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## **PART 1 - GENERAL**

### **1.1 GENERAL**

- .1 Include in electrical section, provision of labour, new materials, tools, transportation, services and facilities for a complete electrical installation. The installation shall be left complete in all respects and ready for operation. Installation shall be deemed incomplete and final payment shall not be released until the electrical installation is completed to the complete satisfaction of the responsible Contract Administrator.
- .2 The electrical scope of work includes, but is not necessarily limited to the following provisions:
  - .1 Provision of electrical distribution including matching circuit breaker in existing pumphouse CDP, feeders, panelboard, branch circuitry and wiring, control panel and wiring including photocell control.
  - .2 Provision of lighting and associated controls, commissioned and programmed to City of Winnipeg's requirements.

### **1.2 LIGHTING DESIGN CRITERIA**

- .1 The following lighting design criteria has been used for this project. This information is provided to assist manufacturers wishing to submit equal requests for luminaires on this project.
  - .1 Lighting must meet RP22-05 Tunnel Lighting.
  - .2 Open road approach to tunnel entrances. North/South orientation. Undivided roadway, bi-directional. No pedestrian traffic allowed.
  - .3 Reflectances: Concrete road surface. (Asphalt not allowed). Wall surface: 50%, Ceiling: 50%. (Note, these values have already been derated for diesel effect and tunnel cleaning schedule)
  - .4 Light Loss Factor (LLF): All interior tunnel luminaires are assumed to have an LLF of 0.65. Exterior luminaires can be assumed to have an LLF of 0.81.
  - .5 Design speed of traffic: 70km/hr
  - .6 From Table 3 of RP22-05, South bound threshold roadway luminance for an open road is 295-cd/sm and 200-cd/sm for north bound travel for a design speed of 70 kph. No adjustments to lower the threshold recommendations are allowed per Table 2.
  - .7 Tunnel wall luminance shall be at least 1/3 of the roadway luminance for a height of 3m above the road surface.
  - .8 Uniformity: Lighted surfaces shall have an average to minimum not exceeding 2.0 and a maximum to minimum ratio of 3.5.
  - .9 Nighttime Lighting: The average maintained road luminance for nighttime is 2.5 cd / sm. The approach and exit roads shall be at least 1/3rd the tunnel roadway luminance for a distance of 1 SSSD before and after the tunnel portal. Uniformity ratios for tunnel surfaces are the same for nighttime as daytime.
  - .10 Voltage: 347V-1ph. Maximum power draw with all luminaires operating at rated wattage: 95kW.

## **1 CODES AND STANDARDS**

- .1 Do complete installation in accordance with the latest edition of CSA C22.1 as ammended by the Manitoba Building Code and the Winnipeg Electrical By-law, except where specified otherwise.
- .2 Comply with CSA Electrical Bulletins in force at time of tender submission, while not identified and specified by number in this Division, are to be considered as forming part of related CSA Part II standard.
- .3 Do overhead and underground systems in accordance with C22.3No.1-M1979 except where specified otherwise.
- .4 Do complete installation in accordance with latest Electrical Bulletins of the supply authority and local inspection authority. Comply with all additional requirements of local inspection authority.
- .5 Abbreviations for electrical terms: to CSA Z85-1963.

## **2 PERMITS, FEES**

- .1 Submit to Electrical Inspection Department, and Supply Authority necessary number of drawings and specifications for examination and approval prior to Commencement of Work.
- .2 Pay associated fees.
- .3 Contract Administrator will provide drawings at no cost.

## **3 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES**

- .1 Submit shop drawings, product data and samples as requested by Contract Administrator and as requested by City of Winnipeg.
- .2 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .3 Where applicable, include wiring, single line and schematic diagrams.
- .4 Include wiring drawings or diagrams showing interconnection with work of other Sections and Divisions.
- .5 Include shop drawings for all electrical items and equipment including wiring devices, distribution equipment, luminaires, lighting control system, etc.

