shall not be possible until after the bypass circuit is closed. Ratings at 60 Hz shall be in accordance with IEEE C37.41 and as follows:

Maximum voltage	25.8kV
Nominal voltage class	25kV
BIL	150kV
Momentary asymmetrical current in the closed position	40kA
Momentary asymmetrical current in the bypass position	30kA
Continuous and interrupting current	600A

Standard accessories and components in accordance with IEEE C57.15 shall be provided. Single-phase units shall be provided with additional components and accessories required by IEEE C57.15 for three-phase units.

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613.47 Structure Mounted disconnect Switches. Hookstick-operated switches shall be distribution class, single pole, single throw and shall be rated for 600 amperes continuous and 40kA momentary. Switches shall be rated for 25.8kV, with a BIL rating of 125kV.

613.47 Relays and Relay Enclosures. Relays for use in the switchgear control system in the West Ventilation Building shall be heavy duty industrial type with modular construction. The relays shall accommodate up to four convertible contact cartridges. Terminals shall accommodate ring or spade type wire terminations. Relays shall be rated for 5 amperes continuous current and shall be rated to make or break 1.1 amperes inductive load and 4 amperes resistive load. The estimated service life of the relays shall be 15 years at 60 operations per hour for a break current of 1 ampere.

Enclosures shall be NEMA 12 rated, with door with continuous piano hinge and three point latching mechanism. Enclosures shall be sized as indicated on the drawings. Enclosure shall be constructed of 12 gauge steel and shall be finished with ANSI 61 gray polyester powder paint on the outside and white polyester powder paint inside. A full size subpanel shall be provided in the rear of the enclosure.

Wiring shall be installed in slotted wiring duct. Terminal strips in new and existing enclosures shall be barrier type with two screws per terminal, capable of accommodating ring type wire terminals.

613.48 Temporary Switchgear. Temporary switchgear shall be vault-type rated for a maximum voltage of 27kV using molded rubber elbow type terminators. The switchgear shall be either solid-dielectric type or shall utilize SF6 gas.

The temporary switchgear shall consist of six 25kV rated three phase switch ways, five with vacuum interrupter overcurrent devices and one switch only, which shall be the main switch. The six switch ways shall each be provided with motor operated open-close for connection to the existing switchgear control system. The existing switchgear control system operates on 125 volts d-c, interfacing relays shall be provided for equipment requiring 120 volt a-c control.

The switch shall interrupt all load and fault currents within the vacuum bottle. Each fault interrupter switch mechanism shall consist of three individual vacuum bottle assemblies mechanically linked to a single spring-assisted operating mechanism. Manual opening and closing of each way shall be via an operating handle.

Cable entrances shall consist of 200A load break apparatus bushings per IEEE 386.

For the vacuum interrupters, an electronic control shall be provided to monitor load and fault current on all three phases of the interrupter. The current transformers encapsulated within the solid dielectric modules provide control power and current sensing. No external power source shall be required for overcurrent protection. Operational temperature range of the control shall be -40°C to +65°C. Maximum time for power up and ready to trip when closing on a circuit shall be ten percent of the trip time or 1/2 cycle, whichever is greater. Trip selection may be made with the interrupter energized. The range of Phase Overcurrent minimum trip settings shall be 15-300A (500:1 CT). The control shall include 30 Time Current Characteristic (TCC) curves, which shall be field selectable using dip switches. The control shall be equipped with multiple TCC curve modification options, including Instantaneous Trip, Inrush Restraint, and Phase Time Delay. In addition, the control shall include a Phase Imbalance (Ground Fault) setting. All settings shall be inputted via selector knobs located on the faceplate of the control. The control shall include a last cause of trip indicator. Trip modules shall not require a computer or other external device for inputting trip settings or other operational parameters.

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24.9KV SWITCHGEAR ASSEMBLIES

Solid dielectric type switchgear shall comply with the following:

The switch shall consist of a solid dielectric insulated load break switches and resettable vacuum fault interrupters electronically controlled.

The switch shall comply with requirements of the latest revision of applicable industry standards, including: IEEE C57.12.28, IEEE C37.74, IEEE C37.60, ANSI/IEEE 386, IEC60529, IEEE 592. The switch manufacturer shall be ISO 9001:2008 and ISO 14001:2004 certified.

