SECTION 670
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SECTION 670 – Street Lighting

670.1 – GENERAL

The Contractor shall coordinate with WE Energies to energize service at electrical service/lighting control cabinets and disconnect any electrical services as needed at their own expense.

A. PROJECT REQUIREMENTS

All electrical work shall be performed by a state licensed electrical contractor, and where pertinent, conform to the State of Wisconsin Electrical Code and good electrical construction practices. The Contractor shall maintain the street lighting systems in such a fashion as to provide for their continuous operation throughout the contract to extent required, which shall be incidental to the work unless stated as a separate bid item.

Work shall conform to Sections 204, 651, 652, 653, 654, 655, 656, 657 and 659 of the latest State Specs and the latest adopted State of Wisconsin Electrical Code, except as modified herein, and the City Specs.

The work under this section includes additions and modifications to the existing City of Wauwatosa street lighting system as shown on the drawings and as specified. All work, including repairs, shall be inspected by City staff. The Contractor shall furnish and install, as incidental unless specifically noted as a separate bid item, all items needed to make the proposed system complete from the source of supply to the most remote unit. Such items include, but are not limited to, wire nuts, grommets, tape, connectors, conduit lock-nuts varnish, and putty.

The Contract drawings for electrical work are in part diagrammatic, intended to convey the scope of work and indicate the general arrangement of, including but not limited to, equipment, cable, conduits, and approximate sizes and locations of equipment and material. They are not to be used for obtaining lineal runs of wire or conduit. Unless otherwise noted, no measurement of an electrical drawing derived by scaling shall be used as a dimension with which to work. Dimensions noted are subject to field measurement of existing construction. All required measurements shall be performed by the Contractor prior to the installation of equipment.

Traffic control devices required for the street lighting work shall be considered incidental to the work under this Contract if a bid item for traffic control is not listed in the proposal. See Section 605 General Provisions in the City Specs for more details on traffic control requirements.

1. CONTINUOUS OPERATION OF STREET LIGHTS

If there are overhead and underground utility facilities located within the project limits, refer to the plans and specifications for any anticipated utility adjustments.

The Contractor shall coordinate his construction activities with a call to Diggers Hotline or a direct call to the utilities which have facilities in the area as required per statutes (see General Provisions for a detailed list of utility contact information).

Contractor shall be responsible for locating existing underground street lighting and traffic signal cables within the project limits.

Bidders are advised to contact each utility company prior to preparing their bids. Any damage to public or private utilities shall become the responsibility of the Contractor. Satisfactory repair or replacement shall be completed at the Contractor's expense.

Where there is enclosed or unenclosed lighting cable within the project limits, care must be exercised by the Contractor to avoid damage to the cable during work. Where the Contractor or any of his subcontractors damage any part of the lighting system which results in inoperative street lights or traffic signals, or an outage has occurred anywhere within the project limits, the damage shall be repaired by a qualified electrician at the Contractor’s expense in accordance with City specifications. All lighting systems shall be kept 100% operational.

a. TIME LIMITS FOR REPAIRS

The Contractor shall have **24 hours** from the report of a problem to inspect and identify the cause. Repairs shall be made no later than **3 days** after the problem is identified. The Contractor may also, at their own expense, install overhead facilities to accelerate the return of functional electrical systems to meet the time limits outlined herein.

Should these limits be exceeded, the Engineer reserves the right to hire a third party, independent of the Contractor, or use City workers to perform the repair(s). The cost of hiring a third party or using City workers and having them repair the damage will be paid for by the Contractor. Contractor agrees they will be informed of the final cost, which will be deducted from monies owed in a subsequent payment. In lieu of hiring a third party or using their own staff, the Engineer may also choose to fine the Contractor as they see fit for the circumstances, to be charged each day the lights are not properly functioning outside of aforementioned time limits,

and to be deducted from monies owed to the Contractor.

b. TEMPORARY LIGHTING

If no plans for temporary lighting are included in the Contract Documents, the Contractor may choose, at their own expense, to maintain street lighting via overhead connections to existing poles, the installation of temporary poles and luminaires with their own wiring, or splicing (in existing wires only) around new and/or old poles and/or pole bases, as needed.

Temporary lighting systems shall maintain equal or better lighting levels throughout the area of construction. The Contractor may propose to reduce these levels by submitting a plan to the City for review and approval to reduce light levels on the project. The plan shall indicate all existing and new lighting proposed to be in service and show what lighting is being proposed to be reduced or removed as part of the temporary lighting for the project. If the City does permit reduced lighting levels within the construction, the Contractor is still responsible for maintaining connections to allow 100% lighting capacity for any circuit(s) that continue beyond the construction limits of the project.

Whenever the Contractor is doing work that involves splicing into existing lighting systems, a tag system shall be employed at the distribution center.

The Contractor shall attach an appropriate tag on all circuits which are required to be opened during the course of his work. Such tags shall bear the date, Contractor's name, and individual worker's name indicating to others that work is being performed on the system.

At the conclusion of work operations on a particular distribution center, the Contractor shall remove such tags and re-energize the affected circuits.

See section 670.1 B. 8 below for detailed requirements.

i. All temporary lighting shall be in accordance with Wisconsin Electrical Code, the sections of the State Specs as mentioned in Section 670.1 A. above, the City Specs, and any applicable Federal, State, and Local laws.

2. PERSONNEL QUALIFICATIONS

Perform all electrical work using a journey worker electrician or an

electrical apprentice under the onsite supervision of a journey worker electrician. Electrical work is defined as any electrical and related construction required to be performed by the Contractor under this contract.

3. QUALITY ASSURANCE

All electrical materials shall conform to the latest requirements of the Wisconsin State Electrical Code (defined as the NEC plus the Wisconsin Supplemental Volumes).

All electrical materials to be furnished and installed under the contract shall comply with the provisions of the Underwriters Laboratories, Inc. and shall be UL listed and labeled.

B. GENERAL MATERIAL REQUIREMENTS

All materials furnished by the Contractor for lighting installation under this contract are subject to approval by the Engineer. Materials and equipment by manufacturers other than those specifically named will not be considered. Unless otherwise stipulated in the specifications or noted on the drawings, all materials and equipment incorporated in the work shall be new and unused and in complete accordance with the specification requirements. Materials and/or work not specifically identified as or in a bid item shall be considered incidental to work, and shall be included with the cost in appropriate bid item(s). All electrical materials to be furnished and installed under the contract shall comply with the provisions of the Underwriters Laboratories, Inc. (UL) and shall be UL listed and labeled.

It is the Contractor’s responsibility to verify the catalog numbers shown on the plans and specifications, and update same before submitting shop drawings. Any catalog number revisions or subsequent material cost increases shall be made at no additional cost to the contract whether it is because of a different type or mounting due to project conditions, discontinued catalog numbers or other such issues. In the case of discontinued catalog numbers, the electrical contractor shall bring it to the Engineer’s attention with the manufacturer’s recommended substitution before shop drawings are submitted so that the appropriate equipment can be selected by the Engineer.