## **4 OPERATION AND MAINTENANCE DATA**

- .1 Provide operation and maintenance data for incorporation into maintenance manual.
  - .2 Include in operations and maintenance data:
    - .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
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- .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists. Advertising or sales literature not acceptable.
- .3 Wiring and schematic diagrams and performance curves.
- .4 Names and addresses of local suppliers for items included in maintenance manuals.

## **5. MAINTENANCE MANURALS**

- .1 Provide 3 maintenance manuals which include local inspection authority Certificate of Inspection.
- .2 O&M manuals are to be provided in hard and soft (.pdf) formats.

## **6. CARE, OPERATION AND START-UP**

- .1 Instruct operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

## **7. VOLTAGE RATINGS**

- .1 Operating voltages: to CSA C235-1969(R1979).
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Where appliances such as stoves are supplied by other sections, advise the Contract Administrator in writing of the voltage at the outlet.

## **8. INSPECTION**

- .1 Furnish a Certificate of Inspection from Inspection Department on completion of Work.

## **9. MATERIALS AND EQUIPMENT**

- .1 Shall be new and CSA approved.
  - .2 Shall be manufactured in accordance with current CEMA, NEMA, or CSA standards.
  - .3 No lot pricing shall be allowed. Distributers submitting prices to Electrical Subcontractors shall not group products and materials.
  - .4 Request for approval of material and equipment, other than those specified on the drawings, shall be submitted in accordance with B6.
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- .5 Materials and equipment of the same classification, type of function, shall be provided by the same manufacturer.

## **10. ELECTRIC MOTORS, EQUIPMENT AND CONTROLS**

- .1 Power wiring to all equipment, motors or control panels to be performed by Electrical Subcontractor. Refer to mechanical section.
- .2 Control wiring is to be provided by the Mechanical Controls Subcontractor or Electrical Subcontractor as indicated in mechanical section of specification. Co-ordinate with mechanical section. Mechanical Subcontractor to provide wiring details.

## **11. FINISHES**

- .1 Shop finish metal enclosure surfaces by removal of rust and scale, cleaning, application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean, prime and paint exposed hangers, racks, fastenings to prevent rusting, unless equipment is constructed of galvanized steel.

## **12.0 EQUIPMENT IDENTIFICATION**

- .1 Identify electrical equipment with lamacoid nameplates with black face and white lettering sized to the approval of the Contract Administrator.
- .2 Wording on nameplates to be approved prior to manufacture.
- .3 Allow for average of twenty-five (25) letters per nameplate.
- .4 Identification to be English.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Identify all electrical equipment such as motor starters, panelboards, distributions, distribution circuit breakers with nameplates.
- .7 Identify panel and circuit number on all outlets with lamacoid nameplates.

## **13. WIRING IDENTIFICATION**

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
  - .2 Maintain phase sequence and colour coding throughout.
  - .3 Colour code: to the latest edition of CSA C22.1.
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- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 For each conductor identify at each termination and junction box, the panel and circuit number for power circuits and zone for fire alarm.

#### **14. WIRING TERMINATIONS**

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

#### **15.0 MANUFACTURERES AND CSA LABELS**

- .1 Manufacturers nameplates and CSA labels to be visible and legible after equipment is installed.

#### **16. WARNING SIGNS**

- .1 Provide warning signs, as specified or to meet requirements of inspection department and Contract Administrator.

#### **17. MOUNTING HEIGHTS**

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not indicated verify before proceeding with installation.
- .3 Confirm luminaire locations with Contract Administrator prior to rough-in.

#### **18. PROTECTION**

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage in English.
- .3 Arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician.

#### **19. LOAD BALANCE**

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
  - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
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- .3 Submit, at completion of Work, a report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

## **20. CONDUIT AND CABLE INSTALLATION**

- .1 Install conduit sleeves prior to pouring of concrete.
- .2 All raceways are to be made water and weatherproof.

## **21. TESTS/STUDIES**

- .1 Conduct and pay for tests and studies of the following:
  - .1 Power distribution system including phasing, voltage, grounding and load balancing. Co-ordination study.
  - .2 Circuits originating from branch distribution panels.
  - .3 Lighting and its control.
- .2 Furnish manufacturer's, certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturers instructions.
- .3 Carry out tests in presence of Contract Administrator. Notify Contract Administrator two days prior to testing.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Submit test results.

