508 ELECTRICAL CONSTRUCTION FOR MOVABLE BRIDGES. (REV 8-2-02) (FA 9-3-02) (7-03)

SECTION 508 (Pages 634-641) is deleted and the following substituted:

SECTION 508
ELECTRICAL CONSTRUCTION FOR MOVABLE BRIDGES

508-1 Description.

Furnish and install a complete and operational electrical system for the operation of movable bridges, in accordance with the details shown in the plans.

508-2 Power Source.

When obtaining electric power from an external source, refer to the Contract Documents for the approximate location of the service point. Refer to the plans for the size and type of the service conductors.

508-3 Working Drawings and Shop Drawings.

508-3.1 General: Submit working drawings, shop drawings, and descriptive material of each separately mounted piece of equipment to the Department as specified in Section 5. Upon completion of the work, furnish the Department five instruction books containing instructions for operation, description of apparatus, maintenance instructions, renewal parts data, and wiring diagrams. The Department will accept the manufacturer's standard leaflets covering standard apparatus. Incorporate all drawings in the instruction books, either as reduced size prints or as full size drawings, neatly folded and suitably bound into the book or folded and inserted into a pocket included in the book.

508-3.2 Drawings:

508-3.2.1 Motor Control Center: Provide one-line and three-line electrical diagrams for all electrical equipment. Provide assembly drawings with front and end views, which gives the necessary dimensions and notations to permit proper equipment installation. Ensure that the drawings shows the approximate location of all apparatus on the front and at the rear of the panel, the size of the individual panels, segregation for shipment and approved engraved metal nameplates with designation as to function of the apparatus mounted on the front of the board.

Provide a bill of material of all apparatus furnished, on both the front and rear of the panels (a different drawing may be supplied for the bill of material if quantity of material or other drawing complications so dictate) with the necessary terminals and terminal blocks clearly designated and notations as to special construction, finishes, etc.

508-3.2.2 Control Console: Provide assembly drawings with front and end views, which gives the necessary dimensions and notations to permit proper equipment installation. Ensure that the drawings shows the location of all apparatus, approved nameplates with designation as to function of the apparatus.

Provide a bill of material and apparatus furnished with the desk. Ensure that necessary terminal and terminal blocks are clearly designated and make notations as to special construction, finishes, etc. Provide the engraving schedule for all nameplates.

Provide a control console wiring diagram, showing detail wiring and position of all apparatus and terminal boards on the control console.

508-3.2.3 Disconnect Switches: Include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.

508-3.2.4 Panel Boards: Provide shop drawings showing outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes. Provide the manufacturer's installation instructions which indicate application conditions and limitations of use stipulated by the product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of all products. Record actual locations of all products; indicate actual branch circuit arrangement.

508-3.2.5 Controls and Relays: Submit shop drawings meeting NEMA ICS 1 standards indicating control panel layouts, wiring connections and diagrams, dimensions, support points. Submit product data and manufacturer's installation instructions for each component. Maintain accurate record of the actual locations of all control equipment. Revise diagrams as necessary to reflect actual control device connections and include in plans.

Provide instructions for adjusting and resetting time delay relays, timers, and counters. Ensure that all maintenance data and recommended preventive maintenance procedures and materials are provided.

508-3.2.6 Electrical Identification: Provide catalog data for nameplates, labels, and markers which indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of product.

508-3.2.7 Supporting Devices: Provide the manufacturer's catalog data for fastening systems, which indicates application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

508-3.2.8 Motors: Submit manufacturer's product data including nameplate data and motor torque curves, installation instructions, operation and maintenance data. Include assembly drawings, bearing data with replacement sizes, and lubrication instructions. Provide one-line and three-line electrical diagrams, schematic diagram (including field wiring), wiring and interconnection diagrams and elevation/plan for all motors.

508-3.2.9 Brakes: Submit manufacturer's operation and maintenance data, catalog cuts, and parts lists.

508-3.2.10 Limit Switches: Submit product data for all products. Submit shop drawings showing mounting details that are not clearly shown in manufacturer's data.

508-3.2.11 Traffic Gate Assemblies: Submit manufacturers shop drawings, product data, installation instructions, operation and maintenance data.

508-3.2.12 Movable Bridge Traffic Signals: Meet the requirements of Design Standards Index No. 17890. Submit Shop Drawings showing proposed pole mounting details and foundations for both overhead signal units, include design calculations.

508-3.2.13 Navigation Lights and Aids: Submit the manufacturers' data, catalog cuts, parts lists, battery-sizing calculations and operation and maintenance data.

508-3.2.14 Conduit: Submit a full size drawing showing all conduit runs between all pieces of equipment for review and approval by the Engineer before the starting any work.

508-3.2.15 Conductors: Furnish test reports from an independent laboratory which approved the conductors. Ensure the test reports define the procedures used and values obtained.

Furnish the manufacturer's installation instructions, application conditions and limitations of use.

