



## SECTION III

# CONSTRUCTION OF LIBERTY STATION CONSTRUCTION SPECIFICATIONS

BID NUMBER 230804

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## GENERAL

### PART 1 - GENERAL

#### 1.1 PROJECT GENERAL REQUIREMENTS

##### A. Scope of Bid

1. The purpose of these specifications is to obtain on a contract basis qualified personnel and mechanized equipment as specified, for the performance of substation construction work (hereinafter called the "Project"), as set forth in the Exhibits listed in Section IV – Contract.

##### B. Location of Work

1. Location of the Project is in Clallam County at 1248 E. Lauridsen Blvd., Port Angeles 98363.
2. The Project will consist of building a new 115kV switching station including new concrete foundations, installation of all equipment including steel, electrical equipment, ground grid, conduit and installation of pre-fabricated control enclosure, all grading and drainage mobilizations, and other related work to provide a complete and operable electrical Switching Station.
3. All material and electrical equipment provided by the District is detailed in EXHIBIT EL-Drawing E3-1 Equipment List. Anything not provided by the PUD will be provided by the contractor. Construction will take place entirely on PUD owned property within and surrounding the construction area.

##### C. Permits

1. The Contractor shall, at its expense, be responsible for obtaining a Right of Way Construction permit from the City of Port Angeles for construction of a new sidewalk driveway apron. Clallam PUD will supply the building permit.

##### D. Time and Manner of Work

1. The contractor certifies a Journeyman Lineman shall be onsite at all times for contract completion of all electrical installation. The assigned Journeyman Lineman shall be verified at a pre-construction meeting with presentation of license. The assigned Journeyman Lineman cannot be changed without verification and the approval of the District. The District can also request the Project Manager be changed with a 10 day notice if the project performance is not deemed satisfactory by the District. A preliminary Project Plan and Gantt Chart shall be submitted with the bid and a final Project Plan and Gantt Chart shall be provided after the contract is awarded and before the beginning of any work. If the schedule moves, the Contractor shall update their Gantt Chart and immediately notify the District of any changes.

##### E. Supervision and Inspection

1. The Contractor shall cause the construction work on the Project to receive constant supervision by an experienced Journeyman Lineman who is qualified for work in an energized electrical substation and who shall be present at all times during working hours where construction is being carried on. The Contractor shall also employ, in connection with the construction of the Project, capable, experienced, skilled, and reliable workers as

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may be required for the various classes of work to be performed. Directions and instructions given to the foreman by the District shall be binding upon the Contractor.

2. The District reserves the right to require the removal from the Project of any employee of the Contractor if, in the judgment of the District, such removal shall be necessary in order to protect the interest of the District. The District shall have the right to require the Contractor to increase the number of its employees and to increase or change the amount or kind of tools and equipment if at any time the progress of the work shall be unsatisfactory to the District; but the failure of the District to give any such directions shall not relieve the Contractor of its obligations to complete the work within the time and in the manner specified in these documents.
3. The manner of performance of the work and all equipment used therein shall be subject to the inspection, tests, and approval of the District. The District shall have the right to inspect all payrolls and other data and records of the Contractor relevant to the work. The Contractor will provide all reasonable facilities necessary for such inspection and tests. The Contractor shall have an authorized agent accompany the inspector when final inspection is made and, if requested by the District, when any other inspection is made.
4. In the event the District shall determine that the construction contains or may contain any defects, it shall be the right of the District to have an inspection made by an engineer approved by the District for the purpose of determining the exact nature, extent, and locations of such defects.

### F. Protection of Persons and Property

1. The Contractor shall be responsible for keeping the worksite free from trespassers. The Contractor shall at all times take all legal and reasonable precautions for the safety and convenience of all workers and the public, and shall comply with all applicable provisions of federal, state, municipal, and District safety regulations or laws and building and construction codes. All machinery and equipment and other physical hazards shall be guarded in accordance with the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, unless such instructions are incompatible with federal, state, municipal, or District laws or regulations. The Contractor shall comply in all respects with the requirements of the Federal Occupational Safety and Health Act as administered by the State of Washington (WISHA).
2. The following provisions shall not limit the generality of the above requirements:
  - a. The Contractor shall so conduct the construction of the Project as to cause the least possible obstruction of public highways or streets.
  - b. The Contractor shall provide and maintain all such guard lights and other protection for the public as may be required by applicable statutes, ordinances, and regulations or by local conditions.
3. The Contractor shall be familiar with and shall comply with the District's "Contractor Safety Plan" attached hereto as **Exhibit "B"**.

### G. Customer Relations

1. The Contractor agrees that its personnel and equipment shall at all times present a neat appearance. All work shall be done and all contacts with the public shall be handled with due regard for the District's public relations. The Contractor agrees that complaints of any nature received from property owners or public authorities shall receive immediate attention. All complaints shall be reported within 24 hours to the District Representative.

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### H. Construction not in Specifications

1. The Contractor agrees that when it is necessary to construct units not shown or described in the specifications, it will construct such units for a price proposed in writing by the Contractor to the District and approved by the District by issuing an approved Change Order, prior to such work being done.
2. No payment shall be made to the Contractor for correcting errors or omissions on the part of the Contractor that result in construction not in accordance with the specifications.

### I. Changes

1. The District may, from time to time during the progress of the Project, make such changes in, additions to, or subtractions from, the specifications and/or exhibits as conditions may warrant. If a change is necessary Contractor must submit a price and scope of work in writing to the District. The District must issue the Contractor an approved Change Order before any work is done.

### J. Materials

1. District-Supplied Materials
  - a. Refer to **Exhibit-EL**, Drawing E3-1, Assembly Material List and Nameplate Schedule, for a list of District-supplied equipment and materials for the project. All other materials for the project shall be supplied by the Contractor.
  - b. All District-supplied materials shall be furnished by the District or arranged for by the District Representative. All materials issued to the Contractor becomes their responsibility. The Contractor will be required to provide a secure area for storage of material issued by the District's Warehouseman.
  - c. All District-supplied materials shall be obtained by the Contractor at the District's Carlsborg Warehouse located at 100 Hooker Road, Sequim, WA 98382, Monday through Thursday between 7:00 a.m. and 4:30 p.m., except holidays. Contractor will be responsible for the safe storage of all materials.
  - d. With the exception of major equipment to include the steel, power transformer, circuit switcher, voltage regulators, 115kV switches, power circuit breakers, switchboard panels and the control enclosure, all District-supplied materials shall be handed over to the Contractor at one time.
  - e. The Contractor shall give a minimum of 24-hours advance notice to the District Representative before materials are issued.
  - f. The contractor or its authorized representative will be required to perform a complete inventory of all materials furnished to the Contractor and sign a receipt in such form as the District shall provide. Upon completion of the Project, the Contractor shall return to the District all materials furnished by the District in excess of those required for construction.
  - g. The Contractor will be responsible for all excess material used on the Project not accounted for, together with any used material that is not returned to the District. Any materials that are not returned to the District by the Contractor will be billed to the Contractor at District book value plus warehousing.
  - h. All materials issued by the District to the Contractor shall be in working condition when received by the Contractor. Any material not in good working condition upon completion of the Project shall be replaced at the Contractor's expense.
2. Contractor-Supplied Materials

## GENERAL

- a. The Contractor shall supply forms, rebar, concrete, mortar, grouting, and sacking materials, specified wire and cable, crushed rock, construction fencing and temporary erosion control materials together with other materials as detailed below and on the drawings.
- b. All Contractor-supplied bolts shall have nuts and lock washers, together with flat washers and locking nuts where required. All nuts, bolts, lock washers, flat washers, and lock nuts used indoors shall be zinc-plated; and those used outdoors shall be 316 stainless steel. All screws shall be round-head or pan-head unless otherwise specified. All slotted holes will require flat or Belleville washers.
- c. All electrical materials and equipment supplied by the Contractor shall be new and undamaged. Unless otherwise approved, similar items used throughout the job shall be the product of one manufacturer.

