Standard Control System Specifications

November 2019

This document is the standard Control System Specification for use in all new construction, retrofits and upgrades in City of North Battleford facilities and shall not be amended in any way without written consent from the City of North Battleford.

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City of North Battleford Standard Specifications

The City of North Battleford Specifications are supplemental specifications for use by engineers, contractors and programmers. The specifications are to be followed as a minimum for all new construction, retrofits and upgrades to Control Systems in water and wastewater facilities owned and operated by the City of North Battleford.

1. GENERAL

.1 Should any equipment or software indicated below be no longer available it is the Contractors responsibility to provide equal or better equipment or software. The Contractor is to confirm with Owners Representative for any part number alterations and order equipment **AFTER** signed reviewed shop drawings have been issued.

2. PRODUCTS

.1 Definitions
- .1 Large Facilities: Water Plants, Wastewater Plants, or similar facilities
- .2 Medium Facilities: Reservoirs, Pump Stations, Large Lift Stations, or similar facilities
- .3 Small Facilities: Medium and smaller Lift Stations, One or Two Pump Systems, Metering Stations, or similar facilities

2.1 PROGRAMMABLE LOGIC CONTROLLERS

.1 Allen-Bradley 1756 ControlLogix System

.2 Location: Large Facilities

Item	Description	Allen-Bradley Part NO.	Qty.
1	4 to 17 Slot Mounting Rack	1756-A**XX**	As Req.
2	85-265 VAC Power Supply	1756-PA72	As Req.
3	ControlLogix 5580 Controller with 3MB of Memory	1756-L81E	As Req.
4	Ethernet Module	1756-EN2TR	As Req.
5	79-132 VAC Isolated Input 16 Pts	1756-IA16	As Req.
6	10-31 VDC Isolated Input 16 Pts	1756-IB16	As Req.
7	74 – 265 VAC Output 16 Pts	1756-OA16	As Req.
8	Analog Input - Current/Voltage 16 Pts	1756-IF16	As Req.

9	Analog Input HART - Current/Voltage 8 Pts	1756-IF8H – To be used for connection to all HART enabled flowmeters	As Req.
10	Analog Output Module, 8 Isolated Points, Current and Voltage	1756-OF8I	As Req.
11	I/O module screw connector	1756-TBCH 1756-TBNH	As Req.

.2 Allen-Bradley 5069 CompactLogix 5380 System

.2 Location: Medium and Small Facilities.

Item	Description	Allen-Bradley Part NO.	Qty.
1	CompactLogix 5380 Controller With 1 Mbytes Memory	5069-L310ER	As Req.
2	Ethernet Module	5069-AEN2TR	As Req.
3	85-132 VAC Isolated Input 16 Pts	5069-IA16	As Req.
4	19-30 VDC Isolated Input 16 Pts	5069-IB16	As Req.
5	74 – 265 VAC Output 16 Pts	5069-OA16	As Req.
6	Analog Input - Current/Voltage 8 Pts	5069-IF8	As Req.
7	Analog Output Module, 8 Isolated Points, Current and Voltage	5069-OF8	As Req.
8	I/O module screw connector	5069-RTB18-SCREW 5069-RTB64-SCREW	As Req.

2.2 ETHERNET DATA SWITCHES

.1 Unmanaged Ethernet Switch

.1 Manufacturer: MOXA

.2 Part Number: EDS-308-MM-ST-T

.3 Ports: 6 RJ45 – with minimum 25% spare ports available 2 – FX Port ST Connector

.4 Data Rate: 100Base-TX

.5 Input Voltage: 9.6 to 60 VDC

.6 Storage Temperature: -40ºC - 85ºC

.7 Operating Temperature: -40ºC - 75ºC

.8 Rating: IP 30

.9 Plug-in Connector: Copper RJ45, shielded and ST for fiber

.10 Mounting: DIN-rail mounting

.11 SNMP Support

.2 Layer 2 Managed Ethernet Switch
- .1 Manufacturer: MOXA
- .2 Part Number: EDS-508A-MM-ST-T
- .3 Ports: 6 RJ45 – with minimum 25% spare ports available 2 – FX Port ST Connector
- .4 Data Rate: 100Base-TX
- .5 Input Voltage: 9.6 to 60 VDC
- .6 Storage Temperature: -40ºC - 85ºC
- .7 Operating Temperature: -40ºC - 75ºC
- .8 Rating: IP 30
- .9 Plug-in Connector: Copper RJ45, shielded and ST for fiber
- .10 Mounting: DIN-rail mounting
- .11 SNMP Support

