Make this section a part of the Standard Specifications:

SECTION 761 – LIGHT EMITTING DIODE (LED) ROADWAY LIGHTING SYSTEMS MATERIALS

761.01 Lighting Poles. Light poles shall be made of aluminum, conforming to requirements of AASHTO publication *Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals*, and this subsection. Drawings for proposed poles shall be submitted in accordance with Subsection 622.03(A) - Equipment List and Drawings.

(A) Aluminum Poles. Aluminum poles shall be spun tapered from seamless aluminum tubing, alloy 6063-T6, conforming to ASTM B 221, with minimum thickness of 0.250 inch. Circumferential or longitudinal welds will be allowed only at lower end of pole where pole is joined to anchor base.

Poles shall have anchor base consisting of permanent mold cast aluminum, alloy 356.0, conforming to ASTM B 108. Anchor bolts shall be stainless steel conforming to Subsection 718.01 - Standard Fasteners, and shall be of quantity and grade indicated in the contract documents. Poles mounted on walls and structures shall have anchor bases and side entry handholes. Poles mounted on bridge structures shall be equipped with vibration damper recommended by pole manufacturer and accepted by the Engineer.

Grounding nut or screw on inner portion of pole shall be placed opposite handhole.

Each pole shall be furnished complete with mast arm, base, ornamental pole top, base cover, and anchor bolts. Unless otherwise indicated in the contract documents, aluminum poles shall have polished natural aluminum finish and stainless steel hardware.

Aluminum poles shall be protected during shipment with protective paper.

761.02 Luminaire Mast Arms. Mast arms shall be made of seamless aluminum tubing conforming to ASTM B 221, and shall be of type, size, length, and rise, as indicated in the contract documents. Mast arms 8 feet long or shorter shall be tapered elliptical, self-supporting mast arms. Mast arms greater than 8 feet long shall be truss-type mast arms. Ends of mast arms shall be completed in two-inch slip fitter with inner-wired-type pole plates.

761.03 Luminaires for Roadway Lighting. Luminaires shall conform to the provisions in Section 761.03, "Luminaires for Roadway Lighting", of Section 761 Light Emitting Diode (LED) Roadway Lighting Systems Materials.

Luminaires shall conform to the following Standards and Special Provisions:

Standards

- ANSI/NFPA 70, National Electrical Code
- FCC 47 CFR Part 15, Federal Code Of Regulation (CFR) testing standard for electronic equipment
- IEEE C62.41, Guide on the Surge Environment in Low-Voltage (1000 V and Less) AC Power Circuits
- IESNA LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products
- IESNA LM-80, Approved Method for Measuring Lumen Maintenance of LED Light Sources
- IESNA TM-15, Luminaire Classification System for Outdoor Luminaires
- NEMA SSL 3-2010, High-Power White LED Binning for General Illumination
- UL1598, Standard for Safety of Luminaires

(A) Luminaires for Roadway Lighting. Luminaires for roadway lighting shall be nominal 4000K Light Emitting Diode (LED) type, suitable for wet locations per UL 1598. Luminaire shall have a BUG rating with U to be zero and produce zero light at or above 90 degrees. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires in wet locations

(1) Housing. Housing shall conform to the following:

(a) Housing shall be rear-entry with horizontal slipfitter for inner wiring, die-cast aluminum with integral heat sinks. The cast aluminum electrical compartment shall be separate from the LED array to ensure cooler operating temperatures of the driver. Access to the electrical compartment shall be tool-less by use of stainless steel latches. Driver and surge module shall be secured to the swing down door which can easily be removed and exchanged without the use of tools by separating a quick disconnect electrical connection. Housing shall be designed to prevent the buildup of water on the top of the housing.

I. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity

to assure proper operation of the luminaire over the expected useful life.

II. The LED manufacturer's maximum thermal pad temperature for the expected life shall not be exceeded.

III. Thermal management shall be passive by design. The use of fans or other mechanical devices shall not be allowed.

IV. The luminaire shall have a minimum heat sink surface such that LED manufacturer's maximum junction temperature is not exceeded at maximum rated ambient temperature.