Bonding wire shall be installed in conduits for equipment grounding. All equipment shall be grounded as required.

1. CABLE, DUCT, AND CONDUIT

a. ELECTRICAL WIRE

All conductors and tracer wire shall be in strict accordance with Section 655 of the State Specs. Conductors shall be of the gage indicated on the plans, stranded copper, XLP insulated, USE rated wire, placed where indicated on the plans, with number of required conductors as indicated on the plans. Conductors shall be installed in duct. No direct-bury proposed conductors shall be allowed without the written permission of the Engineer.
Feeder conductors shall be black or red, and where two of this type are called for on the plans, one shall be black and one shall be red. Neutral conductors shall be white and grounding conductors shall be green. Tracer wire shall be orange or of the color indicated on the plans. Other cable types shall be of the color indicated on the plans or as directed by the Engineer.

b. HDPE Duct

Duct shall be in accordance with Section 655 of the State Specs, Type TC7, Schedule 40, UL listed, and shall be black with a red stripe for electrical installations. Duct shall be installed in the size(s), location, and number as indicated on the plans, and all the way through the tops of bases.

c. Nonmetallic Conduit/PVC

All conduits and sleeves shall be rigid PVC Schedule 40 in accordance with Section 652 of the State Specs, and of the size(s) indicated on the plans. Conduit sleeves for HDPE duct shall be installed at any roadway crossing, in concrete bases, and any other location as shown on the plans and in the detail drawings.

In junction boxes, ducts that are entering shall be cut off no higher than one-half the depth of the box but a minimum of 3” above the gravel base in the box unless otherwise approved by the Engineer.

2. FIXTURES/LUMINAIRES

The contractor shall consult the plans and/or proposal for product numbers and types of fixtures/luminaires to be installed. Either a 10% overage of fixtures or 3 each, whichever is greater, shall be delivered to the City Department of Public Works and shall be incidental to the bid item for fixtures/luminaires.

LED luminaires shall be of a slim, low profile design that minimizes wind loading. Luminaires shall be constructed of cast and extruded aluminum with integral, weather-tight LED driver components with high

performance aluminum heat-sinks. Each luminaire shall use a terminal block for power input suitable for #6 through #14 AWG wire.

The arm mount luminaire shall be designed for installation on a 2-inch nominal diameter mast arm.

Luminaire design shall be modular to accommodate varied lighting output by use of LED light bar modules and/or differing driver outputs. The LED shall have a nominal color temperature of 3000K with a minimum of 70 CRI. Drivers shall operate with an input voltage ranging from 120-277V, 50/60 Hertz, +/-10% as standard. LED drivers shall have a power factor greater than 90%. Anticipated L90 at 25°C shall be 100,000 hours or greater. All luminaires shall come equipped with an integral surge suppression protection standard and a quick disconnect harness suitable for mate and break under load provided on power feed to the driver.

The finish shall be factory applied powder coat durable Gray topcoat, providing resistance to corrosion, ultraviolet degradation, and abrasion. Luminaire manufacturer shall provide a minimum of 10 year warranty on materials and finish.

Luminaires shall be rated and/or certified UL listed for wet locations, IP-66 minimum enclosure rating, IDK dark sky full cutoff compliant, and Design Light Consortium (DLC) qualified. Luminaires shall be provided in a 3000K temperature color unless otherwise specified or directed by the Engineer.

Pole and Bracket Cable shall consist of two insulated single conductors for each luminaire. Conductors shall be stranded copper, AWG #10, 600V, Type XLP-USE having an insulation thickness of at least 45-mils. The conductors shall be continuous, without splices from the underground feeder connection or fuse holder, to the terminals at the luminaire. A sufficient length of excess cable shall be provided at each pole to permit the removal and servicing of the fuse assembly from outside the pole.

3. THREADED FASTNER REQUIREMENTS

These special provisions require the corrosion preventative compound described in Sections 657.3.1(3) and 657.3.5 of the State Specs. Any and all fasteners and other attachment hardware used on the pole

shaft shall be stainless steel unless otherwise approved by the Engineer.

All threaded fasteners (including but not limited to anchor bolts, screws, and bolts) shall be liberally coated with an Engineer approved anti-seize compound, and excess shall be wiped off. Excepting fasteners inside control cabinets, fasteners up to half an inch in diameter shall be stainless steel. Rust, corrosion, and anti-seize protection shall be provided at all threaded assemblies by coating all mating surfaces with an Engineer approved compound. Aerosol cans of anti-seize material are NOT acceptable. Anti-seize material shall be painted or dipped on threads.

4. FINISH REPAIRS

Unless otherwise specified, mars and scratches on painted equipment shall be touched up with two coats of color matched synthetic resin enamel, or with two coats of color matched zinc rich paint acceptable to the Engineer or as directed by the Engineer. Cold galvanizing paint shall be applied to steel surfaces prior to applying paint.

5. PULL BOXES

Covers for pull boxes shall say “STREET LIGHTING” when used in a lighting circuit.

Pull boxes shall be rectangular precast polymer concrete, reinforced by a heavy-weave fiberglass (Quazite or Engineer approved equal), 17”x30” with 18” depth, style Quazite PT, open bottom (flared), and Tier 15 rated. Covers shall be heavy duty, bolted, skid resistant with a minimum coefficient of friction of 0.5, and in concrete gray color. The cover fasteners shall be stainless steel captive 3/8-inch hex head bolts with stainless steel inserts.

Pull boxes shall be placed at all locations indicated on the plans or approved by the Engineer. When indicated on the plans, “communications” pull boxes, as described below, shall be used in the street lighting work where shown, and shall read “STREET LIGHTING” on the cover.

a. COMMUNICATIONS

Pull boxes for communications shall be the same as described above, except they shall have nominal sizes of 24”x36” and 42”

deep, unless otherwise shown on the plans. The cover shall read “COMMUNICATIONS”.

6. LIGHT POLES

a. ALUMINUM LIGHT POLES

Light poles shall be Valmont brand or Engineer approved equal.

The completed lighting unit shall be of such design as will withstand all loads to which the units will be subjected in the field, including the loads applied by the materials attached to the lighting units, in conformance with the latest edition of the AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals. Use a design life of 25 years. Design to withstand a 3 second gust wind speed of 90mph (145km/h).

Poles shall be one extruded piece of 25-foot tapered aluminum, with 6063 satin finish, 0.156 wall thickness, 4-bolt mounting with 11 ½” bolt circle, and single member 6-foot mast arm, or as shown in the plan details. Pole shall be Part No.RTA25C8B4 with No. 69772-001 mast arm as manufactured by Hapco Aluminum Pole Products or Engineer approved equal, unless otherwise shown. Any and all fasteners and other attachment hardware for the pole shaft shall be stainless steel unless otherwise directed or approved by the Engineer, and shall be incidental to the pole.

Shafts with arm mounted luminaires shall have a J-hook at the top of each pole to provide strain relief for the cable.