508-3.2.16 Submarine Cable Assembly: Before obtaining the cables, submit wiring diagrams and data to the Engineer showing the length needed, confirmation that the cables described herein have sufficient conductors for the actual needs of this bridge, and certification that cables to be furnished satisfy these Specifications.

Furnish the manufacturer's data sheets (including weight/length and minimum bending radius) and cross section drawings for each type cable. Furnish manufacturer's data sheets for each type of cabinet and terminal block to be used. Furnish manufacturer's data sheet of protective sleeves and cable clamps. Furnish drawings showing configuration of conduits entering submarine cable termination cabinet, and details and layout of terminal strips within submarine cable termination cabinet. Submit a certified test report showing that the cable supplied has been tested at the factory and meets all the requirements of this Specification.

508-3.2.17 Lightning Protection: Furnish a complete material list, product data and catalog cuts and shop drawings, showing the proposed system for installation and the exact location of each item and material used in the lightning protection system and surge suppression panel.

Furnish an elementary wiring diagram, which shows the control scheme and general connection of all apparatus furnished under this Section, arranged to permit ready analysis of the sequence of operation.

Furnish a wiring diagram showing the detailed wiring of the panels and controllers, with terminals, etc., properly identified and coordinated.

508-3.2.18. Standby Generator System: Provide one-line and three-line electrical diagrams, schematic diagram (including field wiring), wiring and interconnection diagrams for the generator set, Automatic Transfer Switch (ATS), remote status panel, and auxiliary devices including battery(ies), charger, fuel supply monitors, and load bank.

Provide an elevation and dimensioned outline drawings detailing arrangement, wire-way, conduit entry, panel layouts, fuel filling station piping, fittings, and access locations. Also, include the equipment schedule detailing all components of the generator set, ATS, remote status panel, battery system, and fuel system (including the fuel tank).

Furnish a certified shop test report including all reactance values and other electrical parameters, stipulating this generator system meets the requirements of this Specification.

508-4 Materials and Equipment.

Provide only materials and equipment of new stock produced by established, reputable manufacturers of electrical equipment, meeting ANSI, NEC, NEMA, and UL requirements, and approved by the Engineer, except where the Contract Documents permit or specifically require the use of other than new equipment.

508-5 Motors.

Furnish and install single phase and three phase electric motors. Perform all work in conformance with the notes, dimensions and sizes shown on the plans.

508-5.1 Three Phase Motors: Furnish and install motor(s) capable of a minimum of 12 start-ups per hour, 2 in a ten-minute period and the power output, locked rotor torque, breakdown or pullout torque meet the requirements of NEMA Design B Characteristics. Ensure that the design, construction, testing, and performance conforms to ANSI/NEMA MG 1 for Design B Motors and the insulation System meets or exceeds the requirements of NEMA Class F. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data in accordance with ANSI/IEEE 112, Test Method B.

Ensure that all motor frames meet the requirements for NEMA Standard T-frames of steel or cast iron (no aluminum frames allowed) with end brackets of cast iron with steel inserts and are Totally Enclosed Fan Cooled (TEFC) for motors 10 Hp [7.5 kW] and larger.

Ensure Motor Sizes 25 Hp [19 kW] and Larger are equipped with 3 PTC thermistors imbedded in motor windings and epoxy encapsulated solid-state control relay for wiring into motor starter.

Ensure the motor is equipped with grease lubricated anti-friction ball bearings with housings equipped with plugged provision for re-lubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt centerline at end of NEMA standard shaft extension and stamp the bearing sizes on the nameplate.

Ensure the sound power levels are in accordance with ANSI/NEMA MG 1 and the nominal efficiency meets or exceed values in schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112. Provide blower ventilation, if required, for low speed operation to ensure that a safe operational temperature is maintained.

508-5.2 Motor Controls: Furnish and install, where indicated or required, motor controls having the electrical characteristics, ratings, and modifications shown on the plans. Do not use IEC starters, use only full-size NEMA rated starters unless indicated otherwise in the plans. Build and test in accordance with the latest NEMA standards.

508-6 Brakes.

Furnish and install only spring-set, thrustor-released, shoe-type brakes with automatic wear adjustment, open-type construction, with corrosion-resistant fittings, mounted on floor-mounts on structural steel supports.

Ensure the setting are factory set to exert the 60 minute intermittent retarding torques and provide independent time delay adjustment. Ensure the torque setting is adjusted as indicated on the plans.

Do not use brake wheel couplings.

Furnish and install a manual hand release that will not change the torque setting or require removable levers or wrenches, equipped with a lever type limit switch for interlocking purposes. Ensure that it is impossible to manually release the brakes without tripping the limit switch.

Furnish and install 3-phase, 60 Hz squirrel-cage continuous duty motors with cast iron conduit box with drilled and tapped conduit entrance. Ensure the rated stalled thrust of each thrustor is not less than 135% of the thrust actually required to release the brake with the torque adjusted to the intermittent rated value.

Ensure the oil thrustor operating chambers has a free operating temperature range between -20º and 140º F [-11º and 60º C] equipped with a light weight, NEMA 3R, enclosure designed to be lifted as a unit from the unit for inspection. Include provisions to access and operate manual hand release mechanism from outside the enclosure.