(b) Luminaire shall include cast in pipe stops, leveling steps and a four bolt mounting system capable of accommodating 1¼" to 2" ID pipe (1 5/8" to 2 3/8" OD).

(c) The assembly and manufacturing process for the LED luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration. Luminaire shall withstand vibration, meeting ANSI C136.31 American Standard for Roadway and Area Lighting Equipment – Luminaire Vibration for normal and bridge operation (3G minimum).

(d) Housing and door frame shall be aluminum with a nominal 2.0 mil thick paint finish able to withstand a 3000-hour salt spray test as specified in ASTM Designation: B117. Housing shall have a minimum IP rating of IP-65.

(e) The housing shall meet the requirements for NEMA/UL wet location, be UL listed and gray in color with a flat or semi-gloss sheen.

(f) Each LED luminaire shall have the manufacture's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked inside each unit and the outside of each packaging box. The operation characteristics such as rated voltage and rated power in watts and Volt-Ampere shall be permanently marked inside each LED luminaire unit.

(2) Driver. Driver shall conform to the following:

(a) Operation Voltage: The luminaire shall operate from a 60 HZ ±3 HZ AC line over a voltage ranging from 108 VAC to 305 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.

(b) Power Factor: The luminaire shall have a power factor of 0.9 or greater.

(c) Operational Performance: The LED circuitry shall prevent visible flicker to the unaided eye over the voltage range specified above.

(d) Surge Suppression: The luminaire onboard circuitry shall include surge protection devices (SPD) to withstand high repetition noise transients as a result of utility line switching, nearby lightning strikes, and other interference. The SPD protects the luminaire from damage and failure for common (Line-to-Ground) and differential (Line-to-Line) mode transient peak currents up to 10 kA (minimum). SPD conforms to UL 1449. SPD performance has been tested per procedures in ANSI/IEEE C62.41-2:2002 category C high exposure and ANSI C136.2 10kV BIL. The SPD shall fail in such a way as the Luminaire will no longer operate. The SPD shall be field replaceable and IP66 rated.

(e) RF Interference: LED Drivers must meet Class A emission limits referred in Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.

(f) The rated operating temperature range shall be -40°C (-40ºF) to +40°C (104ºF).

(g) The power supply shall be contained inside the luminaire and a mimimum IP rating of IP-65.

(h) Driver shall be IP66 rated and capable of dimming for future controllability.

(i) THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent.

(3) LED Array(s). LED arrays shall be high brightness, nominal 70 CRI at CCT 4000K. The design life of the LED array(s) shall be defined as L70 at 50,000 hours at 40°C.

(a) Each luminaire is capable of operating above 40ºC (104ºF), but not expected to comply with photometric requirements at elevated temperatures.

(b) The rated operating temperature range shall be -40°C (-40ºF) to +40°C (104ºF).

(c) The individual LEDs shall be constructed such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.

(d) The optical assembly of the luminaire shall be protected against dust and moisture intrusion.

(e) Each refractor or lens shall be made from UV inhibited high impact optical grade material and be resistant to scratching.

(4) Illumination. Luminaires shall provide roadway with minimum average maintained illumination value in accordance with manufacturer's specifications and IES light distribution type indicated in the contract documents. Photometric data with certification of conformance shall be submitted.

(a) Photometry must be compliant with IESNA LM-79.

(b) Luminaire shall have a minimum efficacy of 90 lumens per watt and shall not consume power in the off state.

(c) BUG rating shall not exceed U0.

(d) Luminaire manufacturer shall provide the LED manufacturers LM-80 report.

(5) Photoelectric Control Receptacle. Luminaires shall be furnished with or without photoelectric control receptacles, as indicated in the contract documents. When photoelectric control receptacle is included, rain tight shorting cap shall be installed.

(a) When a photo control receptacle is required, it shall be compliant with ANSI C136.41-2013, 7-pin photocontrol receptacle. This shall provide a standard method of light level control between external PCR and a dimmable driver for future use.

(6) Warranty. Luminaires shall be warranted to be free from manufacturing defects for a period of 5 years.

(a) LED luminaire manufacturer shall provide 5-year warranty on LED luminaires that includes LEDs, housing, drivers and finish.

(b) Technical properties must be made available for a minimum of 5 years after the date of manufacture.

