

New Jersey Turnpike Authority

P.O. Box 5042, Woodbridge, NJ 07095



November 23, 2021

Document Change Announcement

2016 Standard Supplementary Specifications

Lighting and Power Distribution Systems

DCA2021SS-07

Subject: Revisions to

Section 104 Control Of Work, Subsection 104.08 Shop and Working Drawings
Section 105 Control Of Materials, Subsection 105.07 Storage of Materials and Staging Areas
Section 106 Legal Relations And Responsibility, Subsection 106.18 Utilities
Section 601 Common Electrical Provisions, Various Subsections
Section 602 Power Distribution, Various Subsections
Section 603 Lighting, Various Subsections
Section 918 Electrical Materials, Various Subsections

Description of Change:

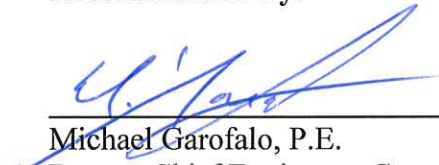
Various sections/drawings of the Authority's Standard Drawings, 2016 Standard Supplementary Specifications, and Design Manual pertaining to lighting and power distribution systems have been updated.

Notice to New Jersey Turnpike Authority Staff and Design Consultants

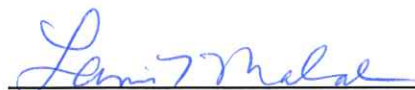
Effective immediately, all contracts currently in the design phase shall incorporate the revisions herein. For advertised contracts awaiting the opening of bids this revision shall be incorporated via addendum. Contact your New Jersey Turnpike Authority Project Manager for instruction.

The revisions may be accessed on the Authority's webpage: <https://www.njta.com/doing-business/professional-services>

Recommended By:




Michael Garofalo, P.E.
Deputy Chief Engineer - Construction



Lamis T. Malak, P.E.
Deputy Chief Engineer - Design

Approved By:



Robert J. Fischer, P.E.
Chief Engineer

Distribution: Senior Staff Engineering, Law, Maintenance & Operations Depts., All Prequalified Consultant Firms, File

NOTE: The following text in tracked changes indicates REVISIONS to the latest version of the 2016 Standard Supplementary Specifications.

SECTION 104 – CONTROL OF WORK

104.08 Shop and Working Drawings

The following is added after the first paragraph:

Shop and working drawings shall be submitted for the following items of work including but not limited to:

...

- See Subsection 601.03(E) for a list of electrical items

SECTION 105 - CONTROL OF MATERIALS

105.07 Storage of Materials And Staging Areas

The following is added after the fourth sentence of the first paragraph:

Storage/Staging areas for this Contract are **[insert allowable staging areas, restrictions, and any work to be completed within the staging areas]**. The Contractor will be required to maintain areas in a clean and neat condition.

The following is added:

The Contractor shall store all Electrical and ITS devices in accordance to manufacturer recommendations. The equipment listed below is required to be stored within a climate-controlled facility in accordance with manufacturer's recommendations and specified storage temperature and humidity range for a maximum period of two months prior to installation and activation:

1. All equipment/ devices containing batteries including, but not limited to, In-Pavement Wireless Sensors
2. Transformers

NOTE: The following text is ADDED to the latest version of the 2016 Standard Supplementary Specifications.

SECTION 106 - LEGAL RELATIONS AND RESPONSIBILITY

106.18 Utilities

The following is added:

(C) Service Requests

New electrical service requests have been made as required. The following is a list of service requests and utility contact information.

Location	Electric Service Job Number and Status	Utility Company	Utility Contact Name	Utility Contact Information
(Provide description of location)	(Provide utility job number and Status such as "Approved")	(Provide utility company name)	(Provide utility representative name)	(Provide utility representative contact information)

SECTION 601 - COMMON ELECTRICAL PROVISIONS

601.02 Materials.

The following is removed from the list:

Materials and equipment shall conform to Section 601 and to the following Subsections:

JUNCTION BOX FRAMES AND COVERS.....909.04; 918.17

The following is added to the list:

Materials and equipment shall conform to Section 601 and to the following Subsections:

ARC FLASH STUDY918.20

ANTI-SEIZE COMPOUND918.60

PRECAST REINFORCED CONCRETE JUNCTION BOX.....918.61

WIRE LABELS.....918.65

Replace the last paragraph with the following:

Portland cement concrete in boxes, bases, manholes, and foundations shall be Class B, meeting the requirements of Section 401.

601.03 General Conditions.

The following is added at the beginning of the Section:

Existing electrical equipment, cabinets, or installations that are indicated on the Plans to be salvaged shall be transported to a location as directed by the Engineer. Request up-to-date contact information for the Electrical Foreman at the specified location and provide 24-hours notice.

(D) Continuity of Illumination, Communication, and Power.

The following paragraph is added to the second paragraph:

Unless otherwise directed, the continuity of illumination is the sole responsibility of the Contractor.

(E) Shop Drawings.

The following paragraph is added to the list under Subsection E:

- Transformers
- Manual Transfer Switches
- Electrical Studies
- Flashing Beacons
- Aviation obstruction beacons
- Navigation lighting installations

(G) Removal of Existing Electrical Facilities.

The following paragraph is added to Item (1)

In all cases where transite conduit to be abandoned or is found abandoned, the Contractor shall install a #12 AWG solid THWN copper with thermoplastic insulation tracer wire in the length of the conduit for future location. Tracer wire shall be sealed at each end to prevent corrosion or damage. Abandoned conduit may require additional documentation (deed notice) to be filed by the Contractor, as required by the NJDEP Division of Solid and Hazardous Waste (DSHW). Consult the Management of Abandoned-in-place Asbestos Cement Pipe section of the Guidance Document for the Management of Asbestos-containing Material (ACM). All transite conduit to be removed shall be handled and transported in accordance with the NJDEP DSHW under the ACM, as well as Federal EPA guidelines.

Replace Item (5), paragraph 2 with the following:

Unless otherwise indicated on the Plans, lighting standard assemblies shall be relocated complete with lighting standard shaft, bracket arm(s), transformer base or shoe base, luminaire(s), and parapet mounting brackets for bridge mounted units. New mounting hardware shall be provided.

The following paragraph is added:

(8) HPS and Mercury Vapor lamps removed from existing installations shall be handled in a manner that they do not break, and shall dispose of the lamps in accordance with the NJDEP by removing lamps from luminaires and turning them over to an acceptance facility in NJ or at one of the processing facilities in PA. Acceptance centers and processing facilities may be found on the NJDEP website, Division of Solid and Hazardous Waste, or by calling the Bureau of Landfill & Hazardous Waste Permitting.

(I) Electrical Shut Down Procedures.

Replace the entire Section (I) with the following:

Shutdown of Authority electrical power will be as directed and approved by the Engineer.

To arrange for a shutdown, the Contractor shall obtain approval from the Authority, through the Engineer, to disconnect the electric service for the required circuits, prior to commencing with any work either directly related to or within the close proximity of the existing electrical facilities. The Contractor is responsible for "Tagging-Out" all circuits he will be working with and following all safety codes adopted by the Authority or other agencies having jurisdiction. At the end of the outage, the Contractor is to remove his tag and restore the circuit. The Authority will not remove a temporary tag placed by the Contractor. The Contractor will be responsible to restore service. In the case of lighting circuits, the circuit restoration shall be performed prior to darkness. In the case of other power circuits, the circuit restoration shall be performed at least one hour in advance of the scheduled end of shutdown.

Shutdowns are available Monday through Friday, excluding holidays from 9:00AM to 3:00PM with 24-hour advance notice to the Engineer. Arrangements between the Contractor, Engineer and Building Maintenance shall be coordinated to re-energize the shutdown circuits. All circuits should be re-energized in a timely manner such that they can be tested for proper operation prior to darkness. Shutdowns outside this time frame will be performed solely at the Authority's discretion and shall be arranged on a case-by-case basis by the Contractor submitted for approval to the Engineer.

The roadway lighting systems at all work sites within the limits of this Contract, are of 2400V Class for series lighting circuits and 208V, 240V, 460V or 480V Class for the multiple circuits and therefore, all required electrical work must be performed in an approved manner, by licensed professionals and in accordance with the standard procedure for the class of voltage.

The Contractor shall furnish and install all temporary cables and ground wire, where required, to accommodate the removal and reinstallation of any existing 24-hour power circuits which shall be maintained as operational at all times.

601.04 Excavation and Backfill.

Replace the third paragraph with the following:

The excavation for precast units shall be carefully made no larger than necessary. The bottom of excavation shall be thoroughly tamped, and the units shall bed evenly on the bottom of excavation. Precast units shall be placed at the same time as the conduit is laid. Fill adjacent to drains shall consist of not less than ten cubic feet of approved gravel or crushed stone.

601.05 Conduit.

Delete the second to last paragraph and replace it with the following:

Conduits shall be maintained free of dirt or other foreign objectionable material. Ends of all conduits shall be closed with caps, plugs, or discs placed under the bushings until the cables and/or wires are installed or if conduit is designated to remain as spare/empty under final conditions.

Delete the last paragraph and replace it with the following:

All conduit installations below grade (in ground) or transitioning to/from below grade shall be sealed with corrosion resistant rodent blocking material and rodent deterrent foam after installation of all wires and cabling. Mesh shall be a minimum of 3 inches of length of conduit where installed. Foam shall fill a maximum of 3 inches of length of conduit where installed. See 918.46 and Standard Drawings.

