CITY OF DAYTONA BEACH

UTILITIES DEPARTMENT

SCADA SYSTEM STANDARDS MANUAL

2024-2025

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THE CITY OF DAYTONA BEACH
UTILITIES DEPARTMENT
125 BASIN ST., STE. 100
DAYTONA BEACH, FL 32114

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ACRONYMS & ABBREVIATIONS

AOI	Add-On Instructions
BPWRF	Bethune Point WRF
CIP	Common Industrial Protocol
CPU	Central Processing Unit
CSV	Comma-Separated Values
DPI	Dots Per Inch
Gb	Gigabit
HART	Highway Addressable Remote Transducer
HMI	Human-Machine Interface
I/O	Input/Output
IOS	Internetwork Operating System
LAN	Local Area Network
MB	Megabyte
ODBC	Open Database Connectivity
OIT	Operator Interface terminal
OS	Operating System
PLC	Programmable Logic Controller
RBWTP	Ralph E. Brennan WTP
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SSD	Solid State Drive
UPS	Uninterruptible Power Supply
VAC	Voltage–Alternating Current
VDC	Voltage–Direct Current
VFD	Variable Frequency Drive
WAN	Wide Area Network
WRF	Water Reclamation Facility
WRWRF	Westside Regional WRF
ISA	International Society of Automation
IEC	International Electrotechnical Commission
NIST	National Institute of Standards and Technology
ODVA	Open DeviceNet Vendors Association (EtherNet/IP)
COTS	Commercial-Off-the-Shelf
IEEE	Institute of Electrical and Electronic Engineers
ISO	International Organization for Standardization

1 INTRODUCTION

The City of Daytona Beach (City) owns and operates two water reclamation facilities (WRFs), one water treatment plant (WTP), and a system of wastewater lift stations, raw water wells, and stormwater pumping stations throughout their service area. These facilities and remote sites include supervisory control and data acquisition (SCADA) equipment – both hardware and software – to monitor and control the processes, provide critical visibility to the systems for proper control, and notify operators of alarm conditions. The SCADA system is critical to the operation of these facilities which provide the City's drinking water and protect the environment by treating the City's wastewater. To increase the effectiveness of the SCADA system, the City the components of the SCADA system – hardware, software, communications, methodology, etc. – should be standardized. This will reduce spare parts, maintain current technology, optimize operation, improve understanding of information presentation, and increase the availability of useful data.

The standards outlined in this document outline the minimum requirements for hardware and software components to the SCADA system that should be implemented consistently. They should be reviewed on a regular basis to address changes in operations, expanded equipment capabilities, and obsolete hardware and software.

2 HARDWARE STANDARDS

2.1 Programmable Logic Controllers (PLCs)

Standardizing PLC hardware benefits the City by reducing needed inventory, increasing equipment familiarity, and reducing configuration efforts. By establishing Allen-Bradley ControlLogix and CompactLogix PLCs as City standards, all programming and configuration can be completed with Studio 5000 software.

All non-standard and obsolete PLCs installed on the City's SCADA network should be identified for phased replacement over the next five years.

The minimum firmware level for installed PLC central processing units (CPUs) shall be 32.02.01 (matching programming software requirements). As Allen-Bradley updates firmware for new features and to enhance security, the City should evaluate these changes to see if updating the firmware level is warranted.

2.1.1 ControlLogix

The primary PLC to be used for all City installations shall be the ControlLogix Logix5580E Series. The Logix5580E performs 5 to 20 times faster than its predecessor and has memory options up to 40 MB. The chassis-based system can accommodate up to 17 modules and can handle up to 128,000 digital or 4,000 analog I/O points. This PLC family includes a 1 Gb embedded Ethernet port, controller-based change detection and logging, digitally-signed controller firmware, and role-based access control for extra security. Bulletin 1756 ControlLogix chassis-based I/O modules shall be used.

Figure 1 - ControlLogix Logix5580E Series CPU

2.1.2 CompactLogix

Recognizing that the capabilities of a ControlLogix PLC are not always needed for some applications, the secondary PLC to be used for the City SCADA system is the CompactLogix™ 5380 L3 Series. These controllers are well suited for remote sites, vendor-provided equipment, and specific function applications. Like the ControlLogix, this PLC family includes an embedded 1 Gb Ethernet port. They also feature dual configurable ports that support dual-IP addresses, memory options up to 10 MB, provide enhanced diagnostics and troubleshooting with a controller status and fault display, offer controller functions optimized for maximum system performance, and offer enhanced security features that include controller-based change detection, logging, encrypted firmware and role-based access control to routines and Add-On Instructions. Bulletin 5069 Compact I/O modules shall be used. This controller can support up to 31 local Compact 5000™ I/O modules.

Figure 2 - CompactLogix 5380 L3 Series CPU

2.1.3 I/O Modules

I/O modules for the respective PLCs shall be selected based on the input or output type and data requirements.

For discrete inputs and outputs, 24 VDC modules are preferred. If 120 VAC inputs/outputs are required (e.g., from equipment status outputs or to operate solenoid valves), they shall be received/driven through control relays.

For analog inputs and outputs, isolated units shall be provided. Analog modules shall also be HART-compatible.

2.2 Network Switches

The means of connecting and managing these PLC network connections require quality network switching to direct traffic data. The City currently has a variety of switches installed, managed and unmanaged, with a variety of different manufacturers. Future improvements and expansions shall use managed Allen-Bradley Stratix Industrial Ethernet Switches as standard. Reasons for this include:

Figure 3 - Stratix Industrial Ethernet Switch

- By staying within the Allen-Bradley family, the standard Allen-Bradley PLC programming software – Rockwell Automation's Studio 5000 – recognizes these switches and allows them to be configured within that software package.
- The Stratix switch was developed by Allen-Bradley in conjunction with Cisco and is configurable using Cisco IOS command sets.
- The Stratix switch includes optimization for EtherNet/IP networks and recognized components.

The use of Stratix managed switches provides well-integrated, secure connections that can also be monitored as part of the SCADA system. Switch must be an active model Example: 5800 Stratix.

2.3 Uninterruptible Power Supplies (UPSs)

To ensure continued network operations during brief electrical power outages, Phoenix Contact UPSs (Phoenix Contact DC UPS -EtherNet/IP) shall be installed with all PLCs. These UPSs have an Ethernet card that shall also be connected to the SCADA network, allowing the condition and status of the UPS to be monitored over the network.

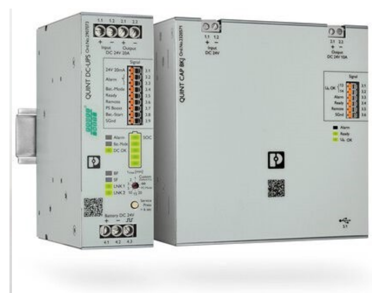


Figure 4- **DC UPS modules with integrated capacity**

UPSs shall be sized to run the PLC and associated equipment and instrumentation for a minimum of 5 minutes, after which time the facility should be transitioned to emergency power.

