

## **ITEM 599.33 10 – BRIDGE ELECTRICAL SYSTEM**

### **DESCRIPTION**

- (a) The work shall consist of completing and placing into satisfactory operating condition some of the remaining Bridge Electrical System components not installed on the initial contract. The major pieces of equipment or systems covered include but are not limited to the six navigation lights, service lighting equipment, CCTV System including cameras and monitor, intercom telephone system, Marine Radiotelephone and Miscellaneous AOB.
- (b) Most but not all cables and conduits have been installed leading toward completion of the remaining Bridge Electrical System.
- (c) The Bridge Control System Vendor was Link Control Systems, Inc., 16 Colt Court, Ronkonkoma, NY.
- (d) An existing intermittent operational error exists causing error messages on the console and stopping of the north bascule span causing the need to restart and raising. This is to be corrected.

Plan Sheets 402, 423, 429, 397, 408, 409, 421, 422, 423, 424, 425.

### **MATERIALS**

#### **Conformance**

- (a) All electrical equipment and its installation shall conform to the requirements of the latest revision of the Standard Specifications for Movable Highway Bridges of the American Association of State Highway and Transportation Officials, except as may be otherwise provided herein.
- (b) Materials and construction shall conform to the requirements of the current National Electrical Code (NEC), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratory (UL), and to any applicable local rules and ordinances. The Contractor shall obtain any required permits and approvals of all Departments or Agencies having jurisdiction.

#### **Equipment and Material Provisions**

- (a) All equipment and materials shall be new. All equipment, materials, and workmanship shall be first-class in every particular and shall be manufactured and erected to the satisfaction of the Engineer. The Contractor shall warrant the in-service working of the electrical installations for one-year following project acceptance. If the Contractor has any objection to any feature of the electrical equipment as designed and laid out, he must state his objection at once in writing to the Engineer, otherwise his objection will be ignored if offered as an excuse for malfunctioning of the equipment or for defective or broken apparatus.
- (b) Each piece of electrical equipment and apparatus shall have a corrosion-resisting metal nameplate on which is stamped the name of the manufacturer and the rating or capacity of

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the equipment or apparatus.

- (c) All metal parts of the installation, except structural steel, shall be of corrosion-resisting material, such as aluminum, bronze, or stainless steel. Cast-iron, malleable iron, or steel with a hot-dip galvanized finish shall be used where specified herein. Structural steel shall conform to the requirements given under Section 564 of the New York State Department of Transportation Standard Specifications.
- (d) All mounting hardware and all wire and cable terminals shall be vibration proof.
- (e) If any departures from the Plans or the Specifications are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted for approval as soon as possible. No such departures shall be made nor work started without approval of the Engineer.
- (f) Material requirements for specific apparatus, equipment, and materials are found in the articles under "Construction Details" in this item.

## **CONSTRUCTION DETAILS**

### **Conduits and Wireway**

- (a) Except for multi conductor, jacketed cables, all wiring shall be installed in conduit or stainless steel wireway as shown in the Plans.
- (b) All conduits shall be standard weight, threaded, rigid steel conduit conforming to the requirements of ANSI Standard C80.1. All conduits shall be hot-dip galvanized, inside and out, to meet the requirements of the above standard for protective coating. Conduit couplings and fittings shall be made of malleable iron or steel, hot-dip galvanized.
- (c) All conduits to be installed in outdoor locations shall be plastic coated as hereinafter specified. Conduit fittings, including couplings, unions, elbows, expansion and deflection fittings, and other items, shall also be plastic coated. Conduits and fittings, which are to be plastic coated, shall be provided with a factory-applied polyvinyl chloride (PVC) coating in the following manner. The exterior of the galvanized rigid steel conduit or fitting shall be coated with an epoxy acrylic, heat-polymerizing adhesive not to exceed 0.1mm. A PVC plastic coating, 0.8mm to 1mm thick shall be bonded to the outside metal surface the full length of the pipe, except for the threads. The plastic coating shall have an 85+ Shore A Durometer rating and conform to NEMA RNI-1998 (Type A), ASTM D746, and Federal Specifications LP406b, Method 2051, Amendment 1 or 25 September, 1952. A two-part red urethane, chemically cured coat shall be applied to the interior of all conduit and fittings. This internal coating shall be at the nominal 2-mil thickness and shall be sufficiently flexible to permit field bending without cracking or flaking. The Plasti-bond, PVC coated, hot-dip galvanized steel conduit shall be UL labeled and listed.
- (d) All hollow conduit and fittings, which serve as part of the raceway, shall be coated with the same exterior PVC coating and red interior urethane coating. The plastic exterior coating

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and the red interior urethane coating shall be factory applied by the same manufacturer who produces the hot-dip galvanized conduit. PVC coated conduit shall be installed in accordance with the manufacturer's installation manual.

