ITEM 599.14010210 - BRIDGE ELECTRICAL SYSTEM REHABILITATION – MEADOWBROOK PARKWAY BRIDGE

DESCRIPTION

The work shall consist of removal and disposal or salvage of existing electrical components, as well as furnishing, installing, and placing in satisfactory operating condition the complete electrical equipment for permanent operation of the bascule span and its auxiliaries, together with service lighting and other electrical facilities, all as indicated on the Contract Plans. The major pieces of equipment or systems covered include, but are not limited to, the bascule leaf motors and brakes, auxiliary motors, direct current clutches, limit switches, programmable logic controller (PLC), power distribution equipment, control console, motor control center, service lights, navigation lights, direct current regenerative motor controllers, a complete conduit and wire system and monitoring equipment.

Shop drawings and Operation and Maintenance (O&M) manuals shall be provided as specified in this Specification.

MATERIALS

Basic Electrical Requirements:
It is the intent of this Technical Special Provision that only individuals of high competence and experience be utilized to perform the work of this Section. Unless otherwise specified, all manufactured items, fabrications, components, pieces, assemblies and appurtenances that are to be removed, salvaged, repaired, rehabilitated, furnished new, installed or reinstalled under these Contract documents is classified as electrical construction.

Provide Shop Drawings in accordance with NYSDOT Specification. Including but not limited to: detailed electrical and control system designs as required to fabricate and furnish the control equipment, define the installation and interconnection of the electrical equipment including all required interconnections with equipment furnished under other Sections, and test and verify that the completed electrical system’s installation and performance is satisfactory with respect to the requirements of this Specification.

Submit prior to purchase a complete list of all Electrical materials and equipment to be used including manufacturer’s catalog numbers, catalog data sheets, illustrations, and shop drawings, to the Engineer for approval.

Prepare detailed design plan drawings of electrical and control system conduit and wiring to provide the functionality specified in the Contract Documents. Provide signed and sealed drawings if proposed system differs from the Contract Documents. Proposed system must comply with the latest AASHTO Design Guideline Standard and NYSDOT requirements.

Furnish and install all wiring, cables, conduits, boxes, terminals, wiring devices, light fixtures, control panels, transmitters and indicators, controllers, relays, control equipment, disconnect and safety switches, and all other apparatus and accessories indicated, specified, or required to complete the control and lighting system for the bridge and as called out in the plans.
Furnish and install the connections to equipment furnished and installed under other Sections of this Technical Specifications.

Wiring and Conduit work includes runs to all light fixtures, automatic transfer switch, service and disconnect switch, motor control monitor equipment, motors, navigation lights, limit switches, position transmission and indication, and any other component necessary for a complete operating system.

Locate operating and control equipment to provide easy access, and arrange entire electrical work with adequate access for operation and maintenance as per the latest version National Electrical Code (NEC) and/or latest version NFPA requirements.

Electrical devices and equipment are shown symbolically on the design contract plans. The use of symbols and notations or the omissions thereof do not relieve the contractor for furnishing a complete and fully functional system. The intent of these specification and accompanying contract plans is to provide a complete and usable project. It shall be understood by the Contractor that contract plans are diagrammatic in character and any items which are clearly necessary for the completion of the work shall be considered a portion of the work even though not directly specified or shown on these documents and shall be provided at no additional cost to the Owner or Engineering firm.

Comply with all local codes, all laws applying to electrical installations in effect and with the regulations of the latest edition of the NEC, AASHTO, MUTCD and Coast Guard, where such regulations do not conflict with the laws in effect and with the requirements of the utility company.

**Conformance:**
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 (AASHTO), except as may be otherwise provided herein.

Materials and construction shall conform to the requirements of the current National Electrical Code (NEC), National Electrical Manufacturer’s Association (NEMA), Underwriter’s 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.

Material requirements for specific apparatus, equipment, and materials are found in the articles under “Construction Details” in this Specification.

**Protection of Electrical Equipment:**
Protect electrical equipment from water damage, rain, condensation, and water dripping or splashing on equipment and wiring, at all times during shipment, storage and construction (prior to final acceptance). Provide temporary electrical connections to equipment heaters, or provide temporary heaters, as required to prevent damage from moisture.
Provide climate-controlled environment for the storage of control equipment/assemblies during construction.

Thoroughly dry out and put through special dielectric tests any apparatus that has been subjected to possible damage by water or dampness (including the interiors of motor control equipment or any other electrical devices).

Protect equipment from damage from mishandling, dropping, or impact. Do not install damaged equipment.

Provide spare parts in sealed, uniform-sized cartons, with typed and clearly varnished labels to indicate their contents, store as directed by the owner. Also, provide a directory of permanent type describing the parts including 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 of this bridge.

Ensure spare parts are available at time of Functional Checkout. Replace spare parts used during Functional Checkout.

**Coordination of Electrical Work:**
The contract documents are diagrammatic in showing certain physical relationships, which must be arranged within the electrical work, and which must interface with other work including utilities and mechanical work.

**Materials and Equipment to be installed:**
Use only new materials that conform to the standards of the UL in every case where such a standard has been established for the particular type of materials and its intended application.

Furnish and install all new conduit, wiring, disconnect switches, controls and relays, wiring devices, boxes, terminal blocks, electrical identification, motor controls, etc. and supporting devices for a complete electrical installation on the bridge.

Ensure all electrical equipment used outside of the conditioned spaces of the Tender House is suitable for use in a marine (salt atmosphere) environment.

**Electrical Journeymen:**
Contractor shall provide a listing of pre-qualified electrical journeymen (electrical journeymen with a minimum of two movable bridge construction projects within the last five years) to perform the electrical work in accordance with this specification. Perform all such work either by, or under the immediate supervision of an electrical journeyman. For this project, “under the immediate supervision” means that the journeyman is in the immediate vicinity and physically involved in performing the electrical work. The journeyman’s knowledge, talents, and skills in performing certain critical work will be judged and approved by the Engineer and then the journeyman will do the actual work utilizing those talents and skills. Helpers are expected to aid the journeyman in the performance of the work and not to act as non-credentialed surrogates of a remote journeyman. Non-approved helpers may only perform tasks of a support nature that do
not directly involve responsibility for the installation, connection, or adjustment of electrical materials.

**Control Systems Integrator:**
Designate an individual such as the Control Equipment Supplier to act as the Project’s Control Systems Integrator. The Project Control systems Integrator shall serve as sole representative for the detail design, development, coordination, and testing of the equipment as called out on the contract plans. Ensure the Control Systems Integrator is qualified in developing and coordinating these types of Specialty Items. He will serve as a single point of contact prior to, during, and after construction, and must be available for consultation during all phases of the project, including Shop Drawing submittal and review.

Ensure the Control Systems Integrator is on site, directing all testing and commissioning of the new bridge equipment and systems.

The Control Systems Integrator must be a registered Professional Engineer licensed in the State in the electrical engineering discipline.

The Engineer will review the pre-qualification submittal of the Control Systems Integrator, and will be the sole judge of the adequacy of the information submitted. Inadequate proof of this ability and experience, or insufficient details, may be cause for disqualification.

**Tools and Procedures:**
Manufacturer Requirements: Install, apply, and adjust all electrical equipment and materials in accordance with the manufacturer’s recommendations including the usage of the manufacturer specified tooling. When such materials are UL, or other third party, listed or recognized, the tooling used for field installation must be the same as, or the manufacturer’s approved equivalent to, the tooling utilized in the approval testing.

**Quality Assurance:**
A. Tooling Identification: When applicable, the approved tooling will provide a suitable identification to the work to allow verification that the appropriate tool was used to perform the work. For example, use crimping dies that contain identification marks that emboss the crimps made with them with an identification embossment.

B. Quality Isolation: Where possible, the requirement to provide a level of workmanship quality is transferred to the tooling rather than the skills of the worker. As examples, but not limited to:
   a. Conductor Stripping: Depend upon the use of approved non-nicking strippers rather than the operator’s skill with knife edged stripping tools to prevent wire nicking.
   b. Crimp Tightness: Proper crimping will depend upon the exclusive use of controlled cycle crimping tools that require the proper degree of compression before releasing the work rather than upon the operator’s judgment of how hard the tool handle is being squeezed.
   c. Tie Tightness: Determine proper tensioning of cable and wrap ties by the use of the manufacturer’s specified calibrated tensioning tool rather than the operator’s judgment of what is “tight enough.”
d. Fastener Torque: Tighten fasteners with a recommended torque, where the proper tightness is important to the performance of the function (which includes all electrical terminals), with a calibrated torque (limiting) screwdriver or other torque-indicating tool.

**Test Equipment:**
Provide test and measurement instruments suitable to perform the required tests including ratings and measurement accuracy as specified by the manufacturer. Clearly indicate the exact make and model of instruments used and include manufacturer’s specification data indicating the suitability of the instrument’s specifications in all procedure submittals.

Do not use any test instrument unless it is calibrated and certified by an independent certification laboratory to the required accuracy and in accordance with the instrument manufacturer’s requirements within a maximum interval of the preceding 12 months. Certify all calibrations as traceable to the National Institute of Standards and Technology (NIST) or other recognized standardization authority.

Test instrument operating manuals and certification certificates must be available on the project site for reference by the Engineer whenever the instrument is being used or evaluated.

**Test Result Reporting:**
Where test or inspection data submittal is required by the articles of this Technical Special Provision, ensure the form(s) provided by the contractor to be used for recording and submitting the data are approved prior to performing the tests. Record the test results directly upon the approved forms as the tests are performed, recopying the data onto the forms from informal field notes is not acceptable. Record all data with ballpoint pen or other non-erasable and non-water-soluble writing media, strike-thru and initial errors or corrections in such a manner that the original is still readable.

Identify each measurement item or group of items with the measurement date and approximate measurement time to the nearest quarter hour.