Furnish and install self-centering brake shoes that are easily replaced from either side of the brake frame without disassembling the top brake connecting rod or pull rod, and without disturbing the torque adjustments. Provide automatic wear compensation and set/release limit switches.

508-7 Interlocking.

Interlock the electrical equipment by suitable conductors, relays, limit switches, Programmable Logic Controller, etc., so that only the following sequence of operation is possible for opening the leafs:

a. Set traffic signals.
b. Lower all safety gates and all traffic barriers.
c. Pull locks.
d. Release brakes.
e. Open span.
f. Set brakes.

For closing the spans, reverse the sequence. Make provision for bypassing the interlocking for emergency operations.

508-8 Limit Switches.

Furnish and install limit switches as indicated in the plans.

508-9 Traffic Gate Assemblies.

508-9.1 Gate Operator and Arms: Furnish and Install vertical to horizontal type; electrically operated gates with manual cranking ability at locations shown on the plans equipped with warning bells on on-coming gate assembly enclosures, in accordance with manufacturer's instructions.

Furnish and install arms equipped with steel hot-dip galvanized, sectional bolt-on type counterweights with at least 10% adjustment and lights in accordance with the Design Standards Index No. 17890. Make all electrical connections to provide proper operation of the traffic gates, lights, bells, etc. Ensure the anchorage for each new gate installation is adequate to support all attachments.

Ensure that during the opening and closing cycles, the gate arm will begin with zero velocity and accelerate smoothly, reaching maximum velocity at mid stroke (45 degrees) then decelerate smoothly to zero velocity at full stroke (90 degrees) without whip or bounce, all within a maximum of 13 seconds for a full opening or closing cycle. Ensure the electrically operated gate will operate the arm with a wind speed of 50 mph [80 kph].

Ensure all items incorporated into the traffic gate assemblies are compatible and provided by the gate manufacturer. Furnish one spare gate arm (complete with lights, and striping) in proper length, and one spare gate operator motor.

508-9.2 Arm Shafts: Furnish and install main arm shafts and sidewalk shafts with a minimum diameter of 2 inches [50 mm], constructed of Class B high strength steel meeting the requirements of ASTM A311 [ASTM A 311M], mounted in heavy duty ball bearings and lubricated from inside.

508-9.3 Transmission: Furnish and install a fully enclosed, all gear, direct drive unit running in oil bath and in a ductile iron gear case. Non-metallic gears, belts, cams, pulleys, linkages, chains, or connecting rods are not acceptable in drive train.

508-9.4 Motor: Furnish and install totally enclosed, class F insulation motors specifically designed for gate actuator capable of operating at full load when the voltage to the motor is ±10% of rate voltage. Use only motors having the voltage capacity as specified in the plans, also verify the voltage capacity at the job site.

Ensure the motor has the capacity to perform all necessary functions to the satisfaction of the Engineer based on the torque required for gate arm and accessories operations.

508-9.5 Braking Mechanism: Ensure the braking mechanism is equipped with a solenoid release, automatic motor brake that automatically releases when hand crank is inserted.

508-9.6 Hand Crank: Provide a hand crank to manually raise or lower gate arm in event of power failure. Provide interlock to prevent operation of the motor if the hand crank is inserted.

508-9.7 Gate Operator Housing: Ensure the housing is manufactured from 1/4-inch [6.35 mm] thick welded plate aluminum with front and rear access doors hung on bronze, slip-off type full cross hinges with stainless steel hinge pins. Ensure the housing base is equipped with four 1-inch [25 mm] holes and for new installations, provide anchor bolts and template.

508-9.8 Gate Arm: Furnish and install gate arms to the length specified in the plans constructed of 6061-T6 rectangular aluminum tubing and fiberglass with ultra-violet resistive treatment.

Ensure that the gate arm is covered on both sides with alternating 16-inch [400 mm] reflective red and white engineering grade sheeting.

508-9.9 Arm Base: Furnish and install a break-away shear pin base for each gate arm so that when excessive force is applied to arm, the pin shears, the arm then swings 45 degrees horizontally and drops free of the gate operator. Design shear pin base and lightweight arm assembly for easy, rapid reinstallation or replacement by one person.

508-9.10 Warning Lights: Furnish and install warning lights with the housing constructed of molded plastic, which are moisture and corrosion proof equipped with 2-way visibility, 7 inch [178 mm] diameter red lenses powered by a 12 V, 1000 hour, 21 candlepower lamp. Ensure the light circuit is equipped with a heavy duty, solid state, fully factory wired flasher, with two alternately flashing circuits

with a flash rate of 0.50 seconds ON, 0.50 seconds OFF and one steady burn circuit. Provide all mounting hardware, solid state flashing circuitry, clearly labeled terminal block, heat sink, and transformer when required.

