SECTION 508
ELECTRICAL CONSTRUCTION FOR MOVABLE BRIDGES

508-1 Description.

Furnish and install an electrical system for the operation of movable bridges, in accordance with the details shown in the plans. Install electric motors; electrically operated brakes; safety gates; traffic lights; warning bells and horns; navigation and pier lights; lights for control house and machinery platforms; limit switches; resistors; control panel with the required circuit breakers, fuses, conductors, relays, etc.; lighting panel board; control desk with the required controllers, meters, switches, push button stations, indicator lights, etc.; transformers; submarine and parkway cable; conduit; wiring and other electrical parts or equipment; together with the necessary clamps, bolts, hangers, etc., for proper installation as shown in the plans or required for the operation of the movable span and safety devices.

508-2 Power Source.

When obtaining electric power from an external source, refer to the Contract Documents for the approximate location of the service pole or manhole. Refer to the plans for the size 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. Furnish the special control drawings for a particular job as listed in 508-3.2. Incorporate these 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: Furnish the following drawings:

1. Motor Control Center:

a. Assembly drawing, with front and end views, which gives the necessary dimensions and notations to permit proper equipment installation.

b. Approximate location of all apparatus on the front and at the rear of the panel.

c. The size of the individual panels, showing segregation for shipment.

d. Approved engraved metal nameplates with designation as to function of the apparatus mounted on the front of the board.

e. 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.

2. Control Console:

a. Assembly drawing, which gives the necessary dimensions and notations to permit the proper installation.

b. Location of all apparatus, approved nameplates with designation as to function of the apparatus.

c. Bill of material and apparatus furnished with the desk.

d. Necessary terminal and terminal blocks clearly designated and notations as to special construction, finishes, etc.

3. 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.

4. A wiring diagram showing the detailed wiring of the panels and controllers, listing all apparatus furnished under this Section, with terminals, etc., properly identified and coordinated.

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

508-4 Materials and Equipment.

Except where the Contract might permit or specifically require the use of other than new equipment, such as might be specified to be furnished by others, provide only materials and equipment of new stock produced by established, reputable manufacturers of electrical equipment, meeting NEC and UL requirements, and approved by the Engineer.

508-5 Motors.

508-5.1 Main Drive Motors: For the main drive motors, provide totally enclosed, weatherproof, crane type, wound rotor induction motors, with oil ring lubricated sleeve bearings or an approved prelubricated and sealed ball bearing design. Provide motors having a maximum running torque of not less than 275% of the full load torque and the capability of developing twice the full load torque for a period of three minutes without electrical or mechanical damage. Ensure that each main motor has a tapered shaft extension for the motor mounted brake and a straight shaft extension on the drive end, unless a pinion is to be mounted directly on the motor shaft, in which case furnish a tapered shaft. Provide wound rotor motors with primary and secondary conduit boxes of adequate sizes.

508-5.2 Accessories and Insulation: Use motors with a suitable bracket to support motor mounted brakes. Use main drive motors that are 30 minute rated in accordance with current NEMA standards. Use only motors provided with inorganic insulation in accordance with current NEMA standards. Ensure that both the mechanical and electrical designs for all motors are suitable for exposure to the excessive moisture conditions incident to the application. Provide a drain plug.

508-5.3 Testing of Main Motors: Perform standard factory short commercial tests on all main motors in accordance with the Standards of the American Institute of Electrical Engineers. Furnish three copies of certified test reports on the short commercial test of each machine and prints of complete test performance curves of one machine, or a machine of an identical design, to the Engineer.

508-6 Controllers and Resistors.

508-6.1 Controllers:

508-6.1.1 General: Provide a separate semi-magnetic reversing controller for each main motor or power unit if two motors are shown to operate as a unit. Provide each controller with at least six power points and a drift point in each direction with an off position reset. Arrange interlocking so that only the first three power points are available after reaching the nearly-open and nearly-closed positions of the span.

508-6.1.2 Operation: Operate the controller with a horizontal handle with positive stop at the off position and at each drift point.