- (e) Unions to connect sections of conduit that cannot be joined to each other or to boxes in the regular manner shall be of malleable iron or steel, hot-dip galvanized, PVC coated.
- (f) Conduits shall not be less than 19mm in diameter. The interior surfaces shall have a smooth finish and be free of burrs or projections, which might cause injury to the cables. All conduits shall be free from blisters, cracks, or injurious defects and shall be reamed at each end after being threaded. Sections shall be connected to each other with screw couplings made up so that the ends of both conduits will butt squarely against each other inside of the coupling. Conduits shall be installed to be continuous and watertight between boxes and equipment. Conduits shall be protected at all times from the entrance of water or other foreign matter by being well-plugged overnight or when the work is temporarily suspended.
- (g) Conduit bends and offsets shall be made by cold bending using approved methods and equipment. The use of a pipe tee or vise for bending conduit will not be permitted. Conduit, which has been crushed or in any way deformed, shall be discarded. All bends shall be long sweep, free from kinks, and of such easy curvatures as to permit the drawing of conductors without injury. Conduit runs shall be made with as few couplings as standard lengths will permit, and the total angle of all bends between any two boxes or cabinets shall not exceed 90 degrees, unless otherwise approved by the Engineer. The radius of curvature of pipe bends shall not be less than eight times the inside diameter of said conduit. Long running threads will not be permitted. Pull boxes shall be used whenever necessary to facilitate the installation of the wire.
- (h) Except for installation indoors in the operator house or where specifically permitted by the Engineer, condulets or conduit bodies shall not be used for pulling conductors or for making turns in conduit runs or for branching conductors. Condulets or conduit bodies, where permitted, shall consist of malleable iron castings with gasketed covers of the same material and fastened with brass cover screws. The bodies shall be hot-dip galvanized.
- (i) All conduits in the operator house shall, wherever practicable, be concealed in the walls, ceilings, or floors. Where conduits pass through the floors or walls of the houses, they shall be cast-in-place, or they shall be provided with galvanized pipe sleeves for free passage of the conduits. After the conduits are installed, the openings shall be caulked with an elastic compound and escutcheon plates provided on the interior walls, ceilings, and floors.
- (j) Conduits and wireway shall be securely clamped and supported at intervals not exceeding 1.5m in length.
- (k) Conduit and wireway runs exposed on the steel structure shall be securely clamped to the steelwork. The conduit clamps, in general, shall consist of U-bolts attached to structural steel supports bolted to the members. The wireway clamps, in general, shall consist of manufacturer recommended stainless steel bracket hangers attached to structural steel supports bolted to the members. The wireway cover shall be on the top or on the side of the

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wireway and be clear of opening obstructions. The minimum thickness of the structural supports shall be 10mm. Supports shall be arranged so that conduits and wireway rest on top of the support and conduit U-bolts rest on top of the conduits. The use of J-bolts to fasten structural supports or to clamp conduits will not be permitted.

- (l) All U-bolts and bracket hangers shall be provided with medium-series lock washers and hexagonal nuts. The bolts, nuts, and washers shall be of stainless steel conforming to the requirements of the Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes, ASTM Designation A276, Type 316.
- (m) Where conduits and wireways are to be mounted exposed on non-steel surfaces, they shall be securely clamped to the surface using bent plate pipe supports with back spacers held by not less than two bolts. The stock size for the bent steel plate supports shall be 6mm thick by 51mm wide. Back plates shall be of 10mm thick steel. Supports and spacers shall be hot-dip galvanized. Bolts shall be not less than 13mm in diameter and shall be of stainless steel conforming to the requirements specified for U-bolts.
- (n) At any point where a conduit crosses an expansion joint longitudinally or where movement between adjacent sections of conduit can be expected, conduit expansion fittings shall be installed. The fittings shall be bronze expansion fittings and shall be provided with flexible bonding jumpers to maintain the electrical continuity across the joints. The fittings shall permit a total conduit movement of 203mm and shall be Engineer approved equal to the O.Z./Gedney Type EX, Spring City Type EF, or the Crouse-Hinds Type XJ.
- (o) At any point where a conduit crosses a joint laterally or where an offsetting type movement between adjacent sections of conduit can be expected, expansion and deflection fittings shall be installed. The fittings shall permit a movement of 19mm from the normal in any direction. The fittings shall be the O.Z./Gedney Type DX, Spring City Type EDF, Adalet Type STX, or Engineer approved equal.
- (p) Flexible conduits for the connections between the rigid conduit system, all motors, and limit switches shall be made with sections of PVC coated, flexible, metallic, liquid tight conduit. Each section shall not exceed 457mm without prior approval of the Engineer.
- (q) All conduit embedded in concrete, insofar as possible, shall be completely encased by concrete of not less than 76mm, measured in any direction, and shall be securely held in place during pouring and construction operations. A group of conduits terminating together shall be held in place by a template.
- (r) All conduit, wireway, and fittings shall be carefully examined before being installed, and all pieces having defects shall be set aside and removed from the site. All conduit bends shall be made with standard size conduit elbows. Conduit shall be assembled hand tight and then using strap wrenches tightened two more turns. Wrench marks or chuck marks shall be touched up with the appropriate touch-up compound. All cuttings and threading shall be performed as recommended by the conduit manufacturer. All conduit, enclosures, and fittings shall be mechanically joined together to form a continuous electrical conductor to provide effective electrical continuity.