## **22. INSULATION RESISTANCE TESTING**

- .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
- .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
- .3 Check resistance to ground before energizing.

## **23. CO-ORDINATION OF PROTECTIVE DEVICES**

- .1 Ensure circuit protective devices such as overcurrent trips, relays, fuses, are installed to values and settings as indicated. Co-ordinate overcurrent protection short circuit interrupting capacity with utility. Ratings to the satisfaction of the Contract Administrator.
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## **24. CLEANING**

- .1 Clean all outlets, cabinets, enclosures, tubs and similar electrical equipment of all construction dust and dirt.
- .2 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.
- .3 Clean all coverplates and insure all paint is removed from wiring devices, panels, luminaires and other electrical equipment.

## **25.0 EXCAVATIONG AND BACKFILLING**

- .1 Ensure that excavation for underground electrical services is in location and at depth indicated. Electrical Subcontractor to provide and directly supervise excavation and backfilling.
- .2 All Work to be accordance with the latest eddition of CSA22.1.

## **26. GUARANTEE**

- .1 The Electrical Subcontractor shall guarantee the satisfactory operation of all Work and apparatus included and installed under this section of the specification.
- .2 Replace forthwith at no additional material, or labour cost any part which may fail or prove defective within a period of twelve (12) calender months after the final acceptance of the complete building, provided that such failure is not due to improper usage, or ordinary wear and tear.
- .3 No certificate given payment made, partial or entire use of the equipment by the The City, shall be construed as acceptance of defective work.
- .4 This general guarantee shall not act as a waiver of any specified quarantee for any greater length of time.

## **27. CUTTING AND PATCHING**

- .1 Pay all costs for cutting and patching required for the installation of electrical work.
  - .2 Assume full responsibility for laying out electrical work and for any damage caused by incorrectly located equipment or improper performance of this Work.
  - .3 Study the structural plans and co-operate with other trades so that the elevation of all outlets shall not necessitate any unnecessary cutting of construction material. If this is not done, the Electrical Subcontractor may be required by the Contract Administrator to move these outlets at no additional cost to The city (including repair).
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## **28.0 CO-OPERATION**

- .1 Schedule execution of work with associated work specified in other Divisions. Check shop drawings of other sections prior to electrical rough-in to co-ordinate physical and electrical requirements. Adjust as required.

## **29. DRAWINGS**

- .1 Carefully examine all drawings and specifications relating to the Work to be certain that the Work under this Contract can be satisfactorily carried out and prior to submission of Bid Opportunity, examine the work of the other trades and report at once to the Contract administrator, any defect, discrepancy, omission or interference affecting the Work of section or the warranty of same in accordance with B4.
- .2 The drawings accompanying these specifications are intended to show the general arrangement and extent of the Work to be done, but the exact location and arrangement of all parts shall be determined as the work progresses. The location of the outlets, equipment, etc. as given on the drawings are approximately correct but it shall be understood that they are subject to such modifications as may be found necessary or desirable at the time of installation to meet any structural, mechanical or architectural conditions. Such changes shall be made by the Electrical Subcontractor, as directed by the Contract Administrator without additional charge.
- .3 At completion of project, provide a complete print of revisions, changes and conduit location as-built drawings to the satisfaction of the responsible Contract Administrator. Provide AutoCAD .dwg files of all changes, revisions, and conduit layouts suitable for printing drawing size reproductions of electrical drawings. Contract Administrator will provide .dwg copies of original electrical drawings.

## **30.0 SPARE PARTS**

- .1 Provide the following spare parts:
  - .1 Lighting: 10% of all lamps. 5% of all lenses. 5% of all ballasts, which shall be complete with ballast trays.