The switch shall be designed for front access to cables and operators. The switch shall be a dead-front design. The operating mechanism housing shall be stainless steel with a viewing window for verification of vacuum interrupter contact position. The mechanism housing shall be painted ANSI 70 light gray using corrosion-resistant epoxy paint. Operating handles shall be padlockable and adaptable to keylock schemes. The operating shaft shall be stainless steel providing maximum corrosion resistance. A double "O" ring shaft seal shall be used for a leak resistant, long life seal. The solid dielectric modules shall be coated with a semi-conductive layer of epoxy, providing a completely dead front device. The semi-conductive layer shall be tested to IEEE 592 to ensure it can carry fault current to ground so as to ensure operator safety.

The switch shall be rated:

Maximum Design Voltage, kV	27
Impulse Level (BIL) Voltage, kV	125
Continuous Current, Amperes	630
Load break Current, Amperes.....	630
One Minute Withstand (dry), AC kV.....	50
Production Test Rating (kV).....	40
15 Minute Withstand, DC kV	78
Momentary Current, kA asymmetrical	20
Fault Close Current, kA asymmetrical.....	20
Fault Interrupter rating, kA asymmetrical.....	20
Fault Interrupter rating, kA symmetrical	12.5
Mechanical Endurance, Operations	2000

SF6 type switchgear shall comply with the following:

The switch shall consist of load interrupting, SF6 insulated, 630A rotary puffer switches and electronically controlled fault interrupters.

The switch shall comply with requirements of the latest revisions of applicable industry standards, including: IEEE C37.71, IEEE C37.74, IEEE C37.60, IEEE 386. The switch manufacturer shall be ISO 9001:2008 and ISO 14001:2004 certified.

Switch construction shall be as follows: Switch contacts and cable entrance terminations shall be contained in a single welded mild steel tank with entrances internally connected by copper conductors. Construction shall be a dead front design. Switches shall be shipped factory filled with SF6 gas conforming to ASTM D-2472. Switch tanks shall be painted ASA70 light gray using a corrosion-resistant epoxy paint.

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REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

Each switching way shall be equipped with an internally mounted operating mechanism capable of providing quick-make, quick-break operation in either switching direction. The mechanism shall be capable of delivering sufficient torque and shall be provided with latches for each position to assure load interrupting, fault closing and momentary ratings. All switch positions shall be clearly identified, padlockable and adaptable to keylock schemes. The operating mechanism shall be actuated from outside the switch tank with an operating handle. The operating shaft shall be made of stainless steel. A double "O" ring type operating shaft seal shall be used for a leak resistant, long life seal. Switch contacts shall be of a rotary puffer design made with copper alloy contacts with silver plating to assure permanent, low contact resistance. Each rotating contact shall simultaneously disengage from two fixed contacts. Contact travel shall be 90 degrees to assure efficient arc extinction and a wide open contact gap. Arcing is confined away from the main contact surfaces. The stationary contacts shall be supported independent of the cable entrance bushings, eliminating possible misalignment. Auxiliary blades used for load interruption are not acceptable.

The fault interrupter shall consist of vacuum bottles and a spring-assisted operating mechanism. The mechanism used shall be designated for three phase operation. The mechanism shall consist of three vacuum bottles mechanically linked to a single spring-assisted operating mechanism. The vacuum interrupter operating mechanism shall consist of the support assembly, linkage, spring latch mechanism, and solenoid utilized for electronic tripping. Maximum interrupting time shall be three cycles (50 msec). The movable contact shaft shall be flagged to indicate the contact position, open or closed. This contact position indicator shall be fully visible through viewing windows supplied in the switch tank. Each tap phase is to be equipped with an individual 630A vacuum interrupter fully enclosed in an SF6 insulated switch tank. Electrical opening shall be by a solenoid that is activated from sources external to the switch tank. Manual reset or closing of the fault interrupter shall be mechanical with the use of an external operating handle. The mechanical linkage assembly shall provide for a "trip-free" operation which allows the fault interrupter to interrupt independent of the operating handle.