508-9.11 Gong: Furnish and Install a heavy-duty, 120 V_{ac} motor driven, industrial quality gong of cast aluminum; machined for proper fit with gasketed rear door hinged with stainless steel hinge pins and equipped with a swing bolt with provisions for a pad lock. Ensure the gear train is journaled in oil-impregnated, bronze bearings and driving a cam and hammer to strike gong shell approximately 100 times per minute. Ensure the gong shell is 12 inches [305 mm] in diameter, constructed of cast bronze held in place with tamper resistant, stainless steel stud and protected by a cast aluminum weather guard.

508-9.12 Warning Bells: Furnish and install weatherproof warning bells with adjustable sound level to 90 decibels, 10-inches [254 mm] in diameter, that will operate on 120 V_{ac}.

508-9.13 Limit Switches: Furnish and install unit assemblies comprised of a minimum of 8 individual switches with one set of normally open and one set of normally closed contacts each. Furnish and install contacts having a UL rating of not less than 10 A at 120 V_{ac}. Use only corrosion resistant non-ferrous materials for the limit switch body, shafts and cams. Ensure that the gear limit switches to the drive mechanism are in step with the actual gate position at all times, whether operation is by power or manual mode.

Do not use cams or screws to set the limit switches or designs requiring battery back up methods to ensure position control in the event of a power failure.

508-9.14 Safety Switches: Equip each gate with a manual disconnect switch and with an automatic disconnect switch to break control circuit when door is opened.

508-9.15 Terminal Blocks: Install pressure type inside housing terminal blocks on the roadway side and terminate all control wires on terminal blocks and clearly label all circuits.

508-9.16 Wiring: Use #16 AWG stranded or larger. Ensure that the color code or number conductors match the wiring diagram.

508-9.17 Completion of Installation: Verify system voltage matches gate requirements, make connections to control console, manually test hand crank, and power test traffic gates to ensure proper operation of warning bells, gate operator, gate arm lights and gate interlock.

508-10 Traffic Lights.

Furnish and Install new traffic lights, signs, and overhead structures (monotube or cantilevered as required) at locations shown on the plans. Furnish and Install new "WARNING DRAWBRIDGE AHEAD" signs per Design Standard Index No. 17890. Construct all necessary concrete support pilasters foundations for these sign units.

Use signal heads of die-cast aluminum with a cutaway visor and a dull black finish equipped with 12 inches [305 mm] acrylic lenses. Use three-lens sections for traffic lights and one-lens sections for warning lights.

Install 24 inches [610 mm] wide thermoplastic stop bars at each on-coming gate as shown in the Design Standards Index No. 17890.

508-11 Navigation Lights and Aids.

508-11.1 General: Furnish and install a complete navigation hazard lighting system operating at 120 V_{ac}, in accordance with the manufacturers' instructions and in compliance with USCG CFR 118.80(b). Perform tests, of components to determine that each individual component operates as intended. Make adjustments as necessary to ensure the system is complete and functional to the satisfaction of the Engineer.

Equip all fender and vertical clearance lights with two 100 watt, 130 volts, brass base, long life lamps, and a means of automatically transferring from one lamp to the other in the event of a lamp failure; or LED array of at least 12 particularly bright RED or GREEN LEDs symmetrically

arranged around the lens focal point and with a minimum of 50,000 hour life. Equip each incandescent fixture with a relay or solid-state device capable of generating a signal to alert the operator that a lamp failure has occurred. Mount LED arrays on an internal shock and vibration isolator. Provide, in the circuit, a lightning surge suppressor capable of absorbing multiple strikes without replacement.

Provide backup power to the navigation and clearance gauge lights by a battery and inverter system (one per pier). Size batteries to provide power for load connected plus 25% for a total of 4 hours. Size inverter so that under normal full load conditions, the load will be no more than 75% of the output rating of the inverter. Provide battery charger to charge the batteries to full capacity in less than 8 hours. Back up power supply equipment includes a wall-hung cabinet housing battery, charger, inverter, and sealed load transfer relays. Navigation lighting fixtures, lighting contactors and photoelectric cell will be remotely located.

Provide temporary navigational lighting when required meeting USCG approval.

508-11.2 Fender Lights: Furnish and install unpainted housings of heavy duty cast aluminum construction with a 1 inch [25 mm] threaded conduit opening on the bottom, equipped with a red 180 degree standard marine molded single-piece fresnel type, rigid, heat resistant glass lens 7 to 8 inch [177 to 200 mm] I.D. Furnish all stainless steel closure bolts, lens tie rods, and attachment hardware for a complete and accepted installation. Use only marine type junction boxes. Provide Rectinoid; solid state to extend incandescent lamp life approximately 20%; or special power supply to provide current limited DC voltage to the LED array.

508-11.3 Channel Lights: Furnish and install unpainted cast aluminum housings with cushioned lenses, weatherproof gasketed joints and a large service access door, equipped with a 180 degree standard marine molded single-piece fresnel type, rigid, heat resistant glass, 7 to 8 inch [177 to 200 mm] I.D. with the lower section of the lens red and the upper section green. Furnish all stainless steel closure bolts, lens tie rods, and attachment hardware for a complete and accepted system. Ensure the swivel assembly is cast bronze housing and bracket with stainless steel pivot, watertight "O" ring seal, bronze bearings, cable entrance fitting, and #35 stainless steel service chain rated for 225 pounds [100 Kg]. Use a hanger stem 1-1/2 or 2 inch [38 or 50 mm] galvanized pipe as recommended by Manufacturer with anti-swing brake and automatic lock.