## **PART 1 - GENERAL**

### **1.1 RELATED WORK**

- .1 Wire and Cable: Section 26 05 21.
- .2 Outlet Boxes: Section 26 05 32.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Connectors complete with locking bushings for armoured cable.
- .2 Aluminum "wet" type or "dry" type for aluminum sheathed cable depending on application.
- .3 Wet type connectors for sealtite flexible conduit.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Remove insulation carefully from ends of conductors and:
  - .1 Install connector in box.
  - .2 Install conductor in connector and tighten. Complete joints inside box using Marrette type connectors.

**PART 1 - GENERAL**

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- .1 Conductors: stranded for 8 AWG and larger.
- .2 Copper conductors sized as indicated with minimum size to be #12 AWG rated R90 : to CSA C22.2No.38-1977.
- .3 Emergency feeders and control wiring to be surface run mineral insulated 2 hour rated conductors - Pyrotenax or approved equal.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- .1 Install wiring as follows:
  - .1 In conduit systems in accordance with Section 26 05 21.
- .2 Install in conformance with wire manufacturers recommendations.

## PART 1 - GENERAL

## PART 2 - PRODUCTS

### 2.1 Materials

- .1 Grounding equipment to: CSA C22.2No.41 1950(R1967).
- .2 Copper grounding conductors to: ASA G7.1- 1964.

### 2.2 Equipment

- .1 Clamps for grounding of conductor, size as required to electrically conductive underground water pipe or ground rods as required by inspection authority.
- .2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, size as required.
- .3 Non-corroding accessories necessary for grounding systems, type, size, material as required, including but not necessarily limited to:
  - .1 Grounding and bonding bushings.
  - .2 Thermit welded type conductor connectors.
  - .3 Bolted type conductor connectors.
  - .4 Bonding jumpers, straps.

### 2.3 Manufacturers

- .1 Acceptable manufacturers: Burndy, Cadweld

## PART 3 - EXECUTION

### 3.1 Installation General

- .1 Install complete permanent, continuous, system and circuit, equipment, grounding systems including, electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of Contract administrator and local authority having jurisdiction over installation. Where EMT is used, run ground wire in conduit.
  - .2 Install connectors to manufacturers instructions.
  - .3 Protect exposed grounding conductors from mechanical injury.
  - .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.
  - .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
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- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install separate ground conductor, to outdoor lighting standards.

### 3.2 Electrodes

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter if available.
- .2 Install rods as required by local inspection authority. Provide all grounding as per local inspection authority requirements.

### 3.3 Tests

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract administrator and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

## **PART 1 - GENERAL**

### **1.1 SHOP DRAINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 01.

## **PART 2 - PRODUCTS**

### **2.1 SPLITTERS**

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.

### **2.2 JUNCTION AND PULL BOXES**

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Provide cast junction boxes for all exterior/weatherproof and surface installations.

## **PART 3 - EXECUTION**

### **3.1 SPLITTER INSTALLATION**

- .1 Install splitters as indicated and mount plumb, true and square to the building lines.
- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

### **3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION**

- .1 Install pull boxes in inconspicuous but accessible locations.
  - .2 Mount cabinets with top not higher than 2 m above finished floor.
  - .3 Provide pull boxes so as not to exceed 30 m of conduit run between pull boxes.
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### **3.3 IDENTIFICATION**

- .1 Install size 2 identification labels indicating system name voltage and phase in accordance with Section 26 05 01.

## **PART 1 - GENERAL**

### **1.1 RELATED WORK**

- .1 Box connectors: Section 26 05 20.

## **PART 2 - PRODUCT**

### **2.1 OUTLET AND CONDUIT BOXES GENERAL**

- .1 Size boxes in accordance with the latest edition of CSA C22.1, Section 12-3042.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Blank cover plates for boxes without wiring devices.

### **2.2 RIGID PVC OUTLET BOXES**

- .1 Rigid PVC utility boxes for outlets connected to surface-mounted PVC conduit, minimum size 102 x 54 x 48 mm.
- .2 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .3 Gasketed and water-tight for spray washing (IP66) environment.

### **2.3 FITTINGS - GENERAL**

- .1 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .2 Water-tight for spray washing (IP66) environment.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
  - .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of construction material.
  - .3 Provide correct size of openings in boxes for conduit connections. Reducing washers not allowed.
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## **PART 1 - GENERAL**

### **1.1 LOCATION OF CONDUIT**

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.