(c) Luminaires shall be fully assembled and individually electrically tested prior to shipment.

(7) Manufacturer. The luminaire manufacturer shall have a minimum of 15 years of experience in the manufacture, assembly, and sale of roadway luminaires in the United States of America. The roadway luminaire shall comply with the Buy America Act and the American Recovery and Reinvestment Act of 2009 (ARRA). The manufacturer shall have a minimum of 10,000 roadway luminaires installed within the United States of America prior to bid opening.

(8) Submittals. Product data submitted for approvals shall include, but not limited to materials, finishes, photometric performance, photometric layouts, dimensional information and LM-79 report for each luminaire.

(9) Delivery, Storage and Handling. Deliver luminaires and components carefully to avoid breakage, bending and scoring finishes. Do not install damaged equipment. Store luminaires and accessories in original cartons and in clean dry space; protect from weather and construction traffic.

761.04 Cables and Wires for Roadway Lighting System

(A) Cables and Wires.

(1) Circuit Cable. Cable for 120/240 volt or 240/480 volt roadway lighting circuits shall conform to the following

requirements: single conductor, 600 volt, AWG sizes as indicated in the contract documents; stranded copper, Type XHHW suitable for use at 167 degrees F, with 2/32-inch-thick rubber insulation, and 3/64-inch thick neoprene jacket. Rubber insulation and neoprene jacket shall conform to NEC, RHW/USE standards, and ICEA S-105 692 standard.

(2) Pole Fixture Cable. Connection of circuit cables from base of light pole or pull box to each luminaire shall conform to the following requirements: single conductor, 600 volt, No. 10 AWG, stranded copper, and Type XHHW or RHW. Unless otherwise indicated in the contract documents, ground conductors shall conform to the following requirements: single conductor, 600 volt, No. 6 AWG, stranded copper, Type XHHW or RHW. Ground conductors shall be installed in conduits.

(B) Luminaire and Cable and Wire Identification. Tags of rigid, non-ferrous material shall be affixed, with machine embossed legend on two sides with non-ferrous wire to feeder, branch feeders, and sub-branch cables and wires in pullboxes and light standard bases. Legend with 1/4-inch-high letters shall indicate feeder designation.

761.05 Disconnect and Protective Devices.

(A) General. Splices and taps shall be limited to minimum number. Conductor-to-conductor connections shall be made with hydraulically indented lugs.

(B) Taps. Taps from feeders to highway lighting luminaires shall be made at lighting standards, with standard connector kits that provide quick-disconnect, fused branch connection to feeder conductors. Waterproof taps shall have dielectric value equal to that of the insulation of conductors joined. Fuses shall be standard midget, ferrule-type, with ampere ratings an indicated in the contract documents.

(C) Splicing. Feeders shall be spliced with standard splicing kits of type recommended by cable manufacturer. Splices shall be waterproof and shall have dielectric value equal to that of the insulation of conductors joined.

761.06 Waterproof Connectors for Roadway Lighting. Where indicated in the contract documents, connector kits shall be of waterproof, molded rubber. Connectors shall be 600-volt, quick disconnect, in-line connectors, fused for ungrounded conductor and non-fused for neutral at each pole. Opening in line conductor connectors shall be suitable for cables furnished. Lubrication and

taping shall be as recommended by manufacturer of connectors. Fused connectors shall accommodate standard midget, ferrule-type fuses with ampere rating as indicated in the contract documents.

761.07 Photoelectric Control. Photoelectric control unit shall have inrush current rating of 120 amperes. Photoelectric control shall withstand surge current up to 1,000 amperes. Chassis shall withstand hi-pot test of 5,000 volts. Cadmium-sulfide cells shall have 300 to 500 milliwatts maximum dissipation operating voltage range between 105 volts to 285 volts, and mounting features that conform to EEI Publication No. 148, NEMA Publication No. SH18-1959. Photoelectric control unit shall be UL listed for wet locations.

Light level setting shall be adjustable from 0.5 to 3.0 foot-candles with time delay of up to three minutes. Light level setting shall be adjusted for turn on at 0.7 $\pm$ 0.2 foot-candles.

END OF SECTION 761