The switch shall be rated:

Maximum Design Voltage, kV	27
Impulse Level (BIL) Voltage, kV	125
Continuous Current, Amperes	630
Load break Current, Amperes.....	630
One Minute Withstand (dry), AC kV.....	60
Production Test Rating (kV).....	40
15 Minute Withstand, DC kV	78
Momentary Current, kA, ASYM	20
Fault-Close Current, kA, ASYM	20
One Second Current, kA, SYM	12.5
Fault Interrupting Rating, kA, SYM	12.5
Mechanical Endurance, Operations	2000
Load Break Operations at 600 Amperes	500

At the completion of the project, the temporary switchgear will become the property of the Contractor and shall be removed from the project site and disposed of by the Contractor.

613.49 Modifications to Existing Power Control Board. The existing Power Control Board, located in the Control Room of the East Ventilation Building shall be modified as indicated on the drawings. New control switches shall be as specified in paragraph 613.36, and shall be provided with key interlocks as indicated on the drawings. Keys for key interlocks shall be furnished in the quantity required, and one spare key of each type shall be provided which shall be turned over to CDOT. Indicating lamps shall be MB120V.

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REVISION OF SECTION 613
24.9KV SWITCHGEAR ASSEMBLIES

613.50 Inverter System. A 20kW inverter system shall be provided which shall obtain its primary power from the existing 125/250V battery system. The inverter system shall include the inverter unit, static switch, maintenance bypass switch, transformer for the bypass supply, panel for the inverter output and circuit breakers for the 250V d-c supply and the 480V a-c bypass supply. The inverter output shall be 120/240V a-c single phase, three-wire.

The Inverter system shall operate in the following modes:

1. Normal: The AC load is continuously powered by the inverter.
2. Bypass: If the UPS must be taken out of service for maintenance or repair, the static transfer switch shall transfer the load to the bypass source. The transfer process shall cause no interruption in power to the load. The switch shall be located in its own compartment such that there is no power inside the UPS compartment when in bypass.
3. Service: If the inverter system requires service, power to the load will be supplied through the maintenance bypass switch. Transfer to the maintenance bypass shall be done with no loss of power to the load.

AC Output shall provide the following:

1. Load Rating: 105% continuous load rating at 104deg F (40 deg C) for any combination of linear and non-linear loads
2. Voltage Regulation: $\pm 3\%$ for balanced load, $\pm 5\%$ for 100% unbalanced load
3. Voltage Adjustment Range: $\pm 5\%$ manually
4. Line Drop Compensation: Adjustable 0 to $+5\%$ of nominal voltage
5. Frequency Regulation: 0.1%
6. Efficiency: Defined as output kW/input kW at rated lagging load power factor.
7. Not less than 90% at all loads from 50% to 100% of rated load at 0.9 power factor lagging
8. Voltage Transients: 100% Load Step $\pm 5\%$, loss of/return to AC input power $\pm 1\%$
9. Output Voltage Transients: Voltage transients shall be limited to a maximum deviation from nominal system output volts of plus or minus 5% with recovery to within 1% of the nominal output voltage within one electrical cycle (16 milliseconds) for each of the following conditions. Limits shall apply to any inverter load within the inverter rating, and frequency shall be maintained at 60 Hz ± 0.1 Hz. The system shall not transfer to bypass under these conditions. The conditions are: 100% load step, loss or return of AC input power, momentary sags, surges or spikes on the input to the inverter, uninterrupted transfer of the critical load to and from the output output and bypass power line (manually initiated or automatic).
10. Voltage Harmonic Distortion: Maximum 2% RMS total (linear load), Maximum 2.5% RMS total for up to 100% non-linear load, per IEC 62040-3

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24.9KV SWITCHGEAR ASSEMBLIES

11. Current Harmonic Distortion: Maximum 8% RMS total (linear load), Maximum 8% RMS total for up to 100% non-linear load
12. Overload at full Output Voltage with $\pm 1\%$ voltage regulation: 105% continuously, 110% of full load for 60 minutes, 150% of full load for a minimum of 60 seconds.
13. Current Limit: adjustable, 100% - 200% of full load current
14. Fault Clearing: Sub-cycle current of at least 200% of normal full load current, for 200 milliseconds (when bypass is not available), and 1000% for 200ms in Inverter pulse-parallel operation when bypass is available

Front panel controls:

1. A startup screen shall be provided on the front panel that is user-interactive in text and graphic form and provides a step-by-step guide for the user to bring the inverter on-line.
2. Two buttons shall provide the means for the user to transfer the load to Bypass and back on inverter. A Sync-scope shall be provided to display the phasing between Bypass and Output in graphical representation.
3. Two buttons shall provide the means for the user to shut down the inverter and transfer the load to bypass or shut down the entire system.
4. A pushbutton shall be provided which will sequentially transfer the load to the bypass supply, open the inverter output breaker.