## **PART 2 - PRODUCTS**

### **2.1 CONDUITS**

- .1 Rigid pvc conduit: size as indicated; to CSAC22.2 No.136
- .2 Flexible metal conduit and liquid-tight flexible metal conduit: size as indicated; to CSAC22.2 No. 56.

### **2.2 CONDUIT FASTENINGS**

- .1 Two hole PVC straps for all conduits.
- .2 Channel type supports for multiple conduits.

### **2.3 CONDUIT FITTINGS**

- .1 Fittings manufactured for use with conduit specified.
- .2 Factory "ells" where 90° bends are required for 25 mm and larger conduits.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Install conduits in neat groupings and where they will cause minimum interference in spaces through which they pass.
  - .2 Use Rigid PVC conduit unless otherwise noted.
  - .3 Use liquidtight flexible metal conduit for connection to luminaires in tunnel.
  - .4 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
  - .5 Install polypropylene fish cord in empty conduits.
  - .6 Where conduits become blocked, remove and replace blocked section.
  - .7 Dry conduits out before installing wire.
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### **3.2 SURFACE CONDUITS**

- .1 Run parallel or perpendicular to building lines.
- .2 Group conduits wherever possible on suspended surface channels.
- .3 Do not pass conduits through structural members except as indicated.

## **PART 1 - GENERAL**

### **1.1 Related Work**

- .1 Luminaire Schedule: Section 26 50 00

### **1.2 Product Data**

- .1 Submit product data in accordance with Section 26 05 01.
- .2 Submit dimensioned drawings of lighting control system and accessories including but not limited to: relay panels, switches, DTC, photocells and other interfaces. Drawings shall indicate exact location and programming of each device. Indicate all time schedules and switch button engraving.

## **PART 2 - PRODUCTS**

### **2.1 Lighting Control System**

- .1 Lighting control system shall be digital and consist of a master LCP with up to 48 individual relays, slave LCPs (for expansion), a micro LCP with up to 4 individual relays, which can be switchable or 0-10VDC Dimmable, digital switches and digital interface cards. All system components shall connect in a "DAISY CHAIN" Style configuration and be controlled via category 5 patch cable with RJ45 connectors, providing real-time two-way communication with each system component. Analog systems are not acceptable. If indicated on the plans, lighting control system shall be able to fully integrate smartbreaker panelboards. All cables supplied by contractor.
  - .2 Relay panels shall be pre-wired, pre-assembled, pre-programmed and listed to UL916(normal). Panels shall be provided with dual voltage power supply and 16 gauge barriers to separate high and low voltage.
  - .3 Standard relays shall have normally closed (NC) contacts rated for 120/277V 20A tungsten, ballast or HID. Standard relays shall be zero-cross type. No exceptions. Optional 600v, 2-pole relay, NO or NC, and 347V single pole relay shall be available.
  - .4 Relay panel electronics shall provide current visual status and control of each relay or zone. All system control electronics shall store programming in a non-volatile memory and provide 10 year battery back up for time of day.
  - .5 Lighting control system shall consist of master and slave panel(s) controlled by a 32-channel digital time clock (DTC) that controls and programs the entire lighting control system. The DTC shall supply all time functions and accept other inputs. The DTC shall accept control locally using built in button prompts and use of an 8 line 21-letter display, from a computer, modem, ethernet or internet. All commands shall be in plain english. Help pages shall display on the DTC screen.
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- .6 All switches shall communicate via RS 485, Cat 5 patch cable with RJ45 connectors. Contact closure style switches are not acceptable. Any switch button function shall be able to be changed locally (at the DTC or a PC) or remotely, via modem, ethernet or internet. Refer to single line diagram for wiring details. Switches which cannot be programmed remotely shall not be acceptable.
- .7 Photocell, exterior (PCO) or interior (PCI), shall provide readout on the DTC screen in number values analogous to foot-candles. Each photocell shall provide a minimum of 14 trigger points. Each trigger can be programmed to control any relay or zone. Each trigger shall be set through DTC, locally or remotely. Photocells that require the use of set screws or manual adjustments at the photocell control card shall not be acceptable.
- .8 Lighting control system interfaces to include a dry contact input interface, BMS interface, dimming system interface, ethernet/internet interface and an interface to smartbreaker panel boards. Verify and install only those interfaces indicated on the plans.
- .9 Standard lighting control system software, pre-installed into the DTC, shall consist of and use standard graphical management software (GMS) pages. GMS software shall provide via local or remote PC a visual representation of each device on the bus, show real time status and the ability to change the status of any individual device, relay or zone. Optional software that accepts job specific graphics shall be available. No exceptions.