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- (s) Ends of abandoned conduits, spare conduits/wireway, and empty conduits/wireway and stubs shall be capped during and after construction, and care shall be taken to ensure that no moisture or other matter is in or enters the conduits.
- (t) All conduits shall be pitched not less than 25mm in 3.5m (except by special permission). Where conduits cannot be drained to pull boxes, a drain "T" with drain fitting shall be installed at the low point and drained to a 0.028 cubic meter dry well of broken stone. Drain fittings shall be of stainless steel and shall be capable of passing 25 cc of water per minute.
- (u) The ends of all conduits projecting into boxes and equipment enclosures shall be provided with bronze insulated grounding bushings. The insulated portion shall be of molded phenolic compound, and each fitting shall have a screw type combination lug for bonding. Insulated bushings shall be the O.Z./Gedney Type RBLG, Spring City Type GB, or Engineer approved equal manufactured by Appleton. All bushings in any box or enclosure shall be bonded together with No. 8 AWG bare copper wire.
- (v) All conduits and wireway shall be carefully cleaned both before and after installation. Upon completion of the conduit and box installation, the Contractor shall clear each conduit by snaking with a steel band, to which shall be attached an approved tube cleaner equipped with a mandrel of a diameter not less than 85 of the nominal inside diameter of the conduit and with a wire brush of the same diameter as the conduit, and shall then draw in the cables.
- (w) Both ends of each conduit or wireway run shall be provided with a brass tag having the same number stamped thereon in accordance with the conduit diagrams, and these tags shall be securely fastened to the conduit ends with No. 20 AWG brass wire.
- (x) Separate conduits or wireways shall be furnished and installed to carry the circuit wiring to all span driving motors.
- (y) All wireways shall be 16 gauge 304 stainless steel bodies with covers and oil-resistant gasket and adhesive. The flanges shall be 10-gauge stainless steel. Wireway fittings, nipples, and elbows shall be 304 stainless steel. A solid oil-resistant gasket shall be positioned between flanges when sections and fittings are bolted together.
- (z) Wireways shall not be less than 102mm x 102mm. The seams shall be continuously welded and ground smooth. There shall be no holes or knockouts. The edges on all sections and fittings shall be smooth and rounded to prevent damage to cable and conductor insulation.
- (aa) The wire way covers shall have heavy butt hinges and external screw clamps to assure complete seal between covers, gaskets, and bodies.
- (bb) When wireway enters an enclosure, a box connector shall be used on the inside of the enclosure to ensure a tight and stable seal. Closure plates shall seal the end of wireway sections or runs.
- (cc) At any point where a wireway crosses a joint, where an offsetting type movement between adjacent sections of conduit can be expected, or where movement between adjacent sections

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of conduit can be expected flexible wireway fittings shall be installed. The fittings shall be the wireway manufacturer's recommended fitting.

- (dd) All conduits projecting into boxes and equipment enclosures shall be provided with water tight, weather proof, insulated throat conduit hubs. The conduit hubs shall be Meyers Watertight Rigid Conduit Hubs or Engineer approved equal.

### **Boxes**

- (a) All surface mounted pull, junction, and terminal boxes shall be of type 316 stainless steel, and shall be provided with full length hinged gasketed, covers held with stainless steel fast operating clamps to provide NEMA 4X watertight construction. They shall be Engineer approved equal to the Hoffman bulletin A4S or equivalent by Weiggman or Hammond.
- (b) All flush mounted pull, junction, and terminal boxes shall galvanized cast iron, and shall be provided with gasketed flat covers to provide NEMA 4 watertight construction. The boxes shall be Engineer approved equal to the O.Z./Gedney Type YF, Spring City Type HP, or the Appleton Type WHF, except with stainless steel cover screws.
- (c) Interior and exterior boxes shall be provided with external mounting lugs and shall be fastened in position with stainless steel through bolts. Stainless steel boxes shall be provided with stainless steel conduit hubs. Cast iron boxes shall be bossed, drilled, and tapped to provide not less than five full threads for conduit ends and fittings. No box shall be drilled for more conduits or cables than actually enter it. Exterior boxes shall be provided with drain fittings of the same type as specified for conduit drains.
- (d) All boxes shall be sized in accordance with the requirements of the National Electrical Code.
- (e) Terminal boxes shall be of sufficient size to provide ample room for the terminal blocks and interior wiring and for the installation of conduit terminations and multi conductor cable fittings. Interior mounting buttons with tapped holes shall be provided for mounting the terminal blocks.

### **Hardware and Supports**

- (a) Supports for conduits, wireways, cables, boxes, cabinets, disconnect switches, small limit switches, and other separately mounted items of electrical equipment shall be fabricated from structural steel not less than 10mm thick. Clip angles and other supporting members, which are fabricated from structural steel plates and shapes and bolted to the structural members, shall be included with the structural steel. All other supporting members shall be included under the electrical work.
- (b) Structural steel brackets, boxes, and other equipment mounted on concrete surfaces shall be provided with a full neoprene gasket not less than 1.5mm thick between the equipment and the surface of the concrete.
- (c) Expansion anchors for fastening equipment or brackets to concrete surfaces shall be wedge type anchor bolts, which shall be locked in place by an expansion wedge as the nut is

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tightened. All parts of the expansion anchors shall be of Type 303 stainless steel. Holes for the anchors shall be drilled to the size and depth recommended by the manufacturer using carbide tipped masonry drills.

- (d) Mounting bolts, nuts, washers, and other detail parts used for fastening boxes, disconnect switches, small limit switches, conduit clamps, cable supports, brackets, and other electrical equipment shall be of stainless steel conforming to the requirements of ASTM Designation A276, Type 316. Bolt heads and nuts shall be hexagonal and shall be provided with medium-series lock washers. Bolts smaller than 13mm in diameter shall not be used, except as may be necessary to fit the mounting holes in small limit switches, boxes, and similar standard devices.
- (e) Usage of beam clamps for supporting conduits, boxes, or other equipment shall not be acceptable without prior approval of the Engineer.
- (f) Preformed metal framing channels, such as Kindorf, Unistrut, Superstrut, etc., will not be acceptable for mounting or supporting electrical equipment, conduits, or boxes.