### K. Compliance with District Instructions

1. All work shall be done in compliance with District job orders or other instructions furnished to the Contractor by the District Representative when applicable. All questions or disputes as to the true meaning of the Specifications or drawings shall be decided in writing by the District.

## 1.2 DRAWINGS AND INSTALLATION DATA

- A. Refer to Exhibits listed in Section IV – Contract, for engineering drawings and installation data for the project supplied by the District.

## 1.3 CODES AND STANDARDS

- A. Equipment and materials used on the job shall be approved by the following industrial organizations:
  1. American Standard Associates, Inc. (ASA)
  2. American Society for Testing Materials (ASTM)
  3. National Electrical Manufacturers Association (NEMA)
  4. Underwriter's Laboratories, Inc. (UL)
  5. National Bureau of Standards (NBS)
  6. National Board of Fire Underwriters (NBFU)
  7. National Fire Protection Association (NFPA)
  8. Insulated Power Cable Engineers Association (IPCEA)

- B. Each major component of equipment shall have the manufacturer's name, catalog number, capacity, and rating on a nameplate securely affixed on the equipment in a conspicuous place.

## 1.4 EROSION AND SEDIMENTATION CONTROL

- A. The Contractor shall be responsible for supplying all materials, construction, installation and maintenance of Erosion and Sedimentation Control structures and facilities as shown on the Drawings. Contractor shall be responsible for implementing recommended stormwater Best Management Practices (BMPs), providing a Certified Erosion and Sediment Control Lead during

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the duration of the project, and complying with all site inspection, monitoring, recordkeeping, and reporting requirements per the Department of Ecology regulations.

END OF GENERAL



## **SITE PREPARATION**

### **PART 2 - SITE PREPARATION**

#### **2.1 GENERAL**

- A. The work described in this section consists of all excavating, filling, grading, backfilling, and related items necessary to complete the site work indicated on the Drawings.
- B. Definitions
  - 1. The term "access roads" shall mean that part of the road outside the fenced enclosure of the substation extending to the designated public thoroughfare.
  - 2. The term "substation area" shall mean that part of the job site within the fenced enclosure plus the immediate adjacent area surrounding the fenced enclosure as specified or indicated on the Drawings.

#### **2.2 CLEARING AND GRUBBING**

- A. Stabilized
- B. The site shall be cleared of rocks, boulders, brush, vegetation and other organic material as directed by the District.
- C. Any roots that are over one (1) inch in diameter, shall be completely removed and disposed of off-site.
- D. Stones and boulders six (6) inches or greater in the longest dimension shall be removed to a depth of six (6) inches below subgrade in fill areas, on the access road, and within the substation area.
- E. Blasting, if required to remove large rocks and boulders shall be permitted only when prior approval is obtained from the District. Contractor shall be responsible for identifying and obtaining approvals and permits from regulatory agencies as required prior to blasting. Such approval shall not relieve the Contractor of any liability resulting from injury, loss of life, or damage to property.
- F. Top soil stripped from the site shall be stored at a location agreed upon by the District. No soil may be removed offsite without the written authorization of the District's Representative.
- G. Contractor shall be responsible for the disposal of all debris resulting from site preparation operations, including trees, brush, roots, and sod stripping. The Contractor may dispose of all spoils on site in a manner acceptable to the District. Burning of debris shall not be permitted.

#### **2.3 SITE GRADING**

- A. Materials

## **SITE PREPARATION**

1. Unless otherwise specified, the Contractor shall be responsible for finding a source for all fill and backfill materials. All costs related to acquiring and transporting material shall be paid by the Contractor.
2. All fill and backfill material shall be free of roots or other organic matter, refuse, ashes, cinders, frozen earth, or other unsuitable material. Only material capable of satisfactory compaction shall be used.
3. Any fill within the fenced enclosures shall be free of rock and also of stones greater than six (6) inches in the longest dimension, particularly in areas where foundations or piers are to be installed.
4. Any on-site borrow areas shall be graded to drain and shall present a neat appearance, as directed by the District.

### **B. Erosion and Sedimentation Control**

1. All erosion and sedimentation control facilities shall be constructed per the Drawings and per the "Strom Water Management Manual for Western Washington".

### **C. Backfill and Fill**

1. All backfill and fill material shall be compacted unless otherwise required by design.
2. Compaction material shall be placed in layers not exceeding eight (8) inches in depth. Lift materials shall be moisture conditioned to within three percent (3%) of optimum moisture content prior to compaction, and compacted by a machine acceptable to the District's Engineer to at least ninety-five percent (95%) of maximum dry density per ASTM D1557. Any material incapable of compaction to ninety-five percent (95%) of maximum density shall be removed and replaced with acceptable material.
3. Sod, roots, snow, ice, or frozen earth shall not be placed in fill, and fill shall not be placed on a frozen surface.
4. Watering, if necessary to obtain optimum moisture content, shall be done without additional cost to the District.
5. Contractor shall arrange for and pay for all compaction testing. One (1) compaction test shall normally be taken per 30,000 square feet (or less) for every two (2) feet of fill or as otherwise specified in the Geotechnical Engineering Report.

### **D. Excavation**

1. Clearing limits and/or any easements or required buffers shall be identified and marked in the field by the Contractor prior to the start of any clearing, grading, or construction by staking and flagging.
2. Excavation shall be performed by any recognized method of good practice to complete the job in the most expeditious manner. The Contractor shall take precautions to ensure no damage is done to existing facilities or equipment, or to other work.
3. All excavation is considered unclassified regardless of the nature of the material.
4. Grading around excavations shall be controlled to prevent surface water from flowing into excavated areas. Draining or pumping, as necessary, shall be required to continually maintain excavated areas free of water or mud from any source, and this material shall be discharged to approved drains or channels.
5. Subgrade material rendered unsuitable by excessive wetting shall be removed and replaced with approved material.
6. Undisturbed subgrade in cuts shall be compacted unless the Design determines that compaction is not necessary.

## SITE PREPARATION

### E. Subgrade

1. After proper compaction the graded area shall be shaped and fine-graded as shown on the Drawings. The accumulation of loose material incidental to fine grading shall be incorporated into the subgrade by means of pneumatic tire roller or other suitable available means of compaction.
2. Excavation or backfill shall be required, as necessary, to construct subgrades to the elevations ( $\pm 0.10$  ft.) shown on the Drawings.
3. The finished subgrade of the substation area shall be graded to ensure adequate drainage gradient. Rolls or low spots which may cause ponding will not be approved.

## 2.4 FINISH-SURFACE PREPARATION

### A. Subsequent to the application of soil sterilant by the District, a uniform layer of crushed rock shall be spread in accordance with the following requirements:

1. The area to be covered shall include the fenced area plus three (3) feet outside the fence on all sides.
2. Contractor shall supply and install the crushed rock. The Contractor shall be responsible for loading, hauling, and installing the crushed rock.
3. The first layer of fill material where over excavation has occurred, shall bring the substation site to subgrade elevation, which is within five-tenths of a foot of the final elevation. The fill material to be used for this first layer shall be pit-run, and it shall be six-inch-minus in size. Pit-run for the Project shall be obtained from the source stated in the Proposal. The Contractor shall haul and install the pit-run in the substation in the required quantity to achieve the compacted subgrade elevation where over excavation has occurred. The subgrade elevation is six (6) inches below the final ground elevation. The second layer of fill material shall bring the substation to final grade elevation. The crushed rock shall be 100% fracture and uniform in quality and substantially free from wood, roots, bark, and other extraneous material and shall meet the following test requirements:

% passing 1-1/2" square sieve	100%
% passing 7/8" square sieve	50%
% passing 1/4" square sieve	5% maximum

4. The portion of crushed surface retaining on a 1/4-inch square sieve shall not contain more than 0.15% wood wastes.
5. The fill material shall be compacted to 95% of the maximum density as determined by compaction control test in accordance with the Method of Test for Compaction Control of Granular Materials (WSDOT Test Method No. 606A). The moisture content of the fill material at the time of compaction shall be as specified by the Engineer. When the fill material contains less moisture than required for proper compaction with the compaction equipment being used, water shall be added in the amounts ordered by the engineer. If it becomes necessary to reduce the moisture content below the maximum limit in order to achieve the required compaction, all costs and expense involved in such drying shall be incidental to and included in other items of work involved.
6. Horizontal layers of fill material shall be placed in layers not exceeding eight (8) inches in loose depth. At all locations that are inaccessible to compaction rollers, the fill material shall be compacted in layers as required herein and shall be compacted to the required density by the use of small mechanical or vibratory compactor units.

