SECTION 901

HIGHWAY LIGHTING

901.1 Description. This work shall consist of furnishing and installing lighting equipment and material as shown on the plans. All work shall meet NEC, NESC and NEMA standards. Existing lighting shall be maintained in effective operation by the contractor except for shutdowns with approval from the engineer for alterations or final removal.

901.2 Temporary Lighting.

901.2.1 Temporary lighting shall consist of furnishing, installing and maintaining wood poles, luminaires, bracket arms, power cable, connection to a power source, mounting hardware and all other material necessary to provide the temporary installation. Any Commission furnished items shall be installed by the contractor. Temporary lighting specified as part of a temporary signal installation shall be installed on the signal poles unless otherwise shown on the plans.

901.2.2 Luminaires shall be 150-watt high pressure sodium with a Type III medium distribution, semi-cutoff light distribution. Luminaires shall be mounted 30 feet above the pavement unless otherwise shown on the plans. Bracket arms shall be oriented at right angles to traffic flow unless otherwise shown on the plans. Photoelectric controls shall be provided and may be installed in the luminaires or in a separate control box at the option of the contractor, unless otherwise shown on the plans. Any existing lighting shall not be taken out of operation until the temporary lighting is ready for operation and with approval from the engineer. All temporary lighting equipment shall be removed by the contractor after the new installation is in operation or as directed by the engineer. Contractor furnished equipment that will remain the property of the contractor may be new or used stock. Contractor furnished equipment that will become the property of the Commission shall be of new stock and shall meet all applicable specifications. Commission owned equipment will remain the property of the Commission and shall be disposed of as shown on the plans or as directed by the engineer.

901.2.3 The contractor shall pay all electrical costs incurred by operation of the temporary lighting until the lighting is removed or until the lighting is accepted for maintenance. For temporary lighting installations where there is not an existing power supply, the contractor shall make any necessary arrangements for providing power to the temporary lighting. Portable generators may be used to provide power to temporary lighting, but any failure of the lighting system due to generator failure will be considered a malfunction as specified in Sec 901.14. No direct payment will be made for power costs. All wire and cable for temporary lighting shall be suspended overhead with proper clearance or buried as shown on the plans.

901.2.4 Temporary lighting shall be installed to meet the construction schedule. The contractor maintain the lighting in proper operating condition in accordance with Sec 901.14. Any damage to the lighting installation shall be repaired by the contractor at the contractor's expense.

901.3 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section/Specification
Concrete	501
Reinforcing Steel for Concrete	1036
Wood Poles for Power Supplies and Temporary Installation	1050
Electrical Conduit	1060
Electrical Conductors	1061
Pull and Junction Boxes	1062
High-Strength Bolts, Nuts and Washers	1080
Low-Carbon Steel Bolts, Nuts and Washers	1080
Galvanized Coating of Steel Lighting Poles and Appurtenances	1080
Lighting Equipment	1091
High-Strength Anchor Bolts	ASTM A 449
Structural Low Alloy Steel for Base Plates	AASHTO M 270, Grade 50 (ASTM A 709, Grade 50)
Stainless Steel Bolts, Screws and Washers	ASTM A 193, Grades B5, B6, B7 or B16
Stainless Steel Nuts	ASTM A 194
Circular Steel Pile Foundation	ASTM A 252, Grade 2 or ASTM A 500, Grade B/C
Steel H-Pile Foundation	ASTM A 709, Grade 36
Screw Anchor Foundation Shaft Helix Helix Core	 ASTM A 252, Grade 2 or ASTM A 500, Grade B/C ASTM A 575, Grade M 1010 or AASHTO M 270, Grade 36 (ASTM A 709, Grade 36) ASTM A 575, Grade M 1023 or AASHTO M 270, Grade 36 (ASTM A 709, Grade 36)
Connector Plates and Steel Closure Plates for Circular Pipes and Connector Plates for H-Pile and Screw Anchor Foundations	AASHTO M 270, Grade 36 (ASTM A 709, Grade 36)

