



January 27, 2021

AIRPORT SUBSTATION CONSTRUCTION SPECIFICATIONS

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PART 1 - GENERAL

A. Overview

1. The Project consists of installation of (6) concrete foundations, removal of (4) concrete foundations, cutting a hole in a cinder block wall, excavating, and backfilling for conduit which will be installed by PUD crews.
2. Limited material and electrical equipment will be provided by the District, as detailed in the specifications and drawings, the remainder will be provided by the contractor. Construction will take place at an existing substation which will be de-energized.

B. Permits

1. The Contractor shall, at its expense, be responsible for obtaining all permits required by governing authorities that affect its work, with the exception of the building permit.

C. Supervision and Inspection

1. The Contractor shall cause the construction work on the Project to receive constant supervision by an experienced substation construction foreman 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 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 that 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.

D. 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.

E. 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.

F. 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 prior to such work being as set forth in Article I and XIII, Contract.
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.

G. 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. Any protest or claim by the Contractor arising from any such change shall be submitted as set forth in Article I & XIII, Contract.

H. Materials

1. District-Supplied Materials
 - a. All District-supplied materials shall be furnished by the District or arranged for by the District Representative. All materials issued to the Contractor become his responsibility. The Contractor will be required to provide a secure area for storage of material issued by the District's Warehouseman.
 - b. All District-supplied materials shall be obtained by the Contractor at the District's Carlsborg Operations Center located at 100 Hooker Road, Sequim, WA 98382, Monday through Friday between 8:30 a.m. and 3:30 p.m., except holidays. Contractor will be responsible for the safe storage of all materials.
 - c. 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.

- d. The Contractor shall give a minimum of 24 hours advance notice to the District Representative before materials are issued.
- e. 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.
- f. 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.
- g. 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

- a. The Contractor shall supply forms, rebar, concrete, mortar, grouting and sacking materials, aluminum bus material and fittings, specified wire and cable, ground grid, fencing, crushed rock, together with other materials as detailed below and on the drawings attached hereto as **Exhibit C through G**.
- b. The Contractor shall supply all circuit breaker slab anchor bolts; above and below grade conduit; conduit fittings; junction boxes; stranded wire of the color, type, and size and type specified; compression-type copper terminal lugs for all wire terminations except for those in the panels and all the nuts, bolts, fittings, and clamps required to assemble and/or mount District-supplied equipment in order to provide a complete and fully functional substation. 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.

I. 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 by the District.

J. Refer to **Exhibit C through G** for engineering drawings and installation data for the project supplied by the District.

END OF GENERAL

PART 2 - SITE GRADING

A. Materials

- a. 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.
- b. 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.
- c. 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.
- d. Any on-site borrow areas shall be graded to drain and shall present a neat appearance, as directed by the District.

B. Backfill and Fill

1. All backfill and fill material shall be compacted unless otherwise required by design.
2. Per the Geotechnical Engineering Report, dated July 14, 2011, prepared by Kleinfelder: "All materials on the site within the substation should be considered structural fill. Native soils are expected to be suitable for use [as backfill and/or fill]. However, the on-site soils generally contain a significant quantity of silt and are moisture sensitive...The contractor should submit samples of each of the required earthwork materials to the District for evaluation and approval prior to use."
3. 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.
4. Sod, roots, snow, ice, or frozen earth shall not be placed in fill, and fill shall not be placed on a frozen surface.
5. Watering, if necessary to obtain optimum moisture content, shall be done without additional cost to the District.
6. Contractor shall 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.

C. 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.

END OF SITE PREPARATION

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.

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 EME, 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 cleanup 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.
- G. Anchor Bolts shall be ASTM F1554 unless noted otherwise.

- H. Circuit switcher foundation anchor bolts shall be supplied and installed by contractor per Drawings

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 shown on the Drawings.
- E. The tops of the drilled piers shall be no less than four (4) inches or more than sixteen (16) inches above the finished crushed rock surfacing, unless otherwise authorized by the District.

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.
- 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.
- 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 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 doveled 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

PART 4 - CONDUIT & FITTINGS

4.1 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 be responsible for installing all other materials and accessories necessary to install a complete conduit system which shall be approved by the District.

4.2 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. 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.
 - 3. 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.
 - 4. 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:
 - 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.

4.3 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 runs are completed and the forms are stripped, all conduit 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.

4.4 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