The following as added:

When conduits are found to be damaged, the Contractor shall inform the Engineer prior to performing any work. The Contractor shall remove the existing conduits and replace with new. The Contractor shall be responsible to dispose of the damaged conduits off Authority property.

The following is added to Subsection B:

(B) Damage Credits.

The last sentence is deleted and replaced with the following:

For all damages determined to be the fault of the Contractor, all costs for the prescribed conduit repairs and new cables and ground wire installation shall be borne by the Contractor at no additional cost to the Authority. For all damages determined to be an existing condition that is not the fault of the Contractor, all costs for the prescribed conduit repairs and new cables and ground wire installation shall be paid under the respective pay item bid.

(D) Rigid Metallic Conduit.

Replace the first two paragraphs with the following:

Rigid metallic conduits (hot-dipped galvanized steel and aluminum) shall be used in exposed above ground installations where the conduit is protected from the elements such as indoors, except where flexible and PVC coated galvanized conduits are called for, and as further prescribed hereinafter or on the Contract plans.

Galvanized steel conduit shall be used only where specifically directed in the plans for exposed conduit installation where the conduit is fastened to either steel structural members or concrete surfaces (pay item noted as "on structures"); unless otherwise noted where the conduit is encased in or embedded in concrete; for short underground runs where specifically called for on the Plans; and for the conduit installations by means of jacking operations.

Replace the twelfth paragraph with the following:

Conduits shall be fastened to structural members by means of conduit supports and U-bolts, as detailed on the Plans, spaced not more than five feet apart. Where possible, raceways and conduits installed on bridges or other structures shall be installed and secured via no-drill methods. No welding of conduit supports to structural steel members will be permitted. All drilling and modification to existing and proposed steel or concrete structures necessary to mount raceway systems shall be approved by the Engineer.

(H) Duct Bank, HDPE Conduits - Directional Drilled.

(8) Directional Drilling Methods.

Replace the entire Item (8) with the following:

Directional drilling shall conform to the following methods and submittal requirements pertaining to the installation of sleeves/conduits under existing embankments and paved roadways of the Authority:

- (a) The minimum allowable cover under roadways is 6 feet at the center of the roadway measured between the top of sleeves/conduits to top of pavement. Minimum cover under ditches is 3 feet measured from top of sleeve or conduit to invert of ditch. Pretreatment of soils or other soil stabilization techniques intended to reduce the minimum cover shall be approved by the Engineer.
- (b) Sending and receiving pits will not be allowed closer than 10 feet from the outer edge of the paved shoulder. Pits located between 10 to 30 feet from the outer edge of the paved shoulder shall be sheeted, braced, and shored in accordance to calculations and drawings provided by the Contractor. . Sending and receiving pits located beyond 30 feet from the outer edge of paved shoulders may have un-sheeted sides provided a 1 to 1 slope can be maintained in accordance with the latest OSHA standards. In this case, the front face of the pit must be sheeted. In all cases, the pit shall be designed to maintain the stability of the embankment and to provide for proper operation of the drilling equipment. End sections of sleeves or pipes which are damaged during installation shall be replaced without additional compensation. Excavated material shall be placed on the side of the pit facing traffic to provide additional protection. Surplus and waste materials are to be disposed off Authority property in accordance with Section 206.
- (c) When pits are located between 10 and 30 feet from the outer edge of paved shoulder, a standard shoulder closing shall be required for the duration of the operation. In addition, a minimum of 30 feet of temporary concrete barrier is required in accordance with Authority standard drawings and in accordance with Division 800 of the Specifications. If the pit is constructed behind existing guard rail which meets current standards, temporary concrete barrier curb is not required. Pits located beyond 30 feet from the roadway require neither a shoulder closing nor temporary concrete barrier.
- (d) It is the Contractor's responsibility to continually monitor the line and grade of the sleeve or pipe to detect abnormal horizontal and/or vertical movements. Necessary controls shall be provided to ensure proper horizontal and vertical alignment. The alignment shall be verified at any time at the request of the Engineer.
- (e) Entry or exit points shall not be installed in roadway medians unless shown on the Plans.
- (f) Detailed drilling operations and equipment shall be submitted to the Authority or their authorized representative for approval. Work is not to start before receipt of required approval.
- (g) All work areas must be enclosed with orange security fencing to maintain security and safety of the work site.
- (h) Strapping shall be stainless steel.

- (i) Show cross section along proposed bore within Authority ROW.
- (j) Detail means and methods to be used to ensure line and grade of pipe sleeve.
- (k) Once pipe sleeve is advanced from the point of entry and is within 10' of roadway edge of pavement all work shall be continuous until sleeve/conduit is advanced to at least 10' beyond the roadway far edge of pavement. Pipe sleeves are only required if noted on the plans.
- (l) During boring operations, roadway shall be monitored for settlement and /or heave along the line of bore.
- (m) Excavation and backfilling of the sending and receiving pits shall conform to Section 206.
- (n) In the event an obstruction or other condition prevents the completed installation, a concrete plug shall be installed at the end of the pipe or sleeve and the remaining void shall be filled in a manner approved by the Engineer. Removal or withdrawal of a drilled pipe, sleeve or casing will not be permitted.
- (o) Delays and/or inconvenience resulting from the presence of water or the pumping of water shall not be considered for additional compensation or extension of time but shall be considered incidental to the pipe or sleeve being installed.
- (p) All welding (for steel pipe sleeves) must be performed by a certified welder.
- (q) The work area shall be restored to its original condition upon completion of the installation subject to inspection and acceptance by the Authority. Care should be taken to protect adjacent trees and shrubs from injury during the progression of work.
- (r) Extend the sleeve at least 10 feet beyond the limits of roadway pavement.
- (s) Provide a method to seal the ends of the sleeve after installation of conduits within the sleeve. The method used shall provide a watertight seal. Provide shop drawings detailing the methods prior to commencement of any directional drilling operations.
- (t) The minimum allowable diameter for HDPE directionally drilled under the mainline is 4" and under ramp roadways is 3".

601.06 Foundations, Boxes, Manholes and Bases.

Replace the first paragraph with the following:

Concrete junction boxes (except Type D junction box), junction box foundations, manholes (except incoming electric and telephone service manholes, which may be of cast-in-place construction), and lighting standard bases (except those units to be constructed integrally with bridge parapet or median barrier) shall be precast monolithically. Junction box foundations and Type C junction boxes shall be constructed with Class B concrete. Manholes shall be constructed with 4500psi minimum air entrained concrete. Forms for cast-in-place junction boxes and manholes shall not be removed for twenty-four hours after the concrete is placed, and the box shall be kept moist for seven days after casting. Construction shall be in accordance with Section 401, using Class B concrete.

Replace the second paragraph with the following:

Ten (10) feet of crushed stone or gravel shall be placed under all in-ground junction boxes for drainage, including junction box foundations and manholes. Depth of crushed stone shall be a minimum depth of 12 inches.

The following is added to the tenth paragraph:

Precast junction box frame and cover shall be incidental to the pay item.

The following is added:

Composite junction boxes shall not be installed in paved surfaces.

All Type C, Type D, and Junction Box Foundation covers shall be bonded to the junction box frame via ultra-flexible tinned copper ground wire. The ultra-flexible ground wire shall be 6 gauge or larger.

Contractor shall perform grading as required if slopes are too steep (greater than 4:1) for installation of proposed foundation, boxes, manholes, and bases. Contractor shall inform Engineer and obtain approval of any installation that grading will be insufficient to mitigate future erosion or flooding under final conditions prior to performing any work.

Contractor shall clean all existing and proposed junction boxes to remain under final conditions within the project limits.

601.09 Testing.

The following is added:

(E) Inspection.

The Contractor shall retain an independent licensed field inspector or licensed inspection service for inspection of all electrical installations the Contractor is responsible for. No separate payment will be made for inspection services retained by the Contractor.

(F) Electrical Studies.

The service disconnect and proposed panelboards are to be labeled with a warning label (detailed under 918.20) with the title "Arc Flash and Shock Risk Appropriate PPE Required" and including the following information: flash hazard at incident energy, flash protection boundary, site specific PPE, required PPE, shock hazard when cover is removed, limited approach distance, and restricted approach distance. Label shall also include the Authority's location ID, Interchange location, date prepared and designer.

The contractor shall prepare and submit for review electrical short circuit, protective device coordination, and arc flash studies. The studies shall be signed and sealed by a Professional Engineering licensed by the state of New Jersey using computer software by SKM Systems Analysis Power Suite, ETAP, or equal.

The studies shall be made in accordance with ANSI/IEEE C37.10 & C37.13, C57.96, C57.12.00, IEEE 141, 242, 399, 551, 1584, IEC P-32-382, IEC P-45-482, and conform to NFPA 70E, Electrical Safety in the Work Place. Studies shall be based on equipment installed in the field and device characteristics supplied by equipment manufacturers.

Contractor shall obtain all data in tabulated form required for completion of the studies. Comply with recommendations in IEEE 1584 and 551 and NFPA 70E for the amount of detail that is required to be acquired in the field. For new equipment, use characteristics submitted under the provisions of shop drawing submittals. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys.