901.3.1 Bolts, nuts and washers specified to be galvanized shall be galvanized in accordance with AASHTO M 232 (ASTM A 153), Class C, or mechanically galvanized in accordance with AASHTO M 298 (ASTM B 695) Class 55. Except for anchor bolts, galvanizing thickness shall not exceed 6 mils. For anchor bolts and nuts and for high strength bolts and nuts, except those in accordance with ASTM A325, the contractor shall furnish to the engineer a test report certified to be the last completed set of mechanical tests for each size in each shipment. For high strength bolts and nuts in accordance with ASTM A325, the contractor shall furnish to the engineer a copy of the manufacturer's inspection test report for each production lot or shipping lot furnished and shall certify the bolts furnished are in accordance with the specifications. Bolts and nuts in accordance with ASTM A 307 shall be accompanied by a manufacturer's statement that the bolts and nuts were manufactured in accordance with ASTM A 307.

901.3.2 Concrete shall be of the class specified in the contract. Material, proportioning, mixing, slump and transporting of concrete shall be in accordance with Sec 501 for the specific class specified.

901.3.3 Equipment and material shall be of new stock unless the contract provides for relocation of existing units or use of units furnished by others. New equipment and material shall be in accordance with ICEA, NEMA, NESC, NFPA and the regulations of the National Board of Fire Underwriters, as applicable, and shall meet the approval from the engineer.

901.4 Equipment List. Three copies of the list of equipment and material to be installed will be furnished to the successful bidder, along with the contract for execution. The contractor shall complete the list by writing in the name of the equipment manufacturer and catalog number of each item listed. A list of pre-approved equipment and material is available through Traffic or MoDOT's web site. Only items on the latest revision of the pre-approved list will be accepted for use. Two copies of the completed list shall be submitted to the engineer and shall be approved in writing before the items are installed. Approval of the items on the list will not relieve the contractor of the responsibility for satisfactory performance of the installation.

901.5 Lighting Poles. The contractor shall furnish the length of pole and bracket rise shown on the plans. The cable entrance at the bracket arm shall be a field drilled 1 1/4-inch hole. The edges of the hole in steel poles shall be deburred and coated with commercially available inorganic zinc-rich paint. All cable entrance holes shall be fitted with a suitable rubber grommet. A grounding conductor shall provide grounding continuity for all metallic, noncurrent carrying poles in one circuit. The grounding conductor shall be securely connected to the grounding electrode on the supply side at the main disconnect switch.

901.6 Navigation Lighting. The navigation lighting system shall consist of furnishing and installing all cable, conduit, controllers, lanterns, lamps, supports and all other equipment as shown on the plans. Bridge navigation lights shall be installed in accordance with Title 33 CFR, Part 118, the manufacturer's recommendations and the following:

901.6.1 Lanterns mounted in an inverted position shall have a hole in the tip of the lens to prevent water from collecting in the lantern. Lamps shall be properly installed and focused in the lenses.

901.6.2 As part of the system, a photoelectric cell shall be provided in accordance with Sec 1091. The photoelectric cell shall be mounted on the control station such that all lanterns within the system operate simultaneously and shall illuminate only during hours of darkness or low visibility.

901.6.3 Equipment used for general illumination of the bridge shall be designed such that the light distribution pattern will not permit high-intensity light to spill over and blind or interfere with marine navigation.

901.6.4 The contractor shall maintain navigational lighting on bridges during all construction and provide permanent navigation lighting on the bridge when the bridge spans the river and falsework has been removed. Existing navigation lighting shall remain in use or temporary navigation lighting installed during the construction period as required. Upon the notice to proceed, the contractor shall maintain and operate the navigation lights until the permanent navigation lights are in operation and the test period completed. Temporary lights and reflectors shall be of the same color and characteristic and have a range of visibility equal to that prescribed for permanent navigation lights.