Provide a welded mounting plate to accommodate side mount luminaire(s) as incidental to the pole. Exact dimensions to be coordinated with the luminaire to match end (arm) dimensions.

b. CONCRETE POLES

The poles shall be sky gray colored, polished finished with acrylic seal.

All standards furnished shall be cast in metal molds true to design. Time of mixing shall be sufficient to ensure that all particles shall be thoroughly wetted.

The pole shafts shall be fiber reinforced, air-entrained concrete, with 5/8” minimum coverage over reinforcement (7,000 psi minimum). Concrete shall be placed in one continuous operation. When filled, the mold shall be rotated at a high speed to insure a dense concrete by centrifugal force, and produce a cable raceway throughout the length of the standard not less than 2 ½” at the location of the hand holes and a minimum of 1 ½” at top of pole. The poles shall then be polished to a smooth ground finish. Reinforcing shall be in accordance with this specification to assure that no cracking shall occur during normal handling.

The span concrete poles are to be octagonal in shape and carry a 0.125 inch/foot taper, and have a sky gray finish. Shaft length is in general to be a minimum of 27'-7" and a maximum of 28'-0". The pole is to be 23'-0" above grade. The butt diameter shall be 8" minimum and the top diameter shall be 5" minimum. The hand hole shall be 2 ½” x 12” minimum and 18" above grade and located on the opposite side of the pole from the curb. Two cable entrances shall be provided across from one another to run parallel with the curb line. Cable entrances shall be 18" below grade and a minimum size of 2-1/4" x 8". Cable entrances shall be sufficient in size to allow a single 1” conduit to enter the pole and terminate no less than 3” below the hand hole but no more than 6” below the hand hole.

The hand-hole cover shall be flush with pole. Poles shall be furnished with flush aluminum cover plate for hand hole and all other necessary hardware. This hardware shall include a removable metal cap which will protect the required open cable raceway at the top from the weather, nonferrous inserts for securing accessories such as cast aluminum pole cap, bracket brace, hand hole cover, etc., 6'-0" x 2" dia. mast arm of galvanized steel or aluminum with 1-1/4" slip fitter, stainless steel or silicone bronze nuts and bolts. Brackets for mast arm are to be one piece (no welds).

Manufacturer's conformance to specifications shall be certified by an independent testing laboratory.

All poles shall be guaranteed against defect for a period of 5 yrs. If defects are discovered, poles shall be replaced on a two-for-one basis.

c. POLE CABLE & FUSE

Conductors from the underground cable network shall be Type RHW-2/USE-2 (XLP) individual conductors. In each utilized phase

conductor in the hand-hole, there shall be installed a 1-pole secondary inline 600 VAC fuse assembly as manufactured by BUSS Tron HEB series fuse holder with weatherproof boots, or Engineer approved equal, with a KTK fuse. Conductors shall have sufficient length to permit removal of the fuse assembly through the hand-hole of the pole.

Exposed ends of fuse holders shall be taped thoroughly with 3M 130C linerless rubber insulating tape and 3M Scotch Super 88 vinyl tape or Engineer approved equal.

d. BASES

Shall be constructed in accordance with Section 654 of the WisDOT Standard Specifications and as shown on the plans, and the requirements of the pole manufacturer.

Light pole bases shall be round, 20” diameter by 5’ deep reinforced concrete, unless otherwise shown on the plans. Bases shall have anchor bolts cast in place with the base. The Contractor shall confirm bolt placing and circle diameters with the pole supplier(s) before pouring bases. Bases of a non-circular shape will not be accepted unless such bases are noted to be installed in the plans.

Bases shall be excavated by use of a circular auger. Top surfaces of concrete bases shall be trowel finished and level with a 1-inch chamfer around the entire top edge. Backfilling and compaction of areas disturbed by construction operations shall be considered incidental. All form material exposed to view shall be removed by the contractor.

Factory made PVC elbows shall be cast in the base as sleeves for the cable-in-duct, incidental to the base. Location and size shall be as shown on the details or directed by the Engineer. Elbows shall be installed in an orientation as to permit conduit to be installed in as nearly a straight-line run as possible, without bends. It is acceptable to the Engineer if the Contractor achieves this by “crisscrossing” the vertical portions of the elbows in the base, and/or orienting the elbows so the tops protrude from the top of the base and are cut down later, in order to create a more gradual curve inside the concrete. The sleeve opening in the side of the base shall be no less than 18” below the concrete top of the base.

Bases shall be constructed so as to center the pole on the concrete. The Engineer may require off-center pole bases to be removed and reinstalled at the Contractor’s expense, or the Engineer may reduce payment for each off-center base. Sonotube

and other forming materials shall be removed from the exposed portion of bases before completion.

7. LIGHTING CONTROL CABINET

The lighting control cabinet shall include a new concrete foundation, NEMA 3R enclosure, panelboard, time clocks, contactors, photocontrol, circuit breakers, wiring, and all equipment and materials as shown in the plans and as listed below, as incidental to the cabinet item. The cabinet with all of its electrical components, wiring and parts shall be listed and labeled by Underwriters Laboratories (UL) or other nationally recognized testing laboratory as a completely assembled unit.

All materials furnished for this portion of the work shall be Listed and Labeled by UL or other National Recognized Testing Laboratory.

Provide factory PAINTED finish on enclosure, meter pedestal and exterior mounted disconnect switch and any exposed conduits to match color of street lighting poles/luminaires.

Provide “LIGHTING CONTACTOR” or “RECEPTACLE CONTACTOR” (1/4”) engraved identification plaque on respective contactor.

Provide “LIGHTING” or “RECEPTACLE” (1/4”) engraved identification plaque on respective H-O-A switch.

a. ENCLOSURE

Control enclosure shall be manufactured by Bison Pro Fab (800) 825-5805, APX Enclosures (717) 328-9399, or Engineer approved equal.

Control enclosure shall be NEMA-3R made from 12-gauge Type 304 stainless steel. Seams shall be continuously welded and ground smooth. All hardware shall be type 304 stainless steel.

Enclosure shall be free standing with an overall height of 54-inches, a width of 48-inches and a depth of 24-inches. Enclosure shall have a 2-inch wide inside flange at the front, back, and sides for anchoring to base. Side and back walls shall be stiffened with 2 vertical stainless steel equipment mounting rails per wall. The door frame shall be double flanged.

The cabinet top shall be sloped to drain and shall have a drip shield over door. Provide screened vent slots (1/8-inch x 1-inch) under the cabinet overhang located in the top face above door opening.

Outer door shall be NEMA 3R, 12-gauge stainless steel, with cellular neoprene gasket and a three position door stop rod. Door shall be hinged with a continuous 14-gauge stainless steel hinge secured with ¼-20 stainless steel carriage bolts. Provide 3-point latching system with ¾-inch diameter stainless steel padlocking handle. Also provide a Corbin No.2 deadbolt lock with 2 keys.