2.3 ANCILIARY HARDWARE & SOFTWARE

Item	Description	Part #	Quantity
1	Rockwell Software Studio 5000 Standard Edition	9324-RLD300ENE	1
2	VTSCADA for Local Panel	Runtime License. I/O count to be confirmed on a project to project basis. Minimum 1000 tag license.	As Req.
3	VTSCADA for Main SCADA Hubs	Dual Server Premium I/O count to be confirmed during project engineering.	As Req.
4	Synology 2-Bay NAS c/w 2 6TB HDDs for Large Stations	Part Numbers to be confirmed with City of North Battleford at time of order.	1 per Large Station
5	Barnette Engineering Hardware Auto Dialer (backup to SCADA auto dialer)	Protalk CV3 c/w all required accessories where cellular connection is required Protalk Plus c/w all required accessories where PSTN is available	1 per station

2.4 CENTRAL SCADA SERVERS:

.1 Location
- .1 Large Control Systems
- .2 Minimum Specifications as follows

Item	Description	Computer Equipment
1	Base System	-HP ProDesk – Latest Gen Intel Core i7 (8C, 3.0GHz, 12MB Cache)
2	Memory	-16GB, DDR4, (2 x 8 GB UDIMMs)
3	Keyboard	-HP USB Keyboard
4	Monitor	-HP 27" Monitor

5	Mouse	-HP Optical USB Mouse
6	Video	-Integrated
7	Speakers	- HP Soundbar
8	Hard Drives	-Boot Hard Drive: 2.5" 512GB SATA Class 20 SSD -2nd Hard Drive: 2.5" 512GB SATA Class 20 SSD -Hard Drive RAID: Hardware RAID 1
9	Raid Controller	- Integrated RAID Controller
10	Operating System	- Windows 10 Pro 64 Bit
11	Software	- Acronis Backup Workstation Perpetual License - City to install Microsoft Office
12	Network Interface Card	- Integrated PCIE 10/100/1000
13	Documentation	Full English Documentation
14	Warranty	-5 Year Next Business Day On-Site

2.5 REMOTE SCADA COMPUTERS (PANEL MOUNTED):

.1 Location
- .1 Medium Control Station (as required, in lieu of HMI)
- .2 Minimum Specifications as follows

Item	Description	Computer Equipment
1	Base System	-HP ProDesk Mini – Latest Gen Intel Core i5 (4C, 3.0 GHz)
2	Memory	-16GB, DDR4, (2 x 8 GB UDIMMs)
3	Keyboard	-HP USB Keyboard
4	Touch Screen Monitor	-ELO Touch Systems 21.5" Commercial Grade Touch Screen 16:9, 1920x1080 -TouchPro PCAP c/w bezel kit, power supply, DP Cable
5	Video	Integrated Graphics
6	Hard Drives	-Boot Hard Drive: 256GB, PCIe Class 40 Solid State Hard Drive
7	Operating System	-Windows 10 Pro 64 Bit
8	Software	- Not Required (City to install Microsoft Office)

9	Mouse	-HP Optical USB Mouse
10	Network Interface Card	-Integrated PCIE 10/100/1000
11	Mount	HP Desktop Mini Security/Dual VESA Sleeve
12	Documentation	Full English Documentation
13	Warranty	-5 Year Next Business Day On-Site

2.6 HUMAN MACHINE INTERFACE

.1 Location
.1 Small Station
.2 Minimum Specifications as follows

RedLion CR300

.1 Manufacturer: RedLion
.2 Model: CR30001500000420
.3 Display Resolution: 1024x768 pixels SVGA
.4 Software: Crimson 3.1 Software
.5 Input Voltage: 10 – 230 VDC
.6 Connections2 10/100 Ethernet ports, 2 RS-232 serial ports, 2 USB host ports, 1 RS-232 / RS-485 serial port, 1 USB port for upload/download
.7 Operating Temperature: -10ºC - 50ºC
.8 Mounting: Flush Mount