Front panel indications:

1. A touch screen display panel shall be provided that allows viewing the following: Input Voltage, Input Current, Output Voltage, Line-to-Line and Line-to-Neutral, Output Current, Output Frequency, Total kVA and kW, and Power Factor per phase.

METHOD OF MEASUREMENT

Add the following subsections:

613.51 Measurement. Electrical Switchgear Assemblies, Step Voltage Regulators, Regulator Bypass Switches, Structure Mounted Disconnect Switches, Temporary Switchgear and Inverter System will be measured by each unit furnished, installed and accepted as described herein.

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24.9KV SWITCHGEAR ASSEMBLIES

613.52 Payment. The completed and accepted work for conduits will be paid for at the contract unit price for the pay items listed below that appear in the bid schedule.

Pay Item	Pay Unit
24.9kV Switchgear	Each
Step Voltage Regulator	Each
Regulator Bypass Switch	Each
Structure Mounted Disconnect Switch	Each
Temporary Switchgear	Each
Inverter System	Each
Relay Cabinet	Each

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REVISION OF SECTION 613
BONDING AND GROUNDING

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.01 shall include the following:

This work shall also consist of furnishing and installing bonding and grounding in the tunnel, at structures, and electrical equipment as indicated on the Contract Drawings. Grounding electrodes and grounding conductors are included herein.

Subsection 613.02 shall include the following:

(l) *Bonding and Grounding*. Bonding and grounding components shall be fabricated of the specified materials and constructed as follows:

1. Mechanical Connectors: All copper alloy compression type.
 - a. Manufacturers: Thomas & Betts Series 54000, American Electric-Blackburn, Carolina Galvanizing Corporation or approved equal.
 - b. Connection of grounding conductor to grounding conductor.
 - c. Provide exothermic weld connections where indicated.
2. Exothermic connections shall meet the following requirements:
 - a. Manufacturers: Cadweld, ERICO Products, Inc., Thermoweld, Techweld, or approved equal.
 - b. Provide exothermic connection in which powdered metals are dumped into a graphite crucible mounted over the components to be connected and then ignited by a spark. The resulting molten metal slag flows over the conductors and welds them together.
 - i. Use in lieu of mechanical compression connectors, where indicated.
 - ii. Connection of grounding conductor to ground rods.
3. Grounding Conductors:
 - a. In conduit: Stranded, bare copper as indicated on the Drawings.
 - b. Buried: Stranded, covered copper as indicated on the Drawings.
4. Grounding Connectors: All copper alloy ground connectors, specification grade. Use Burndy, OZ Gedney "G" Series, Thomas & Betts, American Electric-Blackburn, or approved equal.
5. All grounding materials and components shall be U.L. listed.

Subsection 613.03 shall include the following:

The bonding and grounding of the types specified above shall be installed as follows:

1. Install products in accordance with manufacturer's instructions.
2. Install rod electrodes at locations indicated with exothermic connections to cables. Install additional rod electrodes as required to achieve a maximum of 25 ohms resistance to ground.
3. Provide bonding to meet Regulatory Requirements and as specified herein.

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REVISION OF SECTION 613
BONDING AND GROUNDING

4. All metallic, non-current carrying elements in manholes and on structures pertaining to this work, shall be bonded to the ground system. This shall include, but not be limited to, frames for all manhole racks, manhole ring and cover in new electrical manhole, and angle iron frame and covers in the tunnel manholes.

Subsection 613.11 shall include the following:

Grounding connectors, grounding conductors and associated components described herein and the installation thereof will not be measured and paid for separately. Included in the term “associated components” are all equipment required to perform the complete installation of bonding and grounding required for the tunnel facility. The completed and accepted work for bonding and grounding shall not be paid for separately, but will be incidental to the equipment included.

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REVISION OF SECTION 613
ELECTRICAL IDENTIFICATION

Section 613 of the Standard Specifications is hereby revised for this project as follows:

Subsection 613.01 shall include the following:

This work shall also consist of furnishing and installing nameplates and labels on new equipment and markers on wire and cable installed in the tunnel and as indicated herein and on the Contract Drawings. Color coding requirements are included in this Section.