2.4 Operator Interface Terminals (OITs)

OITs allow operators to view and adjust the treatment process while away from the main control room. As the City transitions to Trihedral VTScada as the SCADA software, there is an opportunity to have the OITs match the control room application. OITs shall be Phoenix Contact Industrial PCs using VTScada as a thin-client. Resolution shall match the desktop monitors – HD 1080P, 1920 x 1080, 16:9 ratio.

2.5 Fiber Optic Cable (Appendix B: Fiber Specs & Service Loop Specs)

As network speeds increased and manufacturing means improved over the past 30 years, so have fiber optic cable standards. Both 62.5/125 μm (designated OM1) and 50/125 μm (OM2) multi-mode fiber optic cables have been used extensively at numerous facilities, including at many City properties. To provide capacity for future capabilities and growth of the SCADA system (such as the ability to expand to Gigabit Ethernet and higher), multi-mode 50/125 μm (OM3), 12-fiber cable with an aqua jacket shall be used for all future on-premise SCADA system networking. The 12-fiber optic cable used for the City's SCADA system shall align with ANSI/EIA/TIA-598 standards, outlined below:

Fiber No.	Color	Abbreviation
1	Blue	BL
2	Orange	OR
3	Green	GR
4	Brown	BR
5	Slate	SL
6	White	WH
7	Red	RD
8	Black	BK
9	Yellow	YL
10	Violet	VI
11	Rose	RS
12	Aqua	AQ

Figure 5 - Fiber Optic Cable Construction

Fibers 1 and 2 (blue/orange) shall be the primary fibers used for the SCADA network with Fibers 7 and 8 (red/black) reserved as backup SCADA network fibers. All other fiber pairs are reserved for other use (CCTV, security, inter-building communications, etc.), to be determined and designated by the City at a future time.

All fibers (used and unused) shall be terminated in patch panels, beginning with Fibers 1 and 2 at the top, left to right as viewed facing the outside of the patch panel continuing down to Fibers 11 and 12 at the bottom. Fiber optic cable shall be labeled with the location of the current termination listed on the top and the destination location listed on the bottom. As an example, for a cable between panels 324-MCP-01 and 306-MCP-01:

324-MCP-01 / 306-MCP-01	←→	306-MCP-01 / 324-MCP-01
Inside 324-MCP-01		Inside 306-MCP-01

Figure 6 - Fiber Optic Cable Label Example

2.6 Network Ethernet Cable

Final run copper connections shall be ANSI/EIA/TIA-568 Category 6 cable. Surge protection shall be provided for all cables that extend beyond the control panel.

All cables shall be labeled with the destination termination at each end. For a cable between network switch #1, channel #5 located in Panel 304-MCP-01 and the RAS Pump #3 VFD in MCC-B2:

VFD RAS-03 MCC-B2	←→	SW01 CH05 304-MCP-01
Inside 304-MCP-01		Inside MCC-B2

Figure 7 - Ethernet Cable Label Example

2.7 Desktop Monitors

HD 1080 1920 × 1080, 16:9 ratio; between 24 and 27 inches in size; City OT standard.

2.8 Desktop Computers and Printers

Desktop computers shall have the following minimum requirements. As technology and software requirements change, these requirements will need to be modified to reflect those changes. As such, these hardware requirements should be used as guidance only. The hardware shall be discussed during software development meetings.

- 64-bit Windows Operating System.
- 3 GHz or more quad-core processor. Note that higher clock speeds are more helpful than more cores.
- Solid State Drives (SSD).
- 2 TB free space. Drives shall be partitioned to have the OS on separate partition. All other applications shall be installed on separate partition from OS.
- 16 GB RAM.
- 1 Gb Ethernet Network Interface Card.
- Hardware shall be manufactured by Dell.

All computer hardware shall be coordinated with the City's OT department.

Printers shall be color laser with a 600 dpi print resolution for both black & white and color. Network interface shall be 10/100BASE-T Ethernet.

Printer selection shall be coordinated with the City's OT Department.

2.9 Control Panel Design

Control panel enclosures shall be rated NEMA 250 Type 12 for dry, interior locations. All other enclosures shall be NEMA 250 Type 4X, constructed of Type 316 stainless steel. Additionally, exterior enclosures shall have a white epoxy paint coating and sun shields.

Enclosure doors shall include a continuous hinge with heavy-duty 3-point latching mechanism with a padlocking handle. All panels shall have a door switch-activated interior LED light.

In addition to a common name (such as "Belt Filter Press #2 Control Panel"), each PLC-based control panel shall be assigned an alphanumeric designation in the following format:

NNN-LLL-nn

Where:

- NNN = the City-assigned building number where the panel is installed
- LLL = the type of control panel
  - MCP = master control panel
  - LCP = local control panel
  - ECP = equipment control panel
- nn = two-digit numeric designation

A master control panel (MCP) is the primary control panel designated for a process area or several pieces of similar equipment. These are custom-built by UL 508A/698A industrial control panel fabricators.

A local control panel (LCP) is a smaller panel, dedicated to and generally located near the controlled equipment, which is also custom-built by UL 508A/698A fabricators.

An equipment control panel (ECP) is provided as part of a process equipment package. While also built by UL 508A/698A fabricators, they are generally programmed and warranted by the associated equipment manufacturer.

For example, the master control panel located in Electrical Building No. 2 (tagged as 302) would be 302-MCP-01. The local control panel for the reuse valve electric actuators located in Reuse Pump Station 10 (tagged 304) would be 304-LCP-01. The previously-mentioned Belt Filter Press #2 control panel in the Sludge Dewatering Building (tagged 240) would be 240-ECP-02.

3 SOFTWARE STANDARDS

The software standards below are for both the VTScada (HMI) and Rockwell Studio 5000 (PLC) used by the City. Any deviations from these standards shall be coordinated with the City prior to developing the software and discussed during the development meetings. The intent is to maintain a consistent look and feel for software features and standard functionality for equipment operation.

3.1 Software Development Meetings

Software Development Meetings shall be scheduled prior to any software development and testing. These meetings are to coordinate with the City and to ensure all configuration software meets the City's preferences and requirements. These meetings shall be scheduled with at least two weeks' notice. A minimum of two meetings (workshops) shall be provided for each software topic.

Topics may include the following:

- HMI system architecture design.
- Database tagging scheme including name and description conventions, scaling, and data storage parameters.
- Navigation menu format, operation, and screen location.
- Text fonts and sizes.
- Standard use of colors by instrument type, run status, alarm status, background and inanimate object type, and animated objects.
- Graphical library symbol elements.
- Alarm handling.
- Historical data collection and trending.
- Access levels, permissions, system security, and redundancy.
- Procedure and details for shared data between the SCADA systems.
- Reporting requirements including automated report generation.
- Backup and restore procedures.
- Typical widgets of dynamic objects such as pumps, valves, blowers, etc.
- Typical widgets of equipment control though pop-up windows.
- General data entry via SCADA HMI.
- Displays which include Process Overviews, Control Displays, Alarm Displays, and Trend Displays.