Enclosure shall have a 0.125-inch thick 5052-H32 aluminum mounting panel at back (interior) of enclosure.

Provide plastic print pocket attached to inside of door.

All abandoned cables shall be removed from the lighting control cabinet.

b. MAIN DISCONNECT

Fusible 200A, 2-pole, 600VAC, NEMA 4X stainless steel, heavy duty with insulated groundable neutral assembly, service ground kit and lockable in ON & OFF positions. Mount directly to back of enclosure as appropriate. Provide Bussmann 200A, 600V FRS-R Class RK5 fuses.

c. CONTACTORS

Contactors shall be 200A, 2-pole, mechanically held, 120V coil, Square-D #8903-SVO10-V02, and shall be mounted directly to back panel. The Contractor shall construct a separate latching/unlatching circuit using an 8-pin DPDT relay and socket (120Vcoil, 10A contacts) Square-D or Engineer approved equal.

d. CONTROL TRANSFORMER

Shall be 240VAC Primary, 120VAC Secondary, 1PH, 3KVA, Square-D #3S1F. The Contractor shall furnish Square-D #9080FB1211R fuse block assembly with 15A fuse to protect the line side of the transformer.

e. TIME CLOCK

The time clock shall be astronomical with non-volatile EEPROM memory, battery backup, -40°F to 155°F operating range, LCD display, daylight saving time and leap year correction. The Contractor shall provide an Intermatic #ET8215C.

f. SECONDARY LOAD CENTER

The Contractor shall provide circuit breaker enclosure for secondary circuits, Square-D #QO24L70S with one 20A breaker (#QO120) for maintenance circuit, one 15A breaker (#QO115) for photocell circuit, and one #PK0GTA2 Ground Bar.

g. PHOTOCELL

The photocell shall be of the button type and installed in the overhang of the control cabinet facing north. The Contractor shall apply silicon caulk to maintain the integrity of the enclosure. The photocell shall be rated for 120V, 1800W with 30-60 second delay between “ON-OFF” operations and be warranted for 5-years by the manufacturer. Photocell shall be Intermatic #K4021C or Engineer approved equal.

h. HAND-OFF-AUTO SWITCH

Switch shall be Square-D #9001-KS43B switch body, #9001-KA1 contact block and #9001-KN760WP nameplate mounted in Hoffman #E-1PB one hole box.

i. OTHER DEVICES

Furnish one 120V GFI duplex service receptacle in the surface mounted box and one 120V LED light fixture. The light fixture shall be surface mounted type with gasketed vapor tight globe, wire guard, lamp, and separate on/off switch in surface mounted box.

j. DUPLEX GFCI RECEPTACLE – Shall be Hubbell #GFR20ILA (20A)

k. 4” SQ DEEP BOX – Shall be Appleton #4SDEK with #8362 Cover

l. VAPOR TIGHT FIXTURE – Shall be E-conolight #E-VT1L141NG

m. 4” OCT. BOX – Shall be Appleton #4SDEK with #8362 cover

n. LAMP – Shall be GE 60W/A19

o. LIGHT SWITCH – Shall be Hubbell #CS1221I (20A)

p. 4” SQ DEEP BOX – Shall be Appleton #4SDEK with #8361 Cover

q. NEUTRAL AND GROUND BAR – 240V CIRCUITS

Shall be 1/4”x4”x12” Copper Bus Bar with mounting hardware. The Contractor shall provide Burndy #KA4C (#14-#4 AWG) or #KA25 (#4-#1/0 AWG) copper mechanical lugs for all conductors to the bus bar, or Engineer approved equal. Appropriate sizes and quantities shall be determined from the plans and details, and space shall be left for future lugs on the bar. Insulated standoffs shall be provided for the neutral bar. A separate copper grounding bar shall be mounted within the cabinet, identical to the Neutral Bar, for terminating field equipment grounding conductors.

r. PANELBOARD

Panelboard shall include 240/480 volt, 400A Square ‘D’ panel, 200A main circuit breaker, and 40A branch circuit breakers and ground bar as follows:

i. Panelboard: (1) – Square-D 400A, 600V, I-Line, #HKA-225-S4
ii. Ground Bar: (1) – Square-D #PK0GTA2
iii. Main Breaker: (1) – Square-D 2-Pole, 200A, 600V, I-Line, #JGA26200AB
iv. Circuit Breakers: (12) – Square-D I-Line one pole, 40A, #FA-14040

Fillers (Square-D #HNM1BL or #HNM4BL) shall be provided as required.

s. METER PEDESTAL

A new meter pedestal (‘Milbank’ or Engineer approved equal) shall be furnished and installed under this item. The Contractor shall arrange for and pay all permits and fees associated with installation of the meter pedestal as incidental to the cabinet work unless a separate bid item is noted.

The Contractor shall furnish and install an Engineer approved meter pedestal, conduit fittings (10,000 AIC or as required by the

local utility), ground rod(s) and connection(s), and all necessary conductors and equipment required by the State Electrical Code and the utility for a service connection. Meter shall be located on the side of the cabinet as appropriate.

t. CONCRETE BASE

The concrete base shall be as shown on the plans and shall comply with the requirements of Section 654 of the WDOT Standard Specifications. Conduit shall be Schedule 80 PVC electrical conduit and shall conform to the requirements of Section 652 of the State Specs.

Anchor rods, nuts, and washers shall conform to the requirements of ASTM A449 or A687 (Grade 105). The entire length of the anchor rods, and the nuts and washers thereof, shall be hot-dip zinc coated in accordance with AASHTO M232.
Concrete Masonry shall conform to the requirements of Concrete Masonry, Grade A, AFA, A-S, A-IS or A-IP, Section 501 of the State Specs.

u. CONSTRUCTION

The cables shall be trained in straight horizontal and vertical directions and be parallel next to and adjacent to other cables whenever possible, using cable clamps attached with #10 screw to mounting panel, Panduit CCH series or Engineer approved equal. Adhesive type clamps are not allowed. All equipment shall be mounted to the panel in the enclosure unless otherwise indicated on the plans or directed by the Engineer. Refer to the plans and details for equipment layout within the cabinet. The cabinet interior shall be cleaned of all construction debris prior to final acceptance.

v. PROGRAM TIME CLOCKS AS FOLLOWS

Lights: turn on 20 minutes after sunset and off 20 minutes before sunrise.

Receptacles: turn on 1 hour prior to sunset and turnoff at midnight. Verify with City or Engineer prior to programming

8. TEMPORARY LIGHTING (WHERE APPLICABLE)

Temporary lighting shall be installed where called out on the plans. If no plans for temporary lighting are provided, the Contractor may still choose – at their own expense – to install Engineer approved temporary lighting (see Section 670.1 A. 1. b. above for additional information).