References. The most recent version of the following laws, codes, regulations, guides, and standards form a part of this Section and Contractor shall comply therewith.

1. American National Standards Institute (ANSI):
 - a. A13.1 - Scheme for Identification of Piping Systems.
 - b. Z535.1-2002 - Safety Color Code.
 - c. Z535.2-2002 - Environment and Facility Safety Signs.
 - d. Z535.3-2002 - Criteria for Safety Symbols.
 - e. Z535.4-2002 - Product Safety Signs and Labels.
 - f. Z535.5-2002 - Safety Tags and Barricades (for Temporary Hazards).
2. Code of Federal Regulations (CFR):
 - a. 29 CFR 1910.145 - Occupation Safety and Health Standards (OSHA) Specification for Accident Prevention Signs and Tags.
 - b. 29 CFR 1910.144 - Occupation Safety and Health Standards (OSHA) Safety Color Code for Marking Physical Hazards.
3. National Fire Protection Association (NFPA):
 - a. 70 - National Electrical Code (NEC) 2011 Edition.
4. Underwriters Laboratories (UL):
 - a. UL 969 - Marking and Labeling Systems.

Subsection 613.02 shall include the following:

Identification Devices. A single type of identification product for each of the following applications. Use colors prescribed by ANSI A13.1, NEC.

1. Colored Adhesive Marking Tape for phase identification of Wires, and Cables: Self-adhesive vinyl tape, not less than 1 inch wide by 3 mils thick. Tape shall be electrical grade.
2. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

Conduit Markers. Conduit markers shall be brass tags, 1 ¼ inch in diameter, attached to the conduits using stainless steel wire with a non-removable crimp type connection. Conduit markers shall be marked with the identification number of the conduit as listed in the conduit and wire schedules on the Drawings. Where a conduit contains only a single circuit, the circuit number shall also be marked on the conduit tag.

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REVISION OF SECTION 613
ELECTRICAL IDENTIFICATION

Color-Coding Cable Ties. Nylon, self-locking type. Colors to suit coding scheme.

Engraved-Plastic Labels, Signs, and Instruction Plates. Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1/16-inch minimum thickness for signs up to 20 sq. in. and 1/8-inch minimum thickness for larger sizes. Engraved legend in black letters on white background. Self-adhesive signs and labels shall be provided on electrical enclosures.

Fasteners for Nameplates and Signs. Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers.

Subsection 613.11 shall include the following:

Nameplates, labels, cable markers, and associated components described herein and the installation thereof will not be measured and paid for separately, but shall be incidental to the equipment that they identify.

FORCE ACCOUNT ITEMS

DESCRIPTION

This special provision contains the Department's estimate for force account items included in the Contract. The estimated amounts marked with an asterisk will be added to the total bid to determine the amount of the performance and payment bonds. Force Account work shall be performed as directed by the Engineer.

BASIS OF PAYMENT

Payment will be made in accordance with subsection 109.04. Payment will constitute full compensation for all work necessary to complete the item.

Force account work valued at \$5,000 or less, that must be performed by a licensed journeyman in order to comply with federal, state, or local codes, may be paid for after receipt of an itemized statement endorsed by the Contractor.

<u>Force Account Item</u>	<u>Estimated Quantity</u>	<u>Amount</u>
F/A Minor Contract Revisions	F.A.	\$175,000
F/A On the Job Trainee	Hour	\$ ♦
F/A Fuel Cost Adjustment	F.A.	\$ 1,000
F/A Partnering	F.A.	\$ 2,000

TRAFFIC CONTROL PLAN – GENERAL

The key elements of the Contractor's method of handling traffic (MHT) are outlined in subsection 630.10. The components of the Traffic Management Plan for this project are included in Subsection 104.04 and Section 630 of the Standard Specifications.

Special Traffic Control Plan requirements for this project are as follows:

During the construction of this project, traffic shall use the present traveled roadway.

The Contractor shall not have construction equipment or materials in the lanes open to traffic at any time, unless directed.

Fifteen (15) minute full traffic stop closures will be permitted as pre-approved by the engineer for the cutover from existing to temporary and temporary to new switchgear. Contractor may propose an alternate method for approval of the Engineer.