## **2.2 Manufacturers**

- .1 Lighting control system to be manufactured by Lighting Control & Design, Los Angeles, CA with local representation RD Sales Ltd.
- .2 Other manufacturers may submit equal requests in accordance with specification section 26 05 01.

## **PART 3 - EXECUTION**

### **3.1 Installation**

- .1 Install system as indicated and in accordance with manufacturer's instructions.
  - .2 Connect luminaire circuits to control panel(s) as indicated.
  - .3 Electrical Subcontractor shall contact manufacturer at least 7 days prior to final inspection. Manufacturer will remotely dial into the lighting control system, run diagnostics and confirm system programming. Electrical Subcontractor shall be available at the time of dial in to perform any corrections required by manufacturer. Electrical Subcontractor is responsible for coordinating with Contract Administrator and The City, the installation of a dedicated telephone line or a shared phone line with a/b switch. Phone jack to be mounted within 12" of master LCP. Label jack with phone number. Electrical Subcontractor shall connect phone line from jack to master LCP. No exceptions.
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### **3.2 Testing**

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Demonstrate that control systems are installed as indicated.
- .3 Demonstrate that the control systems operate as intended and that there are no problems in starting or extinguishing lamps at the intended foot-candle set-points.
- .4 Demonstrate that no interference is carried by system.

### **3.3 Warranty**

- .1 Telephone factory dial-up support shall be available at no additional cost to the Electrical Subcontractor or The City both during and after the Warranty period. Factory to preprogram the lighting control system per plans and approved submittal. The lighting control manufacturer, at no added cost, shall provide additional programming via modem as required by the Electrical Subcontractor or The City for the operational life of the system. Manufacturer warrants that the DTC software can be upgraded and monitored remotely. No exceptions.

## **PART 1 - GENERAL**

### **1.1 RELATED WORK**

- .1 Contactors: Section 26 29 01.

### **1.2 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.

## **PART 2 - PRODUCTS**

### **2.1 SWITCHES**

- .1 15 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.
- .2 Manually-operated general purpose ac switches as indicated and with following features:
  - .1 Terminal holes approved for No. 10 AWG 5 mm<sup>2</sup> wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine molding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 Ivory rocker.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 Switches of one manufacturer throughout project.
- .5 Devices to be premium specification grade.
- .6 Acceptable manufacturers: Arrow Hart, Bryant, Hubbell, Smith and Stone.

### **2.2 RECEPTACLES**

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:
    - .1 Black urea molded housing.
    - .2 Suitable for No. 10 AWG 5 mm<sup>2</sup> for back and side wiring.
    - .3 Break-off links for use as split receptacles.
    - .4 Eight back wired entrances, four side wiring screws.
    - .5 Double wipe contacts and rivetted grounding contacts.
  - .2 Other receptacles with ampacity and voltage as indicated.
  - .3 Receptacles of one manufacturer throughout project.
  - .4 Devices to be premium specification grade.
  - .5 Acceptable manufacturers: Arrow Hart, Bryant, Hubbell
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- .6 Emergency powered duplex receptacles to be red faced.