Where the environment has an effect upon the measurements, such as insulation measurements, record the weather conditions including approximate temperature, rain/fair, and approximate relative humidity, on the form at appropriate intervals as determined by the changing meteorological conditions. Record wind velocity and direction for leaf related tests where the wind loading is a factor in the performance or results.

Identify each measurement item or group of items with the signature or initials of the approved measurement technician performing the tests. A separate sheet cross-referencing the signatures or initials to the printed name of the technician will accompany the submittal of the test results to identify the technician. The use of manuscript initials will be treated the same as the full signature and will constitute the technicians certification that the tests were performed in accordance with the submitted and approved procedures, utilizing approved test instruments, and that the results recorded are a true and accurate representation of the test conditions and results. Assume all testing will be witnessed by the owner or owner’s representative.
Record test instrument identification, including traceable serial number, for each measurement group. Include a copy of the Certificate of Calibration for the particular instrument in the submittal.

Have the Control Systems Integrator review and approve all test data submittals prior to submission to the Engineer.

Submit qualification information for the Control Systems Integrator, qualification information for Electrical Journeymen and Certificates of Calibration for test instruments.

**Working Plans and Shop Drawings:**
Contractor shall submit working plans and shop drawings to the engineer, as detailed in this Section. Clearly mark manufacturer’s standard drawings that indicate dimensions and options for more than one piece of equipment clearly indicating what data applies and striking out what data does not apply.

Provide a separate submittal package for each item unless otherwise indicated in this Section. Label each submittal package to indicate the Project Name, Pay Item number and Article number as listed in the Specifications. Label data sheets for individual components such as transmitters; limit switches, disconnect switches, etc. with the identification numbers shown in the Contract Documents or clearly state the item in tabular for on the shop drawings.

Submit all electrical submittal items in an individual separate three-ring loose-leaf binder or binders suitable for letter size sheets with opening/closing mechanism. Electronic submittal will be subject to owner and EOR approval. Provide a separate individual ring binder or binders for each set of submittal items. Include binder title sheet as first page having names of job and Contractor with second page as table of contents listing each submittal item in same sequence as specified.

Do not submit piece-by-piece submissions of individual components; submit all components of an assembly at the same time. Include shop drawings drawn to scale and certified by the manufacturer for major electrical equipment. Where one-line diagrams, wiring diagrams, schematic diagrams, interconnection diagrams, etc. are called for, they are to be site specific. Submittal approval will be on an “all or none” basis.

Provide complete resubmittals even if some items on the original submittals have not been marked deficient. Provide sufficient time in project schedule to allow for the possibility of repetitious submittals without creating delays to the project. Delays caused by repetitious submittals are not the responsibility of the owner.

**Shop Drawings:**
Submit complete conduit and cable layout drawings for conduit and wiring, including details of all conduit penetrations through structural elements, for review and approval of the Engineer. Include details of reinforcement in the penetration area on conduit penetration shop drawings. Submit full-size drawings showing all conduit runs between all pieces of equipment. Do not install any conduit until these drawings are approved.
Submit shop drawings for all new equipment detailing routing with dimensions, pull box locations, expansion joint fitting type and locations, and conduit support assembly details. Use a set of approved shop drawings (incorporate all review comments if approved as noted) and mark, in red, all circuit changes made in the field.

Maintain these construction shop drawings as working drawings for the duration of construction. Required working drawings include conduit routing plans, schematic diagrams, catalog cuts, assembly drawings, interconnection wiring diagrams, and conduit and cable schedules. Make working drawings available to the Engineer, on request, for review of construction issues.

Maintain a full set of working drawings on the job site at all times.

The working drawings must be available at the time of the Functional Checkout. Unavailability of the working drawings is sufficient reason to cancel the Functional Checkout.

**Electrical Material Submittals:**
Manufacturer’s standard descriptive catalog sheets are acceptable for “off the shelf” items, which require no modification for application on this project unless noted otherwise. For fused disconnect switches and automatic transfer switch, include outline drawings with dimensions, equipment ratings for voltage, capacity, horsepower, and short-circuit capacity. Provide manufacturers fuse curves (time/current on log/log graph) for each rating of fuse supplied and circuit breaker curves for each type supplied.

Provide a submittal for each type of motor. Include a motor data sheet indicating horsepower, voltage, FLA and LRA current, motor speed, NEMA frame size, insulation class, temperature rise, service factor, and any optional equipment or attachments such as tach-generator, encoder, thermal switch, or space heater in the motor submittals. Provide a motor torque-speed performance graph. Provide dimensioned outline, plan/elevation and wiring interconnection drawings. Include installation instructions, operation, and maintenance data with instructions for storage, handling, protection and starting of motors. Include assembly drawings, bearing data with replacement sizes, and lubrication instructions. Provide certified motor drawings to the machinery fabricator for coordination.

Provide catalog data for each type of strut, clamp, insert, and associated hardware; dimensional data for struts; and pullout data for anchors.

Provide catalog data sheets for each type of conduit and fitting and conduit layout drawings, showing routing and penetrations.

Provide catalog data sheets for each type and rating of terminal blocks, include voltage and ampere ratings, materials, and dimensioned outline drawings.

Provide catalog data for each type of identification device. Provide an engraving schedule for all laminated nameplates.
ITEM 599.14010210 - BRIDGE ELECTRICAL SYSTEM REHABILITATION – MEADOWBROOK PARKWAY BRIDGE

Provide the following for the Bridge Controls:

1. Manufacturer’s data sheets for all components (automatic transfer switch, disconnect switch, terminal blocks, switches, indicator lights, meters, transmission decoders, fuses, circuit breakers, sensors, current transformers, power monitors, etc.). Ensure all manufacturers’ data and recommended preventative maintenance procedures and materials are provided.

2. Dimensioned fabrication details for the ATS system, disconnect terminal boxes, and other enclosures including, to scale, equipment layouts, punch outs, nameplate schedules, and material list. Label all components, for which identification numbers have been provided in the Contract Documents.

3. A material list. Provide means of cross referencing the item identification numbers to the materials list by schedule or labeling the applicable catalog data sheets.

4. Engraving schedule for nameplates.

5. Schematic diagrams including field wiring. Assign wire numbers for each wire and include in the schematic and wiring diagrams of existing sections.

6. Dimensioned details for mounting of limit switches, proximity switches and field control devices.

7. Procedures for shop test and functional acceptance testing.

Provide the following for the Navigation Lights and Aids:

1. Include manufacturer’s data sheet for each new light to be provided, solar powered systems.

2. Provide dimensioned outline drawings for mounting detail and any mounting/adapter assembly or component.

3. Submit battery sizing calculations and operation and maintenance data.

Provide a Wiring and Interconnection Diagram for remote control and status panel for the ATS.

Make a submittal for the type lighting fixture. Include catalog data sheets including outline and dimensions as well as product description with ballast, fuses, mounting adaptors, etc. identified. Submit lamp data sheets for each fixture including photometric data.

MATERIALS AND EQUIPMENT

WIRE AND CABLES

Furnish only new materials that conform to the standards of the UL, in every case where such a standard is established for the particular type of material and its intended application. Prior to purchase of any materials or equipment required to be furnished and installed, submit a complete list of all such materials and equipment including manufacturer’s catalog numbers, catalog data sheets, illustrations, and shop drawings to the Engineer for approval.

Wire and cable routing shown is approximate. Route wire and cable, as required, to meet project conditions. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.
Definitions:
Power Conductor: Any wire that feeds power from the utility to the motor control center and to a field device (i.e. gate motors, span lock motors, traffic signals, etc.).

Control Circuit Conductor: Any wire that goes to a pilot device (i.e. limit switches, selector switches, indicating lights etc.).

Field Wire: Any wire that leaves the tender house or any of the electrical rooms or between electrical rooms. Consider the machinery areas to be outside the tender house.

Materials:
Single conductor insulated wire. Provide XHHW-2 rated 600 V_{AC} unless otherwise noted.

Use seven or nineteen strand copper, minimum 98% conductivity conductors for field wiring. Furnish connector accessories for copper in sufficient quantities for a complete installation. Do not use aluminum or solid copper conductors. In cases of low level audio or digital signals, use twisted shielded pairs when required.

Use no wire smaller than No. 12 AWG for power and lighting circuits and no smaller than No. 14 AWG for control wiring within cabinets.

Minimum field wire size is No. 12 AWG for control conductors between cabinets and field devices and No. 10 AWG for motor loads. Pigtails, no longer than 12 inch, are allowed for connection of field devices that cannot accommodate a No. 12 AWG wire. Use No. 10 AWG for 20 A, 120 V_{AC}, branch circuit home runs longer than 75 feet, and for 20 A, 277 V_{AC}, branch circuit home runs longer than 200 feet.
Maximum wire size allowed is 500 kimi, use parallel runs as needed for larger loads. Splices are not allowed. Use terminal blocks in enclosures for splicing.

Construction Details:
Installation includes placement, terminating, identifying, testing, and verifying each circuit and conductor. No splicing is permitted (except for “pigtail” leads and lighting circuits), use insulated terminal blocks rated for 600 V_{AC} in enclosures.

Do not mix power and control conductors in the same conduit.

If more than three current carrying conductors are in a conduit, derate the conductors per Table 310.15(B) (2) (a) of the NEC. For derating purposes, consider all power conductors, other than the ground conductors, as current carrying, this requirement does not apply to control wires. Tape uninsulated conductors and connectors with electrical tape to 150% of the insulation value of the conductor. Neatly train and lace wiring inside boxes, equipment, and panelboards. Place an equal number of conductors for each phase (three-phase system) of a circuit in same raceway or cable. Make conductor lengths for parallel circuits equal. Pull all conductors into a raceway at the same time.
Install two spare conductors, minimum, for long field runs to critical devices such as traffic gates, traffic signals, and all movable span mounted devices, etc.
Use soap base wire pulling lubricant for pulling No. 4 AWG and larger wire. Take precautions to avoid “sawing” through PVC conduit. Use only braided pull ropes. Do not pull bare conductors through PVC conduits except ground bond conductors. Swab conduit with an approved lubricant prior to pulling the conductors.