## SITE PREPARATION

7. The existing elevations are approximate and are shown as a convenience for the Contractor. In no way do these drawings relieve the Contractor of his responsibility to be familiar with the site. In addition, the Contractor shall not be allowed to claim any extra compensation for additional ballasting based on any inaccuracy of the elevation drawing.
8. The Contractor will be responsible for setting the subgrade and final grade elevations from the existing benchmark. The District will check the final grade after compaction, and any deviations will be corrected by the Contractor and re-compacted.
9. The Contractor to provide localized grading around swing gates to ensure gates swing into the station area only, are able to open greater than 90 degrees without obstruction, and do not have a significant gap between the bottom of the swing gate and the top of crushed rock surface.

### 2.5 DRAINAGE STRUCTURES

- A. All culvert pipe is to be HDPE.
- B. All pipes shall be evenly bedded throughout its entire length, not partially resting on rock or earth embankment. The flow-line gradient and elevation shall be in line with that of the natural drainage course insofar as possible. Backfill shall be thoroughly compacted in layers not exceeding eight (8) inches loose depth. Backfill shall be compacted under the pipe haunches to a width of one (1) pipe diameter on each side of the pipe and from the very bottom up to the top of the pipe, to the satisfaction of the District. The pipe shall be covered with compacted fill not less than one half (1/2) the diameter of the pipe, or a minimum of twelve (12) inches.

### 2.6 ACCESS ROAD

- A. Subgrade
  1. Contractor shall prepare and condition the roadbed after the earthwork has been essentially completed and after all adjacent drains and structures have been completed and backfilled. All soft and unstable material and other portions of the roadbed that will not compact readily or serve the intended purpose shall be removed as directed. All boulders or ledge rock appearing in the excavation shall be broken off to a depth not less than nine (9) inches below the finish grade. The resulting areas and all other low sections, holes, or depressions shall be brought to grade with satisfactory selected material and the entire roadbed shaped to line, grade, and cross section.
  2. After the roadbed has been substantially completed, the entire surface of the roadbed shall then receive a finish shaping with a road grader - not a bulldozer - supplemented by handwork where necessary to obtain a smooth surface and a uniform cross section. Selected material shall be placed in low or wet spots and for cushioning rock sections. This material may be obtained from roadway and drainage excavation. No roots, sod, or other unsuitable matter, including stones that would fail to pass a three (3)-inch-square opening, shall be left within the top four (4) inches of the finished road surface.
  3. After compaction and prior to placing the surfacing material on the roadbed, the roadbed shall be shaped and crowned for its full width to the approximate grade and section, with a crown of at least one-fourth (1/4) inch per foot.
  4. The finished roadbed shall be smooth and uniform and shall be maintained in this condition through the end of the project. If determined by the District, the road will be graded smooth at the end of the project and new road surfacing applied at no additional cost to the District.

## **SITE PREPARATION**

### **2.7 ROAD SURFACING**

- A. Road-surfacing material shall be a layer of crushed rock spread twelve (12) inches thick (after compaction) over the area indicated on the Drawings. The crushed rock layer shall comply with AASHTO M147-65, Grade B. The District may approve other crushed rock gradations which have a record of satisfactory use in the local area.

**END OF SITE PREPARATION**

## CONCRETE STRUCTURES

### PART 3 - CONCRETE STRUCTURES

#### 3.1 GENERAL

- A. An experienced concrete foreman shall supervise all concrete work.
- B. Contractor shall supply all equipment and manpower necessary to construct concrete structures, under any field or weather conditions.
- C. Contractor shall use the reference points established by the Design and shall supply all necessary lines and levels to ensure that finished concrete work is properly located, at the proper elevation, true to line and grade, and square.

#### 3.2 CONCRETE REQUIREMENTS

- A. Concrete shall have a minimum compressive strength of 4000psi at twenty-eight (28) days as noted in Drawings, and shall conform to ASTM C94. Absolute water-cement ratio shall not exceed 0.45. Slump shall not exceed four (4) inches without the approval of the District. Maximum nominal coarse aggregate size shall not exceed three quarters (3/4) of an inch. A minimum of six (6) bags of cement per yard of mix shall be used. The concrete mix design shall be submitted to the District for review and comments.
- B. The source of materials and mix design proposed for use shall be submitted to the District for approval. If the materials conform to these Specifications and are approved, no change in sources shall be made without the additional approval of the District. Mix design shall include brand name and quantity of any additives.
- C. Cement shall be Portland Cement Type II in accordance with ASTM C150, unless specified otherwise on Drawings.
- D. Fine aggregate shall be in accordance with ASTM C33, with the exception that only natural sand shall be accepted.
- E. Course aggregate shall consist of clean, durable, hard-crushed stone, gravel, or a proper combination thereof, in conformance with ASTM C33. Exception is taken to ASTM C33 in that only natural material shall be accepted.
- F. Water for mixing and curing concrete shall be potable and free from injurious amounts of any substance that may be detrimental to concrete or reinforcement.
- G. An air-entraining additive according to ASTM C260 shall be used to produce a total air content of six percent (6%) plus or minus one percent ( $\pm 1\%$ ) by volume. No other additives shall be used in concrete without the written approval of the District. No chlorides shall be used in concrete mix.
- H. Perform all work in accordance with ACI 301 and ACI 318.

## CONCRETE STRUCTURES

### 3.3 REINFORCING STEEL

- A. Reinforcing bars shall conform to the latest revision of ASTM Standard Specifications for Deformed Billet Steel Bars for Concrete Reinforcement, Designation A615, Grade 60. If requested by the District, the Contractor shall submit, at no cost to the District, laboratory reports on the reinforcing steel prepared by an approved testing laboratory.
- B. Before the reinforcing bars are placed, the surfaces of the bars and the surfaces of any metal bar supports shall be cleaned of heavy, flaky rust, loose mill scale, dirt, grease, or other foreign substances. After being placed, the reinforcing bars shall be maintained in a clean condition until they are completely embedded in the concrete.
- C. Reinforcing bars shall be accurately placed and secured in position so that they will not be displaced during the placing of the concrete, and special care shall be exercised to prevent any disturbance of the reinforcing bars in concrete that has already been placed. Precast concrete blocks may be used for supporting reinforcing bars.
- D. Reinforcement shall not be spliced unless indicated on the Drawings or with the approval of the District's Engineer. Splices shall be in accordance with ACI 318.
- E. Lateral ties shall be secured to vertical reinforcement with wire ties. Welded connections shall not be allowed.

### 3.4 ANCHOR BOLTS

- A. Anchor bolts shall be galvanized and shall be complete with galvanized nuts and washers. Anchor bolts shall be bundled and tagged with the part numbers assigned on the Drawings.
- B. Anchor bolts shall be accurately positioned. It shall be the Contractor's responsibility to accurately set the bolts initially and to maintain the required position until after the concrete has set.
- C. Prior to setting, the threads on the upper end of each anchor bolt shall be protected to prevent the adherence of concrete. When installed, the bolts shall be clean and the portions to be embedded in concrete shall be free of oil or other detrimental substances which would adversely affect the bond between the bolts and concrete. Anchor bolts shall be in position and at the specified projection height prior to the pouring of concrete.
- D. The location and dimensions of the anchor bolts shall be as exact as possible to the locations shown on the Drawings.
- E. During concrete finish and clean-up, the Contractor shall remove concrete adhering to the portions of anchor bolts extending above finished concrete grade, giving particular attention to concrete at the finish grade line which would prevent base plates on the legs of station structures from seating fully on the finished concrete elevation.
- F. Any foundation which does not satisfy the specified requirements for line and grade shall be rejected. No payment shall be made for any such defective work until the Contractor has completed the necessary corrective work, to the satisfaction of the District. Contractor shall bear the full expense of all such corrective work.