901.6.5 The contractor shall notify the engineer in writing the date the navigation lighting system will be ready for testing. With approval from the engineer, the contractor shall place the navigation lighting system in operation for a 15 consecutive day test period. The test period shall not be started until all lanterns in the system are ready to be tested. The system shall be tested as a unit. Any failure or malfunction of equipment during the test period shall

be corrected at the contractor's expense and the navigation lighting system tested for an additional 15 consecutive day period. This procedure shall be repeated until the navigation lighting system has operated to the engineer's satisfaction for 15 consecutive days.

901.6.6 When the test period is initiated and until completed, the contractor shall provide a service technician in accordance with Sec 901.14.

901.6.7 Before acceptance of the work, the contractor shall furnish the engineer with maintenance information in accordance with Sec 901.16 of all navigation lighting equipment including, but not limited to, lanterns, lamps and auxiliary equipment.

901.7 Contactors. At the option of the contractor, mercury load relays may be used in lieu of contactors.

901.8 Power Supply Assembly. The power supply assembly shall consist of all equipment mounted on a service pole or pedestal as shown on the plans. The configuration and installation of the equipment mounted on the assembly shall meet the safety requirements and approval of the utility company or municipality furnishing power for operation. All contractor provided meter boxes and disconnect boxes shall be constructed of aluminum or stainless steel. All hinges, catches and other hardware shall be non-ferrous metal or stainless steel.

901.8.1 Service poles shall consist of wood poles and crossarms, insulators, necessary pole line hardware, conduit, ground rods, guy wires and anchors and all other accessories and appurtenances mounted on the pole, except those items furnished by the utility company or municipality, or specified separately in the contract.

901.8.2 Pedestals shall consist of two W6 x 9 or two W6 x 15 galvanized steel posts, a concrete footing and all other accessories and appurtenances mounted on the post, except those items furnished by the utility company or municipality, or specified separately in the contract.

901.8.3 Main disconnect switches shall be separately housed on the power supply. The disconnect cabinet shall contain a Type A or Type B circuit breaker in accordance with Sec 1091, of the rating shown on the plans.

901.8.4 Circuit breaker cabinets and meters shall not be installed on the street or walk side of the pole or pedestal.

901.8.5 Meter sockets provided by the contractor shall be UL approved and shall be in accordance with the requirements of the utility company or municipality providing power.

901.9 Rigid Conduit System. Conduit shall be placed as shown on the plans. Rigid conduit shall be installed in accordance with the applicable requirements of Sec 902.

901.10 Trenching and Backfilling.

901.10.1 The depth of trenching and backfilling for conduit and cable-conduit shall be no less than shown on the plans. Conduit or cable-conduit shall not be placed in a trench prior to inspection of the trench by the engineer. All disturbed areas shall be restored to the satisfaction of the engineer.

901.10.2 Type I, 24-inch trenching for cable-conduit will be specified if the excavated material would be classified as Class A Excavation, as defined in Sec 203 and no material is in evidence that might cause mechanical damage to cable-conduit. The cable-conduit shall be laid on the bottom of the trench and the trench backfilled. In lieu of Type I, 24-inch trenching,

the cable-conduit may be installed by plowing. The cable-conduit shall be placed at a minimum depth of 18 inches and the soil over the installation shall be recompacted to the approximate original in-place density.

901.10.3 Type II, 24-inch trenching for cable-conduit will be specified if the excavated material would be classified as Class A Excavation, as defined in Sec 203 and material is in evidence that might cause mechanical damage to cable-conduit. Type II trenching will also include trenching in rock embankment. The cable-conduit shall be embedded in sand as shown on the plans and the trench backfilled.

901.10.4 Type III, 21-inch trenching for cable-conduit will be specified if material that would be classified as other than Class A Excavation, as defined in Sec 203, is encountered. The cable-conduit shall be embedded in sand as shown on the plans and the trench backfilled.