Test each circuit for continuity, insulation resistance, and short-circuits for its complete length before connecting to load. Verify identification numbers for the entire length of the circuit. Inspect wire and cable for physical damage and proper connection.

Perform the insulation resistance test at 1,000 V$_{DC}$ for 1/2 minute. Minimum insulation resistance for new conductors will be 100 M-ohms or greater. The Engineer will witness the test. Record the test results and submit to the Engineer for review prior to energizing the circuit. Include a Table of the test results with the “as-built” drawings with additional columns left blank for recording future readings.

**GROUNDING**

Ground and bond the electrical power and control system in accordance with NEC requirements. Furnish and install grounding conductors in every conduit. Secure to steel of every cabinet, including doors, and junction box and to grounding bushings of each new conduit.

**Materials:**
Use bare stranded grounding conductors sized in accordance with the NEC table 250.122.

Provide hangers and supporting devices as required by the NEC and this technical provision.

Provide stainless steel mounting bolts, nuts, washers, and other hardware used for fastening boxes, disconnect switches, devices, lighting outlet boxes, conduit clamps, and similar devices. Use hexagonal bolt heads and nuts. Do not use bolts smaller than 3/8 inch in diameter except as may be necessary to fit the mounting holes in small devices, outlet boxes, and similar standard equipment.

Provide PVC coated steel support struts and clamps to support PVC coated conduits. Furnish products listed and classified by UL as suitable for purpose specified and shown. Provide adequate corrosion resistance and ensure that the material selected for the hardware is compatible with the material of the device supported.

Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products. Minimum safety factor is 2.0. Provide stainless steel framework for supporting boxes, switches, and other externally mounted electrical devices.

For U-Channel strut systems utilizing bolted construction, provide 12 gage 316 stainless steel.
Construction Requirements:
Do not use powder-actuated anchors, drill or weld structural steel members. Use hexagonal bolt heads and nuts with spring lock washers under all nuts.

Fasten hanger rods, conduit clamps, junction boxes to structure using proper fasteners. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

Use stainless steel straps or hangers held at not less than two points for attachment to steel or concrete. Provide stainless steel concrete inserts.

Install surface-mounted cabinets and panelboards with minimum of four anchors. Fasten device boxes to the mounting surface with not less than two anchors.

Do not fasten supports to piping, ductwork, mechanical equipment, or other conduit. In addition, do not allow piping, or other trades to fasten to electrical conduits and supports.

Fasten hanger rods, conduit clamps, and outlet and junction boxes to structure using proper fasteners.
Ensure that cut offs are cut square, ground smooth and de-burred. Where PVC coated steel has been cut or the coating is damaged, coat the exposed steel with the manufacturer’s touch up coating, to the same thickness as the original, prior to installation.

CONDUIT AND RACEWAYS

Furnish and install conduit and raceways in the quantities and sizes required to complete the work as shown in the Plans. Where conduit size is not shown in the Plans, determine the size as required by the NEC but a minimum of ¾”. Furnish products listed and classified by UL for purpose specified and shown. Do not use non-metallic flexible conduit, aluminum conduit, or electrical metallic tubing (EMT). Use rigid galvanized steel (RGS) conduit indoors and PVC coated rigid conduit. Conduit and circuits indicated in the Plans, diagrams, and schedules may be recombined in the field where appropriate and as approved by the Engineer.

Materials:
PVC Coated Metal Conduit:
Hot dipped galvanized, inside and out, rigid steel conduit (ANSI C80.1) with hot galvanized threads and external PVC coating 40 mils thick; meeting the requirements of NEMA RN 1 and fittings and conduit bodies meeting the requirements of ANSI/NEMA FB 1 with steel fittings with internal and external PVC coatings to match conduit. Provide 40 mils thick PVC coating on the outside of conduit couplings and a series of raised longitudinal ribs to protect the coating from tool damage during installation.
Ensure the bond between the PVC coating and the conduit surface is greater than the tensile strength of the coating. Verify this bond by testing described in NEMA Standard RN-1, section 3.8.

Uniformly and consistently apply a nominal 2-mil thick urethane coating to the interior of all conduit and fittings. Conduit or fittings having pinholes or areas with thin or no coating are unacceptable. Protect all factory cut threads on conduit, elbows, nipples, and fittings by application of a urethane coating. The PVC exterior and urethane interior coatings applied to the conduit must afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F.

Furnish right angle beam clamps and PVC coated U-bolts supplied by the conduit manufacturer especially formed and sized to snugly fit the outside diameter of the PVC coated conduit. Supply all U-bolts with PVC encapsulated nuts that cover the exposed portions of the threads.

Ensure that only tools designed and approved by the conduit manufacturer for use on PVC coated materials are used and the workmen performing the installation are trained and certified in the installation and use of PVC coated conduit and fittings by the manufacturer. Any damage to the PVC coating is to be immediately repaired using materials supplied by the manufacturer. The repair will be reviewed by the owner and may be rejected and require replacement at no cost to the owner.

**Liquid-Tight Flexible Metal Conduit:**
UL 360 listed, interlocked galvanized steel construction, with integral ground continuity and PVC jacket. Use only PVC coated fittings, meeting the requirements of ANSI/NEMA FB 1.

**Construction Requirements:**
Use 1 inch minimum size Schedule 80 PVC or Reinforced Thermosetting Resin conduit for underground installations when installation is more than 5 feet from bascule pier wall. Use 1 inch minimum size Schedule 80 PVC conduit for underground installations.

Use 1 inch minimum rigid galvanized steel (PVC coated) for all outdoor locations, above grade, exposed (leafs) and exposed in dry locations (in pier, control house).

Install conduit in accordance with NECA Standard Practice and in accordance with manufacturer’s instructions.

Do not use plastic straps or plastic hangers. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary support.

Group related conduits; support using conduit rack. Construct rack using stainless steel channel; provide space on each for 25% additional conduits.

Use pull boxes wherever necessary to facilitate the installation of the conductors. Use insulated throat sealing conduit hubs to fasten conduit to sheet metal boxes. Use grounding hubs on all conduits. Avoid moisture traps; provide junction boxes with combination breather/drain fitting.
at low points in conduit system. Install all conduits so that they drain properly and provide drainage tees at low points where required.

Do not use condulets for pulling more than ten conductors or for making such turns in conduit runs or for branching conduits, except for indoor wiring to lighting fixtures and receptacles. Install bronze or alloy expansion fittings at every point where a conduit crosses an expansion joint, and where movement between adjacent sections of conduit can be expected. Arrange conduit to maintain headroom and present neat appearance. Route exposed conduit parallel and perpendicular to walls. Maintain adequate clearance between conduit and piping. Maintain minimum 6 inch crossing and 12 inch paralleling clearance between conduit and surfaces with temperatures exceeding 40°C.

Use flexible metal conduit only for the connection of motors, limit switches, and other devices that have to be periodically adjusted in position. Make connections between the rigid conduit system and all movable motors and movable limit switches with flexible metal conduit with couplings and threaded terminal fittings. Use only fully interlocked flexible metal conduit. Do not use flexible metal conduit extensions longer than 2 feet in length and provide with bonding jumpers. Install flexible metal conduit to drain away from the device it serves.

Provide both ends of each conduit run with a brass tag having a number stamped onto it in accordance with the conduit diagrams. Use bare copper wire to fasten these tags securely and permanently to the conduit ends.

Connect conduit sections to each other with approved couplings. Do not use aluminum couplings. Install conduits to be continuous and watertight between boxes or equipment. Protect conduits at all times from the entrance of water and other foreign matter by being capped or well plugged when the work is not being performed on it. Set conduits mounted exteriorly on parts of the steel work not less than 1-1/2 inch clear from the supporting structure to prevent accumulation of dirt. Space parallel horizontal conduit 1 inch apart and securely clamp to the steel work to prevent rattling and wear. Provide conduit supports at no more than 5-foot spacing and no more than 12 inches from box, fixture, or fitting.

Cut conduit square using saw or pipe cutter; de-burr cut ends. Clean and swab conduit after threading. Bring conduit to shoulder of fittings; fasten securely. Do not use long running threads. Tighten conduits until all threads are concealed by the cuff of the PVC coated fitting or coupling.

Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum. Provide embedded conduit stub-outs with threaded 316 stainless steel couplings.

Install no more than the equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inches. All field bends will be long sweep, with a radius 12 times the
diameter, and free of kinks to facilitate the drawing in of conductors without damage to the conductors. Make conduit runs with as few couplings as standard conduit lengths will permit.

Do not fill control wire conduits to more than 25% fill.

Use suitable caps to protect installed conduit against entrance of dirt and moisture. Upon completion of the conduit installation, clear each conduit with a tube cleaner equipped with a mandrel of a diameter not less than 80% of the nominal inside diameter of the conduit, and draw in the conductors. Provide suitable pull string in each empty conduit.

**BOXES**

Provide pull boxes and junction boxes where required and as shown in the plans, and at locations where more than eight conductors are gathered, and as required by the NEC.

**Materials:**
Ensure pull boxes, junction boxes, and all other miscellaneous housings used for pulling wires, terminating wires, or otherwise used to install electrical equipment, are NEMA 4X 316 stainless steel.

Provide drip proof enclosure opening with a rolled edge and cover held closed with clamps.

Provide enclosures larger than 12 inch in any dimension with a continuous stainless steel hinged cover with an oil and waterproof glued in neoprene gasket.