Regardless of whether temporary lighting is on the plans or the Contractor elects to install it, they shall be responsible for determining and providing any and all materials, labor, equipment, and miscellaneous supplies as needed to maintain lighting during construction, as incidental to the temporary lighting. All temporary lighting shall require submittals (and if applicable, plan drawings) approved by the Engineer. Maintenance of temporary lighting shall be incidental to the work.

a. MATERIALS

i. WOOD POLES

All temporary poles shall be wood unless otherwise approved in writing by the Engineer. Wooden poles shall be Class V or larger with a 35 ft. overall length, but this length shall be adjusted as needed to accommodate locations below existing utility poles and/or lines, and adjustments shall be incidental to the poles. The poles shall be northern pine in accordance with ANSI Standard 05.1 for Specifications and Dimensions of Wood Poles. All poles shall be pressure treated with 5% pentachlorophenol with a minimum of 8 pounds per cubic foot net retention of the oil-borne preservative. Provide 4 AWG copper wiring in accordance with Section 655 for pole wiring. The depth of the wood pole in the ground shall not be less than 5 feet or as directed by the engineer.

ii. DOWN GUYS

All down guys shall be galvanized, 3/8-inch nominal diameter, 7 strand, zinc coated steel wire conforming to ASTM A475, with 11,500 lbs. minimum breaking strength, and utilities grade or better. All guys shall have a 7-foot PVC or plastic guy guards. All guys shall have a guy strain insulator in accordance with ANSI Class 54-2, a tensile strength of 12,000 lbs., and a maximum cable diameter of 1/2-inch.

Anchor rods shall be twin-eye 5/8-inch nominal diameter with a minimum breaking strength of 11,500 lbs. Anchors shall be expanding or plate type with an expanded area of 125 square inches or greater. A screw type anchor may be used provided the anchor is at least 10-inches in diameter, has 78 square inches of an area, and an anchor rod diameter 1-1/4-inch by 66-inches or larger, and galvanized.

Guy wire clamps shall be 3-bolt and have a minimum breaking strength of 11,500 lbs. A galvanized service sleeve shall be used to hold down the loose guy ends beyond the guy clamp.

The dead ends shall be made of the same material as the guy wire.

iii. LUMINAIRES AND ARMS

Fixtures shall be high pressure sodium or LED cutoff luminaires of appropriate output, and mast arms shall be of appropriate length.

iv. AERIAL CABLE

The aerial cable shall consist of #2 AWG triplex or quadplex assembly of two or three XLP insulated power aluminum conductors, respectively, with an ACSR bare messenger wire (may be used as ground conductor if needed).

b. CONSTRUCTION

i. POLES

The depth of pole in the ground shall be no less than 5-feet, or as directed by the Engineer. All poles which are at the end of an aerial cable run, or where aerial cable tension could cause the pole to lean, shall have down guys installed. Any backfill in the hole around the buried section of pole shall be either stone chips, slurry, or other non-compressible material approved by the Engineer. Backfill shall be incidental to the pole.

ii. CABLE

The Contractor shall install the overhead lines in a manner which is safe and in accordance with all applicable codes, and shall correct excessive sag or loose connections until removal of the temporary system is acceptable to the Engineer, or until the final payment of the contract.

Cable shall be a minimum of 20-feet above any roadway or driving surface, and minimum 15-feet above all other surfaces.

Where necessary to connect to existing underground circuiting, the Contractor shall provide an appropriately sized, temporary junction box at the base of the wood pole for an above-ground splice. The cable that extends above grade shall be appropriately protected by a plastic cable guard or conduit for a minimum of 10 vertical feet.

iii. REMOVALS

Temporary lighting shall only be removed when the proposed permanent system is fully tested and functional, or with the express written permission of the Engineer. Once criteria for removals are met, all materials shall be removed as soon as practicable, and any voids or holes left by the temporary system shall be backfilled in compliance with Section 670.1 C. of the City Specs below.

iv. FAILURES, DAMAGE, AND MALFUNCTIONS

All temporary lighting shall be maintained in accordance with Section 670.1 A. 1 of the City Specs, as incidental to the contract, from the time of installation through the time of disconnection at the start of removals.

In the event of circuit failures in and near the project area during construction suspected to relate to construction activities, the Contractor, at his expense, shall respond to and troubleshoot outages. Whether or not the problem or solution lies within the project limits, he shall immediately make the necessary repairs per City specifications. The Contractor shall lay out his own work and shall be responsible for determining exact locations for equipment

and rough-ins and the exact routing of conduits so as to best fit the layout of his work.

Since damaged cable may not be discovered until non-working hours, the Contractor shall maintain a telephone number by which he can be contacted for said repairs 24 hours/day, 7 days/week, including holidays and weekends. Repairs must be permanent in nature and may include installation of an entire conduit crossing with pull boxes, trenching, cable replacement and other work needed as determined by the City Electrician.

Contractor shall be responsible for making repairs to street lighting and traffic signal systems which are believed to have been damaged as a result of the contractor's construction operations. After the Contractor has made sufficient repairs, should the Contractor demonstrate, to the satisfaction of the Engineer, that damage to the underground cable was obviously not a result of construction operations under this contract, and such cables were directed to be repaired by the Engineer, the Contractor shall be reimbursed by the City for actual costs of labor, equipment and material used on a cost-plus-limited basis per the terms of the contract.

The Contractor shall also be responsible for repairs for failure to the street lighting cable within the one-year warranty period following contract acceptance which are shown to be a result of the Contractor's construction activities. If the Contractor fails to abide by the requirements herein, the City reserves the right to complete the work independently of the Contractor and deduct the cost thereof from monies due the Contractor under this contract.

The Contractor or his representative shall respond to all emergency calls from the City of Wauwatosa within one (1) hour after notification and provide immediate corrective action. When equipment has been damaged or becomes faulty beyond repair, the contractor shall replace it with new and identical working equipment within one (1) working day. The cost of furnishing and installing the replaced equipment shall be borne by the contractor at no additional expense. The contractor may institute actions to recover damages from a responsible third party. If at any time, the contractor fails to perform all work as specified herein to keep the

temporary lighting system in proper operating condition; and if the contractor's designated personnel cannot be contacted, the City shall have the normal maintaining authority to perform the required repair. The cost of the repair shall be paid by the contractor.

C. REMOVAL OF EXISTING LIGHTING

Holes left by all removals shall be backfilled with an Engineer approved material. This work shall be incidental to removals.

Where indicated on the plans or as directed by the Engineer, the Contractor may be required to salvage and deliver selected existing light poles, arms, luminaires, pull boxes, frames/covers, signs, or other materials – to be determined on a contract-by-contract basis – to the City of Wauwatosa Public Works Yard at 11100 W. Walnut Rd., Wauwatosa, WI 53226. Contact Randy Michelz, Traffic and Electrical Supervisor, (414) 471-8429

1. LIGHTING UNITS

Where indicated on the plans, lighting units shall be completely removed including pole (direct-bury or base mounted), base (as applicable), mast arm, luminaire, pole wiring, and all appurtenances, and the existing underground cables and conduits/ducts shall be cut off and safely abandoned below ground or temporarily spliced as required to maintain operation of the street lighting, all incidental to the removal unless otherwise noted as a separate base bid item. Except where noted on the plans, all of the above materials shall be disposed of offsite by the Contractor as incidental to all removals. The Contractor shall notify the Wauwatosa Electrical Supervisor 48 hours prior to the removal of the lighting units.