901.10.5 Trenches shall be excavated to the width and depth necessary for conduit installation as shown on the plans. All trenches shall be backfilled as soon as practical after the installation of conduit or cable-conduit. Cinders, broken concrete and other hard or objectionable material that might cause mechanical damage to conduit or cable-conduit shall not be used for backfilling to an elevation 12 inches above the top of conduit or cable-conduit. The bottom of the trench shall be free of such material before the conduit is placed. Backfill material shall be deposited in layers not exceeding 6 inches deep and each layer shall be compacted to the approximate density of the adjacent material by an approved method before the next layer is placed. Red burial tape imprinted with "CAUTION - BURIED CABLE BELOW" shall be installed in all trenches and plowing operations at approximately 1/3 to 1/2 of the depth of the trench. If the trench is to be located under a shoulder that is to be stabilized, the trenching, installation of conduit or cable-conduit and backfilling the trench shall be completed before the shoulder stabilization construction is started. Unless the lighting poles are in place, a coil of cable or cable-conduit of sufficient length to reach the proposed handhole shall be buried near each pole location. The coil shall be covered such that damage will not occur.

901.11 Pull and Junction Boxes. Pull and junction boxes shall be installed at locations shown on the plans in accordance with Sec 902.

901.12 Pole Foundations and Installation.

901.12.1 Concrete foundations for ground mounted poles shall be Class B concrete and shall have dimensions no less than shown on the plans. Concrete shall be placed, finished and cured in accordance with the applicable provisions of Sec 703. Forms will not be required for concrete placed below the finished ground line. All conduit and anchor bolts shall be rigidly installed before the concrete is placed. All portions of the anchor bolts extending above the foundation shall be threaded. Anchor bolts shall align with bolt holes on the transformer base or base plate. Installation of poles on integral concrete median and foundations shall be as shown on the plans. The concrete foundation shall be flush with the finished grade or surface and shall not extend above the finished grade on slopes.

901.12.2 Steel circular and H-pile foundations for ground mounted poles shall be installed in a hole of the approximate dimensions shown on the plans and secured by tamped, wet limestone screenings. Steel pile foundations with poles attached may be installed as a unit. The steel connector plate shall be at the proper elevation and properly oriented to receive the transformer base. The connector plate shall be flush with the finished grade or surface and shall not extend above the finished grade on slopes.

901.12.3 The torque for screw anchor foundations shall not exceed the maximum torque rating shown on the fabricator's shop drawings. The steel connector plate shall be at the

proper elevation and properly oriented to receive the transformer base. The connector plate shall be flush with the finished grade or surface and shall not extend above the finished grade on slopes.

901.12.4 Leveling and raking of poles on structures may be accomplished by the use of shims, not to exceed a total of 1/2 inch on bolts.

901.12.5 If poles are to be placed on existing foundations or structures with anchor bolts in place, the contractor shall furnish poles with a base plate to fit the anchor bolt spacing.

901.13 Luminaires. Luminaires for roadway lighting shall be adjusted to give proper illumination on the roadway. Luminaires for underpass lighting shall be interconnected with one-inch minimum rigid conduit in accordance with Sec 902 unless other provisions are incorporated into the structure. The contractor shall place the standard identification marker, which is included with the lamp, in accordance with the latest version of ANSI C136.15.

901.14 Circuits. Circuits shall be properly labeled in all handholes, pull boxes and junction boxes by means of round aluminum identification tags with a minimum thickness of 0.1 mil attached to the cables with copper wire. Prior to energizing any circuit, the insulation resistance to ground of each completed lighting circuit shall be tested and shall be no less than 10 megaohms. Any circuit less than 10 megaohms to ground will be rejected. The contractor shall provide a suitable 500-volt direct current, zero to 100-megaohm range resistance measuring device for making the resistance test. The circuit test shall be performed by the contractor in the presence of and documented by the engineer.

901.14.1 After the circuits have been tested and found acceptable, the contractor shall, upon approval from the engineer, energize the lighting circuits for a 15 consecutive day test period. All circuits being energized from a control station shall be tested as a system. The entire system shall be tested as a unit. Any malfunction on any circuit shall be corrected and the system tested for an additional 15 consecutive day period. This procedure shall be repeated until the lighting system has operated to the engineer's satisfaction for 15 consecutive days.