Provide sheet metal enclosures with O-ring sealing insulated throat hub connectors with ground bonding, drain and breather fittings, and not less than four mounting lugs.

**Construction Requirements:**
Install insulated bushings on conduit ends projecting into all boxes and enclosures. Do not drill box or enclosure for more conduits than actually enter it.

In locations exposed to weather use side or bottom conduit entries boxes only.

Use of wireways (metallic or non-metallic) and/or sheet metal troughs with hinged or removable covers is not acceptable.

Size boxes per NEC requirements for the size and number of conduits. Additionally, size boxes to include provisions for terminal block wiring clearance. Do not use boxes smaller than 8 by 8 by 4 inches.

**TERMINAL BLOCKS**

**Materials:**
Furnish and install terminal blocks rated at 600 V. Furnish channel mounted screw cage box clamp type terminal blocks for No. 8 AWG and smaller conductors, with vibration proof
nonferrous screw. Provide terminal blocks in groups of 12 with interlocking “finger safe” type barriers with white marking strips.
Furnish power distribution terminal blocks for No. 6 AWG and larger conductors, three-pole, suitable for copper conductors, UL rated for amperage equal to the largest conductor it accommodates and made out of copper.

Provide all current carrying components with corrosion resistant plating on nonferrous hardware. Do not use aluminum components if installed outside of the conditioned spaces of the Tender House.
Provide terminal blocks with wire protectors that physically isolate the conductor from the terminal screw.

Do not use terminal blocks that require special tools.

**Construction Requirements:**
Group terminal blocks for easy accessibility unrestricted by interference from structural members and instruments.

Provide 2 inches minimum on each side of each terminal block and between terminals and wire duct to allow an orderly arrangement of all leads terminated on the block and to allow for wire labels.
Do not terminate more than two wires on any one terminal position and permanently label each terminal block, device, fuse block, and both ends of each conductor to coincide with the identification indicated on the schematic and wiring diagrams. Terminal blocks and devices already numbered on the plans must be so numbered on the equipment supplied.

**ELECTRICAL IDENTIFICATION**

Provide identification for each electrical component including, but not limited to, conduit, wire, panels, boxes, motors, motor controllers, disconnect switches, and control devices.

**Materials:**
**Nameplates**
Provide legend nameplates for all major pieces of equipment named on the plans, and for all control devices.

Provide legend nameplates for devices that show the device designation and name used on the schematic wiring diagram. Provide fuse legend nameplates that show the type, ampere, and voltage rating of the fuses.

Nameplates shall be made of a hot-polished, laminated phenolic compound not less than 3/16 inch thick. The compound shall have a white surface 1/32 inch thick, and intermediate black layer 1/32 inch thick and a white back 1/8 inch thick. All corners shall be rounded, and the edges of the plates shall be chamfered. All engraving shall be upper case, standard gothic characters, cut through the surface into the intermediate layer to show black letters on a white background. All plates shall be securely fastened with stainless steel screws or rivets.
Provide nameplates of minimum letter height as scheduled below:

Panelboards, Switchboards, and Motor Control Centers: ¼ inch; identify equipment designation. 1/8 inch; identify voltage rating and source.

Individual Circuit Breakers, Switches, and Motor Control Centers: 1/8 inch; identify circuit and load served, including location.

Individual Circuit Breakers, Enclosed Switches, and Motor Starters: 1/8 inch; identify load served.

Switches, control relays, timers and other control devices: 1/8 inch; identify load and source and tag identification number.

Control Panel switches, pushbuttons, indicating lights, meters: 1/8 inch; identify function (Raise, Lower, Pull, Drive, etc.). Provide these nameplates in addition to the lettering provided on the switch, button or light face.

**Conduit Markers:**
Provide adequate marking of conduits that are exposed or concealed in accessible spaces, to distinguish each run as either a power or a signal/communication conduit. Use orange banding with black lettering unless otherwise indicated.

Provide snap-on type plastic markers. Indicate voltage ratings of conductors where above 240 V. Locate markers at both ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduits pass through walls, floors or into non-accessible construction, and at spacing of not more than 50 feet along each run of exposed conduit. Do not mark switch-leg conduit and short branches for power connections, except where conduit is larger than 1 inch.

Provide both ends of each marked conduit run with a brass tag having a number stamped thereon in accordance with the conduit diagrams. Fasten these tags to the conduit ends securely and permanently with bare copper or stainless steel wire.

**Conductor Identification:**
Furnish split sleeve, or tubing type wire and cable markers. Use numbers as indicated in the approved shop drawings.

Provide wire labels on each conductor in panelboard gutters, pull boxes, control panel outlet and junction boxes, and at load connection. Provide wire markers on each conductor at terminal blocks.
Provide 4 inches wide plastic tape, colored yellow with suitable warning legend describing buried electrical lines in every conduit trench.
Construction Requirements:
Degrease and clean surfaces to receive nameplates and tape labels. Install nameplates and tape labels parallel to equipment lines. Secure nameplates to equipment using stainless steel screws.

Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connections. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer’s shop drawings for control wiring. Where equipment already has manufacturer’s wire number, place plan wire number label adjacent to the manufacturer’s number.

DISCONNECT AND TRANSFER SWITCHES

Furnish and install, where indicated, heavy-duty disconnect switches having electrical characteristics, ratings, and modifications shown on the drawings. Furnish and install fuses as rated in the drawing.

Provide catalog data, installation instructions, and replacement parts list for each type switch. Include voltage and ampere ratings, construction material, NEMA classification, and dimensioned outline drawing in the catalog data. Include a replacement parts list as part of the installation instructions.

Install disconnect and automatic transfer switches in place of the existing units and in the same locations. Install switches plumb at a height with the operating handle not exceeding 6 feet above the floor. Do not use switch enclosure as a pull box for wiring other than the load it services. Use separate conduits for line and load conductors.

Materials:
NEMA Type 4X (stainless steel) enclosures. Units installed in the Operator Room or the Electrical Room can be NEMA 12. It shall service entrance rated where called out on plans.

Equip with metal factory nameplates, front cover mounted, that contain a permanent record of switch type, catalog number, and hp rating.

Equip disconnect with visible blades, reinforced fuse clips, non-teasable, positive, quick make-break mechanisms with a handle whose position is easily recognizable and is padlockable in the OFF position. Switch assembly plus operating handle as an integral part of the enclosure base. Provide switches that are hp rated and meet NEMA Specifications. Provide switches with defeatable door interlocks that prevent the door from opening when the operating handle is in the ON position. Provide heavy-duty switches with line terminal shields.

Fusible Switch Assemblies: NEMA KS 1; quick-make, quick-break, load interrupter enclosed knife switch. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class R fuses.
Non-fusible Switch Assemblies of NEMA KS 1 construction Type HD with quick-make, quick-break, and load interrupter enclosed knife switch. Handle lockable in OFF position. Furnish non-fusible switches with one N.C. (normally closed) and one N.O. (normally open) set of auxiliary contacts.

**Construction Details:**
Furnish time delay, current-limiting type fuses with 200 kA interrupting rating at 600 V\(_{\text{AC}}\). Use only rejection type fuses, UL listed to minimize short circuit damage and applied as follows: UL Class RK1 - Service entrance, transformer feeder and panelboard feeder; UL Class RK5 - Motor branch circuit.
Service Entrance: Furnish service rated disconnect switch.

Provide automatic transfer switch as detailed in section 7 below.

**LIGHTING**

Provide lighting as required and depicted on the plan. Provide catalog data including dimensioned drawings, materials, application voltage, and wattage ratings.

**Materials:**
Where stainless steel or non-ferrous metal surfaces (other than reflectors) are to remain unpainted, or where steel surfaces are to be electroplated, unless otherwise specified, coat with a baked-on clear lacquer. Omit the clear lacquer coating for anodized aluminum surfaces. Provide sockets for luminaires suitable for the specified lamps and set so that lamps are positioned in an optically correct relationship to lenses, reflectors, baffles, etc. Lenses, diffusers or louvers contained in frames must be removable, but positively held within the frame so that hinging or other motion of the frame will not cause the diffusing element to drop out. Face trims fabricated in pieces for rectangular or square luminaires with mitered corners continuously welded and smoothed before finishing; lapping of trim metal is not acceptable.

**Construction Details:**
Construct, wire, and install luminaires in compliance with all applicable National, State and Local Codes. Unless otherwise specified, furnish UL listed luminaires suitable for application and location shown and conforming to any additional regulations necessary to obtain approval for use in locations shown.
Set lighting fixtures plumb, square, level, in alignment, secured in accordance with manufacturer’s directions, and approved shop drawings. Install per the requirements of the NEC. Install luminaries complete with all equipment, materials, parts, attachments, devices hardware, hangers, cables, supports, channels, frames, and brackets necessary to make a safe, complete and operative installation. Ensure that the manufacturer of each luminaire supplies complete installation instructions including diagrams, illustrations, etc. Install in strict conformance with such instructions. Provide adequate supports for the weight of the luminaries. Provide extra supports from the building structure, if required, at no additional cost.

Replace blemished, damaged, or unsatisfactory luminaries in a manner satisfactory to the Engineer. Do not install reflectors, cones, aperture plates, lenses, diffusers, louvers, trims, and
decorative elements of luminaries until completion of plastering, ceiling tile work, painting, and
general clean-up in the area. Where practical, install such components earlier, if protected by
plastic sheeting, which is not to be removed until completion of the work outlined. Clean all
reflectors.

**AUXILIARY DRIVE MOTORS**

**Description:**
Remove existing auxiliary drive motors. Furnish and install new auxiliary drive motors having
the same electrical and mechanical characteristics of those on the bridge.