### **Wiring and Cables**

- (a) Except where otherwise noted, wiring in conduits shall be single-conductor. Multi conductor cable shall be used for flexible cables and submarine cables.
- (b) All wires and their insulation and covering shall be of a nationally recognized brand, acceptable to the Engineer, and shall have marks always used on the particular brand for identifying it.
- (c) All wiring and cables shall conform to the requirements of NEMA Publication No. WC7-1982. Before wire and cable orders are placed with any manufacturer, the Contractor shall submit for approval typical published test data for the type of insulation proposed, showing that it meets the requirements of NEMA Publication No. WC7. All materials used to fabricate insulated wiring and cables shall be certified to be from stock not more than 1 year old.
- (d) All conductors shall be of stranded copper large enough to carry safely the maximum currents required without injurious heating or serious voltage drop. Conductors shall not be smaller than No. 12 AWG, except as approved for control panel and console wiring or for lighting fixtures. All conductors shall be soft-annealed copper wire conforming to the requirements of NEMA Publication No. WC7. All conductors shall have Class B concentric stranding, except for conductors in flexible cables.
- (e) The insulation shall be a chemically cross-linked, polyethylene compound conforming to the requirements of Part 3.7 of NEMA Publication No. WC7. The thickness of insulation shall be that required for 600 volts rated circuit voltage listed under Column A of Table 3-1. Insulation type shall be Type XHHW-2.
- (f) Equipment ground conductors shall be bare, stranded, coated copper conforming to the requirements of NEMA Publication No. WC7, Part 2.

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- (g) The circuits across the navigable channel shall be carried in armored multi-conductor submarine cables, which is defined under the submarine cable item 10599.1304M.
- (h) Single conductor wiring, including the insulating material, shall be tested to demonstrate that it meets specified requirements. The testing shall be done as stipulated in NEMA Publication No. WC7, Part 6. Wiring and cables shall not be shipped from the plant of the manufacturer until certified test reports on the cable properties have been approved by the Engineer.
- (i) The conductor sizes and number of wires shown on the Plans are the minimum permissible. The Contractor shall provide wiring and cables of sufficient size and number as may be required for the installation in accordance with the wiring diagrams on his approved working drawings. In each conduit and multi conductor cable containing ten or more conductors, at least one spare wire shall be provided for every ten conductors actually used.
- (j) Wiring shall not be installed in any conduit before all joints are made up tightly and the conduits rigidly secured in place. The drawing of cables into conduits shall be done without injury to the wires or their insulation or covering. No lubricant of any kind shall be used for the pulling of wires, unless specifically authorized by the Engineer. Sufficient slack shall be left in all cables to permit proper connections in boxes, cabinets, and enclosures.
- (k) Both ends of every single length of conductor shall be permanently and clearly tagged in accordance with the same numbers or designations appearing on the approved wiring diagrams. Wire tags for marking the conductors shall be heavy duty, waterproof, permanently marked, and resistant to ultraviolet light deterioration. Numbers and letters shall be black or blue on a white background. Each tag shall be either pre-marked or blank and marked using self-laminating markers with legends added with permanent ink as required. The Contractor shall submit the proposed wire marking system and a sample of the wire markers to be installed to the Engineer for approval. Each conductor, except control and instrument conductors, shall be color coded with colored insulation. Color coding for 120/208 volt conductors shall be black for phase A or 1, red for phase B or 2, blue for phase C or 3, white for neutral, and green for equipment ground. Color coding for three phase 240 volt conductors shall be brown for phase A or 1, orange for phase B or 2, yellow for phase C or 3, gray for neutral, and green for equipment ground. Each conductor shall be marked at panelboard gutters, pull boxes, outlet and junction boxes and each load connection and shall include each branch circuit or feeder and control wire.
- (l) Conductors inside terminal boxes, the control console, and control panels shall be neatly formed into cables and laced with approved cable ties, with the individual conductors leaving the cable at their respective terminal points. These conductors shall be looped to allow not less than 76mm of free conductor when disconnected. The formed cables shall be held securely away from the terminals and from contact with the enclosure by means of approved insulating supports.
- (m) All outgoing wires, No. 8 AWG or smaller, in the control console and control panels and in terminal boxes shall be connected to terminal blocks of molded phenolic compound.

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Terminals shall be of screw type suitable for use with solderless, ring tongue, wire connectors. Connectors, which extend beyond the ends of terminal block barriers, shall be furnished with an insulating sleeve covering the metal part of the connector. Taping of extended terminals will not be permitted.

- (n) Each terminal of all terminal blocks shall be permanently marked to show the same number or designation as appears on the wire connected thereto.
- (o) Splicing of wires will not be permitted, except for wiring to service lighting fixtures and receptacles. Wherever it becomes necessary to joint or branch conductors, terminal blocks shall be used, and wires shall be clearly tagged.
- (p) Multi conductor cables supported on the steelwork shall be secured thereto by bent plate cable clamps spaced not more than 1.5m on centers. The cable clamps shall be fabricated from stainless steel plates bent to suit the cables' outside diameters. In general, the clamps shall be fastened to structural brackets bolted to the steelwork. Structural steel brackets and other supporting members bolted to the steel work shall conform to the requirements given under Section 564 of the New York State Department of Transportation Standard Specifications.
- (q) Where multi conductor cables enter the control console or any cabinets or boxes, they shall be provided with watertight cable terminators. Each cable terminator shall provide a watertight seal by compressing a tapered neoprene-sealing ring around the outer jacket of the cable. Cable terminator parts shall be made of bronze and shall be approved equal to the Series SF-327OB Watertight Cable Entrance Seals as made by O.Z./Gedney.
- (r) The Contractor shall take insulation resistance readings on all circuits installed, with electronic equipment disconnected, and furnish to the Engineer a complete record of the results obtained. These circuits shall include connected motors when tested. Conductors rated 600 volts, or more, shall be one (1) megohm, or more. Defective circuits shall be replaced at the Contractor's expense.
- (s) Flexible cable for specified connections shall be rubber-insulated, multiple-conductor portable cords conforming to the requirements of NEMA Pub. No. WC3, Part 7.7 or NEMA Pub. No. WC8, Part 7.4 for hard service. Each cable shall be provided with a heavy-duty neoprene jacket conforming to the requirements NEMA Pub. No. WC3, Part 7.7.5.1 or NEMA Pub. No. WC8, Part 7.4.5.1. Flexible cables shall conform to the National Electrical Code, Article 400 for hard service. Flexible cables shall be provided with strain relief fittings and basket weave cable grips at each end. Strain relief fittings shall be malleable iron, liquid tight strain relief fittings. The cable grips shall be stainless steel, heavy long, closed wire mesh, single weave with a double eye support. All mounting hardware shall be stainless steel.

