

1 GENERAL

- 1.1 The work of this section includes the provision of all design, labour, materials, equipment and services required to fabricate and install electrical controls and instrumentation as required for a complete project. The work includes, but is not necessarily limited to, the items referenced herein:
- 1.1.1 Motor Control
 - 1.1.2 Energy Management
 - 1.1.3 Load Control and Switching
 - 1.1.4 Power Quality
 - 1.1.5 Metering
- 1.2 Provide suitable systems to meet functional criteria for the facility.
- 1.3 Standards:
- 1.3.1 *[CSA C22.1.98]* - Canadian Electrical Code.
 - 1.3.2 *[ANSI/IEEE C624-86]* - Surge Voltage Withstand
 - 1.3.3 NEMA - National Electrical Manufacturers Association
- 1.4 Submittals:
- 1.4.1 Submit shop drawings for record purposes.
 - 1.4.2 Submit all test and verification reports.
- 1.5 Operations and Maintenance Manuals:
- 1.5.1 Provide maintenance details for inclusion in Operations and Maintenance Manual to Section 01730.
 - 1.5.2 Provide list of components.
 - 1.5.3 Provide copies of shop drawings.
 - 1.5.4 Provide operation and maintenance details.
 - 1.5.5 Provide list of spare parts and supplies.
 - 1.5.6 Provide list of devices address identification.
- 1.6 Commissioning:
- 1.6.1 Systems supplied shall be tested, verified and put into operation complete with all necessary training.

2 DESIGN

- 2.1 Motor Control

- 2.1.1 Motor control to be designed to suit building systems requirements and in conjunction with mechanical systems.
- 2.1.2 Local control for motors to be individual starters, grouped starters, unit constructed motor control centre.
- 2.1.3 Each unit to have HAND-OFF-AUTO control with remote capability for system, control by building management system.
- 2.2 Low Voltage Lighting Control System
 - 2.2.1 The low voltage switching system shall consist of relay panel assemblies, low voltage switches, occupancy sensors and/or photocells, as well as their associated wiring. The relay panel shall be mounted in the ceiling space of the area to be controlled and be pre-assembled by the manufacturer to contain the transformer, rectifier, the relays and the photo controller. The relay panel shall be controlled by motion sensors, photo control units and multi-level manual switches.
 - 2.2.2 All areas such as corridors and areas controlled by an independent mechanical system shall be monitored and controlled by the Building Automation System.
- 2.3 Power Quality
 - 2.3.1 Provide a complete system of power quality control to suit project requirements.
 - 2.3.2 Systems to consist of line voltage and communication surge suppression and line voltage power factor connection.
 - 2.3.3 Provide co-ordinated power surge suppression system on the incoming electrical service. Particular attention to be directed at computer, non linear loads.
 - 2.3.4 Provide an automatic power factor correction system to maintain power quality to 95%. The system shall be integrated with the building control system or stand alone to suit individual application.

3 MATERIALS

- 3.1 Low Voltage Lighting Control System
 - 3.1.1 Modular relay panels shall be ULC/CSA listed and consist of the following:
 - 3.1.1.1 Tub: empty NEMA 1 enclosure sized to accept the transformer, rectifier, relays, photo controller.
 - 3.1.1.2 Interior: bracket and circuit board backplane. Each relay be capable of direct ON/OFF control by a low voltage switch or occupancy sensor.

Relays shall be momentary-pulsed mechanically latching contactors rated at 20 A, 347 VAC. They shall attach to the interior by a single plug-in connector.