508-6.1.3 Location: Place the controllers in the control console with handles mounted near the front center. Provide brass operating heads and handles plated with heavy chrome.

508-6.2 Resistors: Ensure that the resistors for the main motors are heavy intermittent duty, as defined by NEMA No. 151, and provide approximately 25% full load motor torque for break away on the first power point of the controller. Use non-corroding, edge wound type resistors provided with heavy-duty terminals mounted on the frame for main connections. Provide a permanent resistor section to give approximately 6% slip at rated load and voltage.

508-7 Brakes.

508-7.1 For Main Motors: Provide each main motor with a motor-mounted, spring-set shoe brake, released by a three phase thrustor with adjustable setting time feature, sized as shown in the plans.

508-7.2 Machinery Brakes: Where shown in the plans, provide three phase, thrustor operated, floor mounted machinery brakes, duplicate as to features, construction, etc., of the motor brakes. Size machinery brakes as shown in the plans.

508-7.3 General Requirements: Equip all brakes with corrosion resisting fittings and with a drip proof and splash proof enclosure with ventilation louvers, arranged to be lifted as a unit from the brake. If the plans call for water tight brakes, construct the enclosing case of welded steel sheets of at least 1/8 inch [3 mm] thickness, and divide the case diagonally so that the brake mechanism will be accessible from above when the upper half of the cover is removed. Construct the joint between the two halves with a neoprene gasket at least 1/4 inch [6 mm] in width, and hold it in place by embedding it in a groove or other approved means. Hold the cover in place by heavy hinge bolts and wing-nuts with the hinge-bolts attached to the lower half of the enclosing case. Provide the motor brakes and the machinery brakes with hand release levers or mechanisms built as integral parts of the brakes. Provide the motor brakes with electric interlocking switches to prevent power from being applied to the main motors with the brakes in the manually released position. Ensure that all brakes have satisfactory means of adjusting torque and taking up the wear.

508-8 Interlocking.

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

1. Set warning lights and bells.
2. Lower all safety gates and all traffic barriers.
3. Pull locks.
4. Release brakes.
5. Open span.

For closing the spans, reverse the sequence.

Make provision for bypassing the interlocking for emergency operation, with sealable heavy duty tumbler switches, semiflush mounted on the control desk.

508-9 Limit Switches.

508-9.1 For Motors: Provide cam type limit switches to stop the main drive motors at the fully open, nearly open, and nearly closed positions, and to stop the lock bars at the fully pulled and fully driven positions. Provide a single foot operated, spring opening switch for fully closing and fully opening the leaf with limited power.

508-9.2 For Span Lock and Traffic Gates: Provide plunger type, fully closed limit switches (or other accurate types if approved by the Engineer) for interlocking the control with the span lock and traffic gates, and also for indicating the fully closed position by means of lights on the control console. Provide switches that have an adjustable plunger with snap action contacts. Ensure that the switch mechanism changes the contacts within 1/4 inch [6 mm] movement of the operating plunger. Only provide limit switches that are of watertight construction and fully enclosed.

508-9.3 Gearing and Coupling: The machinery manufacturer will provide gearing and coupling when required for the leaf and span lock limit switches.

508-10 Traffic Gates.

Meet the requirements shown in the plans and specified herein. Obtain the Engineer's approval of the gates before installing them.

508-11 Traffic Lights and Bells.

508-11.1 Design and Location: Locate traffic lights and warning bells as shown in the plans. Provide warning bells that are either motor-driven or have an approved equal drive mechanism, and are

equipped with 12 inch [300 mm], bell metal gongs. Place the drive mechanism in a water tight enclosure provided with a drain hole.

508-11.2 Switches: Operate the traffic lights, the warning bells, and the safety gate lights by a single circuit. Provide a limit switch in each off going gate to break the bell circuit when the gate is fully closed.

508-12 Navigation Lights and Horn.

508-12.1 Navigation Lights: Meet the regulations of the Department of Transportation, U.S. Coast Guard. Provide lighting units of the types shown in the plans. Ensure that they are aluminum or bronze castings, rugged in construction, and weatherproof, with corrosion resistant fittings.