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### **Navigation Lights**

- (a) Navigation lights shall be provided in accordance with the rules and regulations of the United States Coast Guard as shown on the Plans.
- (b) For all navigation pier lights, the doors and lenses shall be gasketed, and each entire unit shall be completely weatherproof and vandal resistant. Fittings shall be non-corroding, and the sockets shall be of porcelain mounted on shock absorbers. The housings for all units shall be cast-bronze, and a 100-watt 120-volt, 5-year lamp with brass base shall be installed in each socket.
- (c) The bascule span lights shall be controlled by the fully open limit switches so that the green lights shall show when both leaves are fully opened, and the red lights shall show at all other times.
- (d) All bascule lights shall be equipped with dual lamps, transfer relays, and bronze junction boxes.
- (e) Each span navigation light shall be equipped with lamp out feature. Each fixture shall illuminate a small beacon lamp on the fixture when a lamp needs to be replaced.
- (f) There are eight bascule span navigation lights installed, two per leaf. The lights shall be combination red/green lights and shall change from red to green when the span is fully open.

The housing shall be of cast bronze and shall be suitable for marine environment. Construction shall be rain-tight and fully gasketed. The light assembly shall be designed for heavy duty, long life service. Design shall provide ready access for lamp service.

The lens shall be heat-resistant fresnel glass. Lens sections shall be 180 degrees red over 180 degrees green. Inside lens diameter shall measure approximately 178mm. Outside lens diameter shall measure approximately 203mm.

There shall be two lamps per section, for the transfer relay requirement, and each shall be 100W, 120V, A-19 shape, clear. Lamps shall have a rated life of 20,000 hours and shall be of a rough service design with multiple filament support fingers. Medium base receptacles shall be rated for 250V, 660W and shall be porcelain with a nickel-plated brass shell to resist lamp freezing.

Base shall be cast of the same material as the fixture head. Light assembly shall mount via four 12.7mm diameter bolts through the base, provided by installer to suit installation. A junction box shall be provided at the base of the unit. A cast junction box with gasketed access cover shall be provided. Junction box shall be of the same material as the fixture assembly and shall match the navigation light base footprint. Orientation of junction box shall be capable of rotation in 90 degree increments.

- (g) The navigation light system shall be controlled by photoelectric control device. The photoelectric control unit shall be a completely self-contained, weatherproof device rated

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1,800 VA at 120 volts and shall be provided with a time-delay feature and a deluxe, encapsulated lightning arrester for protection against surges and lightning. The unit shall provide turn-on of the pier navigation lighting system at 10.74-lux nominal. The unit shall be suitable for operation within a temperature range of -50 degrees Celsius to 70 degrees Celsius and shall have a fail-safe feature so that the lighting load remains energized in the event of component failure. The unit shall be suitable for installation in a twist lock receptacle with adapter for mounting on PVC-coated rigid metal conduit. Locate the photoelectric controller on the operator house above roadway level, as approved by the Engineer.

- (h) A two-position selector switch shall be provided on the control console for operating the rest pier navigation lights. In the "Auto" position, the lights shall be controlled by the photoelectric control device. The "On" position shall override the photocell and turn the lights on.

### **Service Lighting Equipment**

- (a) A complete system of service lights and receptacles shall be furnished and installed for the machinery areas, walkways, stairs, locks, and at other points where periodic maintenance and inspection is required outside of the operator house. Sufficient lighting shall be installed to provide adequate illumination in accordance with the Illuminating Engineering Society's recommended illuminance values for Control Rooms, Operator Stations and Maintenance Areas and satisfactory to the Engineer. Not less than the number of lights and receptacles shown on the drawings shall be provided.
- (b) Lighting distribution panelboards shall be furnished and installed for distribution of the service lighting circuits. Panelboards shall be provided for the Operator house, West rest pier, and East rest pier.
- (c) Each lighting panelboard shall be of the dead-front type and shall be provided with quick-make, quick-break, thermal-trip, E-frame, branch circuit breakers. Each breaker shall trip free of the operating handle, and the handle shall indicate the position of the breaker. Each panelboard shall be provided with a circuit breaker in the mains and with a full-sized neutral bar. All branch circuits shall be numbered, and a typewritten directory shall be provided on the inside of each door. Circuit breakers shall meet the requirements of UL Standard 489.
- (d) All panelboards shall be 120/208 volt, 3-phase, 4-wire panels surface or flush mounted as called out on the Plans. Panelboard enclosures shall be code gauge galvanized steel with ANSI 61 light gray enamel finish. Panelboards shall be approved equal to Westinghouse Pow-R-Line Series, General Electric A Series or Square-D Type QO.
- (e) All receptacles shall be 20-ampere, 125-volt, three-wire, grounding type, polarized, duplex convenience outlets. Ground fault receptacle outlets shall be installed in locations as shown on the drawings. Each receptacle shall be a yellow heat-resistant melamine body, flush or surface mounted in an outlet box, and shall be provided with a waterproof cover plate. Receptacles shall be specification grade Engineer approved equal to those manufactured by Hubbell, Arrow Hart or Leviton.