Use marine type junction box with 3/4 inch [19 mm] conduit opening on two sides. Furnish and install Rectinoid solid state to extend incandescent lamp life approximately 20%; or special power supply to provide current limited DC voltage to the LED array.

508-11.4 Clearance Gauge Floodlights: Furnish and install one-piece die-cast aluminum fixture housing fitted with watertight gasket, stainless steel hinges and fasteners, and adjustable aiming capability, equipped with a 120 V_{ac}, 50 watt, high-pressure sodium lamp. Use a heavy cast aluminum junction box body and cover with stainless steel swing bolts, watertight gasket and provisions for mounting to a platform with four 3/8-inch [10 mm] diameter lag bolts or screws.

508-11.5 Air Horn: Furnish and install a weatherproof, self-contained, air driven, dual projector, air horn, equipped with a rapid response, direct drive, oil-less piston type compressor, powered by a 60Hz, 120 V_{ac} 1 HP motor with sealed, self lubricated ball bearings.

Ensure the horn mechanism is air pressure actuated with a free floating vibrating type, tempered phosphor bronze diaphragm coupled to a resonant chrome plated zinc die-cast trumpet style projector, capable of producing 120 Decibels measured at a distance of 10 feet [3 m] @ 320 cycles per second.

508-11.6 Batteries: Furnish and install deep-cycle maintenance free valve regulated lead acid Batteries that will not self-discharge more than approximately 1% per month.

Ensure that the maintained life cycle will be in excess of:

1. 2000 cycles at 10% Depth of Discharge (DOD).
2. 800 cycles at 50% DOD.
3. 500 cycles at 80% DOD.

4. 350 cycles at 100% DOD.

508-11.7 VHF Marine Radio: Provide a separate, battery powered, marine radio VHF transceiver (157-160 MHz) with output power of 1.0 watt, capable of monitoring channel 16 and transmitting on at least three additional channels as specified by the Engineer. Couple the radio to a stainless steel or fiberglass whip antenna 39 inches [1 m] in length mounted as shown in the plans. Ensure that the maximum audio distortion is less than 5% and the unit complies with F.C.C. Rules and Regulations, Part 81. Provide a battery charger capable of maintaining the radio battery fully charged.

508-12 Conduit and Wiring.

508-12.1 General: Furnish and install conduit and raceways in the quantities and sizes required to complete the work as shown on the plans and as required by the NEC. Furnish products listed and classified by UL as suitable for purpose specified and shown. Do not use non-metallic flexible conduit, aluminum, or electrical metallic tubing (EMT). Do not use aluminum conductors.

508-12.2 Underground Installations: Use a 1 inch [25 mm] minimum size schedule 80 PVC or fiberglass conduit when installation is more than 5 feet [1.5 m] from foundation wall.

Install 1 inch [25 mm] minimum diameter schedule 80 PVC when installation is within 5 feet [1.5 m] of a foundation wall, in or under the slab on grade.

Install 1 inch [25 mm] minimum diameter rigid steel (PVC coated) or Schedule 80 PVC conduit for outdoor locations, above grade.

508-12.3 In Slab Above Grade: Install 3/4 inch [19 mm] maximum diameter schedule 80 PVC conduit in wet and damp locations. Install 3/4 inch [19 mm] maximum diameter rigid steel (PVC coated) or schedule 80 PVC conduit for dry locations, either concealed or exposed.

508-12.4 PVC Coated Metal Conduit: Furnish and install rigid steel conduit with external PVC coating, 40 mil [0.1 mm] thick meeting the requirements of NEMA RN, ANSI C80.1 and steel fittings and conduit bodies meeting the requirements of ANSI/NEMA FB 1; with external PVC coating to match conduit.

Ensure that only tools designed for use on PVC coated material are used and the workmen performing the installation are trained and skilled in the installation and use of PVC coated conduit and fittings.

508-12.5 Liquid-Tight Flexible Metal Conduit: Furnish and install liquid-tight flexible metal conduit of interlocked steel construction with PVC jacket and fittings meeting the requirements of ANSI/NEMA FB 1.

508-12.6 Nonmetallic Conduit: Furnish and install schedule 80 PVC conduit meeting the requirements of NEMA TC 2 and fittings and conduit bodies meeting the requirements of NEMA TC 3.

508-12.7 Fiberglass Reinforced Epoxy Conduit: Furnish and install rigid non-metallic fiberglass reinforced epoxy conduit and fittings manufactured in accordance with the applicable standards of ANSI and NEMA TC-14B.

Ensure the conduit has a bell and spigot type coupling and the coupling seal is made rigid utilizing an adhesive that will provide a water and vapor tight joint with a tensile strength equal to that listed for the conduit. An alternative type assembly may be used utilizing a triple seal ribbed gasket of E.P.D.M. rubber material. The gasket will be held firmly in place with a compatible adhesive.