**Materials:**
The new auxiliary drive motors shall be bauble shaft motors having the same length, diameter
and characteristics of those on the bridge. The outboard shaft of the motors shall have a square
end capable of accommodate tooling to perform manual operation in the event of power outage
on the bridge. Coordinate geometry of the outboard shaft of the motors with owner.

**Construction Requirements:**
1. Provide auxiliary fans to maintain temperature when running at less than full speed.
2. Install motors per manufacturer’s instructions. Utilize millwright for field installations, base
   modifications, and shaft alignment with the machinery and clutch.
3. Provide motor mounting bases as required to accommodate motors. Properly align motor
   shaft with speed reducer shaft before connecting motor coupling. Make sure clutches are
   properly aligned with speed reducer.
4. Coordinate motor shaft diameter and length with requirements for machine and clutch.
   Verify alignment of the motor shafts with machinery prior to installation of shaft couplings.
   Correct as required to provide proper alignment within coupling misalignment tolerance.
5. Refer to motors section for additional information applicable to auxiliary motors
   construction, storage, installation and quality control.
ITEM 599.14010210 - BRIDGE ELECTRICAL SYSTEM REHABILITATION – MEADOWBROOK PARKWAY BRIDGE

MOTORS

Description:
Remove existing span drive normal motors, send to motor rehabilitation shop, shop rehabilitate, shop test, replace nameplate with new values obtained during testing the rehabilitated motor, return to bridge and store as needed, install with re-alignment, tune drives to motors, couple to reducer and tachometer-generator/speed switch and test run bridge. Also see acceptance testing.

Materials:
The motors shall be furnished with the following:
1. New winding with class HHH insulation, tropicalized for salt water environment and suitable for operation on flux vector drive.
2. New bearings and seals
3. New leads
4. Balance rotor
5. New winding heaters (120 vac)
6. New thermal detectors (klixon type)
7. Clean interior and paint
8. Remove exterior paint and repaint with epoxy outer coating on motor and conduit box.
9. Clean and coat shafts with corrosion resistant material
10. Lubricate bearings and supply addition lubrication for maintaining motor lube for 5 years.
11. Provide new 316 stainless steel bolts, washers, lock washers and nuts of the exact same dimensions as the existing.

Furnish motors designed for continuous operation in 40°C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

Provide new stamped, stainless steel nameplate indicating motor horsepower, voltage, phase, cycles, base RPM, full load amps, magnetizing amps, locked rotor amps, frame size, manufacturer’s name and model and serial number, design class and service factor.

Replace existing span drive auxiliary motors in-kind with the addition of drive shaft extension. See mechanical specification for details. Also see acceptance testing.

Storage:
Provide temporary power connection to internal motor heaters, or provide external heater, to maintain constantly elevated internal temperature to assure prevention of condensation or moisture accumulation. Manually rotate the rotor every thirty days to prevent flattening of bearings. If the storage arrangement permits, rotate the entire housing 90 degrees about the shaft every sixty days. The storage period is assumed to continue after the motors are installed until they are placed into actual repetitive service that will produce heat from operation.

Construction Requirements:
Test in accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data. Perform full load heat run. Perform motor operational testing to document speed/torque/current from 170% torque at zero speed through 170% torque at base speed and similar for braking mode of operation, and produce curves.

Insulation resistance value of the windings shall be at least 1,000 megohms. Provide data sheet with voltage, temperature and humidity at the time of the test.

Motor temperature sensors embedded in the windings shall be the exact same type as the existing.

Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Stamp bearing sizes and number on nameplate.

Sound Power Levels: To NEMA MG 1.

Nominal Efficiency: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

Nominal Power Factor: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

Service Factor: 1.0. Reference horsepower ratings from a 1.0 service factor.

Install motors per manufacturers’ instructions. Utilize millwright for field installations, shimming and base modifications, and shaft coupling alignment.

**Basis of Acceptance:**
Motor shop testing shall be witnessed by the owner or an owner’s representative. All testing as detailed above must be passed and accepted in the shop. In addition, final acceptance testing will be performed in the field and witnessed with acceptance based on performance of the bridge as originally designed and acceptable current and insulation resistance values.

**FUSED SERVICE DISCONNECT**

**Description:**
Furnish and install, in place of the existing non-fused disconnect switch, a heavy-duty service entrance rated disconnect switch having electrical characteristics, ratings, and modifications shown on the drawings. Furnish and install fuses for rated as called out on the drawings.

Provide catalog data, installation instructions, and replacement parts list for each type switch. Include voltage and ampere ratings, construction material, NEMA classification, and
dimensioned outline drawing in the catalog data. Include a replacement parts list as part of the installation instructions.

Install switch in the exact same position as the existing. Use existing conduit. Replace wiring to allow for connection to the load side of the fuses.

**Materials:**
Service entrance switch shall be Siemens type HNF365JW as a direct replacement for the existing Siemens HNF365J switch with the addition of fuses. Contractor to verify the dimensions of the enclosure of the new switches as suitable for installation at the same location as the existing switch.

Provide 250 amp dual element Class R fuses in the switch and three spare.

**Construction:**
Provide a NEMA 12 fabricated from 316 stainless steel. Equip with metal factory nameplates, front cover mounted, that contain a permanent record of switch type, catalog number, and fuse rating. Equip with visible blades, reinforced fuse clips, non-teasible, positive, quick make-quick break mechanisms with a handle whose position is easily recognizable and is padlockable in the OFF position. Switch assembly plus operating handle as an integral part of the enclosure base. Provide switches that meet NEMA Specifications. Provide switches with defeatable door interlocks that prevent the door from opening when the operating handle is in the ON position and provide tool that will allow the use of the defeat feature in the switch’s final mounting position. Provide terminal shields. Design to accommodate Class R fuses.

Provide with one N.C. (normally closed) and one N.O. (normally open) set of auxiliary contacts. Provide time delay, current-limiting type fuses, rated as shown on the drawings, with 200 kA interrupting rating at 600 V<sub>AC</sub>. Use only rejection type fuses, UL listed to minimize short circuit damage and applied as follows: UL Class RK1 - Service entrance, transformer feeder and panelboard feeder; UL Class RK5 - Motor branch circuit.

**Basis of Acceptance:**
Service disconnect switch is to be in brand new condition, provided with fuses as called out on the drawings, shall have no dings, dents or scratches on the enclosure, have full freedom of operation and freedom of door interlock operation.
MOTOR CONTROL CENTER

Description:
Furnish, install, test, calibrate and place into operation one multi-function Power monitor. It shall be mounted on the door of the motor control center main disconnect cubicle. It shall be driven by the two existing potential transformers with fuses, three new current transformers and a new control circuit transformer.

Materials:
The meter, mounted through the door of the main disconnect cubicle of the motor control center shall have the following features:

1. 0.2% Class Energy and Demand Metering
2. Measurements including Voltage, Current, Power, Frequency, Energy, etc.
3. Optional KYZ Pulse and Standard IrDA Port
4. Power Quality Measurements (%THD and Alarm Limits)
5. V-SwitchTM Technology - Field Upgrade withoutRemoving Installed Meter
6. Large Bright Red LED Display
7. % of Load Bar for Analog Meter Perception
8. Optional RS485 Modbus and DNP 3.0 Protocols
9. Optional 100BaseT Ethernet
10. Fits Both ANSI and DIN Cut-Outs
11. Available in a Transducer-Only Version

It shall provide the following selectable information:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
<th>Scorable Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage L-N</td>
<td>0.1%</td>
<td>0-9999 Scalable V or kV</td>
</tr>
<tr>
<td>Voltage L-L</td>
<td>0.1%</td>
<td>0-9999 V or kV Scalable</td>
</tr>
<tr>
<td>Current</td>
<td>0.1%</td>
<td>0-9999 Amps or kAmps</td>
</tr>
<tr>
<td>+/- Watts</td>
<td>0.2%</td>
<td>0-9999 Watts, kWatts, MWatts</td>
</tr>
<tr>
<td>+/- Wh</td>
<td>0.2%</td>
<td>5 to 8 Digits Programmable</td>
</tr>
<tr>
<td>+/- VARs</td>
<td>0.2%</td>
<td>0-9999 VARs, kVARs, MVARs</td>
</tr>
<tr>
<td>+/- VARh</td>
<td>0.2%</td>
<td>5 to 8 Digits Programmable</td>
</tr>
<tr>
<td>VA</td>
<td>0.2%</td>
<td>0-9999 VA, kVA, MVA</td>
</tr>
<tr>
<td>VAh</td>
<td>0.2%</td>
<td>5 to 8 Digits Programmable</td>
</tr>
<tr>
<td>PF</td>
<td>0.2%</td>
<td>+/- 0.5 to 1.0</td>
</tr>
<tr>
<td>Frequency</td>
<td>0.01 Hz</td>
<td>45 to 65 Hz</td>
</tr>
<tr>
<td>%THD</td>
<td>5.0%</td>
<td>0 to 100%</td>
</tr>
<tr>
<td>% Load Bar</td>
<td>1-120%</td>
<td>10 Digit Resolution Scalable</td>
</tr>
</tbody>
</table>

The metering voltage shall be provided by two existing 4:1 ratio potential transformers. The three lines to the meter shall be fused with fuses rated as shown on the drawings and of a type required by the manufacturer.
ITEM 599.14010210 - BRIDGE ELECTRICAL SYSTEM REHABILITATION – MEADOWBROOK PARKWAY BRIDGE

The metering current shall be provided by new 200:5 loose mounted epoxy encapsulated current transformers and shall be Instrument transformer part number AL-201 or approved equal.

The meter power shall be derived from a new 50 VA, 480/120 control circuit transformer with primary and secondary fuse clips with fuses rated as shown on the drawings. The transformer shall be epoxy encapsulated and shall be an Allen-Bradley Bulletin 1497B–A1–M14– 3 – N or approved equal. Provide fuses as required by the manufacturer.