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- (f) All lights shall be controlled from tumbler switches as shown on the Plans. All tumbler switches shall be specification grade, 20-ampere, 125-volt switches. Switches shall be mounted in waterproof, cast-brass, surface mounted boxes. Switches shall be mounted 1.2 meters above the adjacent floor or platform. Switches shall be Specification Grade switches manufactured by Hubbell, Arrow Hart, Leviton or approved equal.
- (g) The Contractor shall furnish two portable hand lamps. Each hand lamp shall have 15m of extra-heavy, Type S0, three-conductor, No. 16 AWG cable. Each cable shall be provided with lamp holder, guard, half-shade, and molded-on rubber cap. A 100-watt rough service lamp shall be furnished with each lamp.
- (h) Lighting fixtures shall be as detailed and tabulated on the plans.
- (i) Battery-operated emergency lighting units shall be furnished and installed in the operator house, machinery rooms, and rest pier access areas. The lights shall be arranged to turn on automatically and instantaneously upon failure of the a-c power supply, and shall remain on until power is restored. Some have already been installed.
- (j) Each emergency light shall consist of three 12-watt, H-lamp, halogen lamps with a solid-state dropout circuit for instantaneous load transfer on A-C failure. The emergency power source shall consist of two sealed, long-life, 10-year minimum, lead-acid batteries, which shall be kept at full charge by a solid-state, pulse type battery charger. The battery shall have sufficient capacity to operate the specified lamps for a period of not less than 5 hours. All components shall be furnished a sheet-steel housing suitable for wall mounting and provided with a permanent conduit connection. Outdoor units shall be rated NEMA 4. Emergency lighting units known to meet the specified requirements are manufactured by Exide Electronics, Emergi-Lite, Dual-Lite, or Engineer approved equal.
- (k) The 3-way (dimming) light switch controls the lighting in the Operator House at the console level.

### **Camera**

The unitized camera/dome assembly shall be a self-contained unit that incorporates an integral color camera, pan-and-tilt motor, zoom lens and receiver/driver. The unitized dome/camera assembly shall be a Panasonic Model WV-CS854A or equivalent. The camera shall have a diameter of 114.3mm. The camera shall feature an advanced 6.35mm CCD with a built-in complimentary color filter and 768(H) x 494(V) pixels with microlens on each pixel. The camera shall be equipped with digital signal processing (DSP) to produce a high quality picture with a horizontal resolution of over 480 lines with a minimum illumination of 0.8 lux (f/1.6) in color mode; 0.06 lux (f/1.6) in black & white mode. The camera shall feature an infrared cut filter capable of being removed automatically upon low light threshold or manually. The camera's CCD shall be charged with long and short charges, creating both standard shutter speeds and fast shutter speeds simultaneously, on a single image field. The CCD shall automatically apply each exposure pattern to bright and normal areas. The camera shall feature a 28MHz 10-bit digital signal processor for image processing of both long and short signals, for a wide dynamic range of up to 64 times.

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The camera shall feature an image hold capability for retaining images during preset acquisition phase. The camera shall be equipped with an auto back light compensation and shall feature mask setting and level adjust capability. The camera shall be equipped with a built-in digital motion detector with mask setting and level adjustment as well. The camera shall also be equipped with an electronic sensitivity up feature to enhance camera performance in extreme low light conditions. The camera shall feature auto tracing white balance capability with a 48 section mask and level adjustment capability for accurate color reproduction. The unitized surveillance device shall feature an electronic shutter adjustable from 1/100 to 1/10,000 second. The camera shall feature an alphanumeric title of 16 characters.

The camera unit shall include 8 privacy zones that mask areas dynamically; the zones shall change size automatically with camera lens focal length and camera pan/tilt position. The privacy zone shall feature a supervisor override function. The camera shall feature titling for each of 8 areas, user-definable 16 character titles or preprogrammed camera position readout (North, NorthEast, East, SouthEast, South, SouthWest, West, NorthWest).

The Camera's zoom lens shall have a 6.35mm format and a focal length of 3.79-83.4mm (22.01X magnification). The zoom lens shall have an auto iris and auto focus feature that shall allow manual override if the need arises. The zoom lens shall provide continuous digital zoom (10X) for a total maximum magnification of 220.1X. The minimum aperture throughout this range shall vary from a minimum of f/1.6 at the wide angle setting to f/3.0 at the telephoto lens position.

The pan-and-tilt motor shall be a high-speed unit allowing 360° rotation with a tilt angle of 180°. The camera shall feature a direct drive motor assembly. Belt driven unitized camera units shall not be acceptable. The camera shall be equipped with a slip ring assembly having an optical interface and be rated for continuous operation. The Camera unit shall support digital flip technology for instant view of objects passing under the camera. The camera unit shall support continuous tilt movement through a 180° tilt range. Units with mechanical pivoting or rotation of imager assembly through the tilt range shall not be acceptable. The pan-and-tilt shall allow for preset sort and sequence rotation speed of 300° per second. The unitized surveillance device shall feature a minimum of 64 preset positions. The camera shall feature a built-in digital motion detector with a 48 section mask and level adjustment capability. The camera shall automatically sequence through the preset positions in logical programming order (sequence mode) or actual position (sort mode). The camera shall include 10 programmable scene files, each having a combination of special camera settings such as built-in digital motion detector and electronic sensitivity up. The camera shall be capable of scanning each preset position for motion at the preset position's scene, and delivering an alarm condition over a single coaxial cable or via RS-485 communications. The camera shall feature four (4) alarm inputs that may activate either of two (2) included, programmable outputs, activate a preset position or send an alarm signal to the multiplexer with control kit. These alarm signals may be send via multiplexed signal (over a single coaxial cable) or via the include RS-485 control communications interface. Any scene file shall be able to be assigned to a camera-preset position for optimum camera performance in difficult lighting conditions. The pan-and-tilt section shall feature automatic panning mode. The automatic panning limits and speed adjustment shall be selectable from an on-screen menu and not with mechanical or physical limit stops. The camera unit shall include a patrol feature in which a user-recorded pattern of pan, tilt and zoom settings may be replayed repeatedly. The dome assembly shall come pre-wired from the factory.