Ensure that all fittings, adapters, and bends are manufactured from the same materials as the conduit and conform to the dimensional requirements of NEMA TC-14.

Use only fiberglass reinforced epoxy conduit and fittings made by the same manufacturer to insure proper fit and assembly, listed on the UL approved list and labeled for Type I service (sizes 2 - 6 inches [50 mm to 150 mm]).

Ensure that each piece of conduit and fitting is clearly mark with durable contrasting ink, stenciled with the following:

1. Nominal size,

2. Mark bends to show the degree and radius of curvature,
3. Type: SW or HW,
4. Manufacturers name or trademark.

508-12.8 Building Wire and Cable: Use only SE or RHW on incoming service unless otherwise noted in the plans and use single conductor with THHW/THWN insulation unless otherwise noted in the plans for all other installations.

Ensure that no wire smaller than No. 12 AWG is used for power and lighting circuits and no smaller than No. 14 AWG for control wiring, except that control wiring within a cabinet may be No. 16 AWG. Ensure that the minimum field wire is size No. 12 AWG.

Use No. 10 AWG for 20 A, 120 V, branch circuit home runs longer than 75 feet [23 m], and for 20 A, 277 V, branch circuit home runs longer than 200 feet [60 m].

Furnish insulated conductors of seven or nineteen strand copper, minimum 98% conductivity and connector accessories for copper in sufficient quantities for a complete installation. In cases of low-level audio or digital signals, use twisted shielded pairs when required.

508-12.9 Identification: Number and tag all interconnecting circuits between motors, brakes, limit switches, control desk, control panel, etc., in accordance with the wiring diagrams. Use tags of rust resistant metal or other durable material, and neatly paint or stamp the numbering thereon. Equip all junction boxes with numbered terminal blocks.

508-13 Motor Control Center or Motor Controller.

Furnish and install Motor Control Center, complete with all equipment as shown on single line diagram in plans and control panel and motor controllers as required.

508-14 Control Desk.

508-14.1 General: Furnish and install Control Console as shown in the plans.

508-14.2 Illumination: Illuminate the top of the control desk by a low wattage incandescent lighting unit with a dimming switch. Ensure that the intensity, the mounting, and the shielding of the unit is such as to give sufficient light for the operation of the bridge, without glare in the operator's eyes, and without obscuring the action of the indicator lights.

508-14.3 Assembly, Testing, and Finish: Ensure that the electrical manufacturer assembles, completely wires, and factory tests the control desk. Provide a finish, for other than the stainless steel portions, similar to that specified for the Motor Control Center.

508-15 Submarine Cable Assembly.

508-15.1 General: Furnish and install bridge submarine cable assembly and bridge submarine cable termination cabinets complete with disconnect type terminal blocks. Make all connections to new bridge submarine cables. Provide necessary clamps to secure bridge submarine cables to pier wall. Bridge submarine cable installation includes lying in trench, protective conduit sleeves on bascule or rest piers, termination boxes, and clamps. Unless otherwise show in the Contract documents, furnish three types of cables as part of the submarine cable assembly, a power cable, ground cable, and a signal and control cable.

Furnish and install signal and control cable with 60 conductors, armored, comprising 50 # 12 AWG and 5 # 14 AWG twisted shielded pairs (highest voltage on any circuit connected to this cable will be 120 V).

Furnish and install power cable with 24 conductors, armored, comprising 12 # 4 AWG and 12 # 10 AWG.

Furnish and install single conductor # 4/0 AWG ground cable (no steel armor).

When the installation requires more conductors than those included in one cable, use multiple cables of the type required. Furnish enough conductors to satisfy the project requirements plus 25%.

508-15.2 Submarine Cable Termination Cabinet: Furnish and install NEMA Type 4X stainless steel submarine cable cabinets equipped with hinged doors and constructed of ample size and arranged so that terminal strips, supports and other devices are readily accessible for maintenance, repair, and replacement. Ensure that only disconnect type terminal strips are installed. The general arrangement and shape of the cabinet will be such as to fit in with the scheme of installation, which will be approved by the Engineer. Furnish space heaters with humidistat control; adjust to turn ON at 80% relative humidity.

508-15.3 Protective Sleeves: Securely fasten PVC (schedule 120) Protective conduit sleeves to the face of the piers. Ensure that the sleeves extend a minimum of 5 feet [1.5 m] above mean high tide and 5 feet [1.5 m] below mean low tide levels. Seal both ends of the sleeves to prevent water from getting into it.

508-16 Bascule Pier Lighting.

508-16.1 General: Furnish and Install lighting fixtures complete with lamps of the number, type, and wattages shown on the plans.

508-16.2 Fluorescent Fixtures: Furnish and install fixtures with hinged frames with latches, and 1/8-inch [3.175 mm] thick virgin acrylic lenses. Ensure each industrial type open-tube fluorescent fixture is equipped with spring loaded telescoping sockets or lamp retainers (two per lamp).

508-16.3 Exterior Fixtures and Accessories: Furnish and install enclosures complete with gaskets to form weatherproof assembly, equipped with low temperature ballasts, with reliable starting to 0E F [-17.8E C].

508-16.4 Lamps: Furnish and install incandescent lamps: clear, rough service, brass base, rated 130 V.

Furnish and install incandescent reflector lamps of the shape as shown in the plans with brass base rated 130 V.

Furnish and install warm white fluorescent lamps all by same manufacturer.

Furnish and install high pressure sodium HID lamps suitable for all burning positions.

508-16.5 Ballasts: Furnish and install ANSI C82.1 high power factor type, labeled Certified Ballast Manufacturers (CBM) certified by Electrical Testing Laboratories (ETI). Ensure the ballasts are Class P and have a sound rating "A." Ensure the fixtures and ballasts are designed and constructed to limit the ballast case temperature to 90E C when installed in an ambient temperature of 100E F [37.8E C].

508-16.6 HID Ballasts: Furnish and install ANSI C82.9 constant wattage autotransformer (CWA), high power factor type, unless otherwise shown in the plans. Ensure the ballasts are designed to operate on the voltage system to which they are connected and are designed for installation in a normal ambient temperature of 105E F [40.6E C].

Ensure that the ballasts are constructed so that open circuit operation will not reduce their average life. Use high pressure sodium (HPS) ballasts with a solid-state ignitor/starter with an average life in the pulsing mode of 10,000 hours at ignitor/starter case temperature of 75E C. Average life is defined as the time after which 50% will have failed and 50% will have survived under normal conditions.

508-16.7 Photocell Switch: Furnish and install hermetically sealed cadmium sulphide cell rated for the system voltage with single throw contacts rated 1,000 watts. Ensure the unit turns ON below 3 foot candles and OFF at 3 to 10 foot candles.

Furnish and install a time delay to prevent accidental switching from transient light sources. Mount a directional lens in front of the cell to prevent fixed light sources from creating a turn-off condition. Aim the unit according to manufacturer's instructions.

508-16.8 Incandescent Emergency Lighting Units: Furnish and install self-contained units with a plastic enclosure, lamps to indicate AC on and recharging, rechargeable storage batteries, charger,

lamps and a TEST switch to test the system. Provide each unit with an automatic power failure device, test switch, pilot light, and fully automatic high/low trickle charger.

Furnish and install sealed wet-cell type batteries, with 1-1/2 hour capacity to supply the connected lamp load, that operates unattended, and are maintenance-free for a period of not less than 10 years. Emergency lighting units must be rated for 12V, except units having no more than two (2) unit-mounted lamps may be rated 6V.

Furnish and install a dual-rate charger, capable of maintaining the battery in a full-charge state during normal conditions, and capable of recharging discharged battery to full charge within 12 hours. Provide minimum 12 watts lamps, sealed beam type in plastic housing.

508-17 Indicators.

Furnish and install indicating lights on the control desk to show the fully opened and fully closed positions of each traffic gate and traffic barrier and each span lock; and the fully opened, fully closed, nearly opened, and nearly closed positions of each leaf. Provide position indicators to show the position of each leaf through all stages of span operation. Provide indicators consisting of moving pointers or LED's approximately 4 inches [100 mm] long, operating over a fixed, graduated scale mounted on the control desk.

508-18 Spare Parts.

Furnish the following:

a. A minimum of one set of contact fingers for every ten of each kind or size of contacts installed, including limit switch and controller contacts.

b. A minimum of one operating coil for every ten of each size contactor installed.

c. A minimum of one relay for every ten of each kind and size of control, timing, or overload relay installed.

d. A minimum of three heaters for every ten thermal overload relays of each size.

e. Other spare parts as called out in individual sections.

Provide spare parts in sealed, uniform-sized cartons, with typed and clearly varnished labels to indicate their contents, and store in a portioned lockable box. Provide a directory of permanent type describing the parts. The directory must state the name of each part, the manufacturer's number, and the rating of the device for which the part is a spare. Mark the spare parts to correspond with their respective item numbers as indicated on the elementary wiring diagram. Plastic laminate the schematic diagrams for the control console and store in the same cabinet.

508-19 Standby Generation System.

508-19.1 General: Furnish, install and place in permanent operating condition a diesel engine-driven stand-by generation system the size and capacity as shown on the plans at an elevation of less than 600 feet [180 m] above sea level, with ambient temperatures between 20º and 100º F [-7º and 38º C]; continuous rating using engine-mounted radiator. The complete system must be assembled by one manufacturer and supplied as a package.

Ensure the package includes engine-generator set, automatic regulator, automatic transfer switches, load bank, standard water cooling system, residential exhaust system, water circulating system, an electric starter with battery and battery charger, provision for remote start push-button located on bridge control console, exerciser and remote fuel tank.

Provide certification from the generator manufacturer that the available starting capacity of the proposed unit is adequate for the requirements of the connected load. If the generator size is changed, change the load bank. Ensure the load bank is 50% of the generator's kW rating.

508-19.2 Engine: Furnish a water-cooled in-line or V-type, four stroke cycle, compression ignition diesel internal combustion engine, with an idle speed of 1,800 RPM. Ensure this unit is equipped

with suitable spring-type vibration isolators and mounted on a structural steel base. Ensure the engine has the capacity to operate at 10% overload for one hour at the specified elevation and ambient limits. Ensure the engine is designed to use of No. 2 fuel oil.

Ensure the engine is equipped with engine shutdown on high water temperature, low oil pressure, over speed, and engine over crank, these limits will be as selected and set by the manufacturer.

Provide DC starting system with positive engagement starter motor, with remote starting control circuit and manual-off-remote selector switch on the engine-generator control panel. When required by the manufacturer, provide a thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90E F [32E C], and suitable for operation on 120 V_{ac}.

Provide a radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110E F [43.3E C] with radiator airflow restriction of 0.5 inches [12.7 mm] of water maximum.

508-19.3 Alternator: Ensure the system is equipped with a ANSI/NEMA MG 1, 3 phase, 4-pole, 12 lead, reconnectible brushless synchronous generator with brushless exciter rated: as shown in the plans, at 0.80 power factor, 60 Hz, with ANSI/NEMA MG 1, Class F insulation and temperature rise of 105E C. continuous.

Directly connect the stator to the engine flywheel housing and the rotor drive through a semi-flexible driving flange to ensure permanent alignment.

508-19.4 Batteries: Provide heavy duty, diesel starting type lead-acid storage batteries, 170 A-hours minimum capacity. Ensure the battery voltage is matched to starting system. Provide all necessary cables and clamps and a plastic coated metal or wooden tray treated for electrolyte resistance.

508-19.5 Battery Charger: Provide a current limiting type designed to float at 2.17 V per cell and equalize at 2.33 V per cell, in a wall-mounted NEMA Type 1 enclosure. Include overload protection; full wave rectifier, DC voltmeter and ammeter, and 120 V_{ac} fused input.

508-19.6 Line Circuit Breaker: Provide a molded case circuit breaker on the generator output with integral thermal and instantaneous magnetic trip in each pole sized as shown in the plans, mounted in NEMA Type 1 enclosure. Include battery-voltage operated shunt trip and connection to open circuit breaker on engine failure.

508-19.7 Fuel Supply: Provide a fuel tank large enough to hold fuel for 12 hours of operation at 100% load, minimum 50 gallon [190 L], with all supports, guards, sunshades, loading valves, and other features required by local codes and ordinances. Provide the tank with a sight-level gauge, in the location approved by the Engineer. Provide a fuel level switch with contacts for remote alarm when 25% of fuel or less remains in the tank. Provide 10 gallon [40 L] day tank, these 10 gallons [40 L] will not be used to calculate fuel tank size. Sleeve the supply line in PVC through walls and provide loops or flexible connections at expansion joints and near the engine to absorb vibration. Do not use copper piping. Ensure the fuel tank is completely full at the time of final acceptance.

508-19.8 Transient Protection: Provide a regulator to protect the generator from transient spikes generated by SCR devices.

508-19.9 Grounding: Provide positive equipment ground for all system components.

508-19.10 Automatic Transfer Switch: Provide an automatic transfer switch of the size and voltage as indicated in plans.

508-19.11 Automatic Sequence of Operation: Initiate time delay to start stand-by engine generator upon initiation by normal source monitor. Ensure that the time delay to start stand-by generator is adjustable.

Upon initiation by normal source monitor and permission by stand-by source monitor initiate transfer of load to stand-by source. Ensure that the time delay before transfer to stand-by power source is adjustable.

When drive motors are not energized initiate retransfer of load to normal source and ensure that the time delay before transfer to normal power is adjustable and bypass time delay in the event of stand-by source failure.

Ensure that the time delay before engine shut down is adjustable, as per engine-generator manufacturer's recommendation.

Ensure that the engine-generator exerciser will start engine-generator every 7 days and run for 30 minutes before shutting down and will by-pass the exerciser control if normal power source fails during exercising period.

508-20 Lighting Protection.

Furnish and install a lightning protection or static charge dissipation system, a surge suppression system, bonding, and grounding as indicated in the plans. Ensure the point discharge system is per NFPA 780.

Select all materials to assure compatibility with each other and with the bridge structure using 300 series stainless steel throughout the system.

Ensure that all joints in the system are controlled thermal weld connection as per Cadweld or Thermoweld (not field brazed). Bolted connections, when required, must use an anaerobic adhesive for thread sealing and locking.

508-21 Surge Suppression and Grounding.

Provide surge suppression and grounding systems as indicated in plans. Do not use aluminum conductors.

508-22 Method of Measurement.

The quantity to be paid for will be at the Contract lump sum price, completed and accepted.

508-23 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section, including furnishing and installing all equipment and materials.

Payment will be made under:

Item No.	508- 1-	Electrical Equipment - lump sum.
Item No.	2508- 1-	Electrical Equipment - lump sum.