- 3.1.1.3 Power supply: transformer assembly with one 40 VA transformer with separate secondaries. Transformer includes reset and metal oxide varistor protection against powerline spikes.
- 3.1.1.4 Cover: surface with captive screws in a hinged, lockable configuration. A wiring schedule directory card shall be affixed to the cover's back to allow identification of circuits/relays/loads controlled when the door is open.
- 3.1.1.5 Photo controller shall provide independent outputs that may be connected directly to relays. The control unit has adjustable switching ranges that allow adjustment for high and low setpoints.
- 3.1.1.6 Relays: to be mechanical latching type for direct plug-in. Three wire dual coil relay to require only momentary 24 V rectified AC switch circuit pulse to open or close line voltage circuits. Coil design shall resist burnout. That could occur if equipment or operational failure energizes the relay for an extended period of time. All relays to be 20 A rated UL listed, CSA certified for tungsten filament, ballast or resistive loads.
- 3.1.2 Switches/Plates
 - 3.1.2.1 Provide specification grade standard, pilot or locator configuration momentary push-button type switches for overriding the relays.
 - 3.1.2.2 Provide matched specification grade plates.
- 3.1.3 Occupancy sensors
 - 3.1.3.1 General
 - 3.1.3.1.1 All sensors shall be directly compatible with the modular relay panels described above and shall wire directly to same without any auxiliary components or devices required above the ceiling.
 - 3.1.3.1.2 Sensors shall be specifically designed for integrated circuit design with operating frequency crystal controlled to within $\pm 0.010\%$. All ultrasonic transducers shall be protected from damage.
 - 3.1.3.1.3 Separate sensitivity and time delay adjustments shall be readily accessible to the user with LED indication of sensed movement to simplify set up.
 - 3.1.3.1.4 When the sensor detects motion, it shall trigger the ON coil of the relay. If it fails to detect motion during the user selected

time delay period, it shall pulse the relay OFF. The LED shall come ON each time the unit senses motion. However, it shall only pulse the relay ON if it had pulsed it OFF previously.

3.1.3.1.5 Unit shall provide manual override in the event of a failure and allow board replacement without removing the unit or its wiring.

3.1.3.1.6 Operation shall be silent.

3.1.3.1.7 Sensors shall be designed specifically for the size and use of the area in which they will be used as indicated below.

3.1.3.2 General Purpose Room Sensors

3.1.3.2.1 These units shall be available with either a single direction coverage pattern or a two-way pattern designed to detect the types of movement typical of an office, conference room or classroom.

3.1.3.2.2 One-way sensors shall provide 83.6 m² coverage of "1/2 step" motion and 62.2 m² coverage of "working-at-desk" motion. Multiple one-way sensors may be wired in a "Master-Slave" format to extend their area of coverage.

3.1.3.2.3 Two-way sensors shall provide 167.2 m² coverage of "1/2 step" motion and 124.9 m² coverage of "working-at-desk" motion. Multiple two-way sensors may be wired in a "Master-Slave" format to extend their area of coverage.

3.1.3.2.4 User adjustable time-delay shall be from 30 seconds to 12 minutes.

3.1.3.2.5 Shall be utilised in discrete room spaces served by dedicated HVAC system to signal BAS to start-stop equipment. Co-ordinate with owner.

3.1.3.3 Corridor and Hallway Sensors

3.1.3.3.1 These sensors shall be specifically designed for use in corridors and warehouses where walking is the predominant motion detected.

3.1.3.3.2 They shall detect motion in a corridor 4267 mm wide and 24,384 mm long with one sensor mounted 3048 mm above the floor.

3.1.3.3.3 They shall detect motion in a warehouse aisle 3048 mm wide and 18,288 mm long (walking motion) or 30,480 mm long (forklift motion) when mounted 6706 mm above the floor.

- 3.1.3.3.4 User adjustable time delay shall be from 30 seconds to 12 minutes.
- 3.1.3.3.5 Multiple sensors of this type may be wired Master/Slave to extend their area of coverage.
- 3.1.4 Photocells
 - 3.1.4.1 General: each photo control point shall consist of an architecturally compatible sensor mounted in the appropriate location for measuring the available day lighting.
 - 3.1.4.2 Control/Calibration Unit
 - 3.1.4.2.1 Control unit shall allow for either direct control of up to three separate devices. These devices can be a relay or any other device which allows control by a three-wire momentary contact.
 - 3.1.4.2.2 Control unit shall be a standard device which can work with any of the 4 possible sensor devices. The unit shall be switchable between four footcandle measurement ranges (1-10 FC, 10-100 FC, 100-1000 FC and 1000-10000 FC), depending on the sensor head and application.
 - 3.1.4.2.3 Control unit shall have separate trip points for the high and low response settings. These settings will be entered via easily readable dial switches, and will not require a separate meter or look-up table to insure a reliable footcandle setting. LEDs shall be provided to illustrate whether the sensor is below the "Low" setting, above the "High" setting or in the deadband range.
 - 3.1.4.2.4 Control unit shall allow for a momentary contact device to override all of the photocell relays to either an ON or OFF state.
 - 3.1.4.2.5 control device shall employ a 3 minute time delay between switching outputs to avoid nuisance tripping. It shall be possible to disable the time delay to aid in initial set-up and troubleshooting.
- 3.1.5 Sensor Devices: Four different sensors shall be available to match the specific application. Each sensor shall employ photodiode technology to allow a linear response to day light in its given footcandle range.
 - 3.1.5.1 For Exterior Lighting: a hooded sensor that can be horizontally mounted on a 13 mm KO or threaded conduit. Shall employ a flat lens, and work with a footcandle range between 1-10 or 10-100 in 10% increments. The