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The camera synchronization shall be internal, line-lock and VD (vertical drive) lock over a single coaxial cable. The video, camera control and synchronization signal shall be transmitted up to 915m over coaxial cable (Belden 9259 or equivalent). Equivalent coaxial cable used shall feature a DC resistance rating of less than 15 ohm/305m, solid copper center conductor and 95% braided, pure copper shield. The camera shall support multiplexed control communications (over a single coaxial cable) or camera control and data access via RS-485 communications. The camera shall be enclosed in an aluminum diecast housing that holds the IP52 drip proof environmental structure rating, and be UL listed. The power source shall be 24VAC, 60Hz at 18W. The camera shall be Panasonic Model WV-CS854A.

### **Multiplexor**

The outdoor pressurized dome camera housing shall be a Panasonic model PPF8C or equivalent.

The housing shall be specifically designed for the CCTV camera. The housing shall be capable of withstanding a total of 35 kPa of nitrogen gas injected through a Schraeder valve located on top machined aluminum plate. A pressure relief valve located across from the Schraeder valve will provide an escape for pressure exceeding 35 kPa. Two (2) o-ring seals shall be included, 3.45 x 235mm (inner diameter) and 3.45 x 114.3mm (inner diameter). A 10-pin hermetically sealed connector, located at the top of the pressurized housing shall provide power, video and control functions. The housing shall be constructed of 3.175mm durable engineered plastic, UV with a UL flame rating of 94V0. The lower dome portion shall be constructed of distortion-free cast acrylic (free blown) and be 226mm in diameter. The dome shall be held in place with minimum of (9) fasteners, and a safety cable shall be provided to hold the dome while servicing. Access to the enclosure shall be from below with (9) captive fasteners used to press the dome against a sealing o-ring. A twist-off feature shall allow for the final removal of the dome. The housing shall come standard with pendant mount.

The housing shall be provided with a wall mount bracket. The housing shall include a camera-mounting bracket that integrates a heater, blower, video and power surge protector capable of clamping differential mode voltage between 24-36V and common mode voltage from 54-72V. The housing shall be powered with 24VAC (60Hz) and have a power consumption not to exceed 68W including Unitized Camera. The blower shall draw 1.4W continuous power. The 50W heater shall turn on at 4.4°C and turn off at 15.6°C. The housing shall support a temperature range of -6.7°C to 49°C.

The duplex multiplexer with camera and VCR control functions shall be a Panasonic WJ-FS616 equal or better. The digital multiplexer shall permit multiplex recording of the images of 16 cameras with a single VCR, switching one to another field by field. The image of each camera shall be recorded with a minimum lapse, or can be played back in continuous moving pictures using a single VCR. The unit shall feature a built-in programmable switcher with dwell time and camera order programming. The unit shall automatically switch multiple camera images to enable sequential spot monitoring and simultaneous field recording. The unit shall feature separate spot and multiscreen monitor outputs. The unit shall offer full screen, 4, 7, 9, 10, 13 and 16 multiscreen monitoring modes with 720 x 486 pixel resolution and 8-bit digitizing. Manual spot selection shall also be available. When an alarm is triggered during time-lapse recording, the unit shall provide automatic field

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switching recording in the 2-hour/6-hour real time mode. The unit shall allow for the recorded images to be played back in full screen, 4, 9 or 16 multiscreen display mode. The multiplexer shall also feature multispot playback mode which combines all 3 primary multiplexer functions: playback, record and live multiscreen monitoring. In this mode, the unit shall feature playback from video tape recorder #1, displayed in the upper left corner display of 4, 7, 10 and 13 multiscreen modes. In addition, the duplex multiplexer shall feature live viewing of cameras on the remaining multiscreen views. In this mode, the unit may also be connected to a videotape recorder in record mode, featuring 3 multiplexer modes simultaneously. Freeze mode shall also be available for VCR playback. The multiplexer shall include front panel or remotely-controlled VTR functions, including record, play, reverse play, rewind, forward, pause, stop and recording time mode. These functions shall also be controllable by using optional system controllers. Up to four (4) multiplexers may be cascaded for a total system capacity of 64 camera inputs, four (4) multiscreen monitor outputs and 1 spot monitor output. The single spot monitor output shall display the video image from any of the 64 system cameras, via the optional system controller. The multiplexer shall provide access to all Panasonic camera control, set-up and alarm functions, including preset sort and sequence, digital motion detector mask set, electronic sensitivity up and back light compensation set-up. Controllable camera functions shall be accessible via front panel controls or the optional system controller. These functions shall include direct access of preset position, zoom (near/far), focus (near/far), iris (open/close) and pan (left/right). Camera functions and control shall be accessible for cameras 1-4 (included with base model). Camera set-up and control functions shall be accessible for cameras 5-8, 9-12, and 13-16 through the use of an optional control board kit (4 boards). In addition, cameras 1-4 shall feature cable compensation up to 915m with no loss of video or control signal degradation when using RG59U cable, Belden 9259 or equivalent. The multiplexer shall also provide 1/60 of a second refresh rate for 4 cameras at once (12/60 sec. for 9 screens, 16/60 sec. for 16 screens). 2X digital zoom and still features shall also be included with the multiplexer. The multiplexer shall feature dynamic alarm recording that will automatically record an additional field of a camera in alarm. The duplex multiplexer shall be able to be remotely controlled via the optional system controller, using 2 pair twisted and shielded cable. The unit shall provide digital display on the monitor and also recording of the following information: year, month, day, hour, minute and second, as well as alphanumeric camera location ID up to 8 characters. In addition to monitor display, the date and time shall be recorded on the tape. The multiplexer shall also feature video loss detection on all channels. The rear panel shall feature 16 video inputs, 16 alarm input connections, spot monitor output, multiscreen monitor output, RS-485 control connection, RS-232 interface connection, record output and playback video inputs, camera switching pulse input, alarm recover input and alarm output. The unit shall feature both video and S-Video (Y-C) inputs and outputs for recording purposes. The unit shall be rack-mountable and occupy two (2) EIA rack height units. The digital multiplexer shall not exceed 87mm H x 421mm W x 349mm D. Power source shall be 120VAC, 60Hz and it shall be UL listed.