Construction:
Protect existing equipment from physical damage and metal chips while installing new equipment. Punch holes in door.

Install toroid current transformers onto line side of main breaker and properly train the wire.

Using additional meters, verify the calibration of the PMM and demonstrate to owner or owner’s representative.

Basis of Acceptance:
PMM will be accepted based on proper installation and demonstration of proper calibration and readings.
AUTOMATIC TRANSFER SWITCH SYSTEM WITH REMOTE ATS CONTROL

Description:
A new automatic transfer switch shall be supplied, installed, wired and tested. The existing automatic transfer switch shall be carefully removed and returned to the owner.

The automatic transfer switch controls on the console will be modified to make it remotely functional as shown on the plans. In addition to the existing functions monitoring the incoming utility power, starting and running the generator and monitoring its power, transferring and retransferring, it will additionally have:

1. Inhibit transfer
2. Inhibit retransfer
3. OFF-AUTO-GENERATOR WITHOUT TRANSFER-GENERATOR WITH TRANSFER remote control
4. Utility power available indication
5. Generator power available indication
6. Utility power in use indication
7. Generator power in use indication.
8. Additional interfacing with the PLC

The control and indication functions shall be from pilot devices mounted to the control console.

A remote annunciator shall be provided on CP-1 as shown on the plans. It shall be a manufacturer’s standard unit and be operated from communications with the ATS and be powered from the ATS

The PLC may need to have programming changes made. Contractor is to provide all programming equipment and programs to perform this work.

Contractor is to install, wire and test all ATS control equipment.

Materials:
The automatic transfer switch unit will be provided as follows:
277/480 volt
260 amp
3 phase/4 wire
60HZ
Open transition
NEMA 12 enclosure
Microprocessor activated momentary test switch
Source one normal position
Source to emergency position
Time delay from emergency switch position to normal on retransfer
Time delay from normal position to emergency position on transfer
Event log for last 16 events
Adjustable over/under frequency sensor for both sources
Frequency indication
LED source one position indication
LED source to position indication
LED source one availability indication
LED source to availability indication
Undervoltage sensing for source two
Overvoltage sensing for source two
Microprocessor activated commit/no commit on transfer to emergency source
Retransfer to normal by adjustable time delay
Bypass transfer timer function
Generator start control
Communication module

Pilot lights and selector switch manufacturer and series shall be units identical to those already provided on the console and as called out on the drawings

**Construction Requirements:**
Protect console equipment and install control pilot devices in the console.

Install ATS control and electronics as instructed by the manufacturer. Reprogram as required.

Modify PLC programming as necessary. Modify ATS programming as necessary.

Intervire equipment, including but not limited to control of the generator, remote controls and indication, controls to the PLC

Test for remote control and automatic control. Automatic control is to be effected by turning off the service disconnect.

**Basis of Acceptance:**
Automatic and remote control shall be demonstrated. Generator starting shall be demonstrated. Proper monitoring of utility and generator sources. Proper transfer and retransfer and engine cooldown timing. Transfer and re-transfer inhibit. All other functions that may be required by the engineering witnessing the Acceptance Testing.
SPAN LOCK ACTUATOR LIMIT SWITCHES

Description:
Provide, mount, wire and test proximity-operated limit switches with underwater capabilities for all Span Lock Bar Pulled and Span Lock Bar Driven positions. Mounting of the switch and target will be performed in the mechanical portion of the contract. Coordinate the positioning and timing of the switches with the programming for proper operation, indication, and interlocking.

Materials:
Provide each proximity type limit switch with double pole, double throw, contact blocks rated 10 A at 120 V AC. Heavy duty, NEMA 4X stainless steel construction with sealed bodies and pig-tail leads. Provide target magnet to extend range. Proximity switches shall be GO Switch Model 81 with AMC1/5 target magnet or Engineer approved equal.

Construction Details:
Install limit switches in accordance with manufacturer’s instructions. Provide 316 stainless steel mounting hardware and supports as required and called out in the mechanical pay item. Install limit switches to allow for field adjustment at construction and for future maintenance. Terminate all limit switches on in existing terminal cabinets. Submit limit switch, target materials, and mounting methods to the Engineer, for review, prior to installation.

Test the operation of the bridge and the function of all limit switches and verify that the bridge functions and triggers as shown in the as-built plans.

Basis of Acceptance:
After installation, test switches, in the presence of the Engineer, to determine if operation is as intended and is acceptable to the engineer. Switches should relay signal to the control system at intended “point of operation” which is shown on the AS-BUILT drawings. Switches should provide positive indications with no intermittent signals or bounce. Adjust position of switches as required.

POSITION TRANSMISSION AND INDICATION AND CONSOLE METERS

Description:
Remove and replace in-kind, or manufacturer’s suggested replacement, the position transmitters (resolvers) that drive the position indication systems. Include the units, mounting brackets, cables and strain relief fittings. Replace in-kind the mounting brackets, cables and fittings for the position transmitters (Digisolvers) that drive the PLC. Modify brackets as necessary.

Replace in-kind or manufacturer’s suggested replacement, the resolver decoders that drive the indicators on the control console. Modify mounting in CP-1 accordingly

Replace in-kind or manufacturer’s suggested replacement, the position indicators on the control console. Modify mounting in CP-2 accordingly.
Replace the conduit from each span position limit switch to the local junction box. Program and startup position transmission system, calibrate and verify indication.

**Materials:**

**Digisolver:**

The Digisolver shall have the following attributes:
1. No optics, MIL-Grade resolver
2. Single-turn, 13-bit Binary, Gray Code, or BCD absolute output
3. Multi-turn, 18-bit Binary or 15-bit BCD and Gray Code absolute output
4. Short-circuit-proof outputs
5. Flexible options of counts-per-turn
6. 5 VDC or 8-30 VDC voltage range
7. Built-in Synchronization for PLCs
8. Analog Angle, Analog Velocity, Direction, and Ripple outputs

The Digisolver shall be an E5N-D-1000-5TOM or approved equal.

**Rotary Encoder:**

The rotary encoder shall have the following attributes:
1. Absolute shaft position
2. No internal electronics
3. Brushless resolver
4. High-resistance to shock and vibrations
5. NEMA 4x to provide protection against water, mist, oil, and dust
6. Broad temperature range -67 deg F to 248 deg F
7. Highly noise immune with shielded cable

The rotary encoder shall be an Autotech Model RL-100-M with mounting bracket and mating cable.

**Decoder:**

The Decoder shall have the following attributes:
1. Resolver based, single-turn, absolute position. No loss of position under any situation
2. Programmable full scale zero offset for easy set-up
3. Variety of outputs, built-in PC-Handshake, permit interfacing to any PLC
4. Multiplexing capability
5. Up to 8192 counts-per-turn resolution at 1800 rpm
6. Highly noise-immune ratiometric tracking converter
7. Extremely rugged and reliable resolver as position transducer

The decoder shall be an Autotech DM5-D-1000-120-TOI
Position Indicator:
The Decoder shall have the following attributes:

1. 4 or 6 digit large display
2. 12 to 24 VDC data and power Inputs
3. Easy hook up to programmable controller
4. Full parallel or digit strobe input
5. Positive or negative true logic
6. Sourcing or sinking inputs
7. Standard 1/8 DIN case, NEMA 4X/IP65 Front

All console meters are to be calibrated and assured to be functional.

Construction Requirements:
Basis of Acceptance:
Verification of calibration of all equipment against separate portable meters and inclimeters.
**FESTOON CABLES**

**Description:**
Remove existing Festoon cable system and junction boxes. Furnish and install four new festoon cables systems at same locations as existing systems. Furnish and install eight new festoon cable terminal boxes, cables, strain relief fittings and grips, and interfacing with existing conduit and wiring as shown in the Plans. Perform continuity and insulation resistance tests on new cable and wiring.

**Materials:**
The near side festoon cable systems shall consist of one (1) 8 conductor #10AWG flexible cable and two (2) 24 conductor #12AWG flexible cables. The cables shall be of proper length as to minimize stress on the cables and to eliminate the possibility of chafing on surrounding equipment. The Contractor shall furnish an additional 50 feet of cord as spare for each cord type. The cables shall be Draka All-Temp Industrite Control Cable or approved equal.

The far side festoon cable system shall consist of one (1) 24 conductor #12AWG flexible cable. The cable shall be of proper length as to minimize stress on the cables and to eliminate the possibility of chafing on surrounding equipment. The Contractor shall furnish an additional 50 feet of cord as spare. The cables shall be Draka All-Temp Industrite Control Cable or approved equal.

The cables shall be provided as follows:

1. **Conductors:**
   
   Extra-flexible stranding (Class K), soft-drawn tinned copper; per ASTM B-33, ASTM B-174, and UL-62 for high flexibility, extended flex-life, reduced copper fatigue and conductor breakage, easy solderability and resistance to corrosion.

2. **Separator:**
   
   Paper separator for easy stripping.

3. **Insulation:**
   
   Thermoset (EPDM) insulation per UL-62 and ANSI/ NEMA WC 70 ICEA S-95-658, providing excellent physical and electrical properties, colored and printed for easy conductor identification and suitable for use in extreme flexing applications.

4. **Cabling:**
   
   Conductors are cabled (maximum of two layers) with non-wicking, non-hygroscopic fillers with an overall binder of rubberized fabric tape for increased mechanical strength/impact resistance and exceptional performance in severe flexing applications.
5. Jacket:

Available in stock with black, oil and flame-resistant, reinforced thermoset jacket per UL-62 and ANSI/ NEMA WC 70 ICEA S-95-658, suitable for use indoors and outdoors in abusive flexing applications where oil, chemicals, and extreme temperatures are considerations.