## CONCRETE STRUCTURES

### 3.5 EXCAVATION AND BACKFILL

- A. Excavation shall be completed to the depths and dimensions indicated on the respective Drawings. Over-excavation adjacent to a bearing surface shall be filled with concrete at the time of structure pour unless otherwise directed by the Contractor's Engineer. Cost of the additional concrete shall be the responsibility of the Contractor. Over-excavation adjacent to a non-bearing surface may be backfilled in lifts and compacted to ninety percent (90%) of natural density per ASTM D1557 unless otherwise directed by the District.
- B. Excavation shall be designed to minimize the amount of disturbance to the surrounding natural terrain and vegetation. Areas inaccessible to excavation equipment shall be excavated by hand.
- C. Contractor shall perform all grading and earth moving necessary to prevent the accumulation of water in the excavations. All excavations are to be kept free of water until all foundations have been placed.
- D. Contractor shall notify the District should an obstruction be encountered which prohibits using normal techniques and tools.
- E. Backfill
  - 1. Concrete shall be backfilled only after it has attained seventy percent (70%) design strength.
  - 2. Backfilling adjacent to structures shall be done only after, in the opinion of the District, a sufficient portion of the structure has been built to resist the imposing load. Backfilling shall be performed simultaneously on all sides of structures. Extreme care should be exercised in the use of heavy equipment in areas adjacent to structures.
  - 3. Compaction material shall be placed in layers not exceeding six (6) inches in depth after compaction. Lift materials shall be moistened and compacted by a machine acceptable to the District.

### 3.6 DRILLED PIERS

- A. Dry drilling is the preferred method of excavation. Unless rock or obstructions are encountered, the excavation shall be completed in a continuous operation and the concrete shall be placed without undue delay.
- B. If unsuitable materials affecting required bearing value are encountered, the excavation shall be continued to whatever depth is necessary to obtain suitable material, as determined by the District.
- C. The excavation shall be protected to prevent sloughing or caving until the concrete has been placed.
- D. The location and dimensions of the drilled piers shall be as exact as possible to the locations and dimensions shown on the Drawings



## CONCRETE STRUCTURES

### 3.7 CASING

- A. Temporary casings shall be required at locations where the soil will not stand without support or where, because of ground water conditions, sloughing of the sides of piers may seriously delay or endanger the satisfactory completion of excavation and placement of concrete.
- B. Contractor shall have available for immediate use on the job an ample supply of casing of each size which will be required for use in the piers and shall provide additional amounts, if required, to ensure orderly progress of the job.
- C. Such metal casing may be in short pieces but with jointing devices of sufficient strength that assembled sections of casing may be pulled complete as concrete is placed (or immediately thereafter). The casing shall also be of such strength and rigidity as to maintain the required excavation lines against the pressure of sloughing material from the sides of piers.
- D. All temporary casing shall be removed from piers as concrete is placed - or immediately thereafter - and in such a manner as to prevent sloughing material from dropping to the bottoms of piers or falling on top of freshly placed concrete. A sufficient head of concrete shall be maintained to prevent intrusion of soil into or on top of fresh concrete.
- E. During casing extraction, upward movement of the steel shall not exceed six (6) inches. Downward movement shall not exceed four (4) inches.
- F. The inside diameter of the casing shall not be less than the specified diameter of the drilled shaft. The length of the casing shall be sufficient to allow the construction of a good-quality shaft.

### 3.8 BOTTOM OF EXCAVATION

- A. The Contractor shall clean the bottom of the excavation so that no more than twenty-five percent (25%) of the bearing area is covered with a maximum of two (2) inches of loose, disturbed material.
- B. When shown on the Drawings, bedding material shall be three-quarter (3/4) inch minus, washed, crushed rock compacted in place to 90% maximum index density as per ASTM D698.
- C. Immediately prior to the placement of concrete, the excavation shall be cleaned of water, debris, or other materials harmful to concrete, including ice, clods, and piles of loose earth. Water in the bottoms of excavations must be removed or absorbed. On-hand equipment shall include a pump and two (2) vibrators in good working condition, hoppers and elephant trunks or concrete pump and tremie for directing the flow of concrete to the bottom of the piers, and an ample supply of sacked cement for use in drying up bottoms of drilled-pier excavations.

### 3.9 FORMING

- A. Forms shall conform to the shapes, lines, and dimensions of the concrete as called for on the Drawings. Forms shall be sufficiently strong to carry the dead weight of the concrete without undue deflection or bulging, and sufficiently tight to prevent leakage of mortar. Forms shall be properly braced and tied together so as to maintain position and shape.

## CONCRETE STRUCTURES

- B. Lumber or other forming material used in forms at exposed surfaces shall be dressed to uniform thickness and shall be free from loose knots or other defects. Joints in forms shall be horizontal or vertical. At all unexposed surfaces and for rough work, undressed lumber or slip forms may be used. Lumber reused in forms shall have nails withdrawn and surfaces to be in contact with concrete thoroughly cleaned before being used again.
- C. Forms shall not be disturbed until the concrete has hardened sufficiently to support any loads that may be imposed upon it. When stripping forms metal wedges or tools shall not be used to pry panels loose. If wedging is necessary, it shall be done with wood wedges lightly rapped to break adhesion between the concrete and form.
- D. Any misshapen concrete due to form slippage shall be replaced at the Contractor's expense.
- E. The bottom of the forms for drilled pier caps shall extend a minimum of six (6) inches below final grade.
- F. One (1)-inch chamfer shall be provided on all exposed top edges of footings.
- G. Forms shall be treated with a release agent such as form oil to facilitate removal.

### 3.10 MIXING

- A. Ready-mixed concrete in accordance with ASTM 94 is preferred on all construction. Contractor shall indicate at bid time if this condition cannot be met and shall submit an alternate mixing procedure for approval by the District.
- B. All concrete shall be sufficiently mixed to ensure complete uniformity of the batch. The volume of the batch shall not exceed the manufacturer's rating of the drum capacity. Rotating speed of the drum shall not exceed its rated speed.
- C. District shall be notified at time of bid if concrete cannot consistently be delivered and discharged within one and one-half (1 1/2) hours from introduction of water to cement. With these conditions, the District may require all water to be added at the jobsite.
- D. The mixer shall be equipped with water storage and measuring device which can be locked, and also with a suitable charging hopper.
- E. The contents of the drum shall be completely discharged before receiving materials for a new batch.
- F. Water shall not be added to the mix after initial batching without the approval of the District.

### 3.11 CONCRETE PLACEMENT

- A. The concrete shall be conveyed from the mixer to the place of final deposit by methods that will prevent the separation or loss of material.
- B. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to handling or transporting.

## CONCRETE STRUCTURES

- C. The Contractor shall not place any concrete until the form work, excavation, and embedded items are inspected by the District. Concrete shall be placed only in the presence of the District or the Districts designated representative.
- D. Concrete shall be placed in the drilled piers as soon after excavation as possible. Concrete shall be deposited continuously and as rapidly as possible until the unit being cast is complete. Construction joints shall not be allowed.
- E. No concrete shall be placed in standing or running water without permission of the Contractor's Engineer, following approval of a depositing method.
- F. Immediately prior to concrete placement, all surfaces against which concrete will set shall be free of any dried concrete, mud, or other foreign matter.
- G. Surfaces against which new concrete will be set shall also be saturated with water immediately prior to placement.
- H. When placing concrete into drilled piers, care shall be given not to pour concrete through rebar cages causing separation of cement and gravel. Care shall also be taken while using vibrators such that vibrators are not held in concrete for a length of time to cause separation of concrete or that vibrators contact forms causing breakage.
- I. A trunk or tremie shall be used to transport concrete to the foundation bottom.
- J. Any concrete retained in the truck mixer long enough to require additional water to permit satisfactory placing shall be wasted at the Contractor's expense. Concrete requiring re-tempering shall also be wasted at the Contractor's expense. Waste concrete shall be removed from the site and disposed of at the Contractor's expense.
- K. Vibration shall not be allowed if slump is greater than six (6) inches. Rodding shall be allowed near pier cap forms to prevent honeycombing. Internal vibration shall be required for concrete with slumps of four (4) inches or less.