### **Monitor**

The color video monitor shall be a Panasonic model WV-CK2020 or equivalent. It shall have a 20" diagonal screen with horizontal resolution of 500 TV lines center. The monitor shall feature manual controls for adjustment of picture and audio level. Terminals located on the back of the monitor shall be: 1 RCA audio input, 1 RCA audio output, 1 BNC video input, and 1 BNC video output. The monitor shall be UL listed. The dimensions shall not exceed 467mm H x 509mm W x 480mm D and its weight shall not exceed 21 kg.

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### **Intercom Telephone System**

- (a) A complete intercom system consisting of twelve stations shall be furnished and installed. The intercom system shall be an AC powered, common line system.
- (b) Each intercom unit shall consist of solid state amplifier, controls, and speaker/microphone in a sealed, submergence-proof cast aluminum case. Amplifier shall amplify both transmitted and received signals. Unit shall be operable with a 105 to 125-Volt AC 60 Hertz source and draw 9-VA at standby to 25-VA at a full output of 8-watts. Each unit shall be provided with a -50 degrees Celsius to +65 degrees Celsius operating temperature range, single knob volume control, and rocker type talk/listen switch normally set to listen, Intercom units shall be Model AD-27 as manufactured by Atkinson Dynamics or approved equal. The bench set intercom unit shall be Model AD-27T as manufactured by Atkinson Dynamics or approved equal.
- (c) Wiring for intercom power shall be as hereinbefore specified for single conductor wiring. Communication wiring shall be 16-gauge low voltage audio cable. When audio cables are installed in raceways with circuits serving equipment other than an intercom, wiring shall be twisted and shielded. Intercom circuits shall not be installed in raceways containing 480-volt motor circuits.
- (d) Component Locations:
  - (1) House Control Room (Upper Level) – One bench set unit
  - (2) House Electrical Room (Lower Level) – One wall mount unit
  - (3) Machinery Rooms – One wall mount unit in each room equals 4 units
  - (4) North Submarine Terminal Cabinet – One unit
  - (5) Northwest Auxiliary House – One unit

### **Marine Radiotelephone**

The marine radiotelephone for installation in the operator house shall be a limited coast station for monitoring and communicating with marine traffic. It shall be designed to transmit on Channel 13 (156.650 MHz) and monitor Channel 16 (156.800 MHz). It shall have a normal power output of 1 watt and maximum power of 10 watts. The radiotelephone shall be furnished complete with all appurtenances required for proper operation, including power supply, microphone, outdoor antenna, interconnecting cables, brackets, plugs, connectors, adapters, and other equipment.

### **Operational Error**

An issue with long wires was considered. It should not cause this problem since the wire length is only related to the drive/motor cross switching. We should remove that from the system. LIPA power drops out fairly often. The DC field power supplies can fail due to inductive spikes. This data is for information.

Most likely the cause of intermittent faults would be the Gemco 2120 bridge position display modules. One or two of the modules indicate an error. If it does the system does fault out because

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the PLC needs the position information. It's possible that one of the twisted shielded pair cables are picking up some intermittent noise and that is faulting the module. The only way to troubleshoot it is to first, make sure that the wires are properly routed in the various terminal boxes, and then run the bridge while observing the resolver module output with an oscilloscope. Eventually noise will be visible, and then either try to move the wiring in the terminal boxes or if necessary utilize the spare twisted shielded pairs in the submarine cables to try and eliminate the noise. This work could be performed by Link or others.

At completion of the work the entire operating system is to be tested to ensure error free operation. Any corrections required are to be performed as approved by the Engineer.

### **METHOD OF MEASUREMENT**

Payment shall be made on a lump sum basis.

### **BASIS OF PAYMENT**

The amount set forth in the proposal is a fixed price for all bidders. Any bid other than the specified amount shown on the itemized proposal will be adjusted to reflect the indicated fixed price and the Contractor shall only be entitled to payment for this item strictly in accordance with this paragraph.

Actual payment for the work performed under this item will be made in accordance with §109-05B *Force Account Work* of the Standard Specifications based on records submitted by the Contractor subject to review and approval by the Engineer.