6. Ratings:

Rated for continuous operation at 105° C to -40° C

UL listed (E2517) Type SoW, 90° C dry, water resistant 60° C

CSA certified (LL231593) Type SoW FT1 UL festooning RoHS compliant

The near side festoon cable terminal boxes shall be sized according to the Plans. They shall be constructed of NEMA 4 316 stainless steel. The near side junction boxes shall contain terminal blocks as shown in the Plans. In order to separate the 480 Volt power from the 120 Volt control, a mild steel terminal divider plate shall be welded in the interior center of the near side junction boxes as shown in the Plans. The divider plate shall be sized as to not interfere with the mounting channels or the junction box door. In addition, a 480 Volt Danger warning placard shall be mounted to the near side terminal boxes. The placard shall be held in place by stainless steel screws. Provide proper ground bonding to the terminal box and bond the door to the box enclosure. The boxes shall be mounted on stainless steel channel with stainless steel hardware. The terminal boxes shall be manufactured by Hoffmann or Hammond or approved equal.

The far side festoon cable junction boxes shall be sized according to the Plans. They shall be constructed of NEMA 4 316 stainless steel. The far side terminal boxes shall be similar to the near side boxes, but without the dividing plate and with differing cable count.

The festoon cable systems shall be furnished with stainless steel mesh grips with strain reliefs, and which shall be hung from 316 stainless steel channel and hardware as shown in the Plans. The mesh grips shall be manufactured by Kellam and sized and installed to completely support the cable with no stress on the box. The mounting channel for the boxes and mesh grips shall be manufactured by Unistrut or Powerstrut or approved equal.

Terminal blocks shall be provided as shown on the plans and as called out in a separate section in the specification.

**Construction Details:**

The festoon cables shall be given slack between the mesh grip and fitting to relieve the strain at the fitting. Mesh grips shall be hung from the separately mounted channel, not the festoon cable junction box.

The near side festoon cables shall be divided between power and control conductors in the junction boxes. The conductors contained in the 8 conductor #10AWG cable shall be connected
to the single, 8 pole terminal block within the terminal boxes. The conductors within the two 24 conductor #12AWG festoon cables shall be connected to the 2-12 and 1-8 terminal blocks on the other side of the terminal box. This is to ensure that power and control is divided within the junction boxes. Under no circumstance shall a power conductor be connected to a control side terminal or vice versa.

The conductors contained in the far 24 conductor festoon cables shall be connected to the 2-12 pole terminal blocks within the terminal boxes.

Festoon cables shall be hung in such a manner to ensure that there is no stress on the cable and that it cannot make contact with any other equipment or structure during any point of operation.

Unterminated spare conductors shall be capped.

**Basis of Acceptance:**
Operation of locks and bascule lights and results of continuity and insulation resistance tests shall be the basis of acceptance.
LIMIT SWITCHES

Description:
Provide, mount, wire and test proximity-operated limit switches with underwater capabilities for all Span Near Closed, Span Near Open, and Span Emergency Open and Span Seated leaf positions. Mounting of the switch and target will be performed in the mechanical portion of the contract. Coordinate the positioning and timing of the switches with the programming for proper operation and seating.

Materials:
Provide each proximity type limit switch with double pole, double throw, contact blocks rated 10 A at 120 V\text{AC}. Heavy duty, NEMA 4X stainless steel construction with sealed bodies and pig-tail leads. Provide target magnet to extend range. Proximity switches shall be GO Switch Model 81 with AMC1/5 target magnet or Engineer approved equal.

Construction Details:
Install limit switches in accordance with manufacturer’s instructions. Provide 316 stainless steel mounting hardware and supports as required and called out in the mechanical pay item. Install limit switches to allow for field adjustment at construction and for future maintenance. Terminate all limit switches on in existing terminal cabinets. Submit limit switch, target materials, and mounting methods to the Engineer, for review, prior to installation.

Test the operation of the bridge and the function of all limit switches and verify that the bridge functions and triggers as shown in the as-built plans.

Basis of Acceptance:
After installation, test switches, in the presence of the Engineer, to determine if operation is as intended and is acceptable to the engineer. Switches should relay signal to the control system at intended “point of operation”, which is shown on the AS-BUILT drawings. Switches should provide positive indications with no intermittent signals or bounce. Adjust position of switches as required.
NAVIGATION LIGHTS

References:

Description:
Remove existing fender and bascule navigation lights and associated hardware, wiring and conduit. Install new LED type dolphin, fender, gauge and bascule lights and associated hardware, wiring and conduit in accordance with this specification and the Plans. Install new bascule navigation lights in the same locations as existing lights. Install new fender lights in the locations specified in the Plans.

Materials:
Fender navigation lights shall be provided as follows:

Applications: The navigation light shall be designed for use as a marine signal light for marking stationary piers and fenders, where the light must be mounted to a vertical surface, and shall meet or exceed all Coast Guard recommendations and requirements pertaining to pier and obstruction marking signals.

Housing and General Construction: The housing shall be of cast aluminum. Casting alloy used 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.

Lens: Lens shall be heat-resistant fresnel glass. Nominal lens section shall be 180 degrees. Inside lens diameter shall measure approximately 7” (175mm). Outside lens diameter shall measure approximately 8” (205mm). Color shall be red. Lens shall have a wide angle of divergence suitable for high mounting on bridges or structures. The angle of divergence shall not be less than 27 degrees.

Lamp and Receptacle: Medium base receptacle shall be rated for 250V, 660W and shall be porcelain with a nickel-plated brass shell to resist lamp freezing. A single medium base, 120V, 100,000 hour LED lamp shall be provided in a color to match the lens.

Stem: Lamp fixture head and base shall be mounted on a 1 1/2” schedule 40 pipe, 1.90” O.D. (48mm) Pipe material shall be galvanized steel.

Mounting: Base shall be cast of the same material as the fixture head (aluminum or silicon bronze). Light assembly shall mount to a vertical surface via four 1/2” diameter bolts through the base, provided by installer to suit installation.

The bracket-mounted pier light shall be Model PL-BM, as manufactured by B&B Roadway.

The gauge lights shall be provided as follows:
Applications: The gauge light shall be designed for use as a gauge sign illumination light per Coast Guard requirements.

Housing and General Construction: The fixture housing body shall be of precision die cast aluminum with a durable powder coat finish. All components shall be corrosion resistant. Construction shall be rain-tight and shall be equipped with a retained gasket. Lens shall be thermal-tempered shock-resistant glass. Fixture head rotation shall be adjustable and incorporate locking teeth and internal gasket for secure, leak-free positioning of the head. Hinge pins and external fasteners shall be of stainless steel.

Lamp: Lamp shall be a 12V LED array. Nominal life shall exceed 50,000 hours life. A step transformer and rectifier shall be provided in the junction box to convert power from 120VAC supply.

ACCESSORY CABINET: A cast aluminum NEMA 4X accessory and electrical connection cabinet shall be included as part of the gauge light assembly. The cabinet shall have a hinged cover fitted with a gasket. Terminal blocks for convenient wiring shall be installed in the cabinet. All wiring shall terminate inside the accessory cabinet. The lamp shall be pre-wired to the terminal block. The cabinet shall provide for secure mounting to the gauge post using a square 4-bolt pattern.

The gauge light shall be Model GL, as manufactured by B&B Roadway.

The bascule navigation lights shall be provided as follows:

Applications: The navigation light shall be designed for use as a marine signal light for marking vertical lift bridge spans, and shall meet or exceed all Coast Guard recommendations and requirements pertaining to vertical lift span marking signals.

Housing and General Construction: The housing shall be of cast aluminum. Casting alloy used 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.

Lens: Lens shall be heat-resistant fresnel glass. Lens sections shall be 180 degrees red over 360 degrees green. Inside lens diameter shall measure approximately 7” (175mm). Outside lens diameter shall measure approximately 8” (205mm).

Lamp and Receptacle: Lamps, one per section, shall be LED type, 120V, 100,000 hour rated and provided in a color to match the lenses. Medium base receptacles shall be rated for 250V, 660W and shall be porcelain with a nickel-plated brass shell to resist lamp freezing.

Stem: Lamp fixture head shall be suspended from the swivel on a 1 1/2” schedule 40 pipe, 1.90” O.D. (48mm). Pipe material shall be galvanized steel. Standard dimension from center of swivel to focal plane of upper lens shall be 48” (1219mm).
Swivel: The swivel design shall provide for all wiring to be completely contained inside the light assembly. Gaskets and o-rings shall be used to provide a weather-tight assembly. Swivel shall be of heavy-duty construction, cast of the same material as the fixture head. Spindle shall be of stainless steel.

Automatic Latch: An automatic latch shall hold the light securely in normal operating and service positions. A firm pull on the service chain shall automatically release the latch, allowing the fixture to pivot. As the light is raised, latch shall automatically engage to hold light in the service position. Service position shall be 30 degrees from vertical. Fixture assembly shall be dual-handed (i.e. light may be pulled up from either side).

Mounting: Base shall be cast of the same material as the fixture head. Light assembly shall mount via four 1/2” diameter bolts through the base, provided by installer to suit installation.

Switching Control: Power shall be switched between red (bridge closed to maritime traffic) and green (bridge open) sections by a separate remote switch as part of the bridge controls.

The vertical lift span light shall be Model VL, as manufactured by B&B Roadway.

Dolphin Navigation Lights shall be provided as follows:

Applications: The navigation light shall be designed for use as a marine signal light for marking stationary piers and fenders, where the light must be mounted to a vertical surface, and shall meet or exceed all Coast Guard recommendations and requirements pertaining to pier and obstruction marking signals.

Housing and General Construction: The housing shall be of cast aluminum. Casting alloy used 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.

Lens: Lens shall be heat-resistant fresnel glass. Nominal lens section shall be 180 degrees. Inside lens diameter shall measure approximately 7” (175mm). Outside lens diameter shall measure approximately 8” (205mm). Color shall be red. Lens shall have a wide angle of divergence suitable for high mounting on bridges or structures. The angle of divergence shall not be less than 27 degrees.