Any partial removal of lighting units shall only be as specifically indicated on the plans, or as directed by the Engineer.

2. CABLE, DUCT, AND CONDUIT

Where new underground conduit or duct is to be installed, the Contractor shall remove existing underground conduits/ducts (note conduits and ducts only need to be removed where exposed after abandonment; no filling or pulling of abandoned runs required) and their wiring, and dispose of/recycle offsite in an appropriate manner, as incidental to removals and proposed installations. All unused or

abandoned wires shall be removed from light poles, junction boxes, ducts, conduits, and the lighting control cabinet. Incidental splices shall be made where needed to maintain continuous operation of the lighting system.

3. SIGNS ON POLES

Signs attached to the existing poles shall be removed by the Contractor. The signs shall be placed on temporary posts, salvaged, or disposed of offsite as directed by the Engineer or shown on the plans. The Contractor shall reinstall the signs, or install new signs if so called for on the plans, on the nearest available new lighting unit or as indicated on the plans. Removing, temporarily posting, disposing of (where applicable), and reinstalling existing signs or installing new ones shall be considered incidental to the work unless otherwise noted as a separate base bid item. It may be noted on the plans the City of Wauwatosa is furnishing some signs.

4. PULL BOXES

Where indicated on the plans, existing pull boxes, frames, hardware, and covers shall be completely removed. The existing pull box frames, covers, hardware, and all other materials therein shall be disposed of off-site by the Contractor as incidental to removals. The existing underground cables and conduits/ducts in the pull box shall be cut off and safely abandoned below ground or temporarily spliced as required to maintain operation of the street lighting, incidental to the removal.

5. CABINETS

Cabinets shall be removed where indicated on the plans. Cabinets shall have all conductors and electric services disconnected in a safe manner. Unless otherwise indicated on the plans, removal shall include as incidental to the work the entire cabinet, the entire base including conduits, ducts, and cable, all internal and external electrical components, wiring, and hardware, meter pedestal (where applicable; unless otherwise indicated as a separate bid item), and any other interior or exterior attachments and their materials. The Contractor shall coordinate cabinet removals with WE Energies, the Engineer, and the City of Wauwatosa Electrical Supervisor as incidental to the removal.

D. INSTALLATION

1. HDPE DUCT

Duct shall be installed 6”-12” from the back of curb, at a depth of 24”-30” of cover from the top of curb. The Contractor shall lay or bore the duct empty, i.e. without any proposed cable inside.

In the roadway (not driveways or walks), duct shall be installed in a 3” PVC Schedule 40 conduit sleeve at a depth of 18”-24” of cover for the sleeve from the top of pavement unless otherwise noted in the plans, but the sleeves shall be installed empty before the duct is pulled through. Duct shall NOT be placed in any sleeves before the sleeves are installed. PVC crossings shall extend 6”-12” beyond the back of curb. Compacted gravel (or spoils in turf areas) may be used for bedding and backfill material but it must be free from all rocks, pebbles, broken concrete, clay chunks or other material that may cause damage to the duct (or conduit). Backfill in these areas shall be thoroughly compacted to prevent future settlement. In paved (or brick paver) areas, the backfill for trenches shall be slurry where directed by the Engineer. Mason sand bedding is only required around direct-buried cable.

Should two or more crossings be required at a location, each crossing shall have its own HDPE duct in its own PVC sleeve, and the crossings shall be laid side-by-side at the same depth. Separate borings and trenches are not required.

The location of each crossing through a roadway shall be marked by arrowhead chisel marks or stamps in the curb edge at the top of curb. If curb at the crossings is to be replaced as part of this contract or from damage, then these marks shall be made in the proposed curb after it is installed.

a. SLC TRANSITION/SHUR-LOCK II BENDS

Where indicated on the plans or as directed by the Engineer, Duraline Shur-Lock II couplers shall be used with Schedule 40 PVC conduit bends, of the size to match the HDPE conduit, to accomplish 90° turns in duct alignments. Couplers shall be sized as appropriate. Where used, Shur-Lock II fittings shall be noted on the as-built drawings and the Contractor shall verify to the Engineer the installation of the SLC transition is complete prior to backfilling. Transitions shall not be paid for unless confirmation of their installation has been made by the Engineer, or proof of their installation is provided to the Engineer, AND they are clearly shown on the as-built drawings. If the Contractor fills their excavation without notifying the Engineer or before the Engineer is able to

confirm installation, the Contractor shall, at their own expense, re-excavate and re-fill around the SLC for the Engineer’s verification.

2. PVC CONDUIT

Unless otherwise noted on the plans, PVC conduit shall only be used as a sleeve for HDPE duct. Boring is only required where indicated on the plans. Boring in areas where it is not shown or directed by the Engineer shall NOT require any additional payment to the Contractor, unless the Engineer agrees in writing to extra costs before the work is performed.

Where the earth trench meets conduit that is either above or below the trench line, the trench line shall be sloped at a grade of not more than two inches (2") per foot to the conduit. The conduit is not to be bent up to meet the trench line. Where trench is excavated around the conduit end; any fill material placed beneath such conduit shall be properly compacted.

The material excavated from the trench shall be stored in such a manner as to do no damage to the adjacent public or private property. All surplus material shall be removed at the Contractor's expense and on the same day as it is excavated unless otherwise permitted in writing by the Engineer. The Contractor shall be strictly responsible for any damage done to adjacent public or private property arising from the excavation of the cable trench, laying the cables, or backfilling the trench. During the period trenches are left open, they shall be either covered or barricaded to the satisfaction of the Engineer.

Conduit sleeves shall be installed at any location where cable needs to cross under a roadway pavement (sleeves at driveways, walks, and trees are not required). These sleeves shall be installed perpendicular to the centerline of the road, at a depth of 18”-24” of cover from the top of pavement. The ends of these sleeves shall extend 6”-12” behind the back of curb. Compacted gravel (or spoils in turf areas) may be used for bedding and backfill material but it must be free from all rocks, pebbles, broken concrete, clay chunks or other material that may cause damage to the duct (or conduit). Backfill in these areas shall be thoroughly compacted to prevent future settlement. In paved (or brick paver) areas, the backfill for trenches shall be slurry where directed by the Engineer. Mason sand bedding is only required around direct-buried cable.

a. BASES

Sleeves shall be placed in all bases (including, but not limited to, for light poles and cabinets), with PVC bends oriented to

accommodate future pulling of duct and cable, and of the size and quantity as indicated on the plans.