901.14.2 When the test period is initiated and until completed, or following the turn-on of temporary lighting, the contractor shall provide at least one service technician to remain in the area and be available for day, night and weekend trouble calls. The contractor shall furnish the name, address and telephone number where each designated technician can be reached at all times. If the lighting system malfunctions and a designated technician cannot be reached or cannot arrive at the location in a reasonable time in the judgment of the engineer, the engineer may exercise the option to direct MoDOT personnel or a third party to correct the malfunction. If this option is invoked, the entire cost of the work performed by MoDOT personnel or the third party will be computed in accordance with Sec 108.9 and deducted from monies due the contractor. Whether or not the engineer elects to correct the malfunction, nothing in this specification shall be construed or interpreted to relieve the contractor of any liability for personal injury or property damage resulting either directly or indirectly from a malfunction during the test period. The contractor and surety shall indemnify and save harmless the State, the Commission, and the Commission’s agents, employees and assigns for any legal liability for such a malfunction.

901.15 Installation of Cable and Cable-Conduit.

901.15.1 Cable-conduit shall be installed in a trench of the type specified. Cable-conduit runs shall be continuous without splice between the control panel, handholes, pull boxes, poles and junction boxes. All conduit ends shall be sealed around the cables with a readily workable, soft, sealing compound. The compound shall be workable at 30 F and shall not melt or run at temperatures up to 175 F. Cable-conduit shall be allowed to "snake" in the trench, but there

shall be no sharp bends and if two or more cable-conduits are placed in a common trench, the cable-conduit shall not cross each other. For concrete foundations, rigid conduit of sufficient size to facilitate the pulling of cable-conduit shall be cast in the foundation as shown on the plans. The cable-conduit shall be installed through the rigid conduit. Cable-conduit shall extend a minimum of 18 inches above the top of the foundation. The conduit of the cable-conduit shall then be cut off circumferentially approximately 6 inches above the base plate in the transformer base or pole, leaving the cables exposed for connection. Where placed under paved roadways, other paved areas and any type of shoulder, the cable-conduit shall be installed in rigid conduit. Standard commercial duct fittings shall be used to connect conduit of cable-conduit to rigid conduit as shown on the plans and the cables shall continue without splice through the conduit to the nearest pole base. The ground wire shall be attached to a ground lug.

901.15.2 Splices shall be made only in pull boxes, junction boxes and pole bases. More than four cables shall not be spliced in above ground tee splices in pole bases and junction boxes immediately adjacent to wall mounted brackets or underpass luminaires. More than three pairs of power cables shall not be spliced at any other location. Straight or line splices shall only be made in pole bases and junction boxes immediately adjacent to underpass luminaires or wall-mounted brackets unless otherwise approved by the engineer. For underpass lighting or wall-mounted brackets, the cables shall continue unspliced to the nearest junction box or luminaire housing if junction boxes are not shown on the plans. Tee splices shall only be made at the locations shown on the plans.

901.15.2.1 Cables shall be continuous and unspliced to the first light pole. Line splicing in all types of poles, above ground junction boxes and luminaire housings shall be accomplished with a pre-molded fused connector assembly. Line splicing in all breakaway pole bases shall be accomplished with a pre-molded fused slip connector assembly as shown on the plans. After a conductor splice is made, the conductor splices shall be insulated with a protective rubber boot designed for the pre-molded connector. All above ground tee splices shall be accomplished with a splice block with a molded plastic insulating cover. Any required taping shall be accomplished with splice tape. All sharp points and edges of the connector shall be padded and all voids filled with extra wraps of plastic tape. Tape shall not be stretched excessively or in such a manner as to cause creeping.