Contractor shall coordinate with the utility to obtain utility available short circuit fault current and utility transformer primary over current protection to include in studies. Contractor shall call the utility main customer service number and reference the applicable meter number in all correspondence to obtain required information.

After the finalization and approval of report and studies, the contractor shall make modifications as recommended by the report approved by the Engineer. After modifications are complete, contractor shall apply arc flash hazard stickers to all equipment. See 918.20(I) for sample.

The extent of the electrical power system to be studied shall originate from the utility service and include all existing and proposed electrical loads connected to the power distribution system. Generators shall be included within the study if applicable.

(1) Report

The report shall contain the following:

- Executive Summary
- Study Descriptions, Purpose, Basis, And Scope
- Qualification Data of Study Preparer and Checker
- Tabular Data of All Results
- One Line Diagram:

- Protective device designations and ampere ratings
- Cable size and lengths
- Transformer kilovolt ampere (kVA) and voltage ratings
- Motor and generator design and kVA ratings
- Switchgear, switchboard, motor-control center, and panelboard designations
- Short-Circuit Study:
 - Low-voltage fault report: three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - Voltage
 - Calculated fault-current magnitude and angle
 - Fault-point X/R ratio
 - Equivalent impedance
 - Momentary Duty Report: Three-Phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - Voltage
 - Calculated symmetrical fault-current magnitude and angle
 - Fault-point X/R ratio
 - Calculated asymmetrical fault currents:
 - Based on fault-point X/R ratio
 - Based on calculated symmetrical value multiplied by 1.6
 - Based on calculated symmetrical value multiplied by 2.7
 - Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - Voltage
 - Calculated symmetrical fault-current magnitude and angle
 - Fault-point X/R ratio
 - No AC decrement (NACD) ratio
 - Equivalent impedance
 - Multiplying factors for 2-, 3-, 5-, and 8-cycle breakers rated on a symmetrical basis
 - Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis
- Protective Device Coordination Study:
 - Recommended settings of protective devices, ready to be applied in the field. Includes manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - Circuit Breakers:
 - Adjustable pickups and time delays (long time, short time, ground fault pick up)
 - Adjustable time-current characteristic
 - Adjustable instantaneous pick up
 - Recommendations on improved trip systems
 - Fuses:
 - Current rating, voltage, and class
 - Time-Current Coordination Curves: Settings of overcurrent protective devices to achieve selective coordination. TCC Curves shall graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. A separate set of curves shall be provided for switching schemes and for emergency periods where the power source is local generation. Include the following:
 - Device tag and title matching one-line diagram with legend identifying the portion of the system covered.
 - Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed

- Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- Plots with the listed characteristic curves, as applicable:
 - Power utility's overcurrent protective device
 - Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands
 - Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 - Cable and conductors damage curves
 - Ground-fault protective devices
 - Generator short-circuit decrement curve and generator damage point
 - The largest feeder circuit breaker in each panelboard
- Provide adequate time margins between device characteristics such that selective operation is achieved
- Arc-Flash Hazard Analysis:
 - Incident Energy and Flash Protection Boundary Calculations
 - Arcing fault magnitude
 - Protective device clearing time
 - Duration of arc
 - Arc-flash boundary
 - Working distance
 - Incident energy
 - Hazard risk category
 - Level of PPE required in standard industry calorie ratings
 - Areas where to prohibit work on energized equipment i.e. incident energy > 40 cal/cm²
 - Recommendations for arc-flash energy reduction
- Description of Results and Recommendations for System Improvements
- Sample Arc Flash Label
- Study Input Data
 - Contractor supplied tabulated data obtained in field and utility supplied data

(2) Short-Circuit Study

Obtain all data necessary for conducting the study. Perform the short-circuit study following the general study procedures contained in IEEE 399. Calculate short-circuit currents according to IEEE 551. Study electrical distribution system from normal and alternate power sources throughout distribution system. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

Include the AC fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low-voltage, three-phase AC systems. The calculations shall also account for the fault-current DC decrement, to address the asymmetrical requirements of the interrupting equipment. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

- Electrical utility's supply termination point
- Control Panels
- Standby Generators and Automatic Transfer Switches
- Panelboards
- Disconnect Switches

(3) Protective Device Coordination Study

Obtain all data necessary for conducting the study. Perform the coordination study following the general study procedures contained in IEEE 399. Comply with IEEE 242 for determining coordination time intervals with the short-circuit currents calculated. Study electrical distribution system from normal and alternate power sources throughout distribution system. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

For transformer primary overcurrent protective devices: device shall not operate in the response to inrush current when transformer is first energized, self-cooled, full-load current or forced-air-cooled, full-load current, and permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

For conductor protection: protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

For generator protection: select protection according to manufacturer's written recommendations and to IEEE 242.

The study performed shall be based on final conditions and include recommendations that can be implemented to improve coordination. The study shall be revised if directed by the Engineer.

(4) Arc-Flash Hazard Analysis

Obtain all data necessary and from short-circuit and protective device coordination studies for conducting the Arc-Flash Hazard Analysis. Perform Arc-Flash Hazard Analysis per NFPA 70E and Annex D.

Calculate the maximum and minimum contributions of fault-current size. The minimum calculations shall assume that the utility contribution is at a minimum and shall assume no motor load. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

Include all low-voltage equipment locations.

Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/cm².

Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

- Fault contribution from induction motors should not be considered beyond three to five cycles
- Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible

Arc-flash computation shall include both line and load side of a circuit breaker when the circuit breaker is in a separate enclosure and when the line terminals of the circuit breaker are separate from the work location.

Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

601.11 Measurement.

The following is added as the first paragraph:

Junction box, junction box foundation, and manhole frames and covers will not be measured separately, and the cost thereof shall be included in the individual pay item.

601.12 Payment.

The following is removed from the list:

#___ A.W.G. SERIES LIGHTING CABLE LINEAR FOOT

The following is added to the list:

ELECTRICAL STUDIES LUMP SUM

The fifth paragraph is replaced with the following:

No separate payment will be made for Liquid-tight Flexible Metallic conduit installations. Such lengths of conduit shall be measured and paid under the items of the conduits to which they are connected.

The following is added:

No separate payment will be made for restoration of disturbed surfaces required to install junction boxes, conduit, or other underground facilities. All costs for the repair of such surfaces, including but not limited to concrete, berm surfacing, and slope protection shall be included in the bid price of the various conduit items installed.

No separate payment will be made for pavement restoration where conduit is installed using an open-trench method across existing roadways. All costs for the sawcutting, excavation, flowable fill, milling, pavement, concrete, rip rap, disposal of spoils, and other work shall be included in the bid price of the various conduit items installed using this method.

No separate payment will be made for conduit embedded within concrete bases and foundations for lighting standards, cabinets, and other electrical equipment. All costs for this conduit installation work, including required bonding and grounding, shall be distributed among the various base, platforms, and foundation pay items.

No separate payment will be made for couplings, condulets, fittings, or other devices required to provide a connected, bonded conduit system in accordance with the stated requirements.

Unless otherwise noted, junction and pull boxes that are sized 18" or smaller in the three ordinal dimensions will not be measured separately for payment. All costs for installation of these junction boxes, including mounting hardware, shall be distributed amongst the various conduit pay items bid.

No separate payment will be made for concrete encasement of conduits. All costs for the concrete encasement shall be included in the bid price of the conduit item.

No separate payment will be made for excavation of the conduit trench, filling the trench with CLSM to the bottom of the pavement structure, replacing the existing pavement structure in kind and restoring disturbed areas to original conditions.

No separate payment will be made for the coordination of conduit routing with existing/proposed utilities, drainage facilities, riprap, structures and/or other site-specific constraints. All costs for this work shall be included in the cost of its respective conduit pay item.

No separate payment will be made for the furnishing and installation of Rigid Non-Metallic conduit, spacers, concrete, excavation and backfill material shall include all labor, material and equipment necessary for the construction of duct banks as configured per plan, conduit support, termination at junction boxes, all as shown on Plans and as directed by the Engineer.

Payment for Duct Bank, HDPE Conduits Directional Drilled shall include excavating, dewatering, test pits, sheeting required for pits whether temporary or left in place, pipe sleeve, conduits and innerducts, disposal of soil materials, and all other incidental work necessary to return the site back to the existing condition. No separate payment will be made for the excavation, backfill, restoration of existing work area, and/or construction and restoration of the pits, or bentonite slurry mixture fill; the cost thereof shall be included in the cost of duct bank installation.

No separate payment will be made for installation of nylon pull cords, tracer wires, or locator wires. All costs for this work shall be included in the costs for the various conduit and duct bank pay items bid.

No separate payment will be made for wire labels or tags. Wire labels and tags shall be included under the appropriate wire and cable items.

No separate payment will be made for cable connector kits. Cable connector kits shall be included under the appropriate wire and cable items.

No separate payment will be made for the furnishing, installation, removal, or modification or any equipment necessary to maintain power distribution and communications to existing installations as required by these specifications.

No separate payment will be made for installation of foundations for load centers or power distribution equipment including concrete maintenance working platforms around power distribution equipment unless indicated otherwise. Contractor shall include all work and costs under the various power distribution equipment items bid.

No separate payment will be made for furnishing and installing structural steel and hardware.

No separate payment will be made to differentiate between the various differences regarding types of transformer foundations. Any differential is considered negligible and all costs thereof shall be included within the transformer foundation pay items bid.

No separate payment will be made for bollards installed around electrical equipment. All costs thereof shall be incidental to the various pay items bid.

The Contractor shall include all work for preparation of Reports, Short-Circuit Studies, Protection Device Coordination Study, Arc-Flash Hazard Analysis, and furnishing and installing labels under pay item "Electrical Studies". No additional payment will be made for any field investigation or coordination effort to obtain information or data to determine this information.

SECTION 602 – POWER DISTRIBUTION

602.01 Materials.

The following is added:

SURGE PROTECTIVE DEVICES.....	918.59
MANUAL TRANSFER SWITCH.....	918.63

602.03 Power.

(E) Roadway, Toll Plaza and Service Area Lighting

The following item and its paragraph are removed:

(9) Series Distribution System

(F) Power Cables

Replace the second paragraph with the following:

All cable splicing for temporary and permanent facilities, shall be made by means of new resin-encapsulated splice kits. The Contractor shall only splice cables in pole bases, junction boxes, manholes, and designated electrical cabinets. The Contractor shall minimize the quantity of splices to the greatest extent as practical. Installation of resin splice kits shall conform to the manufacturer's installation instructions and as per the Authority's standard drawings. All cable connector kits, upon completion of installation, shall be wrapped with several layers of half-lapped jacket tape to insure positive water-moisture proof and submersible type connections.

In the 3rd paragraph, remove the word "test" from the first sentence.

Replace the 4th paragraph with the following:

Cables and wires provided in total Contract quantities over 500 feet shall be 100% impregnated solid factory color coded. For cables with quantities of 500 linear feet or greater, the method of factory color coding must be accomplished. No deviation from factory color coding requirements regarding manufacturer or material specifications will be permitted.

For cable provided in total Contract quantities less than 500 feet, use of heat shrink wrap application may be accepted for all phase conductors. Heat shrink wrap application may be accepted for neutral or ground conductors sized #4 AWG and larger. For these installations if the contractor wishes to use heat shrink wrapping:

- The contractor shall provide a list of each area, including start and end points as well as total length of run indicating total quantity is less than 500', for each section they are looking to use heat shrink wrapping. The designer will confirm or reject each run based upon review of this submission.
- Where approved, color heat shrink shall be accomplished such that all exposed conductors in all junction boxes shall be continuously identified by color within junction boxes, cabinets, etc. using heat shrink made from cross linked materials, flexible, flame retardant UV resistant, operating temperature of -67 degrees Fahrenheit to 275 degrees Fahrenheit, shrink temperature of 194 degrees Fahrenheit, flammability rating of Class 1 Self-extinguishing ASTM D2671 Procedure B Class 2 N/A, flued resistance per AMS-DTL-23053 1000 psi min tensile ASTM D638 400 V/mil min. ASTM D2671, and dielectric strength 500 V/MIL. (19.7 KV/mm) min. ASTM D2671. The color-coding heat shrink shall be installed for the entire length of cable from entry conduit to exit conduit, including all slack. The heat shrink shall be applied so as not to obliterate identification markings of the cable, as approved by the Engineer.

All cables and tabs shall be identified with wire tags with yellow background and 1" tall black lettering. Dedicated neutrals shall be labeled by circuit number, phase designation, and the letter 'N' e.g. "1AN" for circuit 1, phase A.

Replace the 5th paragraph with the following:

All cables in junction boxes, junction box foundations, cabinets, pull boxes, and at equipment terminal connections shall be tested for circuit connections, which shall be in conformity with those indicated on the Plans. After verification of circuit connections, these cables shall be provided with individual identification tags, as per Authority's standard drawings, with circuit and phase designations, such as 1A, 1B, 1C, 1AN, 1BN, etc. for multiple lighting circuits. The tags shall be securely attached to the cables with nylon ties. All lighting standards shall be securely bolted in a vertical position to concrete bases, junction box foundations, or lighting blisters. They shall be plumbed with luminaires perpendicular to the centerline of the roadway by means of stainless steel shims between the transformer bases and concrete bases or junction box foundations or between the base plates and lighting blister.

Label all medium voltage circuits with the applicable voltage rating in every installation requiring access by maintenance including, but not limited to, junction boxes, manholes, and cabinets. Provide this tag in addition to the tag identifying other required cable identification.

Each lighting standard, whether new or relocated, shall be identified by means of aluminum identification plate(s), which shall bear the lighting standard and circuit numbers and phase designation for multiple circuits, the lighting standard number, utilized Voltage, lighting standard and luminaire types, all as shown on the Plans. A separate identification plate shall be provided for each luminaire supported by the lighting standard. Existing identification plates on relocated lighting standards shall be replaced, where required.

(G) Luminaire Installations.

Replace the first paragraph with the following:

Work shall include installation of the luminaire, wiring within the lighting standard, cable connector kits, Luminaire Headframe ring assembly, luminaire lowering device and fuses for all lighting systems.

Replace the second paragraph with the following:

Various types of luminaries, to be used on the Project, shall be as listed on Plans. Prior to installation of each luminaire, the Contractor shall check and verify the catalog number, wattage, Voltage, and the photometric distribution type to produce the specified light distribution.

602.04 Power Distribution and Control Equipment.

Add the following paragraph after the second paragraph:

All surge protective devices placed within existing or new load centers shall be as in the Specifications. No separate payment will be made for surge protective devices or the installation thereof.

Replace the eighth paragraph with the following:

Install Load Center Cabinets and Meter Cabinets at locations as shown on the Plans. The work shall consist of furnishing and installing the cabinets, appurtenances, mounting hardware, and all internal and attached external components as shown on the Plans including but not limited to circuit breakers, meter pans, contactors, transformers, panelboards, photocells, thermostats, heaters, receptacles, and surge protective devices. Furnish and install wiring between devices within the cabinet and terminate all wiring to field devices. Perform grounding work as required by the National Electrical Code. For Meter Cabinets, coordinate with local utility to ensure that details used comply with local requirements. Perform all coordination and work, and obtain inspections necessary to provide a complete, connected power service, including any temporary work necessary to keep existing electrical systems operational.

The following is added:

Install bollards at locations shown on the Plans. Provide bollards with yellow sleeve covers.

Install transformers at locations as shown on the Plans. The work shall consist of furnishing and installing of all primary and secondary connections, dual power sources interlocking, if required, incoming service and outgoing conductors, primary as well as secondary protection, safety locks and identification tags, grounding, bonding, conduit fittings, protective enclosure, concrete foundation and all other mounting hardware. Perform all internal as well as external inspections and tests during and after installation with good workmanship and attention to details. The work shall comply with all safety and NEC requirements.

Install manual transfer switches at locations as shown on the Plans and deliver compatible female cam-style plugs to the Authority. Prior to installation of manual transfer switches, Contractor shall examine the areas and conditions under which the manual transfer switch is to be installed and notify the Engineer in writing if unsatisfactory conditions exist. Manual transfer switch shall be installed as shown on the drawings and per the manufacturer's written instructions. In addition, the installation shall meet the requirements of local codes, the National Electrical Code and National Electrical Contractors Association's "Standard of Installation". Conduit entry into the manual transfer switch shall be by Contractor; Contractor shall furnish and install listed watertight conduit hubs, as manufactured by MYERS or T&B, for each conduit entry on the manual transfer switch. The incoming hub size shall match the conduit size for feeders and ground as shown on the drawings. The outgoing hub size shall match the conduit size for loads and ground as shown on the drawings. Hubs shall be properly installed and tightened to maintain Type 3R integrity of the manual transfer switch enclosure. Contractor shall terminate feeder conductors, load conductors and ground per the manufacturer's

instructions. All field wiring terminations shall be torqued as required per the instructions on the manual transfer switch’s power distribution block, circuit breaker & ground lug. Perform the following field tests for each manual transfer switch:

- 1. Field Tests for Manual Transfer Switches
Prior to energizing manual transfer switch, the Contractor shall perform the following checks and tests as a minimum:
 - a. Verify mounting and connections are complete and secure.
 - b. Verify internal components and wiring are secure.
 - c. Perform continuity check of all circuits.
 - d. Perform 1,000 VDC megger test on feeder, load and ground cables.
 - e. Verify deadfront is secure.
 - f. With the manual transfer switch deadfront in place and the main access door closed and properly latched, actuate both Operator Mechanisms; verify only (1) breaker at a time can be turned to the “ON” position.
 - g. Confirm operation of the manual transfer switch ground receptacle by attaching a plug to the manual transfer switch ground receptacle and then verify that the plug is grounded to the facility ground.

Install power distribution cabinets and perform modifications to power distribution cabinets at location shown on the Plans. The work shall consist of furnishing and installing the cabinets, appurtenances, mounting hardware, and all internal and attached external components as shown on the Plans including, but not limited to, panelboards, circuit breakers, and wiring between equipment. Perform grounding as required by the National Electrical Code. Perform applicable removal and installation of all equipment as shown on the Plans.

602.05 Measurement

- The following is added:
- Transformers will be measured by the number installed.
- Electrical Studies will be measured on a lump sum basis.
- Disconnect Switches will be measured by the number installed.
- Manual Transfer Switches will be measured by the number installed.
- Power Distribution Cabinets will be measured by the number installed.

602.06 Payment.

- The following is added:
- Payment will be made under:

PAY ITEM	PAY UNIT
MANUAL TRANSFER SWITCH.....	EACH
TRANSFORMER, TYPE ___ KVA; VOLTAGE ___ V - ___ V	EACH
POWER DISTRIBUTION CABINET.....	EACH
POWER DISTRIBUTION CABINET, MODIFICATION	EACH

No separate payment will be made to differentiate between the various differences regarding equipment being installed within power distribution cabinets or work required to be performed under power distribution equipment

modifications. Any differential is considered negligible and all costs thereof shall be included within the "power distribution cabinet" and "power distribution equipment, modification" pay items bid.

SECTION 603 – LIGHTING

603.02 Materials.

The following is added:

VIBRATION DAMPING PADS	918.63
NAVIGATION LIGHTS, SOLAR	918.64

603.03 Installations.

(C) Lighting Standard Installations.

The following is added after the first paragraph:

All shoe base lighting standards installed on elevated structures shall be furnished and installed with a vibration damping pad. The damping pads shall be fabricated to the dimensions found on the Standard Drawings.

The vibration damping pads shall be installed under the shoe base of the lighting standard, directly on the mounting surface. The lighting standard base is then placed directly upon the damping pad in such a manner that the bolt holes in the pad and base are accurately aligned. Care must be taken to ensure that the surfaces under and over the pad are clean and free from dirt and foreign matter. The pad and base plate are then secured in place with four hot-dipped galvanized steel studs and washers capped with 3/8" composite washer sandwiched between two stainless steel washers underneath the hot-dipped galvanized steel hex head nut. The nut shall be hand-tightened, plus 1/2 turn. The nut shall not be tightened so much as to cause tearing, rupture, punching or excessive bulging of the composite washers. The lighting standard shall be thusly sandwiched and restrained by vibration absorption materials at all points of physical contact with the elevated structure.

Damping pads shall be incidental to the cost of the lighting standard, and no separate payment will be made for installation of new damping pads.

(E) Luminaire Installations

The following is added after the first paragraph:

Luminaire must be installed in exact location shown on the Plans to minimize the light pollution on residential properties. Furnish and install lighting standards with the exact model number shown on the Plans including luminaires indicated to be provided with factory installed House Side Shield if required on the Plans.

(G) Sign Lighting

The following is added:

The existing sign lighting systems being removed and replaced with an LED sign lighting system shall be removed in accordance to Section 601.03(G).

(H) Temporary Lighting Systems.

The following is added:

Perform all work necessary to maintain illumination of roadway lighting system for the duration of the project construction in accordance with the requirements of the Plans and Specifications.

A temporary lighting scheme and electrical system staging concept is shown on the Plans. The Contractor shall follow this scheme unless otherwise required due to changes in overall project staging. Any deviations to the temporary lighting design shown shall be designed in accordance with the requirements shown on the Plans. The Contractor shall submit signed and sealed designs for temporary lighting, including photometric calculations, to the Engineer for approval. The Authority reserves the right to modify or request revisions to proposed temporary lighting schemes.

This work shall include, but not be limited to, the following:

- Submitting shop drawings
- All temporary lighting and power distribution work for the various construction stages and removal of all temporary equipment at the end of the project.
- Installation of temporary light poles and luminaires
- Modification to existing light poles
- Removal, installation, and relocation of luminaires
- Temporary modifications to proposed light poles
- Temporary power distribution systems, including conduits, boxes, and cables
- Temporary or permanent modifications to existing load/proposed centers, and power distribution equipment
- Temporary electric services or other power sources, if needed
- Field measurement and engineering design work necessary to develop structural mounting details and power distribution designs
- Storage and transportation required for the temporary lighting systems
- Work necessary to return electrical systems to remain to their pre-existing condition at the completion of the project

The Contractor will be allowed to use exposed cables for temporary power distribution installations under 600 Volts. Exposed cable shall be rated for continuous outdoor exposure and shall have a UV-resistant insulation and jacket. Aerial installations will be allowed, with prior Engineer approval, if public safety can be ensured. Aerial cable installations will not be permitted to cross the roadway between lighting standards.

Temporary power distribution serving circuits over 600 Volts shall be continuously enclosed in Schedule 40 PVC or Rigid Metallic Conduit. All splices shall be made within junction boxes.

Temporary junction boxes shall be permitted to be fiberglass, PVC, steel, or other material suitable for continuous outdoor use, and shall be rated for wet environments.

Temporary cables shall be the Section 601.07(A).

Where temporary conductors are subject to damage by vehicular impact or construction activity, or may be readily accessed by unauthorized individuals, cables shall be enclosed within Schedule 40 PVC Conduit. Where installed along bridge parapets, the cables shall be suspended outside the parapet alongside of the bridge within Schedule 40 PVC conduits.

Temporary lighting installations shall meet all applicable OSHA regulations. It shall be the sole responsibility of the Contractor to meet said regulations.

Contractor will be responsible for obtaining all required approvals in a timely manner.

The Contractor may use the existing above-ground highway lighting material designated for removal for the temporary highway lighting system that is not required.

603.04 Measurement.

The following is added:

Relocate Light Pole and Luminaire shall be measured by each set, which will include internal work, exposed work, and all connections to construct a fully installed, connected and operational installation. Perform all work necessary to maintain illumination of roadway lighting system for the duration of the project construction.

Temporary Lighting Systems shall be measured on a lump sum basis.

603.05 Payment.

The following is added:

Payment will be made under:

PAY ITEM.....	PAY UNIT
RELOCATE LIGHT POLE AND LUMINAIRE	EACH
LIGHTING STANDARD, TYPE L-ITS-40	EACH
TEMPORARY LIGHTING SYSTEMS.....	LUMP SUM
ILLUMINATION FOR SIGN STRUCTURE LOCATION NO. ____	LUMP SUM

No separate payment will be made for furnishing and installing luminaires with house side shields. All costs thereof will be incidental to the luminaire pay item.

No additional payment will be made for any work arising from changes to the Temporary Lighting design shown on the Plans.

No separate payment will be made for miscellaneous work required to connect power to proposed lighting standards including, but not limited to, mounting hardware, welding, expansion couplings, and/or conduit reducers.

No separate payment will be made for cables from the luminaire to the nearest adjacent junction box. Contractor shall include all costs to within the various applicable lighting standard, luminaire, and lighting relocation pay items.

No separate payment will be made for miscellaneous work required to connect power to proposed lighting standards including, but not limited to, mounting hardware, welding, expansion couplings, non-destructive proof load testing, and/or conduit reducers.

SECTION 918 – ELECTRICAL MATERIALS

918.01 General.

Add the following to the last paragraph:

Alternate and other equal materials shall be submitted for approval by the Authority.

918.02 Bonding and Grounding Devices

(B) Ground Wire

Delete the first paragraph and replace it with the following:

All grounding and bonding wires smaller than #2 AWG shall be 100% impregnated solid factory color coded green insulated conductors, unless bare are specified. Insulated grounding and bonding wires sized #2 AWG and larger shall be 100% impregnated solid factory color coded green insulated conductors or color coded green heat shrink wrap. 100% impregnated solid factory color coded green insulation is preferred.

Delete the third paragraph and replace it with the following:

Insulated ground wire shall be of uncoated copper conductor conforming to the requirements of ASTM B3 and shall be covered with an insulation that meets or exceeds the requirements of UL Type THWN. Color coding shall be green.

918.04 Cable Connectors.

(A) In-Line Connectors.

Delete the last paragraph.

(B) Wye Connectors.

Add the following paragraph at the end of this Paragraph:

Underground splice kits shall be waterproof fully resin-encapsulated and designed to insulate and seal wire connections in weather-exposed or direct burial locations. Splice kits shall be sized and rated according to the cables to be spliced.

(C) Through Splice Connectors.

Add the following paragraph at the end of this Paragraph:

Underground splice kits shall be waterproof fully resin-encapsulated and designed to insulate and seal wire connections in weather-exposed or direct burial locations. Splice kits shall be sized and rated according to the cables to be spliced.

NOTE: The following text REPLACES its respective Subsection in the latest version of the 2016 Standard Supplementary Specifications.

918.07 Cable and Wire.

Delete the last sentence of the second paragraph and add the following:

For cable provided in total Contract quantities 500 feet or more, all multiple lighting and power cable shall have the outside layer be continuous 100% factory-impregnated solid color-coded. For cable provided in total Contract quantities less than 500 feet, use of heat shrink wrap application may be accepted.

Replace the color coding table with the following tables:

Phase	480Y/277V	460Y/265V*	208Y/120V
Phase A	Brown	Brown	Black
Phase B	Orange	Orange	Red
Phase C	Yellow	Yellow	Blue
Neutral	Grey	Grey	White
* Not a standard for new construction and used on some older systems.			

Leg	480V/240V	240V/120V
Leg A	Brown	Black
Leg B	Yellow	Red
Neutral	Grey	White

Delete the last paragraph under the color tables.

(B) Multiple Lighting and Power Cable.

(1) Type I.

Replace the first paragraph and Item (c) with the following:

Cable and wire shall be Type RHW-2 USE-2 as manufactured in conformance with ICEA/NEMA Publication No. S-95-658/NEMA WC70, and shall meet the following requirements:

- (c) The jacket, over the insulation, shall be of the Chlorinated Polyethylene (CPE) thermoset compound type conforming to the requirements of ICEA/NEMA Publication No. S-95-658 Section 4.1 – Coverings – Jackets.

The following is added:

(2) Type II.

Low-Smoke Zero-Halogen (LSZH) Cable and wire for use in confined spaces shall be manufactured in conformance with ICEA/NEMA Publication No. S-95-658/NEMA WC70 and shall meet the following requirements:

- (a) Stranded copper conductor shall conform to the requirements of the above noted Publication – Part 2, and the concentric stranding shall be Class B, in accordance with Table 2-2.
- (b) Insulation shall be Low-Smoke, Zero-Halogen flame-retardant Cross-linked Polyolefin (LSZH XLPO) in accordance with NFPA 130, Sections 12.1 – 12.3 and NFPA 502, Section 12.2.

(C) Series Lighting Cable.

Delete this Paragraph in its entirety.

(D) Outdoor Network Cable.

Delete the first paragraph and replace it with the following:

Outdoor network cable shall consist of 24 AWG solid bare copper conductors, Category 6 or better, 600 Volt outdoor rated twisted pairs, polyolefin insulation, inner LLPE jacket, overall shield (100% coverage), 24 AWG stranded TC drain wire, industrial grade sunlight- and oil-resistant LLPE jacket.

(F) Fiber Optic Cable – Multi-Mode.

This Paragraph is deleted and replaced with the following:

Fiber Optic Cable - Multimode shall be tight buffered breakout type cable. No splices are permitted, except as required for terminations, unless shown on the plans. Fiber Optic Cable – Multimode shall be multi-mode, 50/125/900 micron, OM-3 or better rated cable, tight buffered breakout type cable with each optical fiber protected in individual color coded breakout buffer tubes and Aramid strength fibers. The buffer tubes shall be cabled around a central dielectric strength element with a gel-less water blocking system to inhibit water migration. The cable shall be indoor/outdoor rated, UV resistant, and suitable for use in cable tray, direct burial, underground duct, and aerial installations.

(G) Fiber Optic Cable – Termination Connector.

The following has been added:

Fiber optic termination connectors for cable between ITS devices and a Systems Control Cabinet (SCC) may be field installed by mechanical means and shall be of the type that matches the connected device or fiber termination panel connector.

(H) Twisted Pair Communication Cable.

Delete the first paragraph and replace it with the following:

Twisted Pair Communication Cable shall consist of 4 pairs of #24AWG stranded copper conductors, each pair individually shielded, covered by a PVC jacket.

Delete the last paragraph of this Paragraph.

(I) SOOW Multi Conductor Power Cable.

Delete the third and fourth paragraphs and replace them with the following:

Provide cord grip connectors at each cable entry/exit point of the luminaire.

918.08 Conduit and Fittings.

(C) Flexible Metallic Conduit.

The following to be added as the first sentence:

All Flexible Metallic Conduit (FMC) shall be Liquid-Tight Flexible Metallic Conduit (LFMC) in all installations and applications.

(F) Duct Bank Spacers.

Delete the first paragraph and replace it with the following:

Spacers shall be prefabricated and made out of high impact Polystyrene.

The following Paragraph is added:

(G) HDPE Conduits Directional Drilled Electrical Installations.

All directional drilled conduits shall be SDR-9 HDPE in accordance with ASTM D3350, with cell classification 345440C.

NOTE: The following text is ADDED to the latest version of the 2016 Standard Supplementary Specifications.

918.13 Lamps

This Subsection is deleted in its entirety.

918.17 Metallic Junction Boxes

Replace the first paragraph with the following:

Metallic junction boxes shall be of the types and sizes as indicated on the Plans. All metallic junction boxes for outdoor use or in tunnels shall be corrosion-resistant materials.

918.20 Power Distribution and Control Equipment.

(A) Panelboards and Circuit Breakers.

Replace the first paragraph with the following:

Panelboards for 600V and below systems shall be single phase 3 wire or 3-phase 4-wire system, and each shall be equipped with integrated surge protection, a solid neutral, a main circuit breaker or main with lugs as specified. Panelboards shall be UL listed, comply with NEMA standards and conform to Federal Specification W-P-115A. Surge protection shall be a minimum of 100kA per phase.

(D) Distribution Transformers.

Replace this subsection entirely with the following:

Distributions transformers shall be totally enclosed and dry type, designed for indoor/outdoor applications suitable for wall or floor mounting as required, and shall meet the phase, KVA, primary and secondary voltage and tap requirements indicated on the Plans and Specifications.

Transformers shall be stored in accordance to manufacturer's recommendations in a climate-controlled facility. Contractor shall install and energize the transformer within 2 months of obtaining the transformer from the manufacturer.

(1) Transformers Installed Indoors or within Electrical Cabinets (rated 600V and below)

The insulation and material shall be Class H which will not permit a temperature rise of 115°C above the 40°C ambient, when tested in accordance with ANSI and NEMA standards.

The core and coil assemblies of transformers below 600V class for up to 37.5kVA, single phase and 15KVA, three phase shall be epoxy encapsulated.

The transformers shall be designed to maximize energy efficiency requirements as per NEMA TP1-2002 and tested in accordance with Harmonic Mitigation requirements of NEMA ST 20 and UL-506 and shall bear the UL label.

The transformer enclosures shall be degreased, primed, and furnished with a coat of outdoor enamel paint and shall be stored in accordance to manufacturer's recommendations in a climate-controlled facility.

(2) Transformers Installed Outdoors (rated 600V and below)

Transformers shall be NEMA 3R stainless steel. It is acceptable for the enclosure to be rated NEMA 2 stainless steel and furnished with a stainless steel weather shield to obtain the NEMA 3R rating.

Transformer shall have aluminum windings, insulation class 220°C, and maximum of 150°C rise above 40°C ambient temperature.

The insulation and material have a temperature rise of 150°C above the 40°C ambient, when tested in accordance with ANSI and NEMA standards.

All components must be dipped in solid-base varnish (not water-based varnish).

If the manufacturer does not furnish the transformer enclosure with stainless steel screws, the Contractor will be required to replace all screws (replacing a few at a time, not all at once) for the transformer with stainless steel screws.

(3) Transformers Installed Outdoors (rated above 600V)

Transformers shall be NEMA 3R, 316 stainless steel enclosure with weather shield. Transformers shall be UL listed and in compliance with applicable NEMA standards. Transformers shall be dry-type with copper windings, insulation shall be class 220°C, and maximum of 115°C rise above 40°C ambient temperature. Transformers shall be 20kV-BIL class, of low inrush design, with Stub-Down terminations, and with cable in/out design.

(E) Constant Current Transformers.

Delete this Paragraph in its entirety.

(F) Capacitor Assemblies.


Delete this Paragraph in its entirety.

The following is added:

(I) Warning Labels.

Panels are to be labeled with a warning label with the title "Arc Flash and Shock Risk Appropriate PPE Required" and including the following information: flash hazard at incident energy, flash protection boundary, site specific PPE, required PPE, shock hazard when cover is removed, limited approach distance, and restricted approach distance. Label shall also include the Authority's location ID, Interchange location, date prepared and designer.

Sample label shown below:

 WARNING		
Arc Flash and Shock Risk		
Appropriate PPE Required		
FLASH PROTECTION		SHOCK PROTECTION
Flash Hazard at	1 ft 6 in	Shock Hazard when
Incident Energy:	0.65 cal/cm ²	cover is removed: 208 VAC
Flash Protection Boundary:	1 ft	Limited Approach: 3 ft 6 in
Site Specific PPE:	Level 0	Restricted Approach: Avoid Contact
Required PPE:	As per NJTA's Requirements	
LOCATION:	PNL LP-S1 (CANOPY)	
N.J. TURNPIKE AUTHORITY		Prepared On: 10/19/2016
INTERCHANGE 11		By: Omron, Inc.
WARNING: Changes in equipment settings or system configuration will invalidate the calculated values and PPE requirements.		

The following is added:

(J) Manual Transfer Switches.

All lighting load centers shall include a manual transfer switch as shown on the Standard Drawings. The transfer switch shall be rated for the current and voltage as required on the Contract Drawings.

The transfer switch shall be UL Listed and be compatible with Authority portable generator connections and interlocks.

- A. Manual transfer switch shall consist of (2) two mechanically interlocked molded case circuit breakers; kirk-locks are not acceptable, cam-style male connectors, power distribution block and grounding terminals, all housed within a padlockable enclosure.
- B. Manual transfer switch enclosure shall be Type 3R, constructed of continuous seamwelded, stainless steel. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via a) drawn flange cable entry openings in the bottom of enclosure for wall mount units, or b) hinged lower door for pad mount units. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened.
- C. Number of male input cams shall not exceed the number as shown on the drawings and must be rated for the specified amperage.
- D. Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. Cam-style male connectors shall be color coded. Cam-style male connectors shall be provided for each phase and for ground and shall also be provided for neutral if required. A corresponding female cam-style connector shall be provided for each male connector by the same manufacturer. Female cam-style connectors shall be delivered to the Authority. Each of the phase cam-style male connectors within the enclosure shall be factory-wired to a molded case circuit breaker. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor. The neutral cam-style male connectors, if required, shall be factory wired to a power distribution block. None of the cam-style male connectors shall be accessible unless both molded case circuit breakers are in the "OFF" position and the main access door is open.

- E. A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.
- F. Molded case circuit breakers shall be UL Listed, and the short circuit interrupt rating shall be a minimum of 35kAIC at 480VAC. Trip rating of the molded case circuit breakers shall be as shown on the drawings. One molded case circuit breaker shall be fed from utility power; the other molded case circuit breaker shall be fed from the camstyle male connectors to supply power from a portable generator. Both molded case circuit breakers shall include UL Listed door-mounted operating mechanisms (with provisions for a locking device), preventing the opening of the main access door unless both breakers are in the "OFF" position. Both molded case circuit breakers shall be mounted behind a deadfront panel. The load-side of the molded case circuit breakers shall not be energizable unless the main access door is closed and one of the molded case circuit breakers is in the "ON" position. The (2) molded case circuit breakers shall be safety interlocked by mechanical means to ensure that only one breaker can be closed at any given time.
- G. Manual transfer switch shall be suitable for use as service equipment in the USA as defined by the NEC.
- H. Manual transfer switch shall include permanently affixed operation instructions.

918.21 Roadway Lighting Luminaires.

Replace the first paragraph with the following:

Luminaire Types and configurations shall be as indicated on the Plans. See the Qualified Products List for approved luminaires and suppliers.

(A) LED Luminaires.

Replace the second paragraph of Item (1) Construction with the following:

The maximum effective projected area shall not exceed 1.31. The housing shall be grey in color with a flat or semi-gloss sheen. Luminaire shall include a 7-pin NEMA photo-control receptacle.

Add the following to Item (2)(a):

The luminaire shall be protected from overvoltage up to 500V from a loss of neutral or other overvoltage event via the LED driver or transformer, fully contained within the luminaire. External transformers will not be approved.

Replace the first paragraph of Item (3) Photometric Requirements with the following:

The luminaires shall produce light distributions in conformance with the current ANSI/IES classifications indicated in the Luminaire Types in this section and shall meet the photometric requirements shown on the Plans. Additional distributions for glare control shall be utilized when direct source must be mitigated. Mitigation utilizing shielding elements shall require approval from the Authority. Optical assemblies shall have a minimum efficiency of 85% regardless of distribution type.

The following is added:

(4) Luminaire Types

The following is a list of the Standard Luminaires for the Turnpike and Parkway. The list contains the general illumination characteristics. Approved luminaires may be found in the Qualified Products List.

- a. Type LP1 Luminaire - Pole-top roadway luminaire with Type III optics
- b. Type LP2 Luminaire - Pole-top roadway luminaire with Type II optics
- c. Type LP3 Luminaire - Pole-top roadway luminaire with Type III optics
- d. Type LP4 Luminaire - Pole-top roadway luminaire with Type II optics
- e. Type LP5 Luminaire - Pole-top roadway luminaire with Type III optics
- f. Type LP6 Luminaire - Pole-top roadway luminaire with Type III optics
- g. Type LP7 Luminaire - Pole-top roadway luminaire with Type III optics

- h. Type LP8 Luminaire - Pole-top roadway luminaire with Type IV optics
- i. Type LP9 Luminaire - Pole-top roadway luminaire with Type IV optics
- j. Type LC Luminaire - Toll Canopy luminaire with Type V optics
- k. Type LW1 Luminaire - Under Bridge luminaire with Type V optics
- l. Type LW2 Luminaire - Under Bridge luminaire with Type IV optics
- m. Type LW3 Luminaire - Under Bridge luminaire with Type V optics
- n. Type LW4 Luminaire - Under Bridge luminaire with Type V optics
- o. Type LH1 Luminaire - High Mast roadway luminaire with Type V optics
- p. Type LH2 Luminaire - High Mast roadway luminaire with Type V optics
- q. Type LH3 Luminaire - High Mast roadway luminaire with Type V optics
- r. Type LS Luminaire - Sign Lighting luminaire with Type IV optics and 5000°k color temperature
- s. Type S1 Luminaire - Under Bridge Structure mount luminaire with Type III optics
- t. Type S2 Luminaire - Under Bridge Structure mount luminaire with Type IV optics
- u. Type S3 Luminaire - Under Bridge Structure mount luminaire with Type V optics
- v. Type S4 Luminaire - Under Bridge Structure mount luminaire with Type IV optics
- w. Type S5 Luminaire - Under Bridge Structure mount luminaire with Type V optics
- x. Type SP Luminaire - Security Perimeter luminaire with dual heads and battery backup.
- y. Type TN Luminaire - Tunnel luminaire

(B) HID Luminaires.

Delete this Paragraph in its entirety.

(C) Ballast Assemblies.

Delete this Paragraph in its entirety.

NOTE: The following text REPLACES its respective Subsection in the latest version of the 2016 Standard Supplementary Specifications.

918.23 Underbridge Lighting Luminaires.

Delete the entire Subsection and replace it with the following:

LED luminaires to be used for under bridge illumination shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply). Each luminaire shall be rated for a minimum operational life of 50,000 hours at an average operating time of 11.5 hours per night at 40°C (104°F) while maintaining greater than 70% of its initial lumen output (L70).

The individual LEDs shall be constructed such that a loss or the failure of one LED will not result in the loss of the entire luminaire. Luminaire shall be constructed such that LED modules may be replaced or repaired without replacement of whole luminaire. Each luminaire shall be listed with Underwriters Laboratory, Inc. under UL1598 for luminaires, or an approved equivalent standard from a nationally recognized testing laboratory and shall have a certification label.

All luminaires of the same type and Wattage to be installed under the same Contract shall be physically identical unless otherwise approved by the Engineer.

Luminaires shall be protected with a 6A fuse in the first above-ground junction box, conforming to applicable requirements of Subsection 918.04.

(1) Construction.

The LED luminaire housings shall be die cast aluminum frame, extruded aluminum heat sinks to an independent electrical compartment. Housing and door frame shall be aluminum with a nominal 2.5mil thick paint finish able to withstand a 3000 hour salt spray test as specified in ASTM designation, B117. Access to the electrical compartment shall be tool-less. The die cast aluminum housing shall be designed to prevent the buildup of water on the top of the housing. Exposed heat sink fins shall be oriented so that water can freely run off the luminaire to carry dust and other accumulated debris away from the unit. Housing shall have cast in pipe, leveling steps and mounting system capable of accommodating 2 3/8" OD.

The housing shall be grey in color with a flat or semi-gloss sheen. Luminaire options to include a 7-pin NEMA photo-control receptacle and the fixture shall be furnished with a shorting cap. The housing shall be provided with a drilled and tapped hole for 3/4" conduit on each side, complete with threaded flush plug.

The assembly and manufacturing process for the LED luminaire shall withstand vibration, meeting ANSI C136.31 American Standard for Roadway and Area Lighting Equipment-Luminaire Vibration for both normal and bridge operation.

The optical assembly of the luminaire shall be protected against dust and moisture intrusion per the requirements of IP-66 to protect all optical components. The electronics/power supply enclosure shall meet the requirements for NEMA/UL wet location.

The optical assemblies shall consist of highly polished and anodic or chemically bonded glass surfaced aluminum reflector to achieve the required photometrics and impact resistant flat tempered glass refractor equipped with a high temperature gasket to provide a completely sealed optical assembly. The gasket shall be a single piece polyester fiber attached around the full perimeter of the reflector to prevent contaminants from entering the optical system. Breathing action of the sealed optical assembly shall be accomplished by means of the reflector gasket, unless otherwise specified.

The luminaires shall have adequate provisions for the dissipation of heat radiated from the electronic driver. All luminaires shall be furnished with corrosion-resistant hardware.

(2) Electrical Requirements.

The electrical requirements to be submitted as part of the shop drawing submittal, shall conform to the requirements set forth in Subsection 918.21.

(3) Photometric Requirements.

The photometric data to be submitted as part of the shop drawing submittal, shall conform to applicable requirements set forth in Subsection 918.21.

NOTE: The following text is ADDED to the latest version of the 2016 Standard Supplementary Specifications.

918.31 CCTV Camera.

(A) General.

The first sentence of the second paragraph has been replaced with:

The camera shall be an outdoor rated day/night PTZ camera and shall have a 1080p HD resolution, high dynamic range, a 30x optical zoom factor, a clear impact resistant polycarbonate bubble, and support High Power-over-Ethernet communications.

(B) The camera shall comply with the following specifications and standards.

The table has been deleted and the following is added:

Refer to the QPL for approved suppliers.

NOTE: The following text REPLACES its respective Subsection in the latest version of the 2016 Standard Supplementary Specifications.

918.46 Rodent Blocking.

Delete the first paragraph and replace it with the following:

The rodent blocking material shall consist of corrosion resistant rodent deterrent copper mesh capped with a pest control expandable foam that fills all voids. Duct seal is not approved material for rodent blocking.

NOTE: The following text is ADDED to the latest version of the 2016 Standard Supplementary Specifications.