2.7 STANDARD DEVICE INPUTS AND OUTPUTS

.1 All devices installed shall have the following inputs and outputs available to be connected to the PLC

.1 Motor Starters
.1 Run Status – Discrete Input
.2 Run Command – Discrete Output
.3 HOA Auto Status – Discrete Input
.4 Motor Alarm – Discrete Input

.2 VFD
.1 Speed Feedback – Analog Input 4-20mA
.2 Speed Command – Analog Output 4-20mA

.3 Two Position Valves
.1 Open Status – Discrete Input
.2 Closed Status – Discrete Input
.3 Open/Close Command – Discrete Output

.3 Modulating Valves
.1 Closed Status – Discrete Input
.2 Position Feedback – Analog Input 4-20mA
.3 Position Command – Analog Output 4-20mA

.4 Chemical Pumps
  .1 Fault Status – Discrete Input
  .2 Speed Feedback – Analog Input 4-20mA
  .3 Speed Command – Analog Output 4-20mA
.5 Analog Instruments
  .1 Scaled Value – Analog Input 4-20mA
  .2 Flow Total (flowmeters only) – Discrete Input (Pulse) & HART Signal
.6 Digital Instruments
  .1 Status - Discrete Input

3. EXECUTION

3.1 DESIGN

.1 Prior to commencing design activities these standards shall be reviewed and discussed with the Owner to determine if upgrades or adjustments are warranted based on life-cycle considerations of equipment or other external factors. Wherever possible, the equipment and standards listed herein should form the basis of design for new industrial control systems.

.2 Where radio communications systems are utilized, a detailed path study will be completed to determine the best applicable technology for the application (400 MHz vs. 900 MHz). Where path study indicates that a marginal radio link may work, on-site testing shall be completed to prove operation of the radio link prior to design finalization. Radio communications systems will maintain compatibility with the existing ethernet radio system connecting the various water and wastewater sites within the City to the central communications hub at the water tower. All radios shall support SNMP protocol and provide the following data:
  .1 Voltage
  .2 Temperature
  .3 Received Signal Strength (RSSI)

.3 All bus communications networks (Level 0 – Instrument Bus Network) shall be designed to be separate from Level 1 / 2 (Controller / Supervisory) networks and shall utilize Ethernet media and Ethernet/IP protocols. The preferred protocol throughout the control system is Ethernet/IP; however alternative protocols will be allowed for OEM equipment which is connected directly to the Supervisory LAN.

.4 Communications from the Controller LAN to the Supervisory LAN shall be direct and shall avoid the use of protocol converters, gateways and data concentrators. Controller to controller communications shall be implemented for all process control functions. To the greatest extent possible, transmitted data which affects process control shall not relay on computer based software systems or internet services providers.

.5 Network designs shall conform to industry best practices and standards for Industrial Control Systems. All network designs must be provided to the Owner for review and comment prior to design finalization.

.6 Control system designer shall work with process system designer to develop a detailed control philosophy for the proposed system. The control philosophy shall detail all control functions, setpoints, setpoint ranges, alarm setpoints, alarm delays and other details required for the programmer to complete the system integration. The control philosophy shall be updated throughout construction and provided as a record document at the outset of the project.

3.2 INSTALLATION

.1 Programmer is responsible for programming and commissioning of all PLC equipment, PLC communication equipment, HMI equipment, PC equipment, SCADA Software and Operator interfaces using conventions as listed in this document, as well as pre-defined Add-On Instructions (AOI) provided by the City at time of construction.

.2 Programmer shall supply all required software, cabling and ancillary devices to complete the programming of the PLC, HMI and SCADA system.

.3 The Programmer shall utilize the City's programming standards in development of the PLC, HMI & SCADA applications. Wherever possible, existing standards will be re-used. In development of new standards, or utilization of existing standards, the PLC, HMI and SCADA programming specifications shall be followed.

3.3 PLC PROGRAMMING

.1 Programmer is responsible for programming the PLC and SCADA system components. All PLC programs will be completed based on Programmer developed control philosophies which are to be reviewed with the City prior to construction.