3.2 Communications Protocol (Appendix G: CODB EtherNet/IP-Network Example)

Common Industrial Protocol (CIP) is an Ethernet-based protocol that is now the preferred networking solution for performance and ruggedness required by industrial applications. CIP-compliant EtherNet/IP is one of the most commonly used CIP protocols and is the most compatible for use with Allen-Bradley PLCs. Compared to legacy fieldbuses, this Ethernet-based protocol offers faster speeds, better handling of large volume of data, easier network expandability, and better monitoring and troubleshooting capabilities. Given its ubiquitous nature, there are many technicians who are proficient with Ethernet, numerous tools for maintaining and troubleshooting Ethernet networks, and an extensive number of equipment manufacturers. Where necessary, protocol converters shall be used to convert other protocols such as Modbus TCP/IP to EtherNet/IP. (Converter: P.N. see page 31 App. A)

Ethernet network infrastructure is flexible and can be implemented using copper or fiber optic cabling in a variety of topologies (i.e. ring, tree, or star). One or multiple topologies can be used on a single Ethernet network, within some rules and limitations. While copper-based cables are often used in short indoor links, fiber optic cables provide immunity from electrical noise and should be used for extended distances between network devices. Ethernet is also adaptable to other communication means, including wireless radios and cellular modems.

Already in use at WRWRF and RBWTP, the City has established EtherNet/IP protocol over fiber optic cable as the preferred communications network at and between its facilities.

3.3 SCADA Software

The SCADA software used is VTScada by Trihedral, Version 12.0.16 (or the latest). Programmers shall be VTScada advance certified to configure and program the applications for the City.

VTScada
Software for Monitoring & Control

3.4 Licensing and Configuration

The software licensing shall be registered to the City of Daytona Beach. The VTScada HMI point count should reflect the number of tags in the system with a 25% spare capacity when additional licensing or clients are being purchased as part of a project.

The City's VTScada application should use a Standards layer (reusable application template layer) for all standards which include as a minimum, the overall security, tag types, widgets and any special graphics or widgets that should be included in the Master Application and as a City Standard. The Standards layer shall contain all the source files. The plant applications are created from this Standards layer per documentation within the software. Any deviations from this architecture shall be communicated with the City.

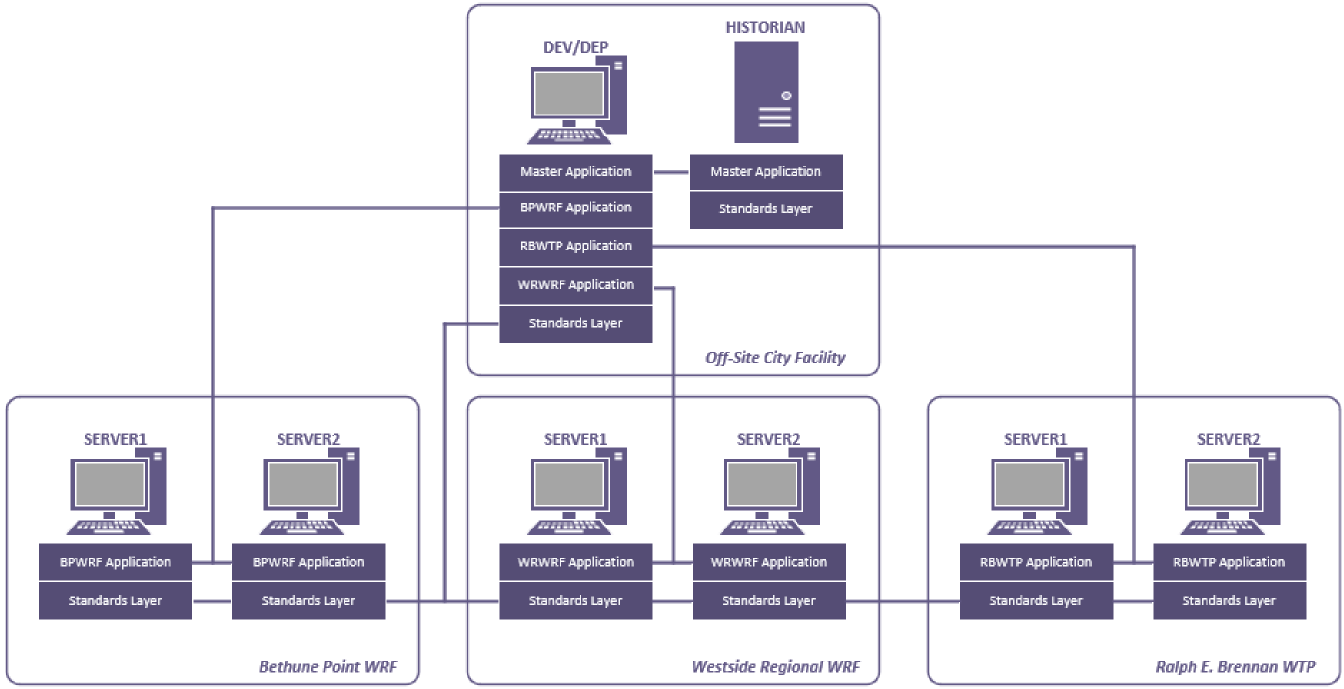


Figure 8 - VTScada Application Architecture

3.5 Tagging Standards

The purpose of this section is to define the tagname standards to be used with Rockwell Automation Studio 5000 PLC programming and VTScada HMI.

Tagnames shall use the following format in the Studio 5000 using UDTs for the PLC and Context Tag types in VTScada:

- FACILITY
    - PROCXX
        - YYYYQQ
            - ↳ ZZZZZZZZ

In both scenarios, FACILITY is the facility or plant descriptor, PROCXX is the process descriptor, YYYY is the equipment prefix with QQ as the numeric identifier, and ZZZZZZZZ is the suffix.

In VTScada, context tags shall be used until the suffix level and I/O calculation tag type shall be used for most tag suffixes.

Facility Descriptors	
BPWRF	Bethune Point Water Reclamation Facility
WRWRF	Westside Regional Water Reclamation Facility
RBWTP	Ralph E. Brennan Water Treatment Plant
BPBPS	Bethune Point Booster Pump Station
UVBPS	University Booster Pump Station
SPBPS	Suburbia Park Booster Pump Station
RWxxx	Raw Water Wells
LSxxx	Lift Stations
RPxxx	Reuse Pump Stations
SWxxx	Storm Water Pump Stations

Table 1 - Facility Descriptors

Process Descriptors

Water					
AS	Air Scour	LIME	Lime	PO4	Polyphosphate
BW	Backwash	LS	Lime Slurry	POLY	Polymer
CIP	Clean-in-Place	LSSL	Lime Sludge	PYS	Polymer Solution
CO2	Carbon Dioxide	NACL	Sodium Hypochlorite	PW	Potable Water
CON	Concentrate	NAOH	Sodium Hydroxide	RAW	Raw Water
DWSL	Dewatered Lime Sludge	NPW	Non-Potable Water	SA	Sample
EFF	Effluent	O3	Ozone	SETW	Settled Water
FL	Fluoride	PA	Plant Air	SW	Surface Wash
FW	Filtered Water	PAC	Powder Activated Carbon	TW	Treated Water
FTW	Filter-to-Waste	PERM	Permeate		

Wastewater					
AS	Air Scour	EQ	Equalization Flow	POLY	Polymer
AIR	Compressed Air	FECL	Ferric Chloride	PYS	Polymer Solution
ARCY	Anoxic Recycle	GLYC	Glycerin (Carbon)	RAS	Return Activated Sludge
BFF	Belt Filter Press Feed	GRIT	Grit	RS	Raw Sewage
BW	Backwash	GS	Grit Slurry	RW	Reuse Water
CEN	Centrate	ML	Mixed Liquor	SA	Sample
CF	Centrifuge Feed	NRCY	Nitrified Recycle	SCR	Screenings
DEC	Decant	OA	Odorous Air	SCUM	Scum
DR	Process Drain	OF	Overflow	SRS	Screened Raw Sewage
DWAS	Dewatered WAS	PA	Process Air	TWAS	Thickened WAS
EFF	Effluent	PAA	Peracetic Acid	WAS	Waste Activated Sludge

Other					
AC	Alternating Current	DIES	Diesel	PROP	Propane
DC	Direct Current	NGAS	Natural Gas	STRM	Stormwater

Table 2 - Process Descriptors

Equipment Descriptors

Water					
AER	Aerator	FLO	Flocculator	SLC	Sludge Collector
BAS	Basin	MIX	Mixer	SLG	Sluice/Slide Gate
BIN	Bin	O3G	Ozone Generator	SV	Solenoid Valve
BLW	Blower	PFS	Polymer Feed System	TNK	Tank
CDS	Carbon Dioxide System	PMP	Pump	TKR	Thickener
CHL	Chlorinator	PxTy	Pump x, Train y	UVD	UV Disinfection System
CLR	Clarifier	SBX	Splitter Box	VLV	Valve
FAN	Fan	SIL	Silo	WEL	Well
FLT	Filter	SLA	Slaker		

Wastewater					
AER	Aerator	GRC	Grit Concentrator	SBX	Splitter Box
BAS	Basin	GRD	Grinder	SCC	Screenings Compactor
BCV	Belt Conveyor	GRS	Grit Removal System	SLG	Sluice/Slide Gate
BFP	Belt Filter Press	MBR	Mechanical Bar Screen	SV	Solenoid Valve
BLW	Blower	MIX	Mixer	TNK	Tank
CFS	Carbon Feed System	OCS	Odor Control System	TKR	Thickener
CLR	Clarifier	PFS	Polymer Feed System	UVD	UV Disinfection System
FAN	Fan	PMP	Pump	VLV	Valve
FLT	Filter	PxTy	Pump x, Train y	WWL	Wet Well

Other					
AHU	Air Handling Unit	GEN	Emergency Generator	PWR	Power Monitor
BYC	Bypass Contactor	MAU	Make-Up Air Unit	RIO	Remote I/O
CB	Circuit Breaker	MPR	Motor Protection Relay	SW	Network Switch
CR	Control Relay	MTR	Motor	SWG	Switchgear
EVA	Electric Valve Actuator	PLC	Programmable Logic Controller	UPS	Uninterruptible Power Supply
		PS	Power Supply	VFD	Variable Frequency Drive

Table 3 - Equipment Descriptors

Suffixes

ALM	Alarm
AMPS	Current Reading (Amperes)
AUTO	Auto Status
AVAIL	Available
CC	Total Starts (Cycle Counts)
CC_TDY	Starts Today (Cycle Counts)
CC_YDY	Starts Yesterday (Cycle Counts)
CL2	Chlorine Residual
CLSD	Closed Status
CMD_CLS	Command Close from the HMI
CMD_FLOW	Flow Command Setpoint
CMD_OPN	Command Open from the HMI
CMD_RST	Command Reset from the HMI
CMD_RST_ETM	ETM Reset Command from the HMI
CMD_RST_CC	Cycle Counter Reset Command from the HMI
CMD_RST_FT	Flow Total Command Reset from the HMI
CMD_SPEED	Speed Command
CMD_START	Start Command from the HMI
CMD_STOP	Stop Command from the HMI
COMM_FAIL	Communications Failure
COND	Conductivity Reading
DIAG_ALM	Diagnostic Alarm
DIAG_WARN	Diagnostic Warning
ETM	Elapsed Time Meter (Runtime) Cumulative
ETM_TDY	Elapsed Time Meter (Runtime) Today
ETM_YDY	Elapsed Time Meter (Runtime) Yesterday
FAIL	Failure Alarm
FAILCLOSE_ALM	Failure to Close Alarm
FAILOPEN_ALM	Failure to Open Alarm
FLOW	Flow Reading
FLOW_FT	Flow Total Lifetime
FLOW_FT_TDY	Flow Total Today
FLOW_FT_YDY	Flow Total Yesterday
GAS	Gas Level Reading
HAND	Hand Status
HI	High
HI_LVL_ALM	High Level Alarm

Table 4 - Suffixes

Suffixes (cont.)

HI_PSI_ALM	High Pressure Alarm
HI_TEMP_ALM	High Temperature Alarm
HI_TORQ_ALM	High Torque Alarm
HI_TORQ_WARN	High Torque Warning
HIHI_ALM	High High Alarm
HIHI_LVL_ALM	High High Level Alarm
HIHI_TORQ_ALM	High High Torque Alarm
LEAK_ALM	Leak or Moisture Alarm
LEL_ALM	Combustible Gas Alarm (Lower Explosive Limit)
LOCAL	Local Status
LO	Low
LO_LVL_ALM	Low Level Alarm
LOLO_ALM	Low Low Alarm
LOLO_LVL_ALM	Low Low Level Alarm
LVL	Level Reading
NO_FLOW_ALM	No Flow Alarm
NTU	Turbidity
O3	Ozone Reading
OFF	Off Status
OPND	Open Status
pH	pH Reading
POS	Position Reading (%)
POWER	Power Reading (Watts)
PSI	Pressure Reading
PV	Process Value
PWR_LOSS	Power Loss
REMOTE	Remote Status
RUN	Running Status
SPEED	Speed Feedback Reading
TOC	Total Organic Carbon Reading
VOLT	Voltage Reading (Volts)
WARN	Warning Alarm

Table 4 – Suffixes (Cont.)

3.6 HMI Graphic Standards

The following standards shall be followed for the HMI whether it be for the VTScada application or within an OIT application at each facility for the City.

3.6.1 SCADA Equipment Control and Monitoring

A. Operator Interface Terminal (OIT) or local computer Human Machine Interface (HMI) Manual Equipment Control shall be used for all equipment controlled by the PLC.

B. If present, the local HAND-OFF-REMOTE switches must be placed in REMOTE for operation by the OIT.

C. Equipment Controls: ON-OFF or ON-OFF-AUTO virtual selector switch where:

1. ON = Equipment shall start and run unless prevented by an interlock as described in the operational description for the equipment. If Variable Speed Drive (VSD) equipped, speed shall be controlled manually by OIT entry.
2. OFF = Equipment shall shutdown and remain off. Latched equipment failures shall be reset.
3. AUTO = Equipment shall be controlled as described in the operation description for the equipment.