### **2.3 SPECIALTY EQUIPMENT**

- .1 Complete installation shall be to the satisfaction of the Departmental Representative.
- .2 Electrical section shall wire and connect all specialty equipment as shown and/or required so as to leave all equipment in an operating condition to the satisfaction of the Contract administrator, the local inspection authority. Any equipment that is supplied with a cord and cap and is not deemed portable by the Contract administrator, shall be direct wired at no additional subsequent cost. Electrical section shall supply and install all disconnects, magnetic starters and matching receptacles for equipment not supplied with same. Ampacity, number of conductors of cord and receptacle configuration to match nameplate rating of equipment.

### **2.4 COVER PLATES**

- .1 Provide cover plates for all wiring devices.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Stainless steel cover plates, thickness 2.5 mm for wiring devices mounted in a flush-mounted outlet box.
- .5 Weather proof double lift spring loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .6 Provide lamacoid labels rivited to cover plate with circuit and panel identification.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Switches:
  - .1 Install single throw switches with handle in "UP" position when switch closed.
  - .2 Install switches in gang type outlet box when more than one switch is required in one location.
  - .3 Mount toggle switches at height specified in Section 260501 or as indicated.
- .2 Receptacles:
  - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
  - .2 Mount receptacles at height specified in Section 260501 or as indicated.
  - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

- .3 Cover plates:
  - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
  - .2 Install suitable common cover plates where wiring devices are grouped.
  - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

## **PART 1 - GENERAL**

### **1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 01.

## **PART 2 - PRODUCTS**

### **2.1 BREAKERS GENERAL**

- .1 Bolt-on moulded case circuit breaker, quick- make, quick-break type, for manual and automatic operation.
- .2 Common-trip breakers with single handle for multipole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers, to operate only when the value of current reaches setting.
- .4 Integrated instantaneous interrupting capacity to be as required by Contract Administrator and co-ordinated with utility.
- .5 Moulded case circuit breakers: to CSA C22. No. 5 -1963.

### **2.2 THERMAL MAGNETIC BREAKERS**

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping under overload conditions and instantaneous magnetic tripping for short circuit protection.

### **2.3 MANUFACTURERS**

- .1 Acceptable manufacturers: to match distribution equipment in pumphouse.

## **PART 3 - EXECUTION**

- .1 Install circuit breakers as indicated.

## **PART 1 - GENERAL**

### **1.1 PRODUCT DATA**

- .1 Submit product data in accordance with Section 26 05 01.

## **PART 2 - PRODUCTS**

### **2.1 EQUIPMENT**

- .1 Enclosed manual air break switches in non- hazardous locations: to CSA C22.2No.4-1974.
- .2 Fuseholder assemblies to CSA C22.2No.39-1972.
- .3 Fusible and non-fusible disconnect switch in CSA Enclosure 1 .
- .4 Fusible and non-fusible disconnect switch in CSA Enclosure 3 if located on exterior of building.
- .5 Provision for padlocking.
- .6 Mechanically interlocked door to prevent opening when handle in ON position.
- .7 Fuses as required where indicated.
- .8 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.
- .9 Quick-make, quick-break action.
- .10 ON-OFF switch position indication on switch enclosure cover.

### **2.2 EQUIPMENT IDENTIFICATION**

- .1 Indicate name of load controlled on nameplate to Section 26 05 01.

### **2.3 MANUFACTURERS**

- .1 Acceptable manufacturers: to match Section 26 28 21.
-

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install disconnect switches complete with fuses as indicated.

## **PART 1 - GENERAL**

### **1.1 RELATED WORK SPECIFIED ELSEWHERE**

- .1 Breakers: Section 26 28 21.

### **1.2 PRODUCT DATA**

- .1 Submit shop drawing in accordance with Section 26 05 01.

## **PART 2 - PRODUCTS**

### **2.1 CONTACTORS**

- .1 Contactors: to CSA C22.2No.14-1973 and EEMAC No.1CS-1970.
- .2 Electrically held controlled by pilot devices as indicated and rated for 1.5x load controlled. Half size contactors not accepted.
- .3 Mount in CSA Enclosure 1 unless otherwise indicated.
- .4 Include following options in cover:
  - .1 Red indicating lamp.
  - .2 On-Off selector key switch.
- .5 Control transformer in contactor enclosure.