For light pole bases, factory made PVC elbows shall be cast in the base as sleeves for the cable-in-duct, incidental to the base. Location and size shall be as shown on the plans or directed by the Engineer. Elbows shall be installed in an orientation as to permit conduit to be installed in as nearly a straight-line run as possible, without bends. It is acceptable to the Engineer if the Contractor achieves this by “crisscrossing” the vertical portions of the elbows in the base, and/or orienting the elbows so the tops protrude from the top of the base and are cut down later, in order to create a more gradual curve inside the concrete. The sleeve opening in the side of the base shall be no less than 18” below the concrete top of the base.

3. CABLE

All new cable shall be installed in HDPE duct. Cable shall NOT be installed before the duct is placed in the ground or bases. The Contractor shall exercise care in the installation of the cable-in-duct to insure that the completed raceway is smooth and free of kinks and sharp bends. The Contractor shall verify that the conductors are free to move in the duct after installation. At the request of the Engineer, the Contractor shall demonstrate free movement of the conductors within the duct after installation and that the conductors can be easily removed and replaced.

Frost loops of at least 12 inches shall be provided where cables enter conduit systems. At any location where existing direct-buried cable is exposed, mason sand shall be used as a bedding material around the cable before backfilling.

Conductors in poles, pull boxes, or other terminations shall be marked with blue tape wrap to identify the set of conductors emanating from the distribution center (feeder). Neutral conductors shall be identified with white tape wrap, and grounding conductors shall be identified with green tape wrap.

4. PULL BOXES

Ground rods (5/8” x 8’) shall be installed in all pull boxes where new construction meets the existing lighting system, and where indicated on the plans. Ground rods shall be paid per the bid item in the plans; if no such bid item exists, ground rods shall be incidental to the contract.

The new pull boxes shall be installed flush with grade, on 12 inches of crushed stone base, or as shown on the plan details, if applicable. Where the pull box joins new and existing cable, sections of existing electrical cables shall be routed through the new box and placed so as to be slack and readily accessible. In locations where new concrete is to be placed around the new box, the seam between the cover and the rim of the box and the bolt holes in the cover shall be taped to prevent accidental introduction of concrete into the seam or bolt holes.

The Contractor shall make every effort to prevent any damage to the existing electrical cables during the removal and installation process. Damage to cables incurred during the removal or installation process shall be repaired by the Contractor at the Contractor's expense.

The pull boxes shall be set flush with the grade or pavement and installed on aggregate per plan details.

All junction box covers are to be bolted down.

5. POLES

Each light pole shall be identified with 5-character, self-adhesive street light numbers. This identification shall consist of 2.5-inch tall black letters (2-inch on residential streets), numbers on a white background, die cut from engineer grade reflectorized sheeting. The identification number shall be assembled as a vertical label applied to the streetlight poles on the quadrant of the surface on the pole that faces oncoming traffic. The top of the label shall be installed at 5 feet above the ground line. Verify pole numbers with Engineer prior to installation of identification labels.

Poles on residential streets and decorative style poles shall NOT have number labels installed on the outside of the pole unless specifically called for on the plans.

Furnish and install all incidental items, such as hardware, transformer, pole wiring/fusing, grommets, etc. necessary to make the unit complete.

Furnish only items (Pole assembly and transformer) are to be delivered (in appropriate packaging/protective materials) to the City of Wauwatosa Public Works Yard at 11100 W. Walnut Road, Wauwatosa, WI 53226. Contact Randy Michelz, Traffic and Electrical Supervisor, 414-471-8429.

a. POLE CONNECTIONS

In circuits with two feeds, red cable shall be used for even numbered poles, and black cable shall be used for odd numbered poles. Contractor shall verify the circuit is appropriately balanced amongst all appurtenances it powers.

6. LUMINAIRES/FIXTURES

Luminaires and their respective arms (where applicable) shall be installed in accordance with Sections 657 and 659 of the State Specs and the manufacturer's requirements.

E. SPLICING REQUIREMENTS

Insulated cables shall be installed in continuous lengths without splices from terminal to terminal. Splicing will be permitted only in hand holes of poles, transformer bases, junction boxes or as otherwise provided on the plans. All splices other than underground cast-in-place splices shall be readily accessible.

Existing direct-buried cable may be spliced into new poles, cabinets, and pull boxes, but new cable-in-duct shall not.

1. LIGHTING UNITS

Splices in poles shall be made with reusable set-screw type connectors. Penn Union SX-2 or equal, copper service entrance connector, or Engineer approved equal. Complete splice with layer of nonstick varnished cambric insulating tape, followed by multiples laps of Scotch 130C rubber insulating tape, followed by multiple laps of Scotch Super 88 vinyl insulating tape. Split bolt compression connectors are not acceptable for this contract. Splice blocks will not be accepted.

Splices in poles shall be incidental to the pole bid item.

2. UNDERGROUND/PULL BOXES

Splices shall accept quantity and size of conductors required at individual pull boxes (which may be of differing configurations), be direct burial and submersible rated. Utilize multi-cable compression connectors with the splice encased in a Scotchcast 85 series multi-mold permanent resin compound. Split bolts are not allowed. No splices are allowed in pull boxes, unless indicated on the plans or otherwise approved by the Engineer.

Splices underground are only for extension of direct buried cables or repairs as approved by the City.

3. BOLLARDS

Utilize silicon-filled wire connectors of proper size equal to King Dryconn waterproof connectors.

F. WARRANTY

The electrical contractor shall provide a written labor warranty for a minimum of 1 year after final acceptance of project installation. Warranty shall include materials damaged by Contractor's installation, otherwise materials shall be warranted by manufacturer. The Contractor shall be responsible during warranty period to coordinate replacement materials under warranty.

G. SUBMITTAL REQUIREMENTS

The Contractor shall furnish a complete list and cut sheets/shop drawings of materials to be furnished and used for lighting and electrical. Such list shall include the names and addresses of manufacturers, together with catalog numbers, certificates of compliance, specifications, and other product information requested by the Engineer. Catalog numbers shall be identified on respective data sheet. The list and cut sheets/shop drawings shall be submitted within 21 calendar days of the award of the contract. No materials shall be incorporated into the lighting system prior to the written approval of the Engineer. Approval does not change the intent of the specifications. The Contractor shall not substitute or make changes in material without resubmittal for approval.

The following list is a general list of items shall be submitted for approval and shall not be considered an exhaustive list of items to be submitted:

- Lighting Control Cabinet (materials and equipment layout/wiring diagrams)
- Fuse Holders/Fuses
- Splices
- Duct
- Conduit (including connectors)
- Electrical Wire (underground and pole wiring)
- Wire Identification
- Pull Boxes
- Poles
- LED Luminaires

- LED Bollards (if applicable)
- Temporary Lighting Plan and Materials (if applicable)
- As-built Drawings (Prior to final payment).

The Contractor is allowed 1 submittal of each item for approval. If more submittals are required, the Contractor will be charged $250 per item (e.g. duct, electrical wire) for additional review time with payment made with re-submittal, to be deducted from monies owed to the Contractor.