### 3.12 FINISHING

- A. Screeding and initial finishing shall be performed before bleed water can accumulate on the surface.
- B. No further finishing shall be performed until bleed water has evaporated.
- C. Smooth, solid concrete surfaces are required throughout the work. The top surface of the concrete foundation shall be finished to conform to the detail shown on the Drawings. In general, a trowel finish on the concrete is required, with edging as necessary. Care shall be taken in the steel troweling not to bring excessive fine material to the surface. Finishing of concrete surfaces shall be performed only by skilled workmen.
- D. All exposed concrete shall be properly cured for seven (7) days by the moist curing method using wetted burlap, Kraft paper, or polyethylene sheets to prevent evaporation, or by spray application of a liquid membrane-forming compound conforming to ASTM C309, Type 1. The membrane shall be applied according to the manufacturer's recommendations. Surface defects shall be filled prior to application of membrane curing compound. All concrete surfaces on which curing

## CONCRETE STRUCTURES

compound have been applied shall be adequately protected for the duration of the curing period from any cause which would disrupt the continuity of the curing membrane. No curing compound shall be used on surfaces requiring subsequent bonding.

- E. After form removal all fins, small projections, or other irregularities shall be removed by tooling.
- F. Following form removal, foundations shall be inspected by the District's representative.
- G. Metal form ties extending from the face of exposed concrete shall be cut off at least three-fourths (3/4) inch deep in the concrete immediately after removal of forms. Holes shall be filled with a cement-sand mortar approximately the same color as the adjoining concrete. The mortar shall be mixed and placed as dry as possible and finished flush with the adjoining surface.
- H. Honeycombed areas shall be removed and patched with grout. The grout shall consist of one (1) part Portland Cement, one (1) part fine sand (passing a No. 30 sieve), and water sufficient to attain a creamy consistency. The area shall be dampened before grout is brushed on. Shallow patches shall be filled with stiff mortar and finished. Deep patches shall be of formed concrete doweled to the hardened concrete as required by the District.
- I. All vertical surfaces or exterior exposed concrete shall be hand-rubbed to a minimum of six (6) inches below finished grade. Rubbing shall be done immediately after the forms are removed (not later than three (3) days after placement). The rubbing mixture shall consist of equal parts by volume of cement and fine sand applied with a wetted wood block or carborundum stone to give a smooth, even, dense surface finish. After rubbing, no form marks or voids shall be visible.

### 3.13 HOT WEATHER

- A. All concrete work done when the air temperature is 80°F (or forecasted to rise above this temperature within twenty-four (24) hours after concrete placement) shall be in conformance with the following:
  - 1. Mixing water shall be kept cool.
  - 2. Aggregate stockpiles shall be saturated and the surfaces kept moist by intermittent sprinkling or by a continuous fog spray.
  - 3. The basic water-cement ratio shall be maintained.
  - 4. Forms, reinforcing, and subgrade surfaces shall be wetted just before concrete is placed. Wetting down of areas around the work is recommended.
  - 5. The temperature of the concrete when placed shall not exceed 80°F.
  - 6. In extremely hot (80°F and above) and windy weather, sunshades, windbreaks, fog sprays, or a combination of such items shall be used during flat-slab finishing operations.
  - 7. When approved by the District, a retarding admixture may be used for slowing down the setting time of concrete to allow for proper finishing.
  - 8. All hot weather concrete work shall be performed in accordance to ACI 305R.

END OF CONCRETE STRUCTURES

## STRUCTURES AND EQUIPMENT

### PART 4 - STRUCTURAL AND EQUIPMENT INSTALLATION

#### 4.1 GENERAL

- A. The erection of structures and installation of the substation equipment shall conform to the manufacturer's recommended installation procedures. In the installation of the structures and equipment, only mechanics skilled in their various trades shall be employed. All work shall be done in a neat and workmanlike manner. Special care shall be taken to ensure that all frames, trusses, columns, guides, and other fixed metalwork are installed in their exact positions. Structures and equipment to be installed over embedded material and concrete shall be placed accurately and shall be supported in a correct position of alignment and grade. After erection and completion of any field welding the areas adjacent to field welds and any areas where paint or galvanizing has been damaged shall be thoroughly cleaned of dirt, oil, weld spatter, or loose paint and repainted with primer and top coat or cold galvanizing as appropriate. The contractor shall properly dispose of all shipping materials and dunnage including but not limited to oil containers and gas cylinders.
- B. The Contractor shall confirm nameplate data of all equipment to agree with ratings and requirements on the drawings and specifications.

#### 4.2 STRUCTURE INSTALLATION

- A. Installation shall consist of all equipment and structures, including stands, pedestals, frames, and/or other structural items required for a complete substation.
- B. All structures and equipment shall be cleaned of dirt, oil, road grime, etc., before erecting. When galvanizing has been damaged, surface shall be replaced as described in Part 11 - Painting.
- C. The structures shall be assembled utilizing the identification marks as shown on drawings to ensure proper fit-up.
- D. The Contractor shall install all hardware and attachments to make complete assemblies and installations of both Contractor-furnished and District-furnished material. All fasteners shall be galvanized, unless otherwise noted.
- E. The Contractor shall provide all miscellaneous drilling, adjustments, mounting holes, touch-up painting, etc., to produce a complete steel structure system to accommodate all equipment, buses, materials, and future equipment and structures where specified.
- F. No structure shall be placed on its foundation until at least seven (7) days after placement of the foundation concrete.
- G. All base plates shall be set level and in exact position. All structures shall be installed with leveling nuts below the structure base plate. Base plates will not be placed directly on top of foundations, unless as specified in the Engineering Drawings.
- H. Connection or erection bolts shall be seated clear to the head and installed with nuts to the inside of the member.

## STRUCTURES AND EQUIPMENT

- I. The structural nuts shall be locked into place with split-type lock washers and tightened to recommended torque values for the respective diameter and material.
- J. For low-carbon, mild-steel bolts (ASTM A307) refer to the torque table below:

Bolt Size	Torque	Bolt Size	Torque
1/2"-13	37 Ft-lbs	1"-8	235 Ft-lbs
9/16"-12	52 Ft-lbs	1-1/8"-7	340 Ft-lbs
5/8"-11	83 Ft-lbs	1-1/4"-7	432 Ft-lbs
3/4"-10	104 Ft-lbs	1-1/2"-6	732 Ft-lbs
7/8"-9	160 Ft-lbs		

- 1. When AISC specification "Structural Joints Using ASTM A325 Bolts" is specified, the "turn-of-nut" method described below may be used:
  - 2. Bolts shall first be brought to a "snug-tight" condition to ensure that the parts of the joint are brought into good contact with each other. "Snug-tight" is defined as the tightness attained by the normal effort of a man using a standard socket wrench. The nuts and steel shall be marked in this position and the bolts systematically turned an additional one-half (1/2) turn for bolts up to eight diameters or eight (8) inches in length and two-thirds (2/3) turn for longer bolts. During this operation there shall be no rotation of parts not turned by the wrench.
- K. Beveled washers shall be used on sloping or beveled surfaces where required to provide a proper fit.
  - L. A reasonable amount of drifting will be allowed in assembling, but reaming for mismatched holes shall not be permitted.
  - M. All structural metals shall be handled with care to avoid bending or damaging. Pieces bent in handling may be used only if they are straightened to the satisfaction of the District.
  - N. All structures shall be assembled and aligned, and all bolts tightened and/or torqued as required by the AISC Code of Standard Practice. After final tightening and before any apparatus is mounted on the structures, the alignment shall be checked by the District. Structures must align within 1/500th of the span horizontally and 1/500th of the height from the top of the foundation to the connecting points of the supporting members of the uppermost apparatus support.
  - O. Whenever torquing is required, the fastener shall be marked with Torque Seal or an acceptable equivalent.
- 4.3 FIELD WELDING
- A. Field welded connections shall be permitted only where shown on the Drawings.
  - B. All field splice butt welds shall be full penetration welds unless otherwise specified.
  - C. Welding required for welded field splices, for steel structure adjustments, or for miscellaneous additions shall be performed by a welder qualified per AWS D1.1 Structural Welding Code -

## STRUCTURES AND EQUIPMENT

Steel or AWS D1.2 Structural Welding Code - Aluminum, and welds shall be such that they will pass a radiographic test.

- D. Any welding that is suspected to be deficient shall be replaced or repaired to the Owner's satisfaction. Should, in the sole opinion of the Owner, the quality of the weld remain in question the Contractor shall prove the quality of the weld(s) through radiographic testing. Weld testing costs shall be borne by the Contractor.
- E. Material to be field welded shall be positioned so that welds can be made in a flat, horizontal, or vertical position whenever possible. Field welding shall be performed in an overhead position only when specifically approved by the District.
- F. Welding shall not be done when the ambient temperature is lower than 0°F. When the ambient temperature is below 40°F, the base metal shall be preheated for both tack welding and finish welding in such manner that the surfaces of the parts on which weld metal is being deposited are at or above a temperature of 72°F for at least three (3) inches both laterally and in advance of the welding. Preheat temperature shall not exceed 400°F.

### 4.4 EQUIPMENT INSTALLATION - GENERAL

- A. Installation of equipment shall consist of scheduling, receiving, unloading, reloading (if necessary), storage, placement and field assembling of equipment in accordance with the manufacturer's installation instructions.
- B. All equipment shall be cleaned of dirt, oil, road grime, and other foreign matter before installation. Refer to the Testing Section of this specification for additional requirements.
- C. District and Contractor supplied equipment installation shall be in accordance with the manufacturer's recommended procedures. The procedures shall include, but not be limited to, bushings, ground assemblies, bussing, terminals, and any other ancillary devices to form a complete installation.
- D. Installation of other high voltage equipment shall be performed in a workmanship like manner and in accordance with the manufacturer's installation procedures. Specific attention is required to rigging and moving procedure.

END OF STRUCTURES AND EQUIPMENT

## ELECTRICAL CONNECTIONS

### PART 5 - ELECTRICAL CONNECTIONS

#### 5.1 GENERAL

- A. Connectors shall include all bolted devices, welded devices, clamps, strain clamps, deadend fittings, terminal devices, and couplings.

#### 5.2 INSTALLATION

- A. All connectors, suspension and strain clamps, and deadend fittings shall be equal to the manufacturer's references. Cable connectors shall be of the compression type unless specifically stipulated otherwise.
- B. Utmost care shall be exercised in installing clamps, connectors, and other bolted devices. The contact surface of the clamp or connectors and the bonding surface of the wire or tubing shall be clean and bright, and an oxide-inhibitor compound such as "Pentrox A" shall be applied. A stainless steel brush shall be the principal cleaning instrument.
- C. All bolted electrical connections, except deadend assemblies, shall be made with stainless steel hardware except the nuts which shall be silicon bronze. Anodized aluminum bolts may be used on deadend terminal connectors. Anodized aluminum bolts may not be cut off and shall be tightened with a torque wrench per the manufacturer's recommendations. Bolts shall be tightened firmly, but threads must not be over-stressed. Bolts in clamps over stranded conductor shall be tightened enough to flatten the lock washers but not enough to deform or damage the conductor. Bolts shall not extend beyond the nut more than one-half (1/2) bolt diameter.
- D. Interface pads shall be installed in all cases of mating aluminum terminal connectors to bronze or copper terminal pads. Where interface pads are not practical, these connections shall be tinned. Oxide-inhibitor compound (Burndy "Pentrox A" or an approved equal) shall be used on all aluminum surfaces.

END OF ELECTRICAL CONNECTIONS



## ELECTRICAL INSULATION

### PART 6 - ELECTRICAL INSULATION

#### 6.1 MATERIALS

##### A. Suspension Insulators

1. Suspension insulators shall be installed per IEEE-NEMA Class 52-3 and Drawings.

##### B. Bus and Station Post Insulators

1. NGK-LOCKE, HUBBEL and LAPP are the approved manufacturers for the station post insulators.
2. Bus insulators shall conform to ANSI C29.2, and station post-type insulators shall conform to ANSI C29.9 and the Technical References as noted in Drawings.

##### C. All insulators shall be ANSI 70, gray unless otherwise specified.

##### D. Insulator bases and spacers shall be of malleable iron or forged steel and galvanized in conformance with ASTM A-153.

##### E. Upon completion of project, insulators shall be cleaned with HP Polywater. Nothing abrasive shall be used on the insulators unless Scott Bright is used. New, lint-free rags shall be used for each step.

#### 6.2 INSTALLATION

##### A. All insulators and bushings shall be cleaned of oil, dirt, paper, tape, or other foreign materials. Any insulator or bushing having the surface glaze damaged in any way shall not be installed.

##### B. Contractor shall be responsible for furnishing and installing all miscellaneous hardware necessary for a complete insulation system. Miscellaneous hardware can include but is not limited to bolts, nuts, lock washers, eye-bolts, shackles, clevis-pieces, etc.

END OF ELECTRICAL INSULATION

## SWITCHES AND FUSES

### PART 7 - DISCONNECT SWITCHES AND FUSES

#### 7.1 GENERAL

- A. All switches and disconnects shall conform to their respective sections of NEMA Standard SG-6, "Power Switching Equipment". Fuses shall conform to all applicable portions of NEMA SG-2. Where there is a discrepancy between the NEMA standards and these Specifications, these Specifications shall apply.
- B. Extra fuses shall be stored by the Contractor in the station control house.

#### 7.2 INSTALLATION

- A. Switch operator platforms or mats shall be provided for all switches as shown on the Drawings. Switch handle and platform shall be grounded.
- B. Mechanical interlocks, electrical interlocks, or key interlocks shall be completely installed as required by the Drawings. The Contractor shall be responsible for the final adjustment of the interlock schemes. Locks for securing operator mechanisms shall be supplied by the District.
- C. Switches, disconnects, and fuses shall be installed in conformity with vendor drawings and instructions which show mounting and installation requirements. The Contractor shall review vendor drawings and shall provide miscellaneous brackets, bearings, couplings, nuts, bolts, lock washers, and other necessary hardware to completely install the switches, disconnects, and fuses. Final adjustments and settings shall be made by the Contractor to produce a complete working assembly. The Contractor shall be responsible for any and all modifications to the steel structures to install a complete working disconnect switch, and/or fuse assembly. Final touch-up painting shall be applied to switch base parts where required.
- D. Switch handles and operating platforms shall be arranged and aligned to ensure the proper switching of the unit from the platform.
- E. Group operated switches shall be installed such that the blades open and close simultaneously. The switches will be manually operated until approved by the District. The Contractor shall adjust all cam, spare contacts, and limit switches in accordance with the drawings and maintenance instructions.
- F. The contractor shall not perform final piercing of disconnect switch operating rods and connections until final inspection and acceptance by the District. Contractor shall give the District 24-hours' notice for final inspection and acceptance by the District on functional operation of devices and equipment.

END OF SWITCHES AND FUSES

## STATION GROUNDING

### PART 8 - SUBSTATION GROUNDING

#### 8.1 GENERAL

- A. This section covers requirements for a complete grounding installation for the substation, which shall conform to these Specifications and all applicable codes. Grounding shall include a complete buried system and a grounding system for all lightning arresters, circuit breakers, circuit switcher, regulators, meter cabinets, potential transformers, power transformers, structures, fence, control building, panels, switch platform, conduit bushings, cables, and other appropriate items.