### **2.2 EQUIPMENT IDENTIFICATION**

- .1 Nameplate in accordance with Section 26 05 01 indicating name of load controlled as indicated.

### **2.3 MANUFACTURERS**

- .1 Acceptable manufacturers: Allen-Bradley, Group Schneider, Westinghouse
-

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- .1 Install contactors and connect auxiliary control devices as indicated.
- .2 Control voltage to be 120VAC.

## **PART 1 - GENERAL**

### **1.1 SHOP DRAWINGS AND PRODUCT DATA**

- .1 Submit shop drawings and product data in accordance with Section 26 05 01.

### **1.2 ACCESSORIES**

- .1 Provide supporting devices, integral surface mounted junction boxes and outlet boxes where required.

## **PART 2 - PRODUCTS**

### **2.1 LUMINAIRES**

- .1 Type A luminaires are to have the following provisions:
  - .1 Fixture shall be UL 595 Marine outdoor and UL 1572 40 degree C listed, and passed IP66 for Dust-tight and water jet proof construction.
  - .2 Housing shall be die cast of alloy 360.1 low copper aluminum with a minimum thickness of 3mm. The finish shall withstand a 160 inch-pound impact measured with a standard Gardner Impact Tester. It shall have passed a 1000 hour salt spray test as specified by ASTM B-117. It shall exhibit no cracking or loss of adhesion. All external hinges, fasteners and screws shall be Type 316 stainless steel or better. Luminaire mounting plate shall be 10 gauge Type 304 stainless steel.
  - .3 The fixture door shall contain all ballast components and be designed for fast removal as a complete assembly. Access to the inside of the fixture housing shall not be required. Replacement shall take less than 60 seconds.
  - .4 The reflector shall consist of high purity alloy#3002 aluminum of minimum 0.08 thick sheet. Lens shall be 4.5mm minimum thickness tempered glass. The luminaires shall provide photometric distribution as specified.
  - .5 Equal to Holophane TPF series.
- .2 Type B luminaires are to have the following provisions:
  - .1 Fixture shall be UL 595 Marine outdoor and UL 1572 40 degree C listed, and passed IP66 for Dust-tight and water jet proof construction.
  - .2 Equal to Holophane Module 600 series.

### **2.2 LAMPS**

- .1 Provide lamps as indicated.
  - .2 400W HPS lamps to be equal to GE 14675 with an initial lumen output of 54,000 lumens, and rated life of 30,000 hours. Clear, non-cycling. Lamps to operate on an ANSI S51 ballast.
-

### **2.3 BALLASTS AND ACCESSORIES**

- .1 All ballasts to be Manitoba Power Smart approved, high power factor. All ballasts to be suitable for mounting in location indicated.
- .2 Ballasts shall reliably start and operate the lamp in ambient temperatures to minus 40 degrees F and be UL listed for 40 degrees C.
- .3 Ballasts shall provide 100% wattage to the lamp and have a published ballast factor of 1.0.

### **2.4 WARRANTY**

- .1 The electrical assembly of luminaires shall be fully warranted for a period of 6 years and the housing for a period of 2 years from date of manufacture.

### **2.5 APPROVED MANUFACTURERS**

- .1 Lighting design and fixture construction is based on the specified Holophane products. Other manufacturers are welcome to submit product information for luminaires they feel are equal to those specified. Equal requests shall be in accordance with section 26 05 01. Additionally, a complete photometric analysis must be provided to the Contract administrator for review. Contract administrator will provide CAD drawings of the tunnel for this purpose. Lighting design criteria is described in section 26 00 05, which must be followed.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- .1 Locate luminaires as indicated.
- .2 Clean all construction dirt and dust from luminaires prior to project turnover.
- .3 Install lamps.

### **3.2 WIRING**

- .1 Connect luminaires to lighting circuits as indicated.
  - .2 Connect luminaires to controls as indicated.
-

### **3.3 TESTS**

- .1 Perform tests in accordance with Section 26 05 01.
- .2 Check luminaires and replace defective lamps, ballasts and accessories.