entire sensor shall be encased in optically clear epoxy resin.

- 3.1.5.2 For Indoor Lighting: A sensor with a fresnel lens providing for a 60 degree cone shaped response area shall be employed to monitor indoor office lighting levels. The sensor shall require only a 9.5 mm penetration hole in the ceiling for mounting.
- 3.1.5.3 For Atriums: Sensor shall have a translucent dome with a 180 degree field of view and respond in the range of 100-1000 footcandles. Sensor shall mounted on a 13 mm KO or threaded conduit.
- 3.1.5.4 For Skylights: sensor shall have a translucent dome with a 180 degree field of view and respond in the range of 1000-10000 footcandles. Sensor shall mount on a 13 mm KO or threaded conduit.
- 3.1.6 Low Voltage Wire
 - 3.1.6.1 All low voltage wiring shall be colour coded to match the relays, switches and sensors. It must also be UL listed a conforming to Class 2 or Class 2P wiring requirements.
 - 3.1.6.2 Switch colour codes as follows:
 - 3.1.6.2.1 Red/Black/White
 - 3.1.6.2.2 Red/Black/White/Yellow (pilot)
 - 3.1.6.2.3 Red/Black/White/Blue (locator)
 - 3.1.6.3 Remote relay colour coding: Red/Black/Blue/Yellow/Yellow
 - 3.1.6.4 Occupancy sensor or photo sensor: Red/Black/White/Blue (same as locator switch).
- 3.1.7 Approved manufacturer: *[GE]* or approved equal.

3.2 Power Quality

- 3.2.1 Surge suppressors for line voltage suppression to be
 - 3.2.1.1 Hard wired multi circuit transient voltage surge suppression device for use at service entrance, distribution panels and branch panels
 - 3.2.1.2 Unit to be all mode protection L-N, L-L normal mode; L-G, M-G common mode.
 - 3.2.1.3 Input power 50 to 420 Hz.
 - 3.2.1.4 Response time to be ≤ 1 nanosecond
 - 3.2.1.5 EMI/EFT attenuation
 - 3.2.1.5.1 up to 38 dB normal mode

- 3.2.1.5.2 up to 34 dB common mode
- 3.2.1.6 LED indicators 1 per phase normally on.
- 3.3 Metering
 - 3.3.1 Electronic metering system with capability to export information via an RS-232 and RS 485 data link to a remote PC.
 - 3.3.2 System unit to be stand alone solid state digital read and with local selector buttons to activate readouts.
 - 3.3.3 System shall be revenue grade and measurement Canada approved. Utilities to be monitored by [*Carma Industries*], energy monitor pod in parallel with existing LAN.
 - 3.3.4 System shall monitor the following:
 - 3.3.4.1 Voltage L-L, L-N
 - 3.3.4.2 Current Amps
 - 3.3.4.3 KVM
 - 3.3.4.4 kW Demand
 - 3.3.4.5 Power Factor kVAR
 - 3.3.4.6 Frequency
 - 3.3.4.7 Watt Hour Meter
 - 3.3.4.8 RMS Current
 - 3.3.4.9 Harmonic Distortion Voltage
 - 3.3.4.10 Harmonic Distortion Current
 - 3.3.4.11 K Factor.

4 INSTALLATION

- 4.1 Install recording monitoring devices in equipment as indicated.
- 4.2 Install low voltage lighting control system as per the recommendations of the manufacturer and the Electrical Safety Code.
- 4.3 Install all interconnecting wiring in EMT conduit.
- 4.4 Make all communications termination in accordance with manufacturers recommendations.
- 4.5 Test and commission all systems and provide instructions to user, put all systems into full operation.

End of Section