#### 8.2 INSTALLATION

- A. The buried grounding system shall be installed in conformance with the Drawings and Specifications. Below-grade connections shall utilize an approved exothermic process. Connections shall be made in conformance with the manufacturer's instructions.
- B. Grounding conductors shall be straight and free from kinks, breaks, and other damage after installation. Conductors shall be thoroughly cleaned prior to making connections. All connections shall be inspected by the District prior to burial.
- C. The ground bus shall be laid slack to the depth shown on the Drawings.
- D. All taps, junctions, and splices shall be left uncovered until inspected by the District.
- E. Ground rod placement and characteristics are as noted in Drawings.
- F. All equipment and all steel structures and electrical equipment shall be connected to the ground system. This includes but is not limited to all panels, junction boxes, and auxiliary equipment. All bolted installations shall use lock washers. Paint, rust, or other non-conducting material shall be completely removed from the contact surfaces and these surfaces coated with oxide-inhibiting compound before making ground connections. Once the connection has been made, any exposed metal shall be painted in accordance with Part 11 - Painting.
- G. All ground bus bars in panels shall be grounded solidly to the ground grid with #6 or larger solid copper wire.
- H. All conduit hubs shall be solidly connected to ground grid. The District will connect the ground grid to the fence, as detailed in EXHIBIT EM – Drawing E5-3 Ground Grid and Grounding details.
  - 1. All metallic conduit and metallic cable shielding and sheath shall be effectively grounded at terminations in conformance with the National Electrical Code.

#### 8.3 TESTING

- A. Using the Fall of Potential Method Test, the Contractor shall measure the resistance of the grid. A distance of five (5) times the longest diagonal shall be used for the current probe separation. Probe P2 shall be placed at ten (10) percent intervals throughout the distance of the current probes. The Contractor shall be cognizant of buried pipes and steel fences, (including barbed wire) during the measurements. A minimum of three (3) measurements will be taken.

## **STATION GROUNDING**

- B. Three (3) copies of the results shall be forwarded to the District. The results shall include a plan view diagram measurement and a graph for each individual measurement. Appropriate dimensions will be included on the plan view diagrams.
- C. Safety during testing and installation is the responsibility of the Contractor.

END OF STATION GROUNDING

## CONDUIT & FITTINGS

### PART 9 - CONDUIT & FITTINGS

#### 9.1 GENERAL

- A. Contractor shall install electrical conduit and accessories required for embedded and exposed conduit systems. Conduit accessories shall include the following: conduit fittings; conduit duct spacers conduit connectors; outlet boxes; outlet bodies; standard pipe tees for conduit drains (as required); pull boxes; junction boxes; locknuts; bond nuts; bushings; materials for sealing joints and for coating external surfaces of conduit; materials for sealing and connecting the ends of conduits terminating at outdoor boxes, panel boards, and cabinets; hanger supports; bracket supports and clamps; and all other devices required to complete the electrical conduit system.
- B. Contractor shall install four (4) conduits per Drawings. Pulling rope shall be installed in empty conduits for future cable pulling.
  - 1. At riser structure end power cable conduits shall be extended above riser structure mounting brace and connected to riser structure via brace.
  - 2. Threaded grounding clamp as per noted in the BOM shall be mounted on top of each riser conduit and solidly connected to station ground grid as per Drawings.
  - 3. At end outside of substation power cable conduits shall be capped and location marked for future locating. Contractor shall give the District 48-hours notice prior to capping and burying power cable conduits.
- C. Contractor shall be responsible for installing all other materials and accessories necessary to install a complete conduit system which shall be approved by the District.

#### 9.2 MATERIAL

- A. All rigid galvanized steel (RGS) and polyvinyl chloride (PVC) conduit shall be Schedule 40 unless otherwise specified.
  - 1. Straight portions of horizontal runs of buried conduit shall be PVC conduit unless otherwise specified.
  - 2. PVC conduit joints shall be made watertight per ASTM D2855.
  - 3. All bends greater than fifty degrees (50°), including those within or at the ends of PVC runs, shall be made with RGS conduit. Adapter connectors are to be provided between PVC conduit and all RGS conduit sections. All RGS bends installed underground shall be coated with Bitumastic 50 or wrapped with PVC tape unless encased in concrete.
  - 4. RGS conduit shall be used to make entrance connections into building or equipment foundations, and vaults. The RGS conduit is to be extended a minimum of eighteen (18) inches beyond exterior walls for buried cables.
  - 5. All exposed conduit shall be RGS unless otherwise stipulated. Where it is connected to buried conduit, a PVC to RGS coupler shall be used at surface level.
- B. Flexible conduit shall not be used without approval by the District. If approved, conduit shall be steel reinforced and liquid tight.
- C. Circuit breaker panels, wiring devices, junction and outlet boxes, together with associated items for attaching and making connections, shall be in conformance with the following specifications:

## CONDUIT & FITTINGS

1. All surface-mounted or exposed outlet boxes shall be cast aluminum or cast iron, with steel or aluminum cover plates. Crouse-Hinds, Russel & Stoll, or similar approved types of outlet boxes shall be used. Sheet metal boxes are not acceptable.
2. Junction boxes for splicing and termination points shall be located throughout the station. They shall be Hoffman type or approved equal rated NEMA 3R or 4X, supplied without knockouts for conduit entry. They shall be heavy-duty, rain-tight, drop-door, screw-cover type enclosures of the sizes required by code. Connections on the top and sides shall be made with waterproof hubs. Connections in the bottom may be made with a bushing and two (2) locknuts. Drilling through the junction boxes is not acceptable.

### 9.3 INSTALLATION

- A. All material and equipment shall be stored so as to be protected from deteriorating effects of the elements. Touch-up paint shall be provided as required.
- B. All conduits shall be installed in a neat and workmanlike manner. Where possible, the runs shall be parallel to the centerlines of structures or parallel to each other in the case of multiple runs. Underground runs shall be as direct as possible, using the least number of bends as is practical.
- C. Conduit runs, embedded or exposed, shall not contain more than the equivalent of four (4) quarter-bends (360° total) between outlet and outlet, fitting and fitting, or between outlet and fitting, including bends located immediately at the outlet or fitting. Pull boxes shall be installed, if required, to limit any run of conduit to four (4) quarter bends (360° total).
  1. All outdoor conduits shall be one (1) inch minimum unless otherwise stipulated. Inside the control enclosure one-half (1/2) inch and larger electrical metallic tubing (EMT) conduit may be used. Control enclosure shall be pre-fabricated type with majority of EMT conduits installed by provider.
  2. Factory bends or bends made with a hydraulic power bender shall be used for conduit larger than one (1) inch. Minimum bend radius shall be seven (7) times the diameter of the conduit.
  3. All exposed ends of conduit shall be protected during construction to prevent the entrance of any foreign material or moisture.
  4. Burrs or sharp projections which might injure the cable shall be removed.
  5. Round, flexible, nylon-covered tapes or nylon ropes shall be used for fishing and wire-pulling in conduit.
  6. Where conduit enters a box, vault, cable trench, or any other fitting or termination, a bushing shall be provided to protect the cable from abrasions. At all points where the conduit terminates, the bushing shall be of the grounding type to provide an effective connection to ground.
  7. Entrances to breaker panels which are inside the control building shall be made with conduit runs from a cable trench or tray. The conduits shall extend through a cutout in the trench cover plates and shall be securely fastened to the trench sidewall.
  8. Conduit, conduit fittings, and conduit boxes to be embedded in concrete shall be held securely in position while the concrete is being placed. All concrete shall be cleaned from the inside of conduit boxes after the forms are removed, and the threads for attaching devices and covers shall also be cleaned.
  9. The ends of conduit shall be protected to prevent the entrance of any foreign material. As soon as practical after conduit rounds are completed and the forms are stripped, all conduit

## CONDUIT & FITTINGS

- runs shall be swabbed to show that they are free of foreign material and have no broken fittings. The plugs or caps shall then have their threads greased and shall be replaced and left in place until the wire is installed.
10. Outdoor conduit runs must be supported at least every six (6) feet horizontally and eight (8) feet vertically. Fittings and outlets that are for conductor feed-through shall have the attached conduit supported within three (3) feet. Eighteen (18) inches shall be the distance between conduit supports and outlets that contain devices (such as receptacles) or boxes that support fixtures. Conduit runs in control buildings shall have supports a maximum of eight (8) feet horizontally and vertically.
    - a. Conduit shall be bent so that no more than four (4) inches separate the conduit and the adjacent surface.
    - b. Drilling through junction boxes is not acceptable for NEMA ratings 3 or above. Unistrut C-channel shall be used for mounting unless otherwise indicated on the drawings.
    - c. Conduit which enters manhole or pull boxes is to be mortared. End bells shall be used and mortar and end bells will be flush with the surface.
  11. Contractor shall cap outside conduits.
  12. After testing and commissioning are complete, the contractor shall seal the conduits.