D. Valve and Gate Controls: OPEN-CLOSE; OPEN-OFF-CLOSE, OPEN-OFF-CLOSE-AUTO; or MAN-AUTO virtual selector switch where:

1. OPEN = Valve or gate shall open.
2. CLOSE = Valve or gate shall close.
3. OFF = Valve or gate does not operate
4. MAN = Modulating valve or gate shall have its position controlled manually by OIT entry.
5. AUTO = Valve or gate shall be controlled as described in the operation description for the equipment.

E. A control program that controls multiple pieces of equipment shall not be prevented from running because not all the equipment is in REMOTE or AUTO. If equipment within an equipment chain is required to be running for program operation and it is running, then the program shall run and control the other equipment that is in AUTO.

F. Unless specifically stated otherwise all control interfaces (switches, buttons, indications, etc.) described shall be graphical software presentations shall be available at the OIT.

3.6.2 Screen Resolution and Layout

The graphics screen shall use the full capability of the standard monitor which is 1920x1080. Below is a representation of how the standard screen layout shall be. The header and footer are default from VTScada except for the City of Daytona Beach logo.

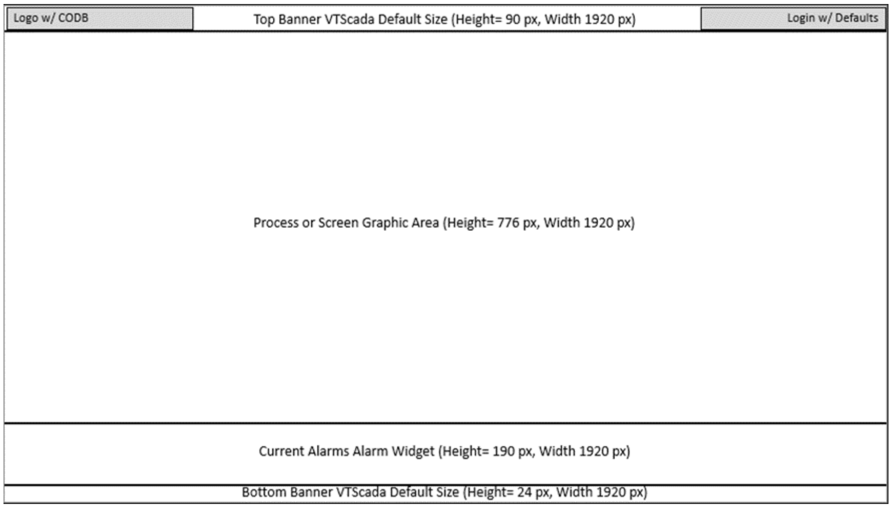


Figure 9 - Screen Layout

The Current Alarms Alarm Widget shall be used to display the current unacknowledged alarms at any given time and shall be on all graphics screens. An example of a screen is shown below.

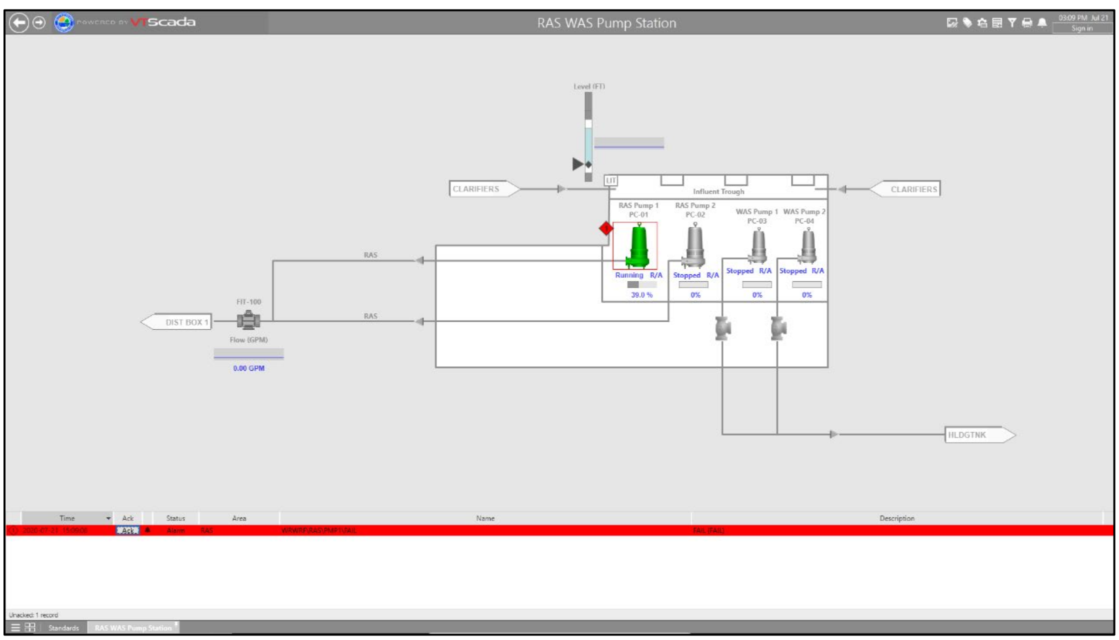


Figure 10 - Current Alarm Widget Example

In general, the graphic screens shall include dynamic data and process equipment representations to accurately represent the operation of the system. A hierarchical structure of displays shall allow for rapid navigation through screen with controls and setpoint entries segregated to pop-up screen to minimize accidental entries.

- Graphics shall follow the principles of High-Performance Graphics. No 3D graphics shall be used. The graphics shall be created from within the VTScada application or shall be able to be modified by using Microsoft Paint or other basic graphic editing software.
- Process overview screen display shall be provided with navigation points available to move easily through the process flow. The process screen shall allow for navigation to a more detailed screen of an area of the treatment process.
- Facility Site Overview shall be provided with navigation links to process areas within the facility.
- Detailed process screens shall provide the relevant information about the process. Animations to indicate the status of equipment using colors and changing text, analytical data, and analog readings are examples of the information that should be provided at a minimum.
- Controlling equipment or adjusting setpoints shall be provided as pop-up windows by clicking on the equipment or highlighted areas.
- Equipment cumulative, today, and yesterday runtimes and starts shall be provided on a separate page.
- Flow totalization screen (cumulative, today, and yesterday) shall be provided for all flowmeters.
- Network overview screen shall provide all information as it relates to the operator's workstation, servers, PLC, and UPS equipment. The information provided shall be at a minimum:
    - The communication status for all equipment shall be available along with statistical information as relates to CPU usage, drive space, and failures.
    - Diagram to show the connectivity of all devices.
    - Time / Date for all PLCs, with the ability to adjust the Time / Date.
    - IP addresses (provided for technician role, hidden for other roles).
    - Ability to click on devices to see web page information for that device, if applicable.

Additional information shall be discussed during software development meetings.

3.6.3 Navigation

Navigation shall be done using the default VTScada menu and by navigation arrows with the detailed process screens. Each major process area shall be listed on the main menu structure with a side pop-up with sub-areas for the typical process to limit the menu. The process overview screen shall be at the top of the menu. Below is an example of the menu structure.

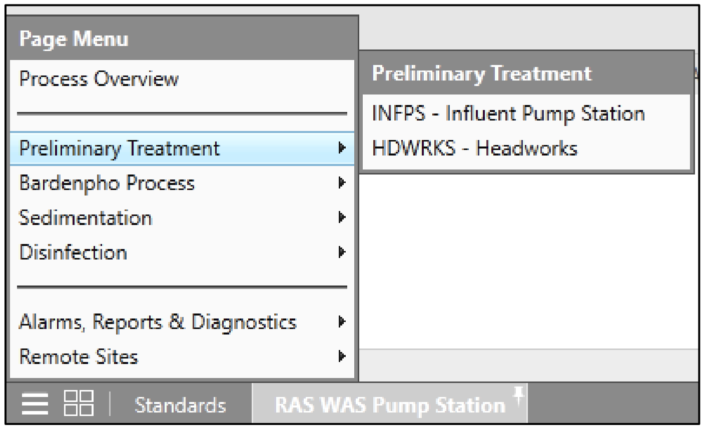


Figure 11 - Process Overview Screen

In addition to the built-in menu navigation, arrows shall be provided on the detailed process screens and shall include a hotlink to that process screen. See example below of a navigation arrow using a widget. Hovering the mouse over the arrow will display a shaded box to let the user know a link is available. This is done by using the built-in page navigation widgets and tools tips.

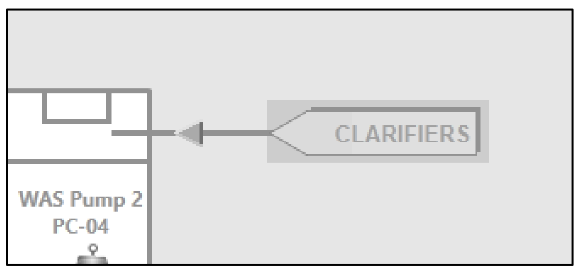


Figure 12 - Navigation Arrow Widget

Below is an example of navigation from the Plant Overview screen and hovering over an area of the facility. This is done by using the built-in page navigation widgets and tool tips.

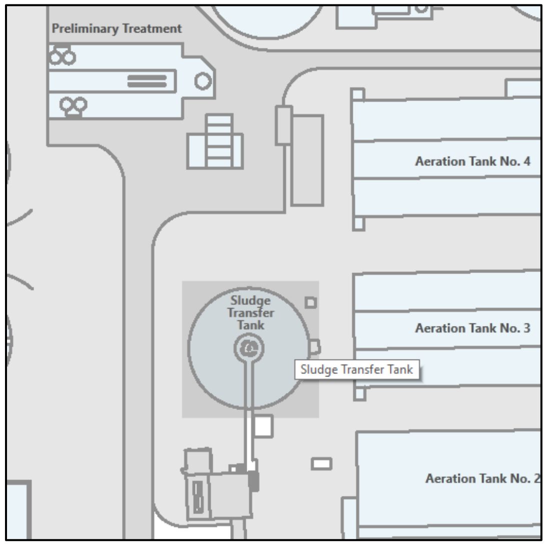


Figure 13 - Overview Screen Navigation

3.6.4 Color Conventions

- Equipment Running = Green
- Equipment Off = Gray
- In Alarm & Unacknowledged = See Section 3.7 HMI Alarm Handling
- In Alarm & Acknowledged = See Section 3.7 HMI Alarm Handling
- Valve Opened = Green
- Valve Closed = Gray
- Valve Transitioning = Green but with indication the valve is transitioning
- Analog Readings = Dark blue
- Setpoints = Light green

3.7 HMI Alarm Handling

The alarming conventions shall follow ANSI/ISA-18.2 Management of Alarm Systems for the Process Industries. VTScada supports this standard and below depicts the Alarm Priority and the Descriptor associated with it. All alarms shall be coordinated during the software development meetings to limit nuisance alarms. The built-in reports shall be used to show the "bad actors" after software development is complete. These shall be reviewed prior to final sign-off of any project where HMI development is done within a facility.

Name	Descriptor	Priority #	Color	Symbol
AlarmPriority0	Event	0	White	none
AlarmPriority1	Critical	1	Red	1
AlarmPriority2	High	2	Orange	2
AlarmPriority3	Warning	3	Yellow	3
AlarmPriority4	Notice	4	Cyan	4

Figure 14 - Alarm Priority

3.8 Remote Alarm Notifications

When using remote alarm notifications, rosters shall be configured for each facility. The roster members and configuration parameters shall be coordinated with the City and the PIN (Alternate Identification) for each user shall be configured as part of the security login. The call-out or text order shall be defined by the City.

3.9 HMI Security (Appendix C-F: Cyber, Network Architecture & SCADA Lifecycle)

The security within the VTScada applications are based on Microsoft Active Directory (AD). Each user shall have a unique login with auto logout after period of 15 minutes has elapsed without any activity. In addition to the AD, smart cards or proximity cards can be used in conjunction with the security for logging into VTScada.

The privileges are defined as roles within the application and each user shall be assigned to those roles. As a minimum the roles shall be configured as follows:

- Administrator = Full access.
- Operator = Control, setpoint changes, no configuration.
- Engineer = View-only, no configuration.
- Technician = Control, setpoint changes, no configuration.

The plant or SCADA manager will assign roles. If realms are being used, the user shall be assigned to a particular realm as part of the security.

3.10 HMI Historical Data

3.10.1 Collection

All I/O tags shall be collected and historized as part of the configuration of the tags, the default logging rates shall be used unless specified differently by the City. A VTScada Master Application shall be set up by using all the facility applications and the Master Application should push the logging data to a

Microsoft SQL Server database for data retrieval by other users such as engineering and other applications.

3.10.2 Reporting

All reports shall be configured according to the operations staff regulatory or daily needs to operate the intended facility by using the VTScada report generator and SyTech XLReporter. The reports shall be configured to send a daily email with the report attached. The reports shall be discussed during the software development meetings.

3.10.3 Trending

All analog values shall open a trend window when clicking on the value or graphic. Trend groups shall be configured for each process area and group the tags most viewed by operations. The trend groups shall be discussed during software development meetings.

3.10.4 Event

All setpoint changes, security logins, and equipment start/stop commands shall be logged as an event with the user information attached to the specific event. Similar to alarms, designation of events for logging shall be reviewed as part of the software development meetings.

3.11 PLC Programming Structure

Rockwell Studio 5000 software shall require Version 32.02.01 or later (to match PLC firmware). All programming shall be done with routines and each routine be called from the Main subroutine. The programming shall use UDTs and AOI as part of the programming to maintain commonality throughout all programs for the facilities.

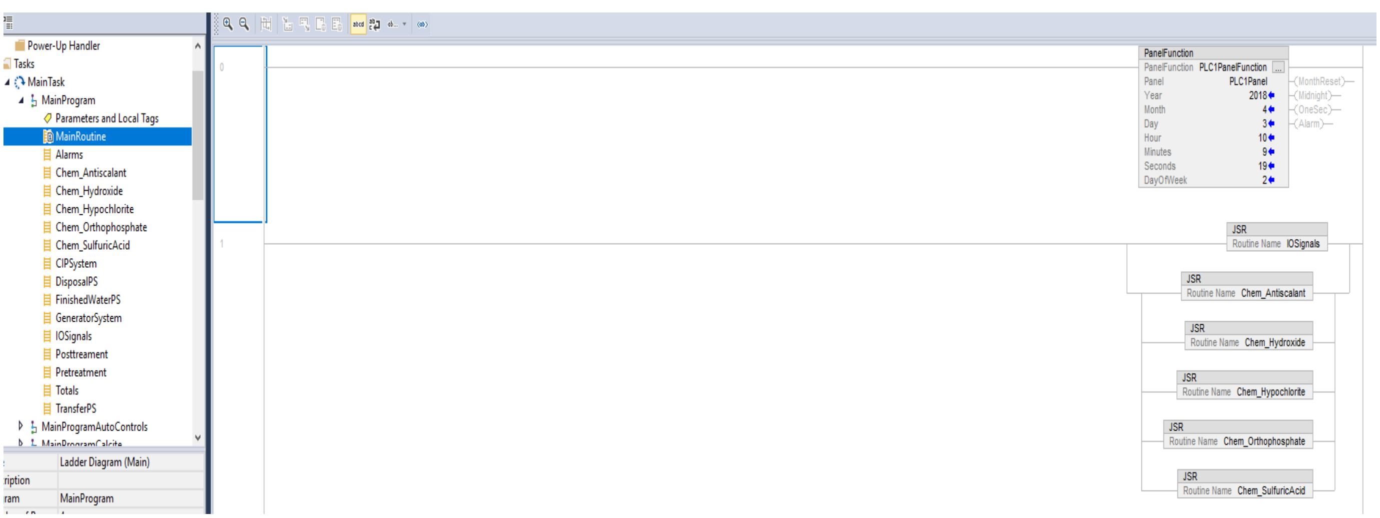


Figure 15 - Rockwell Studio 5000 Screen

3.12 PLC Add-on Instructions (AOI)

Add-on instructions (blocks) are a predefined logic set used to perform a specific function in a program. AOIs are used to maintain consistency within the programming, for example a flow totalization block. The flow totalization would use the Flow Total AOI and be the same for every flow meter in all the PLCs throughout all the City's facilities. Typically, blocks are created for items such as Flow Totals, Runtimes and Starts for equipment, PLC Communications including time/date synchronization, and other building block functions such as motor control and valve controls.

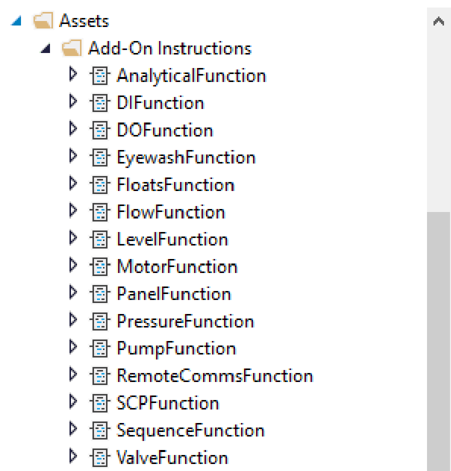
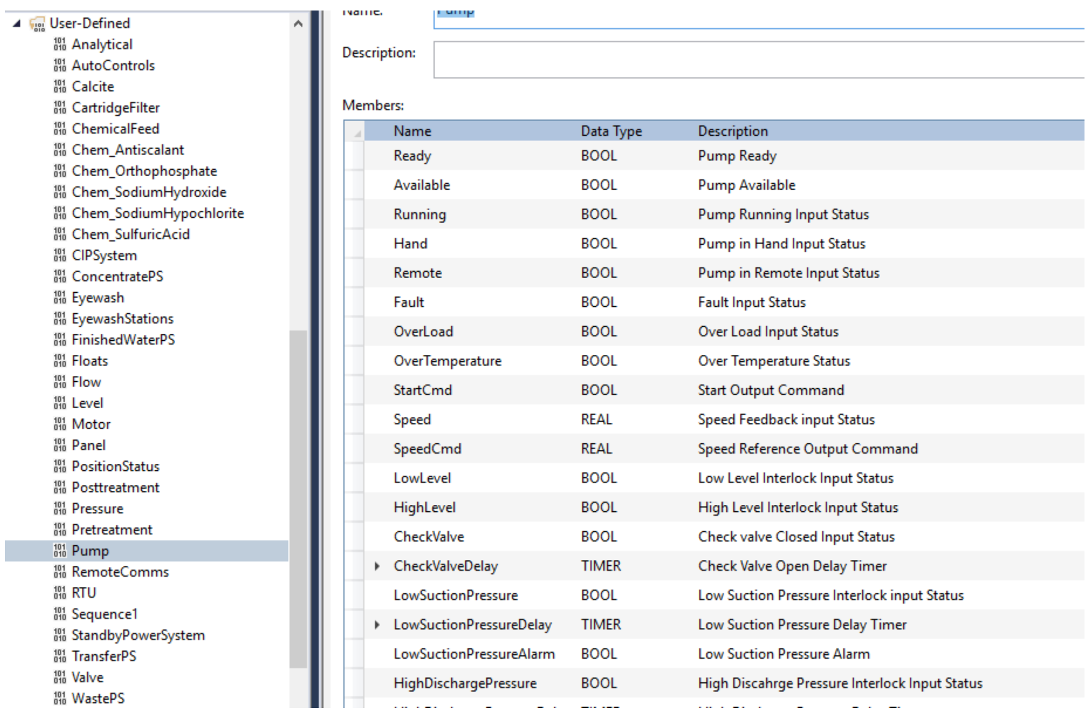


Figure 16 - Add-On Instruction Blocks

3.13 User Defined Tags (UDT)

As with the VTScada application tag structure, the same tagging is applicable to the Studio 5000 programming for the PLC using UDTs. Attributes and suffixes used in Studio 5000 shall match those used in VTScada.



Name	Data Type	Description
Ready	BOOL	Pump Ready
Available	BOOL	Pump Available
Running	BOOL	Pump Running Input Status
Hand	BOOL	Pump in Hand Input Status
Remote	BOOL	Pump in Remote Input Status
Fault	BOOL	Fault Input Status
OverLoad	BOOL	Over Load Input Status
OverTemperature	BOOL	Over Temperature Status
StartCmd	BOOL	Start Output Command
Speed	REAL	Speed Feedback input Status
SpeedCmd	REAL	Speed Reference Output Command
LowLevel	BOOL	Low Level Interlock Input Status
HighLevel	BOOL	High Level Interlock Input Status
CheckValve	BOOL	Check valve Closed Input Status
CheckValveDelay	TIMER	Check Valve Open Delay Timer
LowSuctionPressure	BOOL	Low Suction Pressure Interlock input Status
LowSuctionPressureDelay	TIMER	Low Suction Pressure Delay Timer
LowSuctionPressureAlarm	BOOL	Low Suction Pressure Alarm
HighDischargePressure	BOOL	High Discahrge Pressure Interlock Input Status

Figure 17 - Tagging in Rockwell Studio 5000

3.14 Communications

All communications between PLCs shall be point-to-point using message instructions. No producer/consumer tags sharing shall be used. All communications between PLC and other equipment shall be EtherNet/IP.