901.15.2.2 Underground cable splices, if specified, shall be made in a pull box. Straight or line splices shall be made with copper-clad pressed sleeves or an approved equivalent. Tee splices shall be made with a pressed sleeve, split or unsplit type, or an approved equivalent. All splices shall be protected with a resin splice kit installed in accordance with the manufacturer's recommendations.

901.15.3 Cable shall be pulled with a minimum of dragging on the ground or pavement. Frame mounted pulleys or other suitable devices shall be used for pulling cables out of conduits into pull boxes. Lubricants may be used to facilitate pulling cable. Slack in each cable shall be provided by coiling 6 feet of cable in each pull box and 3 feet of cable in each junction box. Where cable-conduit enters a pull box, conduit shall be cut away from cables in accordance with Sec 902.

901.16 Maintenance Information. Before acceptance of the work, the contractor shall furnish the engineer four copies of the manufacturers' written instructions for maintenance and operation of all lighting equipment and wiring diagrams of the installation or system. At a minimum, the manufacturer's instructions shall include documented, organized instructions, wiring and component layout diagrams, and parts lists with part numbers.

901.17 Final Clean Up. Final clean up of right of way shall be in accordance with Sec 104.

901.18 Method of Measurement.

901.18.1 Measurement of trenching, including backfilling, except for rigid conduit, will be made to the nearest linear foot along the centerline of the trench. No measurement of trenching will be made for rigid conduit.

901.18.2 Measurement of rigid conduit will be made to the nearest linear foot as shown on the plans. Contract quantities will be used in final payment except as hereinafter provided.

901.18.3 Measurement of power cable, pole and bracket cable, multi-conductor cable, wire and cable-conduit will be made to the nearest 10 linear feet as shown on the plans. Contract quantities will be used in final payment except as hereinafter provided.

901.18.4 Measurement of luminaires and bracket arms, including all required material and hardware, will be made per each as separate items.

901.18.5 Measurement of Type AT poles, including the transformer base and all specified hardware, will be made per each. Foundations for Type AT poles, including all specified material, will be made per each.

901.18.6 Measurement of Type B poles, including all specified hardware, will be made per each. Bridge safety barrier curb blisters will not be measured for payment with the Type B pole.

901.18.7 Measurement of Type MB poles, complete in place, will be made per each as a single item, including the footing and the integral portion of median barrier. No direct payment will be made for the footing or integral portion of median barrier for Type MB poles.

901.18.8 Measurement of control stations, including all specified equipment, will be made per each.

901.18.9 Measurement of power supply assemblies, including all specified equipment and cable, will be made per each. The conduit attached to the power supply pole or pedestal and any necessary attachment hardware shall be included with the power supply and no direct payment will be made.

901.18.10 Measurement of pull boxes, including all specified material, will be made per each.

901.18.11 For those items on which final payment is based on contract quantities, final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. The revision or correction will be computed and added to or deducted from the contract quantity.

901.18.12 Measurement of temporary lighting installations will be made per lump sum.

901.18.13 Measurement of navigation lighting systems will be made per lump sum.

901.18.14 Measurement of substituted items in accordance with Sec 901.15 will be made based on metric dimensions, quantities and contract unit price.

901.19 Basis of Payment.

901.19.1 Accepted highway lighting will be paid for at the contract unit price for each of the pay items included in the contract.

901.19.2 If the contract does not contain a contract unit price for Type III Trenching, and material that would be classified as other than Class A Excavation, as defined in Sec 203, is encountered on construction, payment for such trenching will be paid for at the contract unit price of three times the contract unit price for Type II Trenching per linear foot.

901.19.3 Accepted navigation lighting systems, complete in place, will be paid for at the contract unit price. Payment will be considered full compensation for all labor, material and equipment to perform the described work, including, but not limited to, furnishing and installing all cable, conduit, controllers, light fixtures, lamps, and supports.

901.19.4 Payment of substituted items in accordance with Sec 901.15.4 will be made based on the metric dimensions, quantities and contract unit price.

901.19.5 No direct payment will be made for transformer bases.