Lamp and Receptacle: Medium base receptacle shall be rated for 250V, 660W and shall be porcelain with a nickel-plated brass shell to resist lamp freezing. A single medium base, 120V, 100,000 hour LED lamp shall be provided in a color to match the lens.

Stem: Lamp fixture head and base shall be mounted on a 1 1/2” schedule 40 pipe, 1.90” O.D. (48mm) Pipe material shall be galvanized steel.
Mounting: Base shall be cast of the same material as the fixture head (aluminum or silicon bronze). Light assembly shall mount to a vertical surface via four 1/2” diameter bolts through the base, provided by installer to suit installation.

Solar Power and Battery Enclosure: The solar panel fastened on the navigation light stem shall be suited for marine use.

Provide backup power (near and far sides) to the navigation lights by a gel cell battery and inverter system. Navigation lighting fixtures, lighting contactors and photoelectric cell will be remotely located.

Power Supply: Furnish and install a UPS back-up power supply (near and far sides) including a battery charger, battery bank, and inverter sized to provide 8 hours minimum of continuous operation of the navigation light system. Size inverter so that under normal full load conditions, the load will be no more than 75% of the output rating of the inverter. Furnish a power supply that is normally on-line and automatically switch to back up whenever line voltage is lost and automatically switch back to the line when power is restored. Furnish an inverter rated for 100 watts minimum continuous output. Furnish a battery charger that continuously monitors the charge level of the batteries and corrects the charge rate as required and automatically recharges the batteries following a power outage. Size to provide a recharge time of 4-12 hours for 67% discharged batteries. House the Back up Power Supply assembly in a lockable, non-corrosive fiberglass enclosure. Compartmentalize the enclosure to provide a vapor proof barrier between the electronics compartment and the batteries.

Construction Details:
Dolphin Navigation Lights
Level the center piling of the outermost dolphins, removing any deteriorated wood to ensure the material is suitable for the lag bolt mounting of new navigation light. Dolphin Navigation Lights shall be secured to the center of the pilings using stainless steel lag bolts with stainless steel washers. Each solar panel face shall be aligned with solar south and oriented at a 45 degree angle to the vertical.

Fender Navigation Lights:
Install new LED type Fender navigation lights to the vertical surface of the piers just above the pier bumpers, as shown in the plans. Hardware should be stainless steel type to prevent corrosion.

Bascule Navigation Lights:
Clean and paint mounting steel after removal of existing bascule navigation lights

Install new led type bascule clearance navigation lights using properly sized stainless steel bolts and washers.

Basis of Acceptance:
Proper operation of navigation lights, successful demonstration of bascule light interlocking and results of continuity and insulation resistance tests shall be the basis of acceptance.
TRAFFIC GATE ASSEMBLIES

Furnish and install new traffic gates assembly in conjunction with new electrical system as required for a complete electrical installation as shown on the Contract Plans. Two oncoming traffic gates, one on the north side and one on the south side of the bridge. Gates shall comply with the latest AASHTO Standard Specifications for Movable Highway Span Bridge Signals.

Furnish and install new materials as required to interface and wire the gates to the existing bridge service, and provide any other wiring for input to the control schematic diagrams as shown on the Contract Plans.

Gate Performance Requirements:
During the opening and closing cycles, the gate arm shall begin with zero velocity and accelerate smoothly, reaching maximum velocity at mid stroke (45 degrees) then decelerating smoothly to zero velocity at full stroke (90 degrees) without whip or bounce. Standard operating time; 13 seconds for full opening or closing cycle.

Materials:
Type:
Standard Vertical to Horizontal type; electrically operated with manual cranking ability.

Size:
Sized to handle the weight of the arm used and be able to operate against a wind speed of 90 mph.

Counterweights:
Hot-dip galvanized steel, sectional bolt-on type with at least 10% adjustment.

Arm Shafts:
The main arm shaft shall be of a minimum 2.25” diameter, AISI 4150 with a minimum tensile strength of 140,000 PSI. The shaft shall be mounted in heavy duty relubricable ball bearings.

Arm Base:
The arm base shall be designed with a shear pin mechanism to minimize damage to the gate and vehicle in the event of collision. In the event of an impact, the shear pin shall break allowing the arm to swing approximately 75 to 80 degrees. At the full open position, a spring-loaded latch shall engage, preventing the arm from swinging back into traffic.

Doors:
Front and rear doors shall be mounted on full cross straps; hinges shall be of the slip-off type and shall have stainless steel pins, two latches per doors shall be used to compress a neoprene bulb-type gasket to seal the door openings.

Transmission:
The transmission shall be a heavy duty torque limiter so that the installation of heavy arms and high winds operation due to excessive wind load conditions, physical obstruction to the gate arm
or instant reversing of heavy arm assemblies. The torque limiter shall be capable of being set anywhere within a range of 10,000 to 75,000 in-lbs of torque.

The mechanism linkage shall be driven by a fully enclosed, heavy duty worm gear, double reduction speed reducer. The transmission shall have an occasional momentary peak load rating of not less than 30,000 inch-pounds. The output shaft shall be 2” in diameter, a gear ratio used shall produce an operation time of approximately 13 seconds.

Limit Switches:
The gate limit switch assembly shall be a self-contained unit. The assembly shall provide 8 independent SPDT control switches as a minimum.

Motor:
The motor voltage and phase shall be as specified by the engineer in the contact documents or as per customer request. The motor horsepower shall be as recommended by the gate manufacturer to suit the installation, typically ¼ to 1 hp. The motor shall be a C-face design and shall be mounted directly to the transmission.

Braking Mechanism:
The motor shall be equipped with a solenoid release, automatic brake. The brake shall have manual release lever to permit manual operation of the gate during emergencies or initial setup.

Hand Crank:
Provide a hand crank to manually raise or lower gate arm in event of power failure.

Housing:
The operating mechanism and main control components shall be contained in a weatherproof housing. The housing shall be constructed of 0.375” carbon steel, hot dip galvanized after fabrication. Exterior surfaces shall be painted aluminum; all fasteners shall be corrosion resistant and the assembly mounting design shall be fully gasketed. The shaft opening shall incorporate O-ring seals.

Warning Lights:
Molded plastic, moisture and corrosion proof with 2-way visibility, 7” diameter lenses as a minimum with a 12V LED and 10,000 hour rating.

Gong and Warning Bells:
Heavy duty weatherproof with adjustable sound level, cast aluminum housing, gasketed rear door hinged with stainless steel hinge pins. Gong motor shall be 115VAC.

Construction Details:
A. Verify system voltage matches gate requirements.
B. Install in accordance with manufacturer’s instructions.
C. Make connections to control console as require for proper operation.
D. Manually test hand crank.
E. Power test traffic gates to ensure proper operation of warning bells, gate operation, gate arm lights and gate interlock.

**FUNCTIONAL CHECKOUT**

Motors/Drives – Test span operation for speed control. Provide speed/torque/current curves throughout travel and on seating. Operate each leaf through 10 complete cycles without a fault.

Verify the operation, reliability and calibration of the span position system and limit switch/proximity switch systems.

Test emergency operation of the auxiliary clutches and hand crank using emergency generator.

Test operate all lighting and auxiliary systems and verify calibration of equipment.

All testing will be witnessed by the owner and/or the owner’s representative.

Contractor to produce testing forms with test and acceptance criteria and submit at least 2 months prior to the performance of the testing. This will be reviewed by the Engineer and must be accepted prior to the start of testing.

**ELECTRICAL DEMOLITION**

**Description:**
All material removed from the bridge shall be returned to the owner in its original equipment. This equipment will include but not be limited to: navigation lights, unfused service switch, plunger type and lever arm type limit switches, removed ATS controls, pilot devices, position transmission and indication equipment. Owner will instruct on the packaging and delivery location.

All areas affected by the removal of equipment that may have been damaged or exposed will be repaired or properly treated.

**OPERATING AND MAINTENANCE MANUALS**

**Description:**
Review the existing manuals and upgrade with the new information. It shall include operator and maintenance instructions on new equipment and include the service disconnect, automatic transfer switch, power monitor, motor maintenance, limit/prox. Switches, navigation lights, service switch, etc. It shall include all instruction and user manuals and all manufacturer’s drawings, fully edited cuts and list of local vendors. Existing drawings shall be obtained in their electronic form, modified, printed and inserted into the manual. It shall include all spare parts provided and a recommended spare parts list.

**Basis of Acceptance:**
Engineer will review material for accuracy and completeness.
ITEM 599.14010210 - BRIDGE ELECTRICAL SYSTEM REHABILITATION – MEADOWBROOK PARKWAY BRIDGE

METHOD OF MEASUREMENT

Payment for “Bridge Electrical System Rehabilitation – Meadowbrook Parkway Bridge” shall be made on a lump sum basis.

BASIS OF PAYMENT

a) The lump sum price bid for “Bridge Electrical System Rehabilitation – Meadowbrook Parkway Bridge” shall include the cost of all labor, materials, operation and maintenance manuals, training and equipment necessary for a complete installation, ready for operation.

b) The Contractor shall submit to the Engineer a detailed breakdown of his costs under this Item within 30 days of award of the contract. This breakdown shall be evaluated by the Engineer and be utilized as the basis for monthly progress payments up to 85% for work satisfactorily completed. Ten percent (10%) of the bid will be paid by the State upon final acceptance of the bridge electrical system, the Contractor and Control System Vendor have completed all items on their punchlists, and all aspects of bridge operations, operator and maintenance personnel testing, training, and control are complete. The remaining five percent (5%) will be paid upon final approval of the Operation and Maintenance manuals (O&M) is granted by the Engineer.