3.15 Evaluation of Automation and Alarms

3.15.1 Threshold of Setpoints

Setpoints shall be tag based and not hard coded in the logic. VTScada shall be used for entering of setpoints in the PLC logic with the appropriate privileges or roles.

3.15.2 Evaluation of Setpoints

The evaluation of the setpoints shall be done in the PLC logic and not through scripting of the HMI. Evaluation of setpoints shall include time delays to determine maintained conditions with the delay settable from the VTScada. The setpoints shall be stored in the PLC and if power cycle occurs, the setpoint should remain the same when power is restored. Retrieving of program on power cycle shall not occur since it will overwrite the setpoint prior to the failure.

3.15.3 Flow Totals and Runtimes

All flow totals and runtimes shall be calculated in the PLC programming using an AOI. If the flowmeter is capable of EtherNet I/P or HART communications, the preferred method is to read the totalizers directly from the meter for more accuracy. The flow totals, runtimes, and starts shall have cumulative, today, and yesterday columns. The cumulative totals, runtimes, and starts shall be resettable and adjustable. Flow total and runtimes shall be logged to the SD card of the PLC so if a power cycle or failure occurs, the totals / runtimes will not be lost.

3.16 Documentation of Code

All code within the PLC or within special scripting of VTScada shall be documented within the code. For each AOI, there shall be a structured text routine that is commented out to show original created date, revision #, and the modification notes for each revision made. After final commissioning of the code, final documentation shall be updated including documents for the O&M of the project.

Below is an example of commenting within the subroutine.

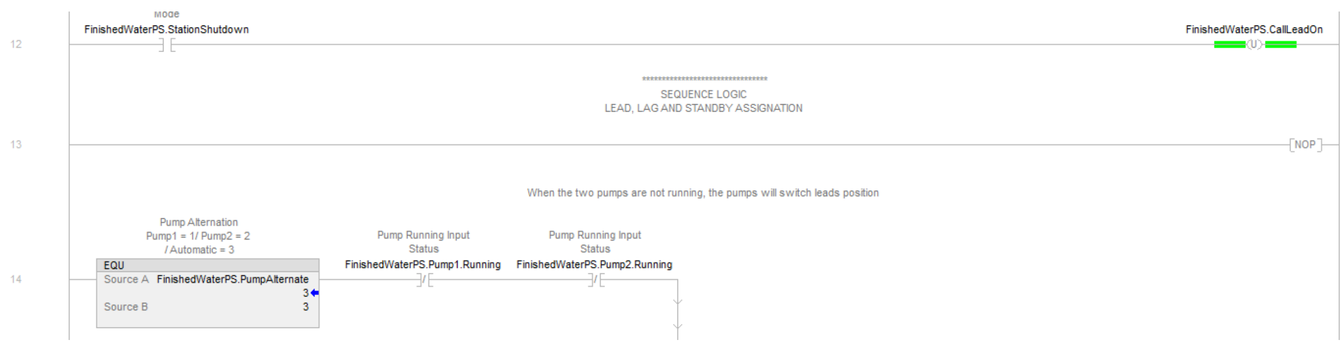


Figure 18 - Subroutine Commenting Example

Below is an example of the Revision Comment Routine to capture all the revisions made to the program. This routine shall be named so that it appears right after the MainRoutine. This routine shall not be called and shall be Structured Text format with all the text being commented out, so the program doesn't contain errors when compiled.

DOFunction - Logic* | MainProgram - AA_Revision_Comments

```
//Revision        By          Date          Comment of Revision
//----------      -----       -----         --------------------
//1.0             Eric Brown  05/01/2020    Initial Installation of Program
//2.0             Eric Brown  06/23/2020    Modified Anti-scalant Tank Alarms under Chem_Antiscalant Subroutine
```

Figure 19 - Revision Comment Routine Output

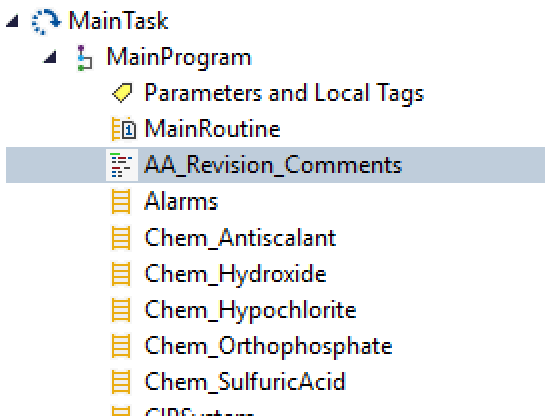


Figure 20 - Revision Comment Routine Structure

Below is an example of comments inside of an AOI. Where Structured Text can't be used, a NOP operand shall be used and comment the rung to show the revision level of the AOI.

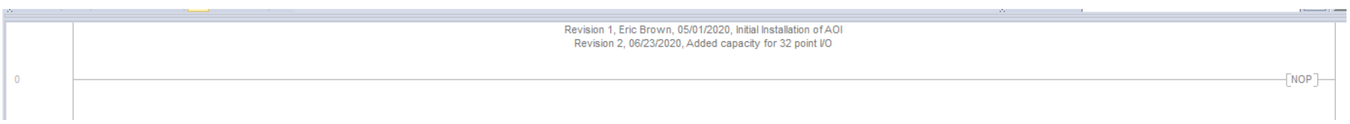


Figure 21 - AOI Comment Example

Appendix A

1) Modbus to EtherNet/IP: Part # MOXA 5135/5435 Series or equivalent Prosoft or Phoenix Contact Converter. https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/

2) If HART to EtherNet/IP is required: Part # Aparian A-IP.HART-I or A-IP.HART-O or equivalent converter. https://www.aparian.com/products/ip-point-hart-out

3) All instrumentation shall communicate I/O's via EtherNet/IP. Example: Flow Meters, VFD's, Actuators, switch gear components, Generator set, ATS's, Level and Pressure sensors etc.
    a. **Pressure Sensor: Substitute 4-20 ma HART**
    b. **Level Sensor: Substitue 4-20 ma HART**

Note: Web-links above are interactive.

Appendix B

1) OM3 is the chosen Fiber per CODB's standard, however if design requirements require OM4 or OM5 may be used, consult with CODB OT / Asset Management Department.

Multimode Designation	Maximum Distance			
	1 GB/s	10 Gb/s	40/100 Gb/s	400 Gb/s
OM