.2 Programmer shall use existing, previously developed, AOI blocks that are used in existing locations throughout the City. AOI blocks will be made available to the Programmer upon request following award of the contract. The details and functions of the AOI blocks is outlined in subsequent paragraphs.

.2 PLC program will be developed in Ladder Logic format. Programs will be structured into one program task, defined as a continuous task. The program task will contain three programs: MainProgram, IO and Processes.

.3 The MainProgram program will contain all routines required for functions which are not explicitly related to process operations. This will include global alarm resets, clock routines and communications messaging.

.4 The IO program will contain routines for IO mapping of all input and output points. The programmer will assign IO points to respective tags in these routines only. Aliasing will be not be accepted for IO assignment and direct IO tags shall not be utilized in other areas of Ladder Logic.

.5 The Process program will contain routines required to achieve the process control philosophy. Routines shall be named according to the process area and will follow conventions defined in the control philosophy.

.6 Programs will be developed using Add-On-Instruction and corresponding data types for the following equipment types (minimum):

.1 Analog Devices
.2 Discrete Devices
.3 Fixed Speed Motors
.4 Variable Speed Motors
.5 Chemical Pumps
.6 Two Position Valves
.7 Modulating Valves
.8 Flow Totalizers
.9 IO Module Monitoring

.7 Add-On-Instructions will be constructed to achieve the requirements of the blocks and will follow industry best practices for naming of devices and attributes, as defined in ANSI/ISA-5.1-2009. All data type members will include a full description illustrating the function of the point. Nesting data types within each other is acceptable and recommended to reduce the number of unique types defined within the application. Logic contained within Add-On-Instructions is to be completed in Ladder-Logic format. Logic is to be fully commented with rung-comments on each line fully explaining the function of the ladder contained there-in and it relation to the overall operation of the instruction. Instructions must be provided without password protection and must allow the Owner to edit each instruction if required.

.8 Each analog instruction will include five alarms: High High, High, Low, Low Low and Out of Range. From the SCADA system, operation staff will have full control to change analog scaling parameters, enable / disable alarms, change setpoints and alarm delays for each individual alarm.

.9 Each motor instruction will include alarms for: Out of Auto, Fail to Run and Overload. From the SCADA system, operation staff will have full control to enable / disable alarms, change setpoints and alarm delays for each individual alarm. Operations staff will be able to place each motor in “Soft Auto” mode allowing the motor to start while bypassing all software interlocks.

.10 Each chemical pump instruction will include alarms for: Out of Auto, Fail to Run and Overload. From the SCADA system, operation staff will have full control to enable / disable alarms, change dosage calculation setpoints and alarm delays for each individual alarm. Operations staff will be able to place each motor in “Soft Auto” mode allowing the pump to start while bypassing all software interlocks.

.11 Each valve instruction will include alarms for: Fail to Open and Fail to Close. From the SCADA system, operation staff will have full control to enable / disable alarms, change setpoints and alarm delays for each individual alarm. Operations staff will be able to place each value in “Soft Auto” mode allowing the valve to operate while bypassing all software interlocks.

.12 Flow totalizer instruction will allow for counting of discrete "pulses" from flow totalizers and / or integration of an analog signal over time into a flow total. The flow totalizer instruction should include a running total, daily total, monthly total and a history of daily totals for the previous thirty-five days.

.13 Throughout the PLC programming metric units shall be utilized for all scaled variables. Setpoints for process variables shall utilize metric units. Setpoints for time delays shall be in seconds. Where non-metric values are requested by the City, these shall be displayed as a secondary variable, calculated from the metric variable.

.14 All PLC programming shall be warrantied for a period of 2 years following project completion.

3.4 SCADA PROGRAMMING

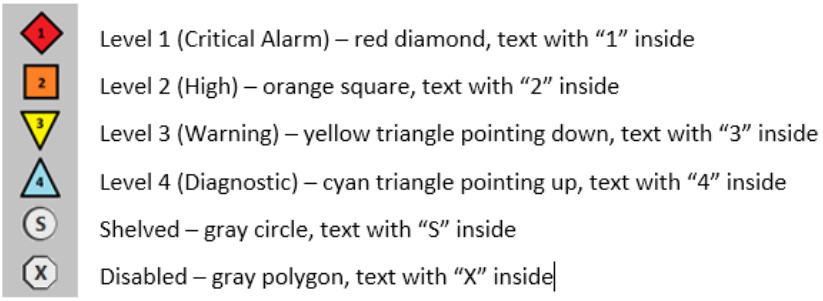
.1 All PLC AOI's shall be accompanied by a corresponding SCADA tag type and graphic widgets.

.2 SCADA Tag Types will be created to mimic the data structure of each associated PLC AOI. Tag Types will utilize parameter expressions to build all IO references upon creation of the tag. Tag Types will require entry of only the Tag Name and description in order to construct a full tag structure corresponding to the PLC AOI. All tag types will be editable on a global basis, allowing changes to be made to a template tag and inherited by all derived tags.

.3 SCADA graphics will be based on industry standard 'High Performance HMI' techniques. All objects in a normal condition on the SCADA screen will be either formed out of grey scale or unsaturated colours. Highly saturated colours will be used only to represent irregular states that require immediate operator attention, such as warnings and alarms, as shown in the figure below:

COLOUR	DESCRIPTION	DESIGNATION
(250, 250, 250)	Gray *(White)*	Equipment running / open
(230, 230, 230)	Gray *(Gainesboro)*	Screen background
(83, 83, 83)	Gray *(Mortar)*	Equipment stopped / closed
(10, 10, 10)	Gray *(Black)*	Equipment outline, equipment labels (text colour)
(172, 229, 229)	Blue *(Powder Blue)*	Valid level range
(88, 134, 177)	Blue *(Air Force Blue)*	Level, or process indication (water)
(78, 122, 106)	Green *(Breaker Bay)*	Level or value indication (non-water)
(0, 64, 128)	Blue *(Smalt)*	Status indication (primary text colour)
(0, 64, 0)	Green *(British Racing Green)*	Status indication (secondary text colour)
(0, 255, 255)	Cyan	Alarm Level 4 – Diagnostic
(255, 255, 0)	Yellow	Alarm Level 3 - Warning
(255, 165, 0)	Orange	Alarm Level 2 - Caution
(255, 0, 0)	Red	Alarm Level 1 – Critical

.4 Alarms will be assigned to one of four priority levels. Each priority level is defined below along with a description of the standard icon used for representing the alarm priority. All graphics objects shall incorporate a globally defined alarm indicator which is adjustable by the Owner.



.5 Analog graphics shall utilize an instrument symbol and a bar graph display to present relevant information. Both graphics shall incorporate indication if an alarm condition is reached. Bar graphs shall be scaled to the range of the instrument, display the current value and provide indication of all alarm limits configured for the device. All analog displays shall use metric units. Where alternate units are requested, they shall be displayed as a secondary reading to the metric units.

.6 "Sparkline" graphs (analog bar graph with short term trend incorporated) will be utilized in lieu of tank or well levels. The "sparkline" graph will incorporate the same features as the analog bar graph and will include a trend display. The duration of the trend display shall be adjustable on a per-trend basis, but generally should represent the same duration throughout the application.

.7 The Programmer will develop all SCADA tag types and Graphics widgets and will present to the Owner for review prior to commencing programming of each SCADA system.

.8 The SCADA system will be a distributed system wherein the SCADA computers will serve as redundant backups to each other. Remote computers will run the same application as the central computers and will utilize Tag and Alarm area filtering to limit the tags running on the local machine to the local workstation. Tag and Alarm area filtering will limit the application on the remote computers to starting only the local tags and displaying only the local alarms.

.9 Where remote computers are installed, IO Drivers, and Historian components will run on each remote SCADA system computer and will fail over to the central computer in the event of a computer failure at a remote station.

.10 The SCADA platform shall be configured with Role-Based security. Each tag will be assigned to a specific security attribute. Roles will be created and attributes will be associated with roles. Users will be created and assigned roles. If required, individual users may be assigned security attributes outside of their defined role. The platform will be configured to enforce secure password conventions, with a minimum requirement of twelve characters including one number.