508-12.2 Horn: Place a fully weatherproof electric horn on the roof of the control house. Provide a horn of the type shown in the plans.

508-13 Conduit and Wiring.

508-13.1 General: Place all conductors in conduit. Provide conduit of standard galvanized rigid steel. Ensure that each joint of the conduit bears a UL stamp of approval. Install all runs of conduit on a slope, and make provisions for drainage. Support the conduit at intervals of approximately 5 feet [1.5 m]. Only use rugged and corrosion resistant conduit fittings and supports on exposed conduit runs. Use back straps or stand offs to keep the conduit far enough away from supporting surfaces to allow painting and to prevent the accumulation of dirt and moisture. Make adequate provisions for the expansion and contraction of long conduit runs, and install expansion joints when deemed necessary by the Engineer. If placing the conduit in concrete, or in other locations, if specifically approved by the Engineer, the Contractor may use high-impact, PVC, Schedule 40 conduit, with a UL stamp, provided that the Contractor provides a satisfactory grounding system. Provide all conduit passing through an expansion joint of the structure with an effective expansion joint at the structural joint.

508-13.2 Insulation: Use interconnecting conductors with UL approved Type RHW or THW insulation.

508-13.3 Conductor Sizes: Provide conductors of such sizes that the voltage drop through the feeders does not exceed 3% for combined lighting and power load and that the voltage drop at any point in the system does not exceed 5% of the rated voltage at that point. Do not use conductors smaller than No. 12 AWG.

508-13.4 Flexible Connections: Where flexible connections are necessary, generally use extra flexible conductors. Use flexible conduit or basket weave armor to provide mechanical protection. Terminate submarine cables in sealed fittings at junction boxes provided with terminal blocks.

508-13.5 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.

508-13.6 Grounding: Bond all noncurrent carrying metal frames of the electrical apparatus and machinery together, and connect them to the system ground. If the system ground is inadequate, the Engineer may also require driven ground rods. Provide conduit lines used for grounding with jumpers or approved equal grounding devices on the expansion joints.

508-14 Motor Control Center or Control Panel.

508-14.1 Equipment Arrangement: Refer to the wiring diagram in the plans for the general arrangement of the equipment involved, its connection, and control. For any equipment not specifically described, arrange the equipment in accordance with the best practice, and obtain the Engineer's approval.

508-14.2 Location and Installation: Place the control panel in the operator's house. Enclose the panel in a free standing NEMA Type 12 cabinet, having panel type hinged doors with internal hinges and sectionalized lift off panels on the rear. Use approved fasteners to hold the doors in place. Externally

operate the feeder circuit breakers, and mount them on a separate section behind a non-hinged panel. Apply two coats of red chromate primer and two coats of dull finish air drying lacquer to both the inside and outside of the cabinet. Ensure that the painting materials and procedures are in accordance with the manufacturer's standard practices. Paint the outside black or gray and the inside light gray, unless otherwise approved by the Engineer. Arrange the apparatus on the control board to provide a neat appearance and ready accessibility for inspection and maintenance.

508-14.3 Assembly and Testing: Provide a control panel that is completely factory assembled, with all the required devices fully wired and factory tested with the control desk to check the correct functioning and sequencing of the control system. Ensure that the detailed apparatus is of the type and rating specified or shown in the plans, or approved equal. Identify all devices mounted on the switchboard with approved, easy to read, engraved metal nameplates.

508-14.4 Individual Circuit Protection: Provide individual circuit protection by air circuit breakers for the main driving motors and brakes, lock and wedge motors, safety gates, and heater circuits for the control desk and the control cubicle.

508-14.5 Additional Circuit Protection: Provide reverse phase protection on the incoming lines, and provide overload and low-voltage protection for each of the drives. Provide magnetic-type relays that include an instantaneous overload trip for the main drive bridge motors. Also, provide thermal overload type relays for all auxiliary drives. Ensure that sensitive relays, whose action would be hampered by dust, have special coverings.

508-14.6 Heaters and Light Receptacles: Furnish suitable heaters, receiving power from the lighting circuit, to keep the equipment above the dew point. Install porcelain receptacles for lights in the control panel.