All Traffic control requiring full traffic stop closures will be performed by CDOT personnel. A minimum of two (2) weeks notice shall be given to the Engineer before each planned operation requiring these closures.

CDOT reserves the right to direct the Contractor to leave the tunnel at any time due to emergencies or unforeseen circumstances, as they may occur. The Engineer shall have the full authority to make this determination and direct the Contractor accordingly. To comply with tunnel emergency procedures, cell phones will be on site with work crew(s) supervisor as well as two-way tunnel frequency radio at all times.

Employee vehicle parking is prohibited where it conflicts with safety, access or flow of traffic. No employee parking will be allowed within the center section. Access to the center section will be limited to the Contractor's vehicle and shall be coordinated with the project Engineer. West side access to the center section will be from the eastbound parking lot. East side access to the center section will be from the westbound parking lot.

All costs incidental to the foregoing requirements shall be included in the original contract prices for the project.

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SPECIAL CONSTRUCTION REQUIREMENTS

It is the responsibility of the Contractor to ensure that the appropriate special requirements are adhered to:

1. The Contractor shall take appropriate action to protect against asbestos contamination and worker exposure when penetrating the control room and electrical ceiling (Fan Room Floor) in the West and East Ventilation buildings. The ceilings of these rooms have approximately ½ inch sprayed-on asbestos covered by approximately one inch of foil-backed fiberglass insulation.
2. All Contractor employees will be required to undergo a background check and will be provided with an identification badge. ID badges must be worn and displayed at all times when working in and around the tunnel complex. All background information is confidential and is to assure building security at EJMT. Two (2) access keys will be provided to contractor employees as determined by the Engineer. No copies of these keys shall be made. Doors shall remain locked at all times. All parking permits, keys and ID badges must be returned to the tunnel control upon completion of project or employee last day.
3. One staging area will be available to the Contractor in the vicinity of the tunnel as directed by the Engineer. The final size of the staging area shall be submitted to the Engineer prior to construction. The staging area shall be defined with eight-foot high chain link fence to be provided by the Contractor. Cost for fencing to secure the staging area shall not be paid for separately, but included in the work. Locking gates shall be provided for access. Temporary lighting shall be provided by the Contractor. Storage within the electrical rooms will be available as directed by the Engineer.
4. All work requiring an electrical outage shall be performed during specific outage periods as identified by the Engineer. A minimum of two (2) weeks notice shall be given to the Engineer before each planned outage.

All complete outages shall be scheduled with the Engineer and shall only be performed during the hours of 8PM to 6AM each day, Sunday night through Friday Morning.

CDOT personnel will operate and disable all switchgear, motor controls, and power switching equipment as necessary for the work. At no time will the contractor operate any of the above equipment himself.

CDOT personnel will ground out, lock out and tag out all switchgear, motor controls and power switching equipment as necessary for the work. The Contractor will verify grounding and lock out/tag out and will add his locks and tags to the equipment to LockOut/Tag Out.

5. The Contractor shall keep one set of plans, reviewed shop drawings and working drawings available on the project site at all times. This set shall be defined as the “construction drawings”. The Contractor shall note on these construction drawings all changes and deviations from the work shown on the plans, shop drawings and working drawings. The construction drawings shall be kept current as the work progresses and notations shall be made within seven days of the change or deviation.

The first sheet or page of each set of construction drawings shall be stamped “As Constructed” and signed by the Contractor.

Upon completion of the work and prior to final payment, the construction drawings shall be submitted to the Engineer.

6. The Contractor shall provide its own sanitary facility for use by Contractor personnel. CDOT restroom facilities shall not be used by the Contractor.

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SPECIAL CONSTRUCTION REQUIREMENTS

The Contractor shall coordinate all operations requiring the EJMT Maintenance Staff with scheduled Holidays and special events. No work will be allowed for the following events:

1. Tuesday November 25 through Sunday November 30, 2014.....Thanksgiving Weekend
2. Saturday December 20, 2014 through Sunday January 4, 2015 Christmas/ New Year
3. Friday May 22 through Wednesday May 27, 2015.....Memorial Day Weekend
4. Friday July 3 through Sunday July 5, 2015Independence Day Weekend
5. Friday September 4 through Monday September 7, 2015Labor Day Weekend
6. Tuesday November 24 through Sunday November 29, 2015..... Thanksgiving Weekend
7. Saturday December 19, 2015 through Sunday January 3, 2016 ...Christmas/ New Year
8. Friday May 27 through Wednesday June 1, 2016.....Memorial Day Weekend

All costs associated with the foregoing requirements will not be paid for separately, but it will be included in the cost of doing the work.