### 9.4 UNDERGROUND CONDUIT BURIAL

- A. Underground conduit runs shall be buried below subgrade (soil grade) as follows:
  1. Control and equipment power cable circuits shall be buried twenty-four (24) inches below subgrade unless indicated otherwise on the Drawings.
  2. Conduit for power cable circuits and communications shall extend six feet outside the substation fence in the direction and depths indicated on the Drawings.
  3. Conduit duct banks with multiple conduit runs shall have conduit spacers to maintain distances between conduits.
  4. Conduit trench bottom shall be smooth and filled with three (3) inches of sand to make it such.
  5. Where native material is unsuitable as bedding material, the Contractor shall provide sand for minimum coverage of (6) inches below and (6) inches above the conduit, prior to backfilling
  6. Substation feeder circuit conduits shall include RGS rigid steel sweeps as indicated on the Drawings. Buried feeder circuit conduits shall be 6-inch PVC, with a minimum coverage of (6) inches below and (6) inches above the conduit, prior to backfilling.

END OF CONDUIT AND FITTINGS

## **CONTROL BUILDING**

### **PART 10 - CONTROL ENCLOSURE**

#### **10.1 GENERAL**

- A. This section covers requirements for the installation of a pre-fabricated control enclosure which shall be supplied complete with the following: heating, ground bus bars, lighting, general power circuits, AC and DC station power breaker panels, relay panels, SCADA/communications panel, overhead cable tray and all wiring and additional material items for a complete enclosure assembly.

#### **10.2 SITE PREPARATION AND FOUNDATIONS**

- A. Site preparation shall be in conformance with the grading and site preparation section of these Specifications.
- B. Foundation work shall conform to the concrete section of these Specifications.
  - 1. The enclosure floor shall be no more than 12” above finished grade per Drawings.
  - 2. The enclosure shall be installed with a single step in the stoop at north entrance per Drawings

**END OF CONTROL BUILDING**



# PAINING

## PART 11 - PAINTING

### 11.1 GENERAL

- A. All field painting costs shall be borne by the Contractor. Exterior building color shall be approved by District.

### 11.2 EQUIPMENT

- A. Surfaces of most electrical equipment (such as panels, switchgear, transformers, circuit breakers, etc.) are finished at the factory. Great care shall be exercised to prevent damage to this original finish during installation of the equipment and during construction work.
- B. If the factory finish is damaged during the course of construction, the entire surface of the damaged component shall be refinished.
- C. The refinished surface shall be equivalent in every respect to the original surface, including color, texture, and smoothness. Refinishing paint, if furnished with the equipment, may be used; otherwise, the paint shall be obtained from the equipment manufacturer.

### 11.3 STRUCTURAL STEEL

- A. Contractor shall be responsible for repairing surface coating (paint and galvanizing) damaged in shipping and construction, and for applying the surface coating over any bare metal areas which were not painted (galvanized) during fabrication. All bare metal areas which are subject to rust shall have a protective coating applied.
- B. After field erection has been completed, the welds shall be ground smooth and the adjacent uncoated areas and any areas where the coating has been damaged shall be cleaned in conformance with SSPC-SP3, power tool cleaning.
- C. All steel requiring touch-up painting shall be prime painted and finish painted in accordance with the following:
  - 1. Surfaces shall be free of abrasive, oils, dirt, or contaminants when primed.
  - 2. Handling of coating equipment and the steel surfaces to be primed shall be done in a manner to avoid contamination during and following application of the primer coat.
  - 3. The surface temperature of the steel to be coated shall be 50°F minimum and at least 5°F above the wet-bulb air temperature reading.
  - 4. The primer thickness shall be 2.0 mils (dry). The thickness shall be monitored by wet-film thickness measurements.
  - 5. The primer shall be allowed to cure prior to application of second (or top) coating for at least the minimum time recommended by the paint manufacturer.
  - 6. Areas with dry-film thickness of less than 1.7 mils or greater than 5.0 mils shall be corrected by additional primer coating or by wire brushing and recoating.
  - 7. The primer shall be of a zinc-rich inorganic type which is identical to the primer applied by the steel fabricator. The primer shall not be applied over the topcoat.

## PAINTING

8. Top coating shall be applied after any corrections have been made to the primed surface and the primer is fully cured.
  9. The topcoat shall be applied to a thickness of 3.0 mils dry (primer plus topcoat = 5.0 mils dry) using the manufacturer's recommended procedures. The topcoat thickness shall be monitored by a wet-film thickness method. Areas where the dry-film thickness of the primer plus topcoat are less than 4.5 mils or greater than 8.0 mils shall be corrected.
  10. The topcoat shall be a polyamide epoxy type. It shall be identical to the topcoat applied by the steel fabricator.
  11. Touch-up painting shall be done in conformance with SSPC-PA 1 "Shop, Field, and Maintenance Painting".
- D. All steel requiring galvanizing repair shall be repaired in conformance with SSPC-PA 1 "Shop, Field, and Maintenance Painting" and ASTM A 780 "Repair of Damaged Hot-Dip Galvanized Coatings". Since different pigments exist, the appropriate pigment will be selected by the Contractor to match the existing surface.

END OF PAINTING

## PART 12 - OVERHEAD STRAIN BUS

### 12.1 GENERAL

- A. These Specifications provide for the construction of the overhead transmission entry strain span or spans, including but not limited to the hardware, strain insulators, dead-end tongue type connectors, etc., as required and highlighted in Drawings. A vertical strain bus tap will be connected near mid-span per Drawings. All construction work shall be done in a thorough and workmanlike manner in conformance with the Specifications and Drawings.

### 12.2 MATERIALS

- A. All material and equipment to be used in construction shall be only that included in the current "List of Materials Acceptable for Use on Systems of REA Electrification Borrowers" (including revisions) unless otherwise stipulated.

### 12.3 INSTALLATION

#### A. Structures

- 1. Span shall span between substation H-frame structures as per Drawings.

#### B. Conductor

- 1. Conductors may be strung by either conventional or tension-stringing method.
- 2. Care shall be exercised to avoid kinking, twisting, or abrading the conductors in any manner. Conductors shall not be trampled on, run over by vehicles, or dragged over sharp rocks. The wire on each reel shall be inspected for cuts, kinks, or other injuries. Injured portions or crooked or imperfect splices in either the conductor.
- 3. Conductors shall be pulled over suitable rollers or stringing blocks properly mounted on the pole or crossarm to prevent binding while stringing.
- 4. Installation of conductors and accessories shall be done in conformance with the manufacturer's recommendations.
- 5. There shall not be any conductor splices.
- 6. Conductors and overhead ground wires shall be sagged in conformance with the furnished sag tables in Drawings. The sag of all conductors after stringing shall be in conformance with the tables within a tolerance of 0.01 times the sag in feet, up to a maximum increase of one-half (1/2) foot. Under no circumstances shall a decrease in the specified sag be allowed. Sagging by sighting between targets is required.
- 7. The air temperature at the time and place of sagging shall be determined by a certified thermometer placed inside a two (2)-foot-long piece of the specified conductor. The temperature at which the conductor is sagged and the spans in which sags are measured, shall be recorded and the information given to the District's Engineer.

END OF OVERHEAD STRAIN BUS