1. SUBSTITUTIONS

   Any request for substitutions will only be reviewed by the City and Engineer after the award of the contract following the bid opening. Materials, equipment or methods of installation other than those named, will be considered only if such articles are in accordance with the general requirements and are similar in composition, dimension, construction, capacity, aesthetics, finish and performance.

   In any case where the Contractor wishes to use equipment or methods other than those listed by name, such equipment shall be considered a substitution and must be approved by the City and Engineer. To gain approval for substitutions, the Contractor shall submit the following to the City and Engineer for review.

   Documentation from the equipment manufacturer indicating where this equipment meets and does not meet the specifications or drawings as written. This documentation shall state all exceptions taken to the specification and the reasons for such exceptions. All documentation relative to the request for substitution shall be submitted on the manufacturer's letterhead and signed by a representative of the manufacturer. Equipment and materials submitted for review without proper documentation will be rejected without review.

   a. MANUFACTURER'S CUT SHEETS: Cut sheets shall be originals as are contained in the manufacturer's catalog. Photocopies of these sheets will not be accepted for review.

   b. LUMINAIRES: Request for substitutions shall include photometric test reports performed by an independent testing laboratory, as well as a summary of energy loading. Calculations indicating lighting levels and uniformities based on plan layout shall be included in the request. Photometric calculations for specified luminaire and submitted substitution shall be submitted for review. Substitutions shall meet or exceed photometric and energy use of specified luminaires. No substitution request will be considered if calculations are not submitted. Any luminaires on project that have specified same manufacturer/luminaire family elsewhere will require

acceptable substitution requests for ALL related luminaires from an equivalent manufacturer/luminaire family - no exceptions.

The Contractor shall provide samples of the proposed equipment for the Engineer's review, if requested by the latter, and any other information or materials as requested by the Engineer to establish equality.

The Contractor shall acknowledge that they have reviewed the submission criteria for the request for substitution by stamping the submission with a review stamp or acknowledgment by an accompanying letter.

Review fees are $250 per each bid item substitution request, to be deducted from monies owed to the Contractor.

H. CIRCUIT IDENTIFICATION REQUIREMENTS

Color coding shall be accomplished by use of cable jackets of the proper color. All tails of all splices shall be coded. Secondary distribution circuits shall be color-coded with even circuits red, odd circuits black, neutral conductor white, and the ground conductor shall be green.

Each of the line-side underground conductors at every pole, bollard and pull box shall additionally have a 6" wrap of blue electrical tape applied to identify the set of conductors emanating "from" the control cabinet.

Each accessible location of underground cable in control cabinets, pull boxes, and pole/transformer bases shall have a permanent embossed 304 stainless steel tag with 3/16" characters (equal to Panduit #MEHT187 system) attached in a "flag" manner using a black outdoor rated nylon tie. The tag shall include information identifying the cabinet and conductor circuit number (i.e. L-3).

I. BRANCH CIRCUIT TAG OUT REQUIREMENTS

The Contractor may, at his option, work on live circuits or he may disconnect and tag out circuits. Any branch circuit not disconnected and tagged out shall be considered live, and the Contractor shall restrict his work force to those qualified to work on live circuits. Disconnection may be made by disconnecting branches at the overcurrent device.

Tag outs shall be made with manufactured electrical warning tags furnished by the Contractor and endorsed with the name of the Contractor, the date, and the project I.D. The Contractor shall clear all completed tag outs by the end of the workday.

J. EQUIPMENT BONDING REQUIREMENTS

Bonding wire shall be installed in conduits for equipment grounding. All equipment shall be grounded as required.

K. TESTING REQUIREMENTS

The Contractor shall perform acceptance tests for circuits installed under this project, and shall record that information on “Insulation and Equipment Testing Schedule” at the end of this Section 670 after construction is completed, as incidental to the contract. The Contractor shall create and provide all documentation to the City at completion of tests, with all system issues corrected at the Contractor’s expense and all tests passing.

All testing shall occur in the presence of the Engineer or the City Electrical Superintendent. The Contractor and the City shall agree on a time for testing of the completed installation with the required parties present.

The contractor shall create and provide all documentation to the City at completion of tests (with all system issues corrected).

The cost of testing shall be considered incidental to the installation of all electrical items and will not be paid for separately or as an extra/change order.

The lighting system is not complete until all electrical work is complete and inspected by the Engineer, and all electrical systems work properly.

A general system “Test Burn” shall be performed with any failed luminaires being replaced, along with any other non-functioning component(s) at the Contractor’s expense. Only one test burn for the purpose of identifying initial failures will be required. Insulation testing shall also be performed, as detailed below.

1. INSULATION TESTING/”MEGGER” TEST

   On new underground conductors, fuses shall be removed from all fuse holders to not damage LED luminaire drivers during testing. Each conductor (entire length) shall have its insulation tested to ground from the control cabinet. The conductors shall have a reading of infinity at 1000Vdc impressed voltage to be accepted. If any readings do not meet the infinity requirement, the Contractor shall sequentially test each portion of the lighting circuit between termination points until the issue(s) can be identified. The issue(s) shall be mitigated by corrections or replacements including, but not limited to, tightening lugs, or replacing defective splices and conductors. Additional splices will NOT be allowed.

Testing instruments shall be accurate and reliable. It is strongly recommended that this testing be carried out after each span of cable is installed in a section of duct.

Light fixtures (LED and HPS) and existing conductors shall NOT be part of the insulation testing.

If equipment associated with the project does not operate properly or fails the tests as outlined, it is the Contractor's responsibility to determine issues and to correct and/or repair each defect at their own expense. If the Contractor does not test the new installation(s) prior to backfilling, paving, or any other surface restoration, they shall bear the expense of any excavations and/or removals required to complete repairs and testing

L. AS-BUILT INFORMATION

Upon completion of the project, the Contractor shall prepare an easily readable as-built plan and deliver one original copy to the Engineer. All changes from the original plan that were built into the project shall be noted in **red permanent ink** upon the original plans. As-built information shall be turned over along with testing results.

Any angled segments/shortcuts, bends, or any other locations where the new construction deviates from the specified plan locations, dimensions, alignments, or materials, shall be CLEARLY noted in the as-built so the City can provide accurate locating services in the future. As-built plans shall be submitted to the City within 3 weeks of the Engineer granting substantial completion of the project or for any portion of the project granted substantial completion.

M. ENERGY REBATES

The Contractor shall provide the Engineer with a copy of material invoice (pricing not necessary) for indicating proof of purchase, quantities, and complete manufacturer name/catalog number of luminaires provided on project. The City shall use this information to apply for any available rebates.

N. EXAMPLE TESTING REPORT TABLE

INSULATION AND EQUIPMENT TESTING FOR **PROJECT: _____**					**COMPANY:** _____ _____
EQUIPMENT OR CIRCUIT NAME:	TEST BY:	TEST RESULT: PASS OR FAIL	DATE TESTED:	OWNER OR ENGINEER PRESENT:	COMMENTS: