NOTICE:

Bids to be opened at
at the office of
Officer in Charge of Construction
Jacksonville, North Carolina Area
Building 1005, Marine Corps Base
Camp Lejeune, North Carolina 28542

NAVFAC
SPECIFICATION
NO.

NAVFAC CONTRACT NO.

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# REBUILD ELECTRICAL SUBSTATION

at the

Marine Corps Air Station (Helicopter), New River,

Jacksonville, North Carolina

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DESIGN BY: Henry von Oesen and Associates, Inc.
Consulting Engineers & Planners
611 Princess Street/P. O. Drawer 2087
Wilmington, North Carolina 28402

SPECIFICATION PREPARED BY:

Electrical Engineer: R. Duncan McFadyen, P. E.

APPROVED BY: James R. Benson, Jr., P. E. Date:

SECOND SUBMITTAL
90 PERCENT
23 JULY 79

SECOND SUBMITTAL
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CONTENTS

SECTION 00101. Bidding Information

DIVISION

1. General Requirements

SECTION

01011. General Paragraphs

2. Site Work

SECTION

02600. Asphaltic Concrete Surface and Patchwork

02711. Fence, Chain Link

02822. Establishing Vegetation

3. Concrete

SECTION

03300. Cast-in-Place Concrete

16. Electrical

SECTION

16302. Overhead Electrical Work

16335. Substations and Switchgear, Exterior

16XXX. Disassembly and Erection of Existing Substation Structure

16XXX. Transistion From Existing Substation to New Steel Structure

16XXX. Cleanup, Grading and Grassing Abandoned Facilities

DIVISION 1. GENERAL REQUIREMENTS

SECTION 01011. GENERAL PARAGRAPHS

1. GENERAL INTENTION: It is the declared and acknowledge intention and meaning to provide and secure the rebuilding of the MCAS(H) electrical substation, complete and ready for use.

2. GENERAL DESCRIPTION: The project includes relocating an existing unused steel substation structure, transferring major components from an operating substation to the new structure, installing new components, line work adjacent to the structures, site work and incidental related work.

3. LOCATION: The work shall be located at Marine Corps Air Station (Helicopter), New River, Jacksonville, North Carolina, approximately as shown. The exact location will be indicated by the Contracting Officer. "Officer in Charge of Construction (OICC)" and "Contracting Officer" are used interchangeably in this specification and have the same meaning.

4. COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK: The Contractor will be required to commence work under the contract 15 calendar days after the date of "Notice of Award", to prosecute said work diligently, and to complete the entire work ready for use within 120 calendar days. The time stated for completion shall include final cleanup of the premises. The contract completion date will be computed starting 15 calendar days after the date of the Notice of Award. This 15-day period is to allow for mailing of the Notice of Award and the Contractor's submission of required bonds. Periods of time when work is prohibited by this document will not be included in calculating the completion date.

5. LIQUIDATED DAMAGES: In case of failure on the part of the Contractor to complete the work within the time fixed in the contract or any extensions thereof, the Contractor shall pay to the Government as liquidated damages pursuant to Clause 5, "Termination for Default - Damages for Delay - Time Extensions", and Clause 80, "Damages for Delay - Defense Materials System and Priorities" of the General Provisions the sum of $35.00 for each day of delay.

6. DRAWINGS ACCOMPANYING SPECIFICATION: The following drawings accompany this specification and are a part thereof. Drawings are the property of the government and shall not be used for any purpose other than that contemplated by the specification.

| NAVFAC DWG. NO. | SHEET NO. | TITLE |
|---|---|---|
| | | One Line Diagram and Details |
| | | Existing Facilities Plan |
| | | New Facilities Plan |
| | | Relocated Steel Structure Details |
| | | Station Grounding and Details |

7. FACTORY INSPECTION: (See Clause 10 of the General Provisions) Factory inspection of material and equipment for which tests at the place of manufacture are required in referenced specifications will be waived if notarized copies of factory reports are furnished that show compliance with the specification requirement. Factory inspection will be required only where specified herein or in the technical sections of this specification. (Factory inspection will not be required for lumber if it is grade-marked and trade-marked by the association under whose rules it is graded, or if it is accompanied by certificates of inspection issued by the association under whose rules it is graded or by another inspection agency that is satisfactory to the Contracting Officer.) The government reserves the right to charge to the Contractor any additional cost of government inspection and tests when materials and equipment are not ready at the time inspection and tests are requested by the Contractor.

8. MINIMUM WAGE RATES AND OTHER LABOR STANDARDS: The Contractor shall pay mechanics and laborers employed or working directly upon the site of the work, wage rates not less than those contained in the attached wage determination decision of the Secretary of Labor. Rates for

shall apply to all work in this contract. The Wage Rates are attached to the back of this specification.

9. NORTH CAROLINA SALES AND USE TAX IS REQUIRED. (See also section entitled "Additional General Paragraphs".)

10. SCHEDULING THE WORK: Immediately after award, the Contractor shall meet with the Contracting Officer and prepare a schedule of work. The existing MCAS(H) electrical substation will remain in operation during the entire construction period and the Contractor shall conduct his operations so as to cause the least possible interference with the normal operations of the activity. The new substation structure shall be useably complete and ready for operation as approved by the Contracting Officer before any work is started on the existing MCAS(H) electrical substation which would interfere with normal operation. Equipment to be relocated will be available to the Contractor for relocation immediately after the award of the contract. Permission to interrupt any utility service shall be requested in writing at least 10 days in advance and approval of the Contracting Officer shall be received before any service is interrupted. Interruptions of utility services will be allowed only when they will cause no interference with the operations of the activity. All utility cutovers shall be made after normal working hours or on weekends. Anticipated costs shall be included in the bid. The existing substation shall be kept secure at all times and the Contractor shall provide all temporary closures as required to maintain security as directed by the Contracting Officer. The Contractor shall remove all debris from all spaces being used by the activity as required to keep the space useable. Protective enclosures shall be provided to protect existing work to remain and government material located in the existing substation during the construction period. The normal working hours of Contracting Officer personnel are from 8:00 A.M. to 4:30 P.M., Monday through Friday.

11. SAFETY PROGRAM: The Contractor shall implement a safety program conforming to the requirements of Federal, State and local laws, rules and regulations. The program shall include but is not limited to the following:

a. "Occupational Safety and Health Standards", which can be examined at the Office of the Contracting Officer or be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

b. Department of the Army, Corps of Engineers, "General Safety Requirements", which may be examined at the office where bids are being received or may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Stock No. 008-022-00106-9.

c. General Provisions, Clause 45.

12. TECHNICAL PUBLICATIONS: The Contractor shall furnish to the Contracting Officer three copies each of installation, operation maintenance manuals and parts list for all Contractor-furnished mechanical and electrical equipment.

12.1 Operating instructions for the principal plant mechanical and electrical components, for use by operating personnel, shall be provided. They shall be laminated between thermoplastic sheets and affixed where directed. The instructions shall describe the function of the equipment, its most economical operation, start-up and shut-down procedures, procedures to follow in the event of failure, normal maintenance practices, and caution and warning notices.

12.2 Maintenance and operation manual shall be furnished to the Contracting Officer for approval. The manual shall be mounted in flexible binders with oil-resistant covers and shall contain, but not be limited to, installation and operating instructions, maintenance procedures, illustrations, drawings, detailed descriptions, tests, adjustments, safety precautions, and parts list.

12.3 Parts list, giving part numbers and prices for the equipment furnished, shall be submitted to the Contracting Officer as soon as practicable after the award of the contract, but not later than 90 days after notice of award has been received.

13. MATERIALS AND EQUIPMENT TO BE SALVAGED: Existing materials and equipment to be removed and listed following, shall be salvaged and shall remain the property of the government. Work to be salvaged shall be carefully removed and handled in such a manner as to avoid damage and shall be delivered to storage on the station at a location designated by the Contracting Officer, or installed in new construction as indicated. The following equipment shall be salvaged from the existing abandoned steel substation structure and reinstalled on the relocated steel

structure:

Air Break Switches (5) and Arrestors
Fused Cutouts (Number as required)
Unfused Cutouts (Number as required)
25 KVA Transformer
Insulators and Conductors

The following equipment shall be salvaged from the existing MCAS(H) substation and reinstalled at and on the relocated steel structure:

Oil Circuit Breakers (4)
Voltage Regulators (2)
Metering Equipment
Insulators and Conductors
Fused Cutouts (Number as required)
Unfused Cutouts (Number as required)

14. TRAILER OR STORAGE BUILDINGS will be permitted on the job site, where space is available, subject to the approval of the Contracting Officer. The trailers or buildings shall be suitable painted and kept in a good state of repair. Failure of the Contractor to maintain his trailers or storage buildings in good condition will be considered sufficient reason to require their removal from the job site.

15. SCHEDULE OF PRICES: The original and seven copies of the Schedule of Prices shall be submitted to the Officer in Charge of Construction for approval in accordance with the General Provisions.

16. CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT: Requests for payment in accordance with the terms of the contract shall consist of:

a. Contractor's Invoice on Form NAVFAC 10-7300/30 (4-68) which shall show in summary form the basis for arriving at the amount of the invoice, and

b. Contract Performance Statement on Form NAVFAC 10-7300/31, required by Clause 86(b) of the General Provisions is deleted.

c. Contractor's Monthly Estimate for Voucher (5ND GEN 5265/1).

d. Affidavit to Accompany Invoice (5ND LANTDIV Form 4-4235/4) (Rev. 1/68).

Forms will be furnished by the Officer in Charge of Construction. Monthly invoices and supporting forms for work performed through the 15th of the month shall be submitted to the Officer in Charge of Construction by the 20th of the month in the following quantities:

a. Contractor's Invoice - Original and five copies.

b. Contractor's Monthly Estimate for Vouncher - Original and two copies shall be required on all jobs where there is a Schedule of

Prices.

c. Affidavit - Original.

17. GOVERNMENT-FURNISHED WORK AND EQUIPMENT: The government will furnish water and electricity free of charge for pursuance of the work under this contract. The government will furnish the existing unused steel substation structure, four (4) existing oil circuit breakers, two (2) existing step type voltage regulators, existing metering equipment, and other items specifically noted on the contract drawings to be salvaged from existing construction for installation by the Contractor. The Contractor shall disassemble, load, transport, unload, assemble, install and connect and test all existing government-furnished, Contractor-installed equipment. The Contractor shall notify the OICC in writing at least 14 days in advance of the date the government-furnished equipment will be needed for installation.

18. WRITTEN GUARANTEES AND GUARANTOR'S LOCAL REPRESENTATIVE: Prior to completion of the contract, the Contractor shall obtain and furnish to the Contracting Officer's designated representative written guarantees for all equipment furnished under the contract. The Contractor shall furnish with each guarantee the name, address and telephone number of the guarantor's representative nearest to the location where the equipment is installed, who, upon request of the using service's representative, will honor the guarantee during the guaranty period and will provide the services prescribed by the terms of the guarantee. At the time of installation, the Contractor shall tag each item of warranted equipment with a durable, oil and water resistant tag approved by the Contracting Officer. Leave the date of acceptance and inspector's signature blank until the project is accepted for beneficial occupancy. The tag shall show the following information:

EQUIPMENT WARRANTY TAG

Type of Equipment _____
Accepted Date _____
Warranted Until _____
Under Contract No. N62470-_____
Inspector's Signature _____

STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

END

SECTION 02600

ASPHALTIC CONCRETE SURFACE AND PATCHWORK

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to elsewhere by basic designation only, form a part of this specification to the extent indicated by the references thereto (where a number is suffixed to the specification number, it denotes the effective amendment to the specification):

State Government Specifications and Standards.

North Carolina State Highway Commission, Raleigh, N. C. (NCSHC).

Standard Specifications for Road and Structures, July 1972.

2. GENERAL REQUIREMENTS: All "Section" references refer to NCSHC "Standard Specifications for Roads and Structures". In all references:

(1) the articles entitled "Method of Measurement", "Basis of Payment" and "Acceptance of Bituminous Materials" will not apply.

(2) all references to "Engineer" shall mean "Contracting Officer".

3. PRIME COAT: Work and materials shall be Grade MC-30 or RC-30 conforming to Section 600.

4. TACK COAT: Work and materials shall conform to Section 605.

5. ASPHALTIC CONCRETE SURFACE COURSE also specified as "Bituminous Concrete" shall be Type I-I, conforming to Section 645.

6. CRUSHED STONE: Work and materials shall conform to Section 520.

7. CONSTRUCTION EQUIPMENT:

7.1 Mixing Plant shall conform to the requirements of Section 610-5.

7.2 The Spreading and Finishing Equipment shall be the electronic-screed type and shall be capable of spreading the bituminous mixtures to a uniform density, striking a smooth surface true to cross section and producing a finish surface of the specified evenness. Electronic-screed type equipment will not be required on stone base course overlaying.

7.3 Compacting Equipment shall include a tandem roller.

8. CONSTRUCTION METHODS: Work shall conform to the Sections referenced hereinbefore and to the following:

8.1 Before commencing the operations on any portion of the work, the surface of the existing pavement and new base course shall be thoroughly cleaned of all foreign matter, including grass, by mechanical means, if feasible.

8.2 Patchwork: All asphalt surfacing and loose stone base course shall be removed. Stone base course materials removed shall be replaced with a new stone base course and asphaltic concrete mixture. The patchwork shall be accomplished in advance of placing the surface course, and the surface course placed continuously over the entire area.

8.3 Placing of the Asphaltic Concrete shall be as nearly continuous as possible. The rollers shall pass over the unprotected end of the mixture only when laying is discontinued for sufficient time to permit the mixture to cool, in which case a joint shall be made by cutting back the surface course to expose a granular surface for its full depth to bond with the fresh mixture. When laying is resumed, the exposed edge shall be coated with hot asphaltic cement and the fresh mixture raked against the joint, thoroughly tamped with hot tamps and rolled.

8.4 Finished Surfaces shall be uniform in texture and appearance and free from cracks and creases. The finished surface shall vary not more than 1/8-inch when the test for smoothness is performed with a 10-foot straightedge. The finished thickness shall be not less than the specified thickness minus 1/8-inch. Where the irregularities of the surface or the deficiency in depth is more than the specified tolerances, the defective work shall be removed and replaced with new material, as directed, without additional cost to the Government.

8.5 Bituminous Materials and/or Mixture shall not be produced or placed when weather is rainy or foggy, or when the air temperature is less than 40 degrees F. in the shade away from the artificial heat.

8.6 Protection of Pavement: After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened and, in no case, in less than eight hours.

E N D

SECTION 02711

FENCE, CHAIN LINK

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

1.1 Federal Specifications:

| | |
|---|---|
| FF-P-101E and Am-2 | Padlocks |
| RR-F-191 G/GEN | Fencing, Wire and Post, Metal and Gates, Chain Link Fence Fabric and Accessories |
| RR-F-191/1A and Am-1 | Fencing, Wire and Post, Metal (Chain Link Fence Fabric) |
| RR-F-191/2A and Am-1 | Fencing, Wire and Post, Metal (Chain Link Fence Gates) |
| RR-F-191/3A and Am-1 | Fencing, Wire and Post, Metal (Chain Link Fence Posts, Top Rails and Braces) |
| RR-F-191/4A | Fencing, Wire and Post, Metal (Chain Link Fence Accessories) |

1.2 Military Specification:

| | |
|---|---|
| MIL-B-52775A and Am-1 | Barbed Tape, Obstacle, General Purpose and Barbed Tape, Fence Topping |

1.3 American Society for Testing and Materials (ASTM) Publication:

| | |
|---|---|
| C94-74a | Ready-Mixed Concrete |

2. DELIVERY, STORAGE AND PROTECTION: Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper protection against oxidation caused by ground contact.

3. MATERIALS: Materials shall conform to referenced specifications and other requirements as specified herein.

3.1 Chain Link Fencing, Fabric, Gates, Posts, Top Rails, Braces and Accessories: Fed. Spec. RR-F-191/Gen and detailed specifications as referenced herein.

3.1.1 Chain Link Fencing Fabric: Fed. Spec. RR-F-191/1; Type 1, zinc-coated steel, 9 gage coated wire size. Mesh size shall be 5.1

centimeters (2-inch). Minimum weight of zinc for zinc-coated steel shall be 1.2 ounces per square foot of uncoated wire. Selvage shall be knuckled at top selvage and twisted and barbed at the other.

3.1.2 Chain Link Fencing Gates: Fed. Spec. RR-F-191/2; Type I, single swing; Type II, single sliding; Type III, double swing. Shape and size of the gate frame shall be as indicated. Framing and bracing members shall be round, of steel alloy. Steel member finish shall be zinc-coated. Gate fabric shall be as specified herein for chain link fencing fabric. Barbed wire top on gate shall be as specified herein. Coating on latches, stops, hinges, keepers and accessories shall be zinc-coated steel having a weight of zinc-coating not less than 1.2 ounces per square foot. Gate latches shall be plunger bar type. Gate leaves more than 8 feet wide shall have intermediate members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Attach gate fabric to the gate frame by method standard with the manufacturer, except that welding will not be permitted. Arrange latches for padlocking so that padlock will be accessible from both sides of the gate regardless of latching arrangement.

3.1.3 Chain Link Fencing, Posts, Top Rails, Bottom Rails and Braces: Fed. Spec. RR-F-191/3; posts Type I, Class I steel pipe; bottom and top rails Type II, Class I steel pipe; braces Type III, Class I steel pipe. Material shall be zinc-coated steel; weight of zinc coating shall be 1.6 ounces per square foot of base metal surface.

3.1.4 Chain Link Fencing Accessories: Fed. Spec. RR-F-191/4.

3.1.5 Barbed Tape: Mil. Spec. MIL-B-52775, stainless steel, Type II, double-coiled 30-inch/24-inch top assembly.

3.1.6 Concrete: ASTM C94, using 3/4-inch maximum size aggregate and having minimum compressive strength of 3,000 psi at 28 days. Proportion grout one part portland cement to three parts clean, well graded sand and the minimum amount of water to produce a workable mix.

3.1.7 Padlocks: Fed. Spec. FF-P-101, Type EPB, 1-3/4 inch size with chain.

4. INSTALLATION: Install the fence on previously prepared surfaces to line and grade as indicated. Install fence in accordance with the fence manufacturer's written installation instructions except as modified herein.

4.1 Excavation: Excavate for concrete embedded items to the dimensions indicated. Clear post holes of loose material. Dispose of waste material as directed.

4.2 Post Setting: Set posts plumb within a tolerance of 4 degrees. Provide concrete bases of dimensions indicated. Thoroughly compact concrete to be free of voids and finish in a dome. Straight runs between braced posts shall not exceed 500 feet. Cure concrete a minimum of 72 hours before any further work is done on the posts.

4.3 Post Caps: Post caps shall be of the design as required to accommodate the top rail. Install post caps as recommended by the manufacturer.

4.4 Top and Bottom Rails: Install top and bottom rails before installing chain link fabric. Pass the top rail through intermediate post caps. Provide expansion coupling spaced as indicated.

4.5 Fabric: Pull fabric taut and secure fabric to the top rail and bottom rail close to both sides of each post and at intervals of not more than 24 inches on centers. Secure fabric to posts using stretcher bars and ties or clips or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for the full length of each post. Install fabric on the opposite side of posts from the area being secured. Install fabric such that bottom of fabric is at two inches above ground level.

4.6 Barbed Wire: Install barbed wire on supporting arms above the fence posts. Pull each strand taut and securely fasten each strand to each supporting arm. The method of securing wires shall be positive and complete.

4.7 Gates: Install swing gates to swing through 90 degrees from closed to open.

4.8 Padlocks: Provide padlocks for gate openings and provide chains that are securely attached to the gate or gate posts. Provide padlocks keyed alike and provide two keys for each padlock.

5. GROUNDING of fencing is specified in Section

6. SECURITY: Construction of new security fencing and removal of existing security fencing and related work shall be provided and scheduled to provide continuous security for the using activity and shall be fully coordinated with the Contracting Officer and the cognizant Security Officer.

END

SECTION 02822

ESTABLISHING VEGETATION

1. GENERAL REQUIREMENTS: The work includes seedbed preparation, liming, fertilizing and seeding of all areas where natural soil conditions have been disturbed by this contract and in areas designated on the contract drawings.

2. MATERIALS:

a. Fill shall be obtained from a base provided borrow pit located within five miles of the construction site. Fill shall be free from roots, wood, or other scrap material, and other vegetable matter and refuse. Fill shall be friable sandy loam with pH 6.0 to 7.0, soluble salts less than 550 ppm, high organic matter content, which is capable of producing satisfactory agricultural crops.

b. Lime shall be ground dolomitic agricultural limestone containing 10 percent magnesium oxide.

c. Fertilizer shall be standard commercial product of 10-10-10 analysis.

d. Seed shall be 65 percent Ky-31 fescue, 15 percent annual rye grass, and 20 percent Bermude (unhulled), and shall be certified seed or equivalent based on North Carolina Seed Improvement Association requirements for certification.

3. SEEDBED PREPARATION: The areas to be vegetated shall be prepared by removing all existing gravel, concrete pads and foundations, unused structures, fencing where noted, and by thoroughly loosening the soil to a depth of 4 inches. After loosening the soil, all surface irregularities where surface water could collect and pond shall be smoothed out. Topsoil removed shall be reinstalled and leveled.

4. LIMING: Limestone shall be uniformly applied at the rate of 40 pounds per 1,000 square feet to all areas to be vegetated. Limestone shall be applied after seedbed preparation; but before seeding, lime shall be incorporated into the entire depth of prepared seedbed thoroughly.

5. FERTILIZING: Fertilizer shall be uniformly applied at the rate of 25 pounds per 1,000 square feet. The fertilizer shall be incorporated into the upper three or four inches of prepared seedbed.

6. SEEDING: Seed shall be sown by hand or an approved seeder and distributed uniformly at the rate of three pounds per 1,000 square feet. The seed shall be planted no deeper than 1/4-inch. After seeding, the seeded areas shall be compacted lightly with a hand roller. All seeding and compacting shall be done when weather conditions are favorable and not when seedbed is wet.

SECTION 03300

CAST-IN-PLACE CONCRETE

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

1.1 American Concrete Institute (ACI):

| | |
|---|---|
| ACI 211.1-74 | Recommended Practice for Selecting Proportions for Normal Weight Concrete. |
| ACI 308-1 | Curing Concrete. |
| ACI 315-65 | Manual of Standard Practice for Detailing Reinforced Concrete Structures. |
| ACI 318-71 & 71C Supp. | Building Code Requirements for Reinforced Concrete. |
| ACI 347-68 | Recommended Practice for Concrete Formwork. |

2. QUALITY CONTROL provisions of Division 1, General Requirements, apply to this section.

3. SUBMITTALS: Certificates: The testing requirements for materials incorporated in reference documents will be waived provided the Contractor submits notarized certificates from the manufacturer stating that the products furnished for this project conform to all requirements of this specification and the reference documents.

4. MATERIALS shall conform to the requirements and reference documents listed.

4.1 Concrete: Use ready-mixed concrete meeting design requirements of ACI 211.

4.2 Reinforcement: Use reinforcing as recommended by ACI 315.

4.3 Formwork: All formwork shall conform to ACI 347.

4.4 Curing Concrete: Cure concrete in accordance with ACI 308.

5. WORKMANSHIP: All work shall meet requirements of ACI 318. The surface immediately under concrete installed on grade shall be wetted as directed immediately before the concrete is placed. Reinforcing shall be placed prior to beginning concrete pour. Where concrete abuts, adjoins, or overlays existing concrete, approved expansion joints, bonding agents, or surface preparations shall be used.

SECTION 16302

OVERHEAD ELECTRICAL WORK

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

1.1 American Society for Testing and Materials (ASTM) Publications:

| | |
|---|---|
| A120-76 | Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless, for Ordinary uses. |
| A153-73 | Zinc-coating (Hot-Dip) on Iron and Steel Hardware. |
| A475-72 (Rev. A) | Zinc-coated Steel Wire Strand. |
| B1-70(R1976) | Hard-Drawn Copper Wire. |
| B2-70(R1976) | Medium Hard-Drawn Copper Wire. |
| B8-72 | Concentric Lay Stranded Copper Conductors, Hard, Medium Hard, or Soft. |
| B232-74 | Aluminum Conductors, Concentric Lay, Stranded, Coated Steel Reinforced (ACSR). |

1.2 American National Standards Institute (ANSI) Publications:

| | |
|---|---|
| B16.11-1973 | Forged Steel Fittings, Socket-Welded and Threaded. |
| C2-1977 | National Electrical Safety Code. |
| C29.2-1977 | Wet Process Porcelain Insulators and Toughened Glass Insulators (Suspension Type). |
| C29.3-1967 (R1974) | Wet Process Porcelain Insulators (Spool Type). |
| C29.4-1977 | Wet Process Porcelain Insulators (Strain Type). |
| C29.5-1977 | Wet Process Porcelain Insulators (Low and Medium Voltage Pin Type). |
| C29.7-1977 | Wet Process Porcelain Insulators (High Voltage Line-Post Type). |

| | |
|---|---|
| C37.32-1972 | Schedules of Preferred Ratings, Manufacturing Specifications and Application Guide for High Voltage Air Switches, Bus Supports and Switch Accessories. |
| C37.42-1969 (1974) | Distribution Enclosed, Open and Open Link Cutouts. |
| O 5.1-1972 | Specifications and Dimensions for Wood Poles. |

1.3 American Wood Preserver's Association (AWPA) Publications:

| | |
|---|---|
| C.4-77 | Standard for the Preservative Treatment of Poles by the Pressure Process. |
| C.25-76 | Standard for the Preservative Treatment of Crossarms by the Pressure Process. |

1.4 Institute of Electrical and Electronic Engineers (IEEE) Publication:

| | |
|---|---|
| 48-1975 | High Voltage Alternating Current Cable Terminations. |

1.5 National Electrical Manufacturer's Association (NEMA) Publications:

| | |
|---|---|
| LA1-1976 | Surge Arresters. |
| WC 7-1971 | Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable for the Tramission and Distribution of Electric Energy. |
| WC 8-1976 | Ethylene-Propylene-Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. |

1.6 National Fire Protection Association (NFPA) Publication:

| | |
|---|---|
| 70-1978 | National Electrical Code. |

1.7 Rural Electrification Administration (REA) Publications:

| | |
|---|---|
| DT-5B/PE-16 (Jan. 1972 (R1976) | Wood Crossarms (Solid and Laminated), Transmission Timbers and Pole Keys. |

1.8 Underwriter's Laboratories (UL) Publications:

| | |
|---|---|
| 6-1976 | Rigid Metallic Conduit. |
| 44-1976 | Rubber Insulated Wires and Cables. |
| 83-1975 (R1976) | Thermoplastic Insulated Wires. |

2. GENERAL REQUIREMENTS: Section 16011, General Requirements, Electrical, with the following additions and modifications:

2.1 Submittals: The following information shall be submitted for approval.

2.1.1 Catalog Information:

Conductor (list each size and type)
Insulator (list each size and type)

2.1.2 Certification of Competency:

Cable splicer - terminator

2.1.3 Manufacturer's Certification:

Aluminum/copper splices, connectors, lugs and fittings.

2.1.4 Manufacturer's Directions:

Aluminum/copper connection make-up directions
Cable terminations
Manufacturer's directions for use of ground megger with proposed method indicated

3. MATERIALS AND EQUIPMENT: Materials specified herein or shown on the contract drawings which are identical to materials listed in REA Bulletin 43-5 shall be considered as conforming to all requirements.

3.1 Poles: Provide wood poles machine trimmed by turning, Southern Yellow Pine conforming to ANSI 05.1. Poles must be gained, bored and roofed before treatment. Poles shall be full length pressure treated with Chromated Copper Arsenate (CCA) conforming to AWPA C4. Poles shall be branded by the manufacturer with his mark and date to treatment, height and class of pole, wood species, preservation code and retention. Place the brand so that the bottom of the brand or disc is 10 feet from the pole butt for poles up to 50 feet long.

3.2 Crossarms: Provide wood crossarms conforming to REA DT-5B. Crossarms shall be pressure treated with Chromated Copper Arsenate (CCA). Treatment shall conform to AWPA C25.

3.2.1 Provide crossarm braces of steel angle for 28 inch span with 8 foot crossarms.

3.3 Hardware: Pole line hardware shall be hot dip galvanized conforming to ASTM A153.

3.4 Insulators: Provide wet-process porcelain insulators which are radio interference freed.

Line post type insulators shall be Class 57-1 per ANSI C29.7

Suspension insulators shall be Class 2/52-2 per ANSI C29.2.

Spool insulators shall be Class 57-1 per ANSI C29.3.

Guy Strain Insulators shall be Class 54-2 per ANSI C29.4.

Pin insulators shall be Class 55-3 per ANSI C29.5 and shall be radio interference freed.

3.5 Conductor: Provide overhead conductors of bare copper and clad aluminum conductor steel reinforced (ACSR) of the sizes and types indicated.

3.5.1 Aluminum conductors, steel reinforced shall conform to ASTM B232.

3.6 Guy Strand: Provide High-strength 7-strand steel cable with Class A or B galvanizing per ASTM A475. Guy strand type, and size shall be as indicated.

3.6.1 Provide three bolt clamp guy terminations designed for use with the particular strand and developing at least the ultimate breaking strength of the strand.

3.6.2 Provide thimble eye guy attachment using a lift plate on the down side.

3.7 Anchors and Anchor Rods: Provide secrw anchors presenting the holding area indicated on the drawings as a minimum. Anchor rods shall be twin thimble-eye, 3/4 inch diameter by 8 feet long unless otherwise indicated and must be hot dip galvanized.

3.8 Ground Rods: Provide copper-encased steel ground rods at least 3/4 inch in diameter and 10 feet long unless otherwise indicated. Die-stamp each near the top with the name or trademark of the manufacturer and the length of the rod in feet. The rods shall have a hard, clean, smooth, continuous, surface throughout the length of the rod.

3.9 Ground Wire: Provide copper wire ground conductors no smaller than No. 6 AWG. Ground wire protectors may be either PVC or half round wood molding.

3.10 Surge Arresters: Provide valve type surge arrestors when indicated conforming to NEMA LA1 arranged for crossarm mounting. Rating shall be 9kV.

4. INSTALLATION: Provide overhead pole line installation conforming to the requirements of ANSI C2 (NESC) for grade B construction of overhead lines in medium loading districts. Regard NESC statements using the term "should" as mandatory unless an exception therefrom in writing is granted by the Contracting Officer.

4.1 Pole Setting: Pole holes shall be at least as large at the top as at the bottom and shall be large enough to provide 4 inches clearance between the pole and the side of the hole.

4.1.1 Pole setting depths shall be as follows:

| Length of Pole (feet) | Setting in Soil (feet) |
|---|---|
| 40 | 6.0 |
| 45 | 6.5 |
| 50 | 7.0 |

4.1.2 "Setting in Soil" depths shall apply where pole holes are in soil, sand or gravel or any combination of these, At corners, dead ends and other points of extra strain, poles 40 feet or more long shall be set 6 inches deeper.

4.1.3 Pole backfill shall be thoroughly tamped for the full depth of the hole and the excess fill shall be mounded around the pole.

4.1.4 Set poles so that alternate crossarm gains face in the opposite directions, except at terminals and dead ends where the gains of the last two poles shall be on the side facing the terminal or dead end. On unusually long spans, set the poles so that the crossarm comes on the side of the pole away from the long span. Where pole top pins are used, they shall be on the opposite side of the pole from the gain, with the flat side against the pole.

4.1.5 Poles shall be set in alignment and plumb except at corners, terminals, angles, junctions, or other points of strain, where they shall be set and raked against the strain, not less than 2 inches for each ten feet of pole length above grade, nor more than 4 inches for each ten feet of pole length after conductors are installed at the required tension.

4.2 Anchors and Guys: Place anchors in line with the strain and as nearly as possible a distance from the pole equal to the vertical distance from the pole ground line to the point of guy attachment on the pole.

4.2.1 Set anchors in place with the anchor rod aligned with, and pointing directly at, the guy attachment on the pole with the anchor rod projecting 6 to 9 inches out of the ground to prevent burial of the rod eye.

4.2.2 Install screw anchors by torquing with boring machine. Anchor rod tie shall extend 6 to 9 inches above grade.

4.2.3 Complete the anchor and guy installation and tighten the guy before wire stringing and sagging is begun on that line section. Effectively ground and bond guys to the system neutral.

4.3 Hardware: Hardware shall be installed with washer against the wood and with nuts and lock nuts applied wrench tight.

4.4 Grounding: Provide grounding for pole lines conforming to ANSI C2 except that each separate ground electrode shall have a resistance to the solid earth not exceeding 25 ohms. When work in addition to that indicated, or specified, is directed in order to obtain the specified ground resistance the provisions of the contract covering "changes" shall apply.

4.4.1 Ground rod connections on pole lines shall be made by exothermic weld for all gound wire or wire to rod connections.

4.4.2 Exothermic welds shall be made strictly in accordance with the manufacturer's written recommendations. Welds which have puffed up or which shown convex surfaces, indicating improper cleaning are not acceptable. No mechanical connectors are required at exothermic weldments.

4.4.3 Noncurrent carrying metal parts of equipment or enclosures shall be grounded.

4.4.4 Separate surge arrester grounds from other grounds.

4.4.5 The primary neutrals shall be connected to ground.

4.4.6 Protect grounding conductors which are run on the surface of wood poles by wood molding or plastic molding of equal mechanical strength within 8 feet of finished grade.

4.5 Conductors: Conductors shall be handled with all care necessary to prevent nicking, kinking, gouging, flattening or otherwise deforming or weakening the conductor or impairing its conductivity. Any damaged section of conductor shall be removed and the conductor spliced.

4.5.1 Conductor splices, as installed, shall exceed the ultimate rated strength of the conductor and shall be of the type recommended by the conductor manufacturer. No splice shall be permitted within 10 feet of any support.

4.5.2 Ties on pin insulators shall be tight against the conductor and insulator and ends shall be turned down flat against the conductor so that no wire ends project.

4.5.3 Existing conductors to be reinstalled or resagged shall be strung in "FINAL" sag table values for the particular conductor type and size involved.

4.5.4 String new conductors to "INITIAL" sag table values recommended by the manufacturer for the conductor type and size of conductor and ruling span indicated.

4.5.5 Protect ACSR conductors by armor rod at pin insulators by flat aluminum wire at attachments made of galvanized or coated iron or steel.

4.5.6 Dead end fittings, clamp type, shall conform to the written recommendations of the conductor manufacturer and shall develop the full ultimate strength of the conductor.

4.5.7 Make aluminum connections to any other material using only splices, connectors, lugs or fittings designed for that specific purpose. Submit the manufacturer's directions for applying these fittings for reference and one additional copy maintained at the job site for the use of the inspector.

4.6 Risers: Secure conduits on poles by two hole galvanized steel pipe straps spaced no more than 10 feet apart and within 3 feet of any outlet or termination. Ground metallic conduits.

5. FIELD TESTS: As an exception to requirements that mah be stated elsewhere in the contract, the Contracting Officer shall be given five working days notice prior to all grounding system tests.

5.1 Ground Rod Tests: Do not connect the ground rods until they have been tested for ground resistance value. A portable ground testing megger shall be used to test each ground or group of grounds. Follow the directions provided by the equipment manufacturer for proper use of the equipment. Provide one copy of the directions for the use of the observing inspectors.

5.2 Devices Subject to Manual Operation: Each device subject to manual operation shall be operated at least 3 times, demonstrating satisfactory operation each time.

E N D

SECTION 16335

SUBSTATIONS AND SWITCHGEAR, EXTERIOR

1. APPLICABLE PUBLICATIONS: The following publications of the issues listed below, but referred to thereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

1.1 Federal Specifications (Fed. Spec.):

| | |
|---|---|
| L-P-387A(1) Int Am 2 | Plastic Sheet, Laminated, Thermosetting (For Designation Plates). |
| W-C-375B | Circuit Breaker, Molded Case, Branch Circuit and Service. |

1.2 Military Specifications (Mil. Spec.):

| | |
|---|---|
| MIL-M-14G | Molding Plastics and Molded Plastic Parts, Thermosetting. |
| MIL-C-18480A & Am 3 | Coating Compound Bituminous Solvent, Coal Tar Base. |

1.3 American National Standards Institute (ANSI) Publications:

| | |
|---|---|
| C2-1977 | National Electrical Safety Code. |
| C12-1975 | Electricity Metering, Code for |
| C37.90-1974 | Relays and Relay Systems Associated with Electric Power Apparatus, including Supplement C37.90a. |
| C39.1-72 | Electrical Analog Indicating Instruments, Requirements for |
| C57.13-1968 | Requirements for Instrument Transformers. |
| C119.2-1974 | Separable Insulated Connectors for Power Distribution Systems Above 600 Volts. |

1.4 American Society for Testing and Materials (ASTM) Publications:

| | |
|---|---|
| D117-76 | Electrical Insulating Oils, Method of Testing. |
| D877-76 | Dielectric Breakdown Voltage of Insulating Liquids using Dick Electrodes. |
| D3146-76. | Oxidation-Inhibited Mineral Insulating Oil for Use in Transformers and Oil Circuit Breaker. |

1.5 National Electrical Manufacturers Association (NEMA) Publications:

SG 2-76 High Voltage Fuses.

1.6 National Fire Protection Association (NFPA) Publication:

NFPA 70-1978 National Electrical Code.

1.7 Underwriters Laboratories, Inc. (UL) Publication:

467-1972 (Rev. NOV 1976) Grounding and Bonding Equipment, Electrical.

2. FACTORY TESTS:

2.1 Switchgear Tests: ANSI C37.20. Certified copies of design tests, production tests, and conformance tests of the switchgear shall be submitted and approval shall be received before delivery of equipment to the project site. In particular, for Oil circuit breakers, after completion of interrupting test at full rating, there shall be no evidence of any damage to any part except for minor burning of the arcing contact tips. The breaker shall be satisfactory for immediate return to service at full rating without repairs or maintenance of any kind. One breaker of each rating shall be given impulse, momentary and interrupting tests at its full rating, witnessed by the representative of the Contracting Officer. In leiu of the above tests, a report of these tests previously performed on identical units of each rating will be acceptable.

3. SUBMITTALS:

3.1 Materials and Equipment Schedules: As soon as practicable after notice to proceed and before commencement of installation of materials or equipment, a complete list of materials and equipment to be incorporated in the work shall be submitted. List shall include catalog numbers, cuts, diagrams, and such other descriptive data as may be required. No consideration will be given to partial lists submitted from time to time. Approval of materials will be based on manufacturer's published ratings. Materials and equipment listed that are not in accordance with the specification requirements will be rejected.

3.2 Shop Drawings: Shop drawings and catalog cuts for the following items shall be submitted and approval received before delivery of equipment to the project site.

Panelboards
Lighting Fixtures
High Voltage Cable
Load Break Oil Switches
Oil Circuit Breakers
Oil Circuit Reclosers
High Voltage Connectors

Shop drawings for switchgear shall indicate, but shall not be limited to, the following:

a. Overall dimensions, front view and sectional views.

b. Maximum short circuit bracing.

c. Circuit breaker type, interrupting rating, trip setting.

d. Ratings and sizes of lugs.

e. Elementary diagrams and wiring diagrams having their terminals identified, and indicating the internal wiring for each item of equipment and the interconnection between the items.

In addition, the Contractor shall submit the manufacturer's published time-current curves on full size logarithmic paper of each oil circuit breaker and recloser to allow designer to verify that proper protection and coordination has been achieved.

3.3 Spare Parts Data: As soon as practicable after approval of materials and equipment the Contractor shall furnish spare parts data for each different item of equipment listed. The data shall include a complete list of parts and supplies, with current unit prices and source of supply! The foregoing shall not relieve the Contractor of any responsibilities under the guaranty.

3.4 Certificates of Conformance or Compliance: Before delivery of materials, certificates, in triplicate shall be submitted for the following:

High Voltage Cable Tests.

3.5 Operating and Maintenance Instructions: Instructions for operating and maintenance shall be furnished for the following equipment:

Oil Circuit Breakers
Oil Circuit Reclosers
Load Break Oil Switches

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4. GENERAL REQUIREMENTS: General requirements include those specified in Section 16011, General Requirements, Electrical and as specified herein. The work includes the modification of existing substations. Materials, not normally furnished by the manufacturer with the equipment shall be provided in Section 16300, ELECTRICAL DISTRIBUTION, EXTERIOR. These materials include tapes, terminators, conduit and incoming and outgoing cable.

4.1 Insulating Liquids:

4.1.1 Mineral Oil: ASTM D3146 tested in accordance with ASTM D117.

4.1.2 High Fire Point Transformer Liquids: NEC for non propagating liquids having a fire point not less than 300 degrees C tested per ASTM D-92 and a dielectric strength not less than 33 kv tested per ASTM D-877. Askarel and insulating liquids containing polychlorinated biphenyls (PCB's) shall not be provided.

4.2 Nameplates: Laminated plastic nameplates shall be provided for each relay, switch and device to identify its function, and where applicable, its position. Laminated plastic shall be 1/8 inch thick Melamine plastic conforming to Fed. Spec. L-P-387 black with white center core. Surface shall be a matte finish. All corners shall be square. The lettering shall be accurately aligned and engraved into the white core. Size of nameplates shall be one inch by 2-1/2 inches minimum. Lettering shall be minimum 1/4 inch high normal block lettering. Number, location, and letter designation of nameplates shall be as indicated.

5. MATERIALS, EQUIPMENT AND ASSEMBLIES:

5.1 Vacuum Circuit Breakers:

5.1.1 Vacuum circuit breakers shall be rated 15.5 kv, 1,200 amperes and 20,000 amperes interrupting capacity. Breakers shall be designed, built and tested in accordance with the latest applicable NEMA, IEEE and UL standards. Exterior paint finish shall be USA No. 24, light blue.

5.1.2 The voltage, continuous current, 3-second close, carry and interrupt, impulse, hipot and interrupr ratings shall be in accordance with the latest standards of NEMA, IEEE and UL.

5.1.3 The interrupter construction shall consist of a pair of butt contacts, a vapor-condensing sheild, and a bellows through which one of the contacts is moved through a one-half inch stroke, all sealed in a vacuum-tight insulating glass enclosure. There shall be only one high-voltage compartment containing three vacuum interrupters mounted horizontally between the entrance bushings and supported by them. Air-filled porcelains shall serve as entrance bushings. Epoxy galss rods shall connect the interrupter's moving contact to the linkage. Air, at atomospheric pressure shall provide the primary insulation. Space must be available on all bushings for two current transformers per bushings of relay type or metering type.

5.1.4 All three poles of each recloser shall be operated simultandously by a motor-closing, spring-tripping mechanism in its own weatherproof house. The unit shall be mechanically and electrically trip-free and anti-pump. The mechanism shall be a four-bar linkage

type with a direct motor drive. A universal 230 V AC/250 DC motor shall act through a closing cam to move the mechanism linkage. The linkage on closing, shall be moved overcenter and maintained in that position by an overcenter stop. After completion of the closing cycle, a positioning cam directly connected to the closing cam shall stop and position the operator. The operator shall be capable of tripping operation immediately after a closing operation. Maximum clearing time from fault initiation shall be under two cycles. A dashpot shall be provided to absorb the excess kinetic energy in the motor after closing operation. This dashpot shall be cam operated. A trip latch shall cause collapse of the linkage and thus the opening of the breaker. The mechanism shall be housed in a metal weatherproof cabinet with a door that can be padlocked, and shall contain a window through which the contact position can be observed. The cabinet shall contain fuse protection for the power for the operator motor and for the heaters and tripping circuits. Heaters shall be provided in both the mechanism and relay houses. They shall be 160 watts 230 volts AC. Provisions shall be in the operating cabinet for closing and tripping the breaker manually by electrical means. Tripping shall be permitted mechanically. Mechanical closing shall be limited to maintenance operation only on a de-energized unit. All operator parts shall be permanently lubricated. Tripping voltage shall be 230 volts AC current trip.

5.1.5 Three NEMA Standard multiratio bushing current transformers with relaying accuracy shall be provided. All current transformer tap leads shall be brought to the mechanism and terminated on blocks. Also all connections between current transformers and connection points shall be bolted or crimped. No split or disconnecting lugs shall be used.

5.1.6 Provide a relay cabinet with three phase overcurrent relays with instaneous units, one ground overcurrent relay, three indicating ammeters, control fuses, circuit breaker, manual trip switch and all required appurtenances.

5.1.7 The breaker shall be mounted on a painted steel frame suitable for substation mounting and capable of providing adequate horizontal and vertical support. The breaker shall be shipped completely assembled and all parts mounted.

5.1.8 The breaker shall be installed where shown on the contract drawings and secured to the concrete pad as indicated.

5.2 Oil Circuit Breakers:

5.2.1 Oil circuit breakers shall be rated 15.5 kv, 600 amperes and 8,900 amperes interrupting capacity. Breakers shall be designed. built and tested in accordance with the latest applicable NEMA, IEEE and UL Standards. Exterior paint finish shall be USA No. 24, light blue.

5.2.2 The voltage, continuous current, 3-second close, carry and interrupt, impulse, hipot and interrupt ratings shall be in accordance with the latest standards of NEMA, IEEE and UL.

5.2.3 The breaker shall be mechanically and electrically trip free and non-pumping under all operating conditions. Separate fuse pull-out blocks and fuses shall be provided to de-energize the control, motor and heater circuits. All terminal blocks shall be in accordance with industry standards as given above. Heaters shall be provided in the mechanism house and in the relay house and shall be 160 watts, 230V AC. There shall be no resistors in trip circuits.

5.2.4 All breakers shall be equipped with a universal 230 V AC/250 DC motor. This motor will operate a torsion spring supported only at both ends which in turn drives a cam drive transmission. This mechanism and spring shall be so interlocked that closing the breaker cannot be achieved either manually or electrically unless the spring is fully wound. Means for easily charging the torsion spring shall be provided so that full power manual closing can be accomplished and easy discharge of the spring for maintenance is essential. A latch checking switch and a breaker position indicator shall be provided. It shall be possible to slow close the breaker in minute steps for easy and accurate checking of contact adjustment. The wiring shall be neatly arranged in a harnessed switchboard type manner. The tripping shall be from 230 V AC current trip.

5.2.5 The bushings required by this specification shall be of the paper and oil-filled type and finished USA No. 70 light grey.

5.2.6 Two cross blast interrupters per phase shall be supplied to insure fast, low carbon extinction of the arc. Butt wipe contact fingers backed up by heavy springs should act to clean the moving contack surface and provide a quick contact gap. Fault and load current shall be carried thru bearings or pivot pins. No interrupter barriers shall be required.

5.2.7 Three NEMA Standard multiratio bushing current transformer with relaying accuracy shall be provided. All current transformer tap leads shall be brought to the mechanism and terminated on blocks. Also all connections between current transformers and connection points shall be bolted or crimped. No split or disconnecting lugs shall be used.

5.2.8 Provide a relay cabinet with three phase overcurrent relays with instantaneous units, one ground overcurrent relay, one reclosing relay, three indicating ammeters, control fuses, circuit breaker, manual trip switch, reclosing cut-off switch and all required appurtenances.

5.2.9 The breaker shall be mounted on a painted steel frame suitable for substation mounting and capable of providing adequate horizontal and vertical support. The breaker shall be shipped completely assembled and all parts mounted.

5.2.10 The breaker shall be installed where shown on the contract drawings and secured to the concrete pad as indicated.

5.3 Load interrupting oil switches shall be rated 15 kV, 110 kV BIL, 600 amperes continuous and load interrupting, 40,000 amperes RMS asymmetrical momentary and close and hold, and capable in final installation condition of withstanding 70 kV DC for 15 minutes. After withstanding or closing in on a maximum rated fault current, the load interrupting oil switch must still be operable in the normal manner and capable of carrying its rated current without exceeding temperature rise limitations.

5.3.1 Each switching way of the load interrupting oil switch shall be equipped with an internally mounted operating mechanism capable of providing quick make, quick break operation for each switching operation in either switching direction; i.e., clockwise or counter-clockwise. This mechanism must be capable of delivering sufficient torque to assure that the load interrupting and latch ratings can be met regardless of the location of the switch link within the switch tank or the movement of the switch link relative to the other switch components during a switching operation. The mechanism shall use compression type springs.

5.3.2 The operating mechanism is to be actuated from outside of the switch by means of a removable break away handle which can be located to give the greatest mechanical advantage for a particular switching sequence. The mechanism handle is to move in the same direction (clockwise or counter-clockwise) as the resultant switch motion. External components of the mechanism shall automatically limit the possible number of different switch link positions to those required by the particular switch configuration without any field adjustment or rearrangement.

5.3.3 The external components shall have provisions for padlock and/or key locking and for additional ground position padlock where applicable.

5.3.4 The switch contacts shall be copper alloy with plating, to assure permanent low contact resistance. Contacts shall be designed to substantially limit arcing encountered during interruption to leading edges, and to minimize the effect on main contact surfaces. Contact pressure shall increase with increased currents. Stationary contacts shall be completely supported independent of entrance bushings. Contact temperature rise shall not exceed the switch limitations. The switch contacts are to be visible in the open position through viewing windows provided in the switch tank.

5.3.5 All switch links and cable terminations shall be contained in a single oil-filled, 1/4" thick, mild steel tank with entrances internally connected by tinplated copper wire ropes. Switch tank must be capable of accepting the cable terminating devices listed below without field modification and without requiring the re-establishment of critical contact alignment after the cable has been properly terminated within the device. The tank shall be completely cleaned and degreased, phosphatized and painted inside and out by dipping in a heated oil-resistant paint sky blue in color. The tanks shall be provided with an oil gauge showing the level of the oil and with viewing windows permitting the visual inspection of the switch links of all ways in the "OFF" position. An oil filling plug, air test plug and drain valve shall be included. All openings shall be provided with suitably gasketed covers with closely spaced bolts or studs.

5.3.6 The design of the switches shall conform to sound engineering practice and any applicable standards of the IEEE. Switches shall be Type RAL, Series RA-40, as manufactured by G & W Electric Specialty Company, or approved equal.

5.3.7 Top cable entrance shall be single conductor divergent porcelain entrances, top-mounted on the switch cover. Entrance bushings shall be porcelain, outdoor type, rated 1,200 amperes continuous, 15 kV, 95 kV BIL. Bushings shall include suitable stud connectors to accomodate aerial cable, as shown on the drawings.

5.3.8 Side cable entrances shall be universal apparatus bushing, side mounted on the switch tank, arranged for use with the universal splice, rated 15 kV, 95 kV BIL. Cable entrances for the outgoing ways will be located on the side of the switch tank, and shall be single conductor type, which will provide for the relief of any high voltages stresses without building up an external stress cone.

5.4 Basic Materials and Methods for Station Power and Control:

5.4.1 In general, all low voltage (120/240 volt) station power and control wiring shall consist of individually insulated copper conductors installed in metallic raceways. There the work "conduit" is used on the plans, or in these specifications, it shall mean rigid galvanized steel conduit.

5.4.1.1 Conduit shall be installed in accordance with Art. 346 of the NEC except the maximum spacing of supports and/or anchorage shall be 8 feet for conduits 1/2" through one inch and 10 feet for conduits 1-1/4 inches and larger. Where concentric or eccentric knockouts are encountered a grouding bushing shall be installed with a copper bonding jumper securely attached to the bushing and solid metal of the box or cabinet. "Grounding Wedges" or "Washers" are not acceptable. Conduit ends shall be cut square with the longitudinal axis of the conduit, reamed and filed smooth, and threaded long enough to jam together in a conduit coupling, or come up hard and tight

against the bushed shoulder of a cast conduit fitting. Field threads shall be of same type and have same effective lengths as factory cut threads. Raceway joints shall be made with approved couplings or unions. Bends and offsets shall be made with a hickey or power bender without kinking the raceway. Deformed raceway shall be replaced Where conduits are exposed to the weather, buried in concrete, or installed below grade, the threads shall be treated with anit-seize thread lubricant/sealer before screwing up into final position.

5.4.1.2 Rigid metal conduit installed underground shall have two heavy coats of asphaltum and all wrench marks, etc., shall be touched up after being made up. All underground conduits shall be run a minumum of 24 inches below finished grade.

5.4.1.3 Where indicated on the drawings, raceways shall be run exposed. Exposed raceways shall be run parallel to, or at a right angle with the structure. Outlets, junctions, taps, ect., on exposed rigid metal conduit shall be cast metal conduit fittings or cast metal boxes of the type and size appropriate for the location. Sheet steel outlet boxes shall not be permitted.

5.4.1.4 Raceways shall be sized as indicated on the drawings and/or required by the National Electrical Code, 1/2 inch shall be the minimum size.

5.4.1.5 During installation, conduit ends shall be capped or plugged to prevent the entrance of foreign matter. All raceways shall be clean and free from any foreign matter inside before any conductors are pulled in. A run of conduit which has been clogged shall be entirely freed or shall be replaced.

5.4.1.6 All raceway systems shall be installed complete before any conductors are pulled in.

5.4.1.7 Liquid tight flexible metal conduit shall be installed in accordance with Art. 351 of the National Electrical Code. In lieu of bonding as described in para. 351-4, an insulated green copper grounding conductor sized in accordance with Table 250-95 of the National Electrical Code shall be installed within the flexible conduit and securely attached and grounded to the electrical raceway system at each end of the flexible section.

5.4.1.8 Grounding type convenience outlets shall be solidly grounded to equipment grounding system with a green colored insulated conductor. Electrical connections shall be continuous from equipment ground bus in panelboard to the hex-nut on convenience outlet.

5.4.1.9 All raceways entering or leaving the main distribution panelboard shall be provided with grounding and bonding bushings and each separate piece of raceway shall be individually bonded to the equipment ground bus by means of copper conductor sized in accordance with Table 250-95 of the National Electrical Code.

5.4.1.10 Circuiting is shown schematically. Exact routing of branch circuits may be varied to suit construction; however, combination of circuits within raceways and panelboard connections shall not be changed from those shown on the drawings.

5.4.1.11 Raceways and Box Supports: Raceways and boxes shall be attached to the structure as follows with attachment spacing as indicated in subparagraph above. Raceways shall be fastened to structural steel with beam clamps, conduit hangers, or other devices approved for such usage. Perforated iron shall not be used to support raceway.

5.4.1.12 All raceways, panelboards, transformers, fixtures, switches, receptacles, etc., shall be firmly and solidly secured to structural members of the structure with suitable hangers, clamps, bolts and supports designed for service required.

5.4.2 Raceways and Fittings:

5.4.2.1 Rigid conduit shall be galvanized and shall bear the Underwriters' Laboratories, Inc. label of approval.

a. Rigid steel conduit, couplings and elbows shall be iron pipe size, threaded and shall be Pittsburgh Standard, Republic or Triangle of sizes indicated or required. All steel conduit shall be hot dipped galvanized, UL approved and meet the latest NEMA Standards.

b. Conduit fittings shall be corrosion resistant steel, threaded type as manufactured by Appleton, Crouse-Hinds or Killark.

5.4.2.2 Liquidtight flexible metal contuit shall bear the Underwriters' Laboratories, Inc. label of approval, and shall meet all applicable NEMA standard requirements. Liquidtight flexible steel conduit shall be "Sealtight" as manufactured by American Brass. Equals by American Flexible Conduit Co. and American Metal Moulding Co. will be acceptable. Fittings shall be Series 6000 "Super-tite" as manufactured by T & B or equal by Crouse-Hinds or O. Z. Gedney.

5.4.2.3 Junction and outlet boxes shall be 4 inches square and 2-1/8 inches deep, unless otherwise indicated on the contract drawings. Where larger junction boxes are required they shall be fabricated from No. 10, 12, 14 or 1t gauge sheet steel as required by the Underwriters'

Laboratories, Inc. and galvanized after fabrication. All junction boxes shall have screw fastened covers. Junction and outlet boxes shall be cast malleable ferrous metal, or bronze with threaded connections, external mounting lugs, and gasketed covers. Ferrous metal boxes shall be galvanized. Cast boxes shall be by Crouse-Hinds, Appleton or Killark. All boxes shall be UL approved.

5.4.2.4 Insulated bushings shall be O. Z. Gedney Type B or equal by T & B or Crouse-Hinds.

5.4.2.5 Insulated bonding and grounding bushings shall be T & B Series 3882 or equal by O. Z. Gedney or Crouse-Hinds.

5.4.3 Conductors:

5.4.3.1 Conductors for branch circuits, feeder circuits, service entrance and grounding shall be color coded as follows:

120/240 volts

Phase A - Black
Phase B - Red
Neutral - White
Ground - Green

Conductos shall be color identified at each outlet box, switchbox, junction box, pull box, cabinet and distribution panel. Conductor sizes #2 and smaller shall be factory color coded. Conductors #1 AWG and larger shall be identified by applying a one inch band of the proper colored waterproof plastic marking tape to each conductor 2 inches from the end of the conductor. Conductors #1 AWG and larger exposed to the weather shall be painted with the identifiying color in lieu of using plastic marking tape. Low voltage and/or control wiring may be color coded also but the colors shall not be those allocated to the main wiring system.

5.4.3.2 Conductors shall be of copper with the type insulation indicated below. Wire sizes, insulation type and manufacturer's name shall be permanently marked on conductor jacket at regular intervals. All wire and cable shall be delivered to job in complete coils and be color coded as hereinbefore specified. Wire shall be as manufactured by Phelps Dodge, Anaconda or Triangle. In general, conductors installed in locations indicated and/or shown on the drawings shall be:

a. Type THW in raceways for service conductors.

b. Type THW in raceways for panelboard and power feeders and grounding conductors.

c. Type THWN and/or THHN in raceways for branch circuit conductors.

d. Type AVA in raceways exposed to extremely high ambient temperatures.

5.4.3.3 Minimum wire size for current carrying conductors, neutrals, equipment grounds and bonding jumpers shall be #12 AWG. Conductors No. 10 AWG and smaller shall be solid. Conductors No. 8 AWG and larger shall be stranded.

5.4.3.4 Conductors shall be spliced and tapped as follows:

a. Solid branch circuit conductors, namely those sized #10 and #12 AWG copper, shall be spliced in junction boxes and lighting fixtures using Ideal "Wing Nuts" or T&B "Piggy" connectors. All compression type connectors shall meet requirements of applicable NEMA Standards and shall be UL approved.

b. Conductors #8 AWG and larger shall be stranded and joined by solderless screw or screw clamping type connectors, or compression connectors (see para. below). Joints shall be smoothly covered and shaped with rubber gum tape with a final cover of vinyl plastic electrical tape. In lieu of rubber gum and vinyl plastic tape, factory fabricated, preformed insulating covers may be used. Screw or screw clamping connectors and preformed insulating covers shall be Underwriters' Laboratories, Inc. approved.

c. Conductors shall not be spliced or tapped in interior wiring systems of any description using "split bolt" connectors. All conductors in interior wiring systems shall be continuous without splice between junction, outlet, or switch boxes. No splicing will be permitted in panelboard cabinets, safety switches, etc.

5.4.3.5 Wire shall meet latest requirements of NEMA and IPCEA and shall be approved by the Underwriters' Laboratories, Inc.

5.4.3.6 Conductors in panelboards, junction boxes, etc. shall be grouped together and laced with T&B "Ty-Raps", or approved equal, in a neat, substantial and approved manner. Each conductor in junction boxes, etc., shall be permanently marked showing panelboard and circuit number in panelboard, room served, etc., with T&B or Brady wire markers.

5.4.3.7 Conductors shall not pass through cabinets, switch enclosures, etc., unless intended for specific use within the cabinet or enclosure. Junction boxes or auxiliary gutters shall be used in such cases.

5.4.3.8 Junction and/or pull boxes shall be furnished and installed where necessary to avoid excessive runs and/or too many bends between outlets. Not more than the equivalent of two (2) 90 degree bends will be allowed in any feeder circuit run or more than the equivalent of three (3) 90 degree bends will be allowed in the any branch circuit run without junction or pull boxes being installed.

5.4.3.9 Powdered soapstone or approved equal, shall be used to facilitate pulling conductors into conduits.

5.4.3.10 A pull wire shall be left in each run of empty conduit. Pull wire shall be 14 gauge steel or approved nylon cord.

5.4.4 Grounding Systems: The neutral of the secondary electrical distribution system shall be grounded at one point only which shall be at the main disconnecting device. From the main disconnecting device a copper grounding conductor sized in accordance with Table 250-94(A) of the NEC shall be extended to the earth electrode. Main grounding conductors #8 through and including #4 AWG shall be insulated and identified by a green colored insulation. All grounding conductors shall be installed in conduit sized in accordance with Table 3A. Chap. 9 of the NEC. Conduit carrying a grounding conductor shall also be grounded at the earth electrode. Main grounding conductors #2 and larger shall be bare.

5.4.4.1 Grounding conductors shall be installed as to permit the shortest and most direct path from equipment to ground. All connections to ground conductors shall be accessible for inspection and made with approved solderless connectors, brazed or bolted to the equipment or structure to be grounded. All contact surfaces shall be thoroughly cleaned before connections are made to insure good metal to metal contact.

5.4.4.2 Equipment grounding continuity shall be maintained through flexible conduit as required in previous sections.

5.4.4.3 All wiring devices equipped with grounding connections shall be permanently and securely connected to the enclosure in which they are mounted with a copper grounding jumper.

5.4.4.4 The frame of all lighting fixtures shall be securely grounded to the equipment ground system with grounding conductor.

5.4.4.5 An equipment ground bus shall be installed in each panel-board for terminating grounding conductors from branch circuits and conduit grounding bushings bonding jumpers.

5.4.4.6 All equipment housing and/or enclosures and all non-current carrying metallic parts of electrical equipment, raceway systems, etc., shall be effectively and adequately bonded to ground.

5.4.5 Panelboards shall be of the totally enclosed, dead front type provided with main disconnecting and protective devices and/or lugs only as indicated on the contract drawings. Panelboard mains shall be of copper, rated as indicated on the contract drawings, and one and two and three pole branch circuits shall be provided as indicated in the panel schedules.

5.4.5.1 Panelboard cabinets shall be fabricated from galvanized sheet steel meeting the requirements of the NEC and UL and shall be so marked or labelled. Cabinets shall not have prepunched concentric or eccentric knockouts. Trims shall be designed for surface mounting shall be finished with gray baked on enamel, and shall be provided with flush latches and locks.

5.4.5.2 All panelboards shall have locks and all locks shall be keyed alike. Deliver all keys to the Contracting Officer at the time of final inspection.

5.4.5.3 A typewritten schedule shall be provided for and installed in each panelboard. Schedule shall indicate location and usage of circuits such as "Receptacles", "Lights:, etc. The typewritten schedule shall be installed in a framed clear plastic holder permanently attached to the back of the hinged access door.

5.4.5.4 Panelboard Main Disconnect: The main disconnect shall be a two or three pole molded case circuit breaker mounted within the panelboard enclosure. The breaker shall be rated as indicated in the panel schedules on the contract drawings.

5.4.5.5 Panelboard branch circuit breakers: The branch circuit breakers shall be one, two or three pole, molded case breakers mounted within the panelboard enclosure and connected to the main bus by bolting directly or with a bolt held clamp. Connections to the main bus of the panelboard shall be silver or tin plated. Circuit breakers size shall be modular such that two or three pole breakers may be interchanged with two or three single pole breakers. Breakers shall be rated as indicated in the panel schedules of the contract drawings.

5.4.5.6 All circuit breakers shall be common trip, single handle. Handle ties are not acceptable. Circuit breakers shall be of the frame sizes required in order to provide adequate short circuit interrupting capacities and integrated equipment ratings as shown on the drawings.

5.4.5.7 Panelboards shall comply with the requirements of NEMA Standard No. PB 1-1977, and shall be UL approved. Panelboards shall be as manufactured by Westinghouse, General Electric, FPE or Square D.

5.4.6 Wiring Devices:

5.4.6.1 Toggle switches shall be single pole, rated 20A, 120/277 V, AC. Switches shall have neon lights of the correct voltage rating where indicated on the contract drawings. All switches shall have quiet operating mechanisms without the use of mercury switches. All switches shall be UL approved for the voltage and amperage indicated. Switches shall be as manufactured by Hubbell, or equal by General Electric or Bryant. Switches shall be of the quality indicated on the contract drawings, and shall be specification grade.

5.4.6.2 Receptacles:

a. Duplex receptacles shall be of the grounding type with separate single or double, grounding terminals. Receptacles shall be straight blade, rated 20A, 125V, and the face configuration shall conform to the NEMA Standard No. WDI.1-1968 and shall be UL approved.

b. Self grounding or automatic type grounding receptacles are not acceptable in lieu of receptacles with separate grounding screw lugs and a green jumper connection to the grounding system.

c. Receptacles shall be of the quality indicated on the contract drawings, specification grade, mounted vertically and shall be as manufactured by Hubbell, General Electric or Bryant.

5.4.6.3 Cover plates for wiring devices shall be weatherproof, single or ganged as shown on the contract drawings.

5.4.7 Lighting Fixtures and Lamps:

5.4.7.1 All lighting fixtures shall be approved by UL and NFPA and shall bear their label.

5.4.7.2 All fixtures shall have a stock, or standard, finish unless otherwise specified.

5.4.7.3 All fixtures shall be installed complete and lamps, and lamps shall be new and unused at time of final inspection of the project for acceptance

5.4.7.4 Lighting fixtures shall be standard substation high intensity discharge type with prismatic top lens and one piece tempered glass refractor designed for low glare. Unit shall be mounted on a cast bracket/box outlet assembly. Ballast shall be for 120 volt service and shall be low temperature type. Lamp shall be 400 watt metal halide. The top lens shall be removable for lamp replacement.

5.4.8 High Intensity Discharge Lamp Ballasts:

5.4.8.1 Ballasts shall conform to the specifications of the Underwriters' Laboratories, Inc. and American National Standard Institute (ANSI), and shall display their labels and/or symbols. They shall meet or exceed ANSI requirements for crest factors, starting currents, starting voltage and operating conditions.

5.4.8.2 Ballasts shall be of the peak lead auto-transformer type, high power factor, and a primary voltage regulator range of ±10 percent for a ±5 percent or less change in lamp wattage.

5.4.8.3 Ballasts shall have lowest sound rating available for lamps specified and shall clearly show their respective sound ratings. Ballasts found by the Engineer to be unduly noisy shall be replaced without charge by the General Contractor prior to acceptance of the job.

5.4.8.4 Ballast shall be as manufactured by Advance, Universal or General Electric.

5.5 High voltage shielded power cable shall be rated 15 kV and shall be single conductor, shielded and jacketed. Cable shall be rated for use in underground ducts at 90 degrees Centigrade and shall exibit excellent corona resistance and resistance to moisture. Cable shall be UL listed as Type MV-90.

5.5.1 Conductor: Conductor shall be uncoated copper, Class "B" stranded per ASTM B-8.

5.5.2 Strand Screen: Strand screen shall be extruded semi-conducting material meeting or exceeding the electrical and physical requirements of IPCEA S-68-516, NEMA WC-8-1976 and UL 1072.

5.5.3 Insulation: Insulation shall be an ethylene propylene base, thermosetting compound, 220 mils thick for 133 percent insulation level. Insulation shall meet or exceed the electrical and physical requirements of IPCEA S-68-516, NEMA WC-8-1976 and UL 1072.

5.5.4 Isolation Screen: Extruded semi-conducting insulation shall be applied directly over the insulation. The screen shall meet or exceed the electrical and physical requirements of IPCEA S-68-516, NEMA WC-8-1976, or AEIC 6-75 and UL 1072.

5.5.5 Shield: The shield shall be bare copper tape helically applied with minimum overlap of 12.5 percent.

5.5.6 Jacket: The polyvinylchloride jacket shall be resistant to most oils, acids and alkalies and shall meet all applicalbe IPCEA, NEMA and UL requirements.

5.5.7 The Contractor shall be required to furnish for each reel of cable prior to installation a certified manufacturer's test report for approval by the Contracting Officer. The approved cable shall be installed in continuous lengths. All terminations, including stress cones for cable as required, unless specified otherwise, are to be fabricated in accordance with cable and terminator, or pothead manufacturer's recommendations.

5.5.8 Provide terminations and in-line splices for single cables as indicated. Potheads shall conform to the requirements of IEEE 48 Clas I termination. Potheads components and filling compound shall be as recommended by the manufacturer. Submit copies of the manufacturer's directions for assembling, filling, and putting the unit in service. Installation shall include stress relief cones and shield grounding. Aluminum and copper or copper bearing parts shall not be used in contact with each other. Terminations shall be designed for use with the specific cable indicated.

5.5.8.1 Submit high voltage cable splicer/terminator's certification of competency and experience before splices or terminations are made in high voltage cables. Splicer's experience during the immediate past three years shall include performance in splicing and terminating cables of the type and classification being provided under this contract.

6. INSTALLATION:

6.1 General Requirements: Electrical installations shall conform to the National Electrical Safety Code, the National Electrical Code, and to the requirements specified herein. All equipment and materials shall be new unless indicated or specified otherwise.

6.2 Grounding: Grounding shall be in accordance with the National Electrical Code and the National Electrical Safety Code, except that grounds and grounding systems shall have a resistance to solid earth ground not exceeding the following values:

| | Ohms |
|---|---|
| For grounding main substations, distribution substations, and switching stations on primary distribution systems enclosed by protective fences. | |
| (a) 5,000 KVA and above | 3 |
| For grounding other metal enclosures of primary voltage electrical and electrically operated equipment. | 10 |
| For surge arrester grounds on pole line distribution systems. | 10 |
| For grounding secondary distribution systems (neutral) noncurrent carrying metal parts associated with distribution systems. | 25 |
| For grounds not covered above. | 25 |

When work in addition to that indicated and specified is directed, in order to obtain the specified resistance to ground, the provisions of the contract respecting an adjustment for changed conditions shall apply.

6.2.1 Grounding Electrodes: Where practicable, electrically continuous metallic buried water piping shall be utilized for grounding electrodes. Artificial grounding electrodes shall be the sectional type driven ground rods as specified in Section 16300, Electrical Distribution, Exterior. Approved copper-alloy clamps shall be brazed to the upper end of the ground rods and ground wires shall be securely attached thereto by means of a bolted connection.

6.2.2 Substation Grounding: A bare copper cable not smaller than No. 4/0 AWG shall be provided not less than 24 inches below grade connecting to the indicated ground rods. Fence and equipment connections shall not be smaller than No. 4 AWG. Fence shall be grounded at each gate post and cornerpost and at intervals not exceeding 10 feet. Each gate section shall be bonded to the fence post through a 1/8-inch by one inch flexible braided copper strap and clamps. Where the measured ground resistance exceeds three ohms, additional ground rods or deep-driven sectional ground rods shall be provided not less than 6 feet apart, and shall be connected by cable not smaller than No. 4/0AWG, two feet below grade, until a ground resistance of three ohms or less is obtained, except that the total length of additional ground rods required shall not exceed 50 feet.

6.2.3 Welded or Brazed Connections: Joints in grounding conductors and mats shall be welded or brazed. The welding or brazing processes shall not in any way cause the parts joined to be damaged or weakened and shall join all strands. The welding process shall be an exothermic type, and the completed connection or joint shall be equal or larger in size than the conductors joined. The brazing process shall be in accordance with MIL-B-7883.

6.2.4 Grounding and Bonding Equipment: UL 467, except as indicated or specified otherwise.

6.3 Installation of Equipment and Assemblies: The installation of oil circuit breakers and reclosers, oil switches, etc., furnished under this section shall be installed and connected as indicated on project drawings, the approved shop drawings and as specified herein.

6.3.1 Distribution Transformer Installations shall include one primary fuse cutout and one surge arrester for each ungrounded phase conductor. Cutouts and arresters shall be as specified in section: "Electrical Distribution, Exterior".

6.4 Foundation for Equipment and Assemblies: Substation Equipment shall be mounted on concrete slabs. Unless othersise indicated, the slabs shall be at least 8 inches thick, reinforced with a 6- by 6-inch no. 6 mesh and with a 6-inch thick, well-compacted gravel subbase. Thetop of the concrete slab shall be approximately 4 inches above the finished grade. Edges above grade shall have chamfer as indicated. The slab shall be of adequate size to project at least 8 inches beyond the equipment. Concrete work shall be as specified in Section 03300, "Cast-In-Place Concrete".

7. FIELD TESTS AND INSPECTIONS:

7.1 General: The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Tests shall be such that each item of control equipment will function not less than five times. The Contractor shall give the Contracting Officer days advance notice of the dates and times for tests and inspections.

7.2 Tests: After installation, relay setting and coordination tests and dielectric tests shall be performed, Certified copies of the relay settings and dielectric tests shall be provided to the Contracting Officer.

7.3 Equipment and Apparatus Tests: Unless specific factory-witnessed tests are specified, tests normally made by the manufacturer will be acceptable for all equipment and apparatus, and the Contracting Officer will authorize shipment on receipt of satisfactory evidence of such test.

7.4 Ground Resistance Tests: Ground resistance measurements of each ground rod shall be taken and certified by the Contractor. Upon completion of the project, the Contractor shall submit in writing the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system, as well as the resistance and soil conditions at the time measurements were made. Ground resistance measurements shall be made in normally dry weather, not less than 48 hours after rainfall, and with the ground under test isolated from other grounds. Ground resistance shall also be measured from each piece of equipment to the ground electrode.

7.5 Retesting: Any deficiencies found shall be rectified and work affected by such deficiencies shall be completely retested at the Contractor's expense.

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SECTION 16XXX

DISASSEMBLY AND ERECTION OF EXISTING SUBSTATION STRUCTURE

1. The Contractor shall disassemble and transport to the new MCAS(H) substation site, the existing steel substation structure located near Building No. 45, Marine Corps Base, Camp Lejeune, North Carolina as shown on the location map of the contract drawings.

1.1 The Contractor shall carefully mark each member of the structure, to assure proper placement of each part, and then disassemble the structure. Disassembly shall include salvage of all switches, cutouts, arrestors, transformers, insulators, cable bus, capacitors, lighting fixtures, etc., that are mounted on and/or associated with the structure and stored in the fenced area. All salvaged equipment not desginated on the contract drawings to be reinstalled on the new MCAS(H) substation shall be delivered to the Owner at a location as directed by the Contracting Officer.

1.2 Salvaged materials shall be carefully examined before loading and transporting to the new substation site. If any damage is found, the Contractor shall immediately notify the Contracting Officer for instructions.

1.3 After unloading the structure and salvaged materials at the new site, the structure and materials shall be thoroughly cleaned and all rust, corrosion, etc. shall be removed and clean bare metal exposed. Two coats of rust inhibiting zinc based primer shall be immediately applied after cleaning. Two coats of hard finish matching color enamel shall then be applied. Paint coats shall be applied at intervals as recommended by the paint manufacturer. Scratches and surface damage to the galvanized finish of the steel structure shall be cleaned as above and two heavy coats of cold galvanizing zinc paint compound applied.

1.4 The existing steel substation structure shall be erected as shown on the contract drawing using as much salvagable hardware as possible. Additional hardware required to install the structure, such as anchor bolts, shall be furnished by the Contractor as required. All new hardware, steel parts, anchor bolts, angles, etc., shall be heavily hot dip galvanized.

1.5 The Contractor shall install five salvaged air-break switches in the same manner as they are presently installed on the abandoned steel structure. Orientation, placement, alignment and all adjustments shall be the Contractor's responsibility. Switch operating mechanisms shall be modified as necessary to accomodate conditions encountered. Switches shall be lubricated as required to operate with minimum effort.

SECTION 16XXX

TRANSISTION FROM EXISTING SUBSTATION TO NEW STEEL SUBSTATION

1. The Contractor shall coordinate with the Contracting Officer as required by Section 01011.

2. After the new substation structure is essentially complete and the underground feeders are installed, the Contractor shall begin the transistion to the new substation facility. The transistion shall be accomplished one feeder at a time so outages are kept to an absolute minimum.

3. Existing cutouts and fusible cutouts sizes and ratings shall be carefully noted before the transition is made to assure continued proper sizing. Cutouts salvaged from the existing steel structure may be used on the new facility as necessitated by the transistion procedure followed by the Contractor.

4. All fusing shall be as existing or as directed by the Contracting Officer.

5. Existing metering shall be installed on the steel station structure as directed by the Contracting Officer.

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SECTION 16XXX

CLEANUP, GRADING AND GRASSING ABANDONED FACILITIES

1. The Contractor shall remove and dispose of all concrete foundations, pads, conduit, gravel, wood poles, etc., at both the site of the existing steel structure and the existing MCAS(H) substation. Fencing at the steel structure site shall remain in place. Fencing at the existing MCAS(H) substation site shall be removed and materials delivered to the Owner at a location designated by the Contracting Officer.

2. The designated cleanup area for both sites shall be the area enclosed by the existing fence, but in the case of the existing MCAS(H) substation site, this area shall also extend to a line five feet beyond the fence.

3. The Contractor shall establish vegetation in accordance with Section 02822.

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