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UTILITIES

The Contractor shall comply with Article 1.5 of Title 9, CRS ("Excavation Requirements") when excavating or grading is planned in the area of underground utility facilities. The Contractor shall notify all affected utilities at least two (2) business days, not including the actual day of notice, prior to commencing such operations. The Contractor shall contact the Utility Notification Center of Colorado (UNCC) at 811, to have locations of UNCC registered lines marked by member companies. All other underground facilities shall be located by contacting the respective owner. Please note that UNCC marks only its member's facilities – Other facilities, such as ditches and drainage pipes may exist, and it is the Contractor's responsibility to investigate, locate and avoid such facilities. Utility service laterals shall also be located prior to beginning excavation or grading.

The following table includes contacts within CDOT that can assist in locating CDOT owned facilities. Please note CDOT is now affiliated with UNCC. Locators will mark CDOT owned facilities except for CDOT Fiber Optic backbone. For Fiber locates call Dave Judy 303-880-0784. For additional assistance, call 303-365-7312.

UTILITY OWNER / ADDRESS	CONTACT / EMAIL	PHONE / FAX
CDOT Electric – Region 1 EJMT (Tunnel) Offices at Eisenhower tunnel	Ken Martinez Kenny.Martinez@state.co.us	303-512-5733
CDOT Utilities – Region 1 18500 E. Colfax Ave. Aurora, CO 80011	Dave Ruble, Utility Engineer Dave.Ruble@state.co.us Tracy Vance, Asst. Utility Engineer Tracy.Vance@state.co.us David (Red) Campbell, Utility Inspector David.Campbell@state.co.us	303-757-9250 303-757-9927 303-757-9850
CDOT ITS (FIBER) (Comcast Maintains and Locates) 425 C Corporate Circle Room 109 Golden, CO 80401	Rich Sembrat - Fiber Manager Richard.Sembrat@state.co.us Dave Judy Dave.Judy@state.co.us	303-512-5804 – Office 303-880-0784 – Cell
CDOT Traffic Signals Mountain Areas Only 219 County Road 1003 Frisco, CO 80443	Steve Smith steve.smith@state.co.us	(970)668-0253 Office (970)485-0136 Cell (970)668-0276 Fax
Loren Vawser XCEL Energy (West Portal)	Loren.vawser@xcelenergy.com	970-262-4034
Jonnye Worrell XCEL Energy (East Portal)	Jonnye.worrell@xcelenergy.com	303-445-4504

Although no conflict with any utility is expected the Contractor shall coordinate with the CDOT Project Engineer and any appropriate utility company to facilitate the installation, placement and relocation of all utilities impacted on this project.

The work described in these plans and specifications requires full cooperation between the Contractor and the utility owners in accordance with Subsection 105.11 in conducting their respective operations, so the utility work can be completed with minimum delay to all parties concerned. Also, in accordance with the plans and specifications, and as directed by the Engineer, the Contractor shall keep each utility owner advised of any work being done to its facility, so that each utility owner can coordinate its inspections for final acceptance of the work with the Engineer.

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UTILITIES

The Contractor shall coordinate the work with the owners of the utilities impacted by the work. Coordination with utility owners includes, but is not limited to, staking construction features, providing and periodically updating an accurate construction schedule which includes all utility work elements, providing written notification of upcoming required utility work elements as the construction schedule indicates, allowing the expected number of working days for utilities to complete necessary relocation work, conducting necessary utility coordination meetings, and all other necessary accommodations as directed by the Project Engineer. Surveying and/or staking of utility relocations to be performed by the owner shall be the responsibility of the utility owner.

Prior to excavating or performing any earthwork operations, the Contractor shall positively locate all potential conflicts with existing underground utilities and proposed construction, as determined by the Contractor according to proposed methods and schedule of construction. The Contractor shall modify construction plans to avoid existing underground facilities as needed, and as approved by the Engineer.

The CDOT Contractor shall provide traffic control for any utility work expected to be coordinated with construction, as directed by the CDOT Engineer.

All costs incidental to the foregoing requirements will not be paid for separately but shall be included in the work.