918.58 End Node Radio.

This Subsection is deleted and replaced with the following:

The End Node Radio shall consist of an enterprise-class, outdoor, software-defined, TCP/IP wireless subscriber terminal operating in the 4940-5875 MHz band for PMP and PTP applications. The radio shall be fully compatible with Redline RDL-3000 Ellipse base stations, including auto-acquire and remote configuration features. The specified End Node Radio Equipment will serve as an extension to the Authority's existing proprietary broadband wireless Wide Area Network and shall consist of one-each of the items listed in the Supplemental QPL. No substitutions will be allowed without written approval from the Authority's Integrated Technology Services Department.

(A) End Node Radio

Refer to the QPL for approved suppliers.

(B) End Node Radio, Enterprise Software Key

Refer to the QPL for approved suppliers.

(C) End Node Radio, Indoor Injector

Refer to the QPL for approved suppliers.

(D) End Node Radio, AC Power Cord

Refer to the QPL for approved suppliers.

(E) End Node Radio, Surge Protector

Refer to the QPL for approved suppliers.

Add the following Subsection(s):

918.59 Surge Protective Devices.

The surge protective device shall be as described in the Contract Plans. Installation of the device shall be performed by the Contractor. The surge protective device shall be a Type 1 or Type 2 Surge Suppression Device and shall be UL listed, Standard 1449, Third (3rd) Edition.

(A) Electrical Requirements.

1. The Maximum Continuous Operating Voltage (MCOV) shall not be less than 125% of the nominal system operating voltage.
2. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
3. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes
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Configuration	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

4. Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20kA In rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage.
5. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
Delta	1200	2000	3000

(B) SPD Design.

1. The SPD shall be maintenance free and shall not require any user intervention throughout its life.
2. The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV.
3. Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method.
4. No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. Each SPD shall provide the following integral monitoring options:
 - a. Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
 - b. Provide Form C dry contacts (one NO and one NC) for remote annunciation of its status.
 - c. The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
 - d. The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of $50 \pm 20A$ occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter.
 - e. The unit shall contain thermally protected MOVs. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

- f. All of the SPD's components and diagnostics shall be contained within one discrete assembly.
- g. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

918.60 Anti-Seize Compound.

Anti-seize compound shall be marine grade non-metallic compound to inhibit galvanic corrosion and prevent fasteners from fusing together from oxidation. Application shall be a paste and shall conform to MIL-PRF-907F or later. The Contractor shall apply anti-seize compound in the field as per manufacturer's instructions. Anti-seize compound and application thereof shall be incidental to the cost of the attachment hardware.

918.61 Precast Reinforced Concrete Junction Box.

Precast reinforced concrete junction boxes, junction box foundations, and manholes shall be as specified in Section 601 and as shown in the Standard Drawings. Frames or covers, installation aids, and hardware shall be incidental to the cost of the junction box, junction box foundation, or manhole.

918.62 Manual Transfer Switch.

Manual Transfer Switch (MTS) shall consist of (2) two mechanically interlocked molded case circuit breakers, cam-style male connectors, power distribution block, solid neutral plate, and grounding terminals, all housed within a padlockable enclosure. Current rating and number of poles as indicated on drawings.

Manual transfer switch enclosure shall be Type 3R, constructed of continuous seam-welded, stainless steel. The main access shall be through an interlocked, hinged door that extends the full height of the enclosure. Access for portable generator cables with female cam-style plugs shall be via cable entry openings in the bottom of enclosure. A hinged flap door shall be provided to cover the cable openings when cables are not connected; the hinged flap door shall allow cable entry only after the main access door has been opened.

Cam-style male connectors (inlets) shall be UL Listed single-pole separable type and rated 400 amps at 600VAC. Cam-style male connectors shall be color coded. Cam-style male connectors shall be provided for each phase and for ground and shall also be provided for neutral unless otherwise noted. Each of the phase cam-style male connectors within the enclosure shall be factory-wired to a molded case circuit breaker. The ground cam-style male connectors shall be bonded to the enclosure, and a ground lug shall be provided for connection of the facility ground conductor. The neutral cam-style male connectors shall be factory wired to a power distribution block. None of the cam style male connectors shall be accessible unless both molded case circuit breakers are in the "OFF" position and the main access door is open.

A power distribution block shall be provided for load-side field wiring. The power distribution block shall be factory wired to the molded case circuit breakers.

Molded case circuit breakers shall be UL Listed, and the short circuit interrupt rating shall be a minimum of 35kAIC at 480VAC. Trip rating of the molded case circuit breakers shall be as shown on the drawings. One molded case circuit breaker shall be fed from normal power; the other molded case circuit breaker shall be fed from the cam-style male connectors to supply power from a portable generator. Both molded case circuit breakers shall include UL Listed door-mounted operating mechanisms, preventing the opening of the main access door unless both breakers are in the "OFF" position. Both molded case circuit breakers shall be mounted behind a deadfront panel. The load-side of the molded case circuit breakers shall not be energizable unless the main access door is closed and one of the molded case circuit breakers is in the "ON" position. The (2) molded case circuit breakers shall be safety interlocked by mechanical means to ensure that only one breaker may be energized at any given time.

918.63 Vibration Damping Pads.

The vibration damping pads shall be furnished in 1/2" thickness accurately cut to the dimensions shown on the plans. The pads shall consist of a high quality fabric and rubber body. The pad shall be made with new unvulcanized rubber and unused fabric fibers in a random distribution of proper proportions to maintain strength and stability

The surface hardness expressed in standard rubber hardness figures shall be 30 Shore A Durometer plus or minus 10 durometer average.

The average deflection of a 2 inches x 2 inches x ½ inch thick specimen of the vibration damping pad shall be as follows:

<u>Load (PSI)</u>	<u>Deflection (in)</u>
200	0.013
400	0.027
600	0.040
800	0.052
1000	0.065
1200	0.077
1400	0.088

A deflection tolerance of 15% is allowable:

The ultimate breakdown limit of the pad under compressive loading shall be no less than 7000 psi for the specified thickness without extrusion or detrimental reduction in thickness.

The composite washers shall be furnished in 3/8" thickness x 1" I.D. x 2 ¼ inch O.D. The washers shall consist of 21 plies of 8 oz. of cotton duck impregnated with high quality natural rubber. The Shore Durometer hardness of the composition shall be about 90. The breakdown stress for compression perpendicular to the plane of fabric shall be not less than 17000PSI. One composite washer shall be provided for each anchor bolt.

The base plate anchor bolts with nuts shall be 1" diameter hex head stainless steel of such length to ensure proper placing of lamppost damping pads and all washers.

The stainless steel washers shall be 1-1/16" I.D. x 2 ¼" O.D. x 3/16" thick. Three stainless steel washers shall be provided for each anchor bolt.

918.64 Navigation Lighting, Solar.

Navigation Lighting shall be specifically designed to clearly mark bridges and structures extending over navigable waterways as found in 33 CFR § 118. Where required by the United States Coast Guard (USCG) navigation lighting including LED fender and LED channel marker lights shall be solar powered with battery backup. Navigation lighting shall conform to 33 CFR § 60 and 33 CFR § 118. Navigation lighting shall include a lantern unit and self-contained solar powered assembly housed in a weatherproof enclosure including solar array, sealed battery, and charge controller. The lantern power supplies shall be available individually and are suitable for powering up to 12 sectored bridge light heads. Power supplies shall be provided with solar power calculations from the manufacturer, showing that autonomy requirement is met or exceeded.

The lantern unit shall be IP68 waterproof and operate via nominal 12VDC with integrated circuit protection and operating temperature range between -40° to 80°C, colors as defined by 33 CFR § 118, and shall be configured steady-on with 24-hour operation. Any internal dawn-to-dusk or other photocell shall be bypassed by the factory such that it may not be inadvertently activated upon or after installation. The lantern unit visibility requirement shall be 2 nautical miles (NM), measured as in 33 CFR § 118.60. Lantern units shall have horizontal output of 180° or 360°, depending on plan requirements and vertical divergence of nine degrees (9°). The lantern unit construction shall be of all corrosion resistant materials with UV-stabilized polycarbonate lenses.

The navigation lighting shall have the option of a self-contained solar powered assembly housed in a weatherproof enclosure including a solar array with adjustable mount. The enclosure shall have hinged captive latches and shall open away from the parapet without obstruction. The solar panel mounting shall allow the panel to rotate and tilt and shall be oriented to face solar south and tilted such that snow and debris are less likely to accumulate. The self-contained solar power supply shall be able to be mounted away from the lantern unit and connected via heavy-duty SOOW power cabling.

Navigation lighting solar power array shall be configured and installed per manufacturer's direction and approved by the Engineer.

918.65 Wire Labels

Wires shall be labeled in all JBs, JBFs, manholes, load centers, splice cabinets, meter cabinets an enclosure. Brass tags are no longer used and shall be replaced with plastic wire marker (tags) as follows:

- Polyethylene tags shall be black letters on yellow, 1" high and inserted into polyethylene tag holders. Holders are secured to each wire with Ty-Raps.
- Wire labels shall indicate circuit and phase, VMS, HCMS, or camera (i.e. Cir 2B, Cir 4C, VMS 24HR, HCMS 24HR, Camera 24HR, etc.) and be placed at the top of wire loops in JB's. The neutral shall be labeled with its corresponding circuit and phase if more than one neutral is present (ex. Cir 2BN).