.11 The central SCADA workstations will be configured to allow access, via VPN tunnel, to users utilizing either the VTSCADA Internet Client or VTSCADA Anywhere Client. The SCADA application shall not be directly accessible from the internet. Furthermore, the SCADA computers shall not have direct access to the internet. Only required protocols and ports shall be allowed through the configured firewalls.

.12 The SCADA system will include an automated reporting system. The reporting system will extract data from the SCADA historical records at no less than five minute intervals and tabulate data into daily, monthly, quarterly and annual formats. The reporting system will utilize a spreadsheet program to present reports to operators. Data to be reported includes all analog level, flow, pressure and analytical readings as well as equipment indicators such as pump runtimes and number of starts. Data analysis will include daily minimum, maximum and average readings, daily totalizer readings, peak-hourly-flow values and CT calculations. Additional reporting parameters may be requested by the District, depending on the nature of the facility.

.13 Radios shall be integrated with the SCADA system using SNMP. The following data shall be collected complete with alarms for out of range values:

.1 Voltage
.2 Temperature
.3 Received Signal Strength (RSSI)

.14 All SCADA programming shall be warrantied for a period of 2 years following project completion.

3.5 HMI PROGRAMMING

.1 Local HMIs will replicate the screens created in SCADA for that specific area. The layout, colours, alarm handling, security and other specifications detailed in the SCADA programming section shall be followed for the HMI.

.2 All HMI programming shall be warrantied for a period of 2 years following project completion.

3.6 PROGRAMMING REVIEW

.1 The Programmer will host a 50% PLC / HMI / SCADA design review meeting with the Owner and Engineer to allow for review and comment on PLC, HMI and SCADA programs for each facility.

4. CONTROL PANEL CONSTRUCTION

4.1 GENERAL

.1 Provide only CSA approved materials and meet all applicable industry standards and codes. Panels to be constructed in a CSA approved shop.

.2 Control panels shall be field marked to warn qualified persons of potential electric arc flash hazards. the marking should be located so as to be clearly visible to qualified persons before examination, adjustment, servicing or maintenance of the equipment. All components used interior to the control panel to be "touch safe" to person or persons opening the control panel while energized.

.3 All control panel wiring to be "touch safe" as per ip20 standards. This rating assures that a probe approximately the size of a finger is not able to make contact with any hazardous or energized parts.

.4 Clearly indicate on the door of the control panel if there is more than one voltage source within the panel.

.5 Shop Drawings

.1 Contractor to provide shop drawings for all equipment in this specification.

.2 Contractor to provide detailed and dimensioned control panel layout drawings prior to construction.

4.2 CONSTRUCTION

.1 Provide only CSA approved materials and meet all applicable industry standards and codes.

.2 Control panel shall be a NEMA enclosure c/w back panel or similar alternate.

.1 Finish: gray polyester powder paint inside and out.

.2 Construction: code gauge steel

.3 Rating: NEMA/EEMAC Type 12

.4 Oil resistant gasket

.5 3-point latch mechanism with oil tight keylock handle

.6 Heavy-gauge continuous hinge for door.

.7 Back mounting pan

.8 Side mounting pan (where shown on drawings)

.9 Complete with interior light and door switch

.3 Terminals

.1 All terminals to be from same manufacturer

.2 Provide and install in control panel 10% spare terminals of each type used.

.3 Unfused terminals to be CSA approved for 600 V, 10A, accepting No.12- No.18 wire. Terminals to be one of:

.1 Wieland WK4/U

.2 Weidmuller SAK4

.3 Phoenix Contact UT 4

.4 Fused terminals to be CSA approved for 300 V, 10A, with blown-fuse indicator operating on 120 VAC, accepting No.10 - No.14 wires, and either 5x20 mm fuses or 1/4" x 1.4" fuses, or both. Terminals to be one of:

.1 Weidmuller ASK-1

.2 Wieland WK4/THSI6GL250U

.3 Phoenix CONTACT P-FU 6,3X32 LA 250 WITH UT 6-TG

.5 Grounding terminals to be CSA approved for 300V, 15A, accepting No.14 wires, grounding to the rail, colored green & yellow. Terminals to be one of:
  .1 Weidmuller SAK2.5
  .2 Wieland WK4SL
  .3 Phoenix Contact UT 4-PE
.6 Shorting bars to be used for jumpering. Wire jumpers are not acceptable.
.7 Terminals to be colored as shown:
  Ground - green & yellow
  120V line - black
  120V neutral - white
  24V DC - blue, red
.8 All terminals to be din rail mounted

.4 Labeling
  .1 Each terminal to be labeled with snap on plastic tags, Wieland type 9705, Weidmuller type FW or FS, Phoenix Contact UC-TM or, machine-printed.
  .2 All panel-mounted devices to be labelled by means of engraved lamacoid labels, white lettering on black.
  .3 Write on labels are not acceptable.

.5 Control Relays
  .1 Control relays to be installed in socket, with built-in LED or neon operation indicator, push-to-operate button, coil voltage as required, CSA approved.
  .2 Contacts to switch 5A 120/240VAC inductive or resistive.
  .3 Operating times to be 20 ms max for AC coil, 30 ms max for DC coil
  .4 Life expectancy to be 100,000 operations @ 5A 120/240V AC
  .5 Relays shall have varistor protection for AC coil, and diode protection for DC coil
  .6 Relays to be:
    .1 Allen-Bradley/Rockwell Automation 700-32 TYPE
    .2 OMRON MK2PIN series
    .3 Phoenix Contact PR2-RSC3 Series
    .4 Weidmuller Rider series

.6 Time-Delay Relays
  .1 Time-delay relays to be installed in socket, with manually-adjustable timing via knob with dial, output status light, operating voltage as required, on-delay or off-delay time as indicated, CSA approved
  .2 Contacts to switch 5A 120/240V AC inductive or resistive
  .3 Life expectancy to be 100 000 Operations @ 2A 120/240V AC
  .4 All relays to be OMRON type h3bh, h3g, h3ca, or h3cr or approved alternative

.7 Pilot Lights
  .1 Water and dust-proof with internal gasket, jeweled lens, color as shown on drawings, led bulb, voltage 120VAC, push to test
  .2 Lights to be one of following:
    .1 Allen-Bradley 800T
    .2 Siemens Class 52

.8 Push Buttons
  .1 Water and dust-proof with internal gasket, flush head, contacts rated 5A 20/240 VAC, accepting AWG 18-12 wires, removable contact blocks
  .2 Push buttons to be one of following:
    .1 Allen-Bradley 800T
    .2 Siemens Class 52

.9 Selector Switches
- .1 Manual selector switches to be water and dust-proof with internal gasket, standard black lever actuator, maintained position unless indicated, contacts rated 5A 120/240 VAC, accepting AWG 18-12 wires, removable contact blocks.
- .2 Selector switches to be one of following:
  - .1 Allen-Bradley 800T
  - .2 Siemens Class 52

.10 Wire Ducts
- .1 Use Panduit or equivalent plastic type.
- .2 Wiring not installed in wire ducts are to be neatly bundled and secured with wrap around spiral banding, secured with cable ties and mounting bases.
- .3 Minimum width of 50mm in control panels

.11 24 VDC DC Power Supplies
- .1 Power supply with 24 VDC 10A output for PLC I/O to include over-voltage shutdown, 120VAC input, and CSA approval.
- .2 Output voltage to be adjustable 10% via screwdriver.
- .3 Power supplies to be one of the following:
  - .1 Allen-Bradley
  - .2 OMRON
  - .3 Phoenix Contact Quint Series
  - .4 Weidmuller

.12 Uninterruptible Power Supply
- .1 UPS to be of the "dual online conversion" type, with 120VAC input and 120VAC sine-wave output, light to indicate output active, light to indicate whether unit is operating from battery or 120VAC input, and output switch.
- .2 UPS to be CSA approved
- .3 UPS units to come complete with external battery fail and low battery external contact relay card module. Contacts are to be 5A 120/240VAC inductive or resistive.
- .4 Provide and install manufacturer recommend breaker in local electrical panel
- .5 UPS to include hot swap maintenance bypass (MBP) option
- .6 Acceptable Manufacturers: Eaton

END OF SECTION