508-15 Control Desk.

508-15.1 Design and Construction: Design and construct a cabinet type control desk of 0.125 inch [3 mm] steel. Provide corners that are ground smooth or well rounded. Construct the desk top, including the sloping back section, of non-glare stainless steel. Design the back section to slope 30 degrees or more from a horizontal front section. Mount the meters and position indicators on the sloping section. Mount the controller handle and operating switches on the horizontal section. Identify all devices with easy to read, engraved metal nameplates. Conveniently mount the controller, terminal board, etc., on the desk. Design the front of the desk with a large double door, and the ends with either doors or removable panels. Use hinges of the concealed or flush-mounted type. Provide opening handles of a type and mounting that, in the closed position, will not protrude far enough to catch the clothing or hamper the movements of the operator. Provide a pocket for instruction books and drawings on the back of one of the doors. Form the pocket approximately 3 inches [75 mm] deep by 10 inches [250 mm] high and of a width determined by the door width and clearances.

508-15.2 Illumination: Illuminate the top of the control desk by a fluorescent, or approved equal, lighting unit (or units) with a 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.

508-15.3 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.

508-16 Submarine Cable.

508-16.1 General Requirements: Provide submarine cable of the nonlead type with a neoprene jacket and galvanized steel wire armor. Use UL approved Type RHW insulation. Choose an insulation thickness in accordance with IPCEA requirements for non-leaded submarine cable.

508-16.2 Neoprene and other Materials: Use neoprene meeting the requirements of ASTM D 4247. For other materials and construction, meet IPCEA and industry standards.

508-16.3 Installation: Install submarine cables, as shown in the plans, and securely clamp them to the structure to eliminate sway. Terminate the armor in fittings which will support the cable by clamping armor strands. Use these fittings to prevent the entrance of water into the cable. Refer to the plans for additional details and location information.

508-17 Lights.

Install conduit fixtures, complete with lamps and conveniently located wall switches, over all machinery units and at all platforms and stairways. Place a suitable ceiling light fixture, with a concealed light source, and a wall switch in the control house.

508-18 Indicators.

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 approximately 4 inches [100 mm] long, operating over a fixed, graduated scale mounted on the control desk. Also, provide vernier pointers to show the span movement through at least the last ten degrees of opening and closing.

508-19 Spare Parts.

Furnish and store conveniently in boxes two sets of coils and contacts for each different size contactor on the switchboard and also one thrustor motor for each different size thrustor brake. Also, furnish 12 extra indicator lamps.

508-20 Engine-Generator Unit.

508-20.1 Generator: If specified in the plans, furnish an engine-generator of the indicated size and voltage.

508-20.2 Testing: Furnish three copies of the electrical manufacturer's Standard Commercial Test Report to the Engineer. Ensure that the rating, tests, etc., are in accordance with IEEE standards.

508-20.3 Voltage Regulator: Provide a voltage regulator for the generator, of quick-acting, dynamic, or semistatic type, or other approved design, complete with stabilizer, transformers, etc. Ensure that the regulator has sensitivity of 5% or better.

508-20.4 Engine: Provide a four cycle, diesel operated engine, having a rated output of at least 25% greater than that required to operate the generator and equipped with a complete electric starting system (starter, battery, and charging unit), muffler, radiator, and fan; governor for close regulation; and all necessary accessory equipment such as water, oil, and fuel pumps; oil, fuel, and air filters; flywheel; carburetor with choke control; and a 20 gallon [75 L] fuel tank.

508-20.5 Battery Charger: Provide a battery charger to charge the diesel engine starting battery. Use a charger capable of charging the battery from completely discharged to fully charged in not over eight hours and having provisions for automatically (and independently if more than one battery is involved) stopping the charge when the battery is fully charged. Use a charger suitable for operation from 120 V, single-phase, 60 Hz.

508-20.6 Control Information: If the supplier of the engine generator is not also the control manufacturer, furnish the control manufacturer with all necessary information for the proper control of this unit and data for the wiring diagrams.

508-21 Method of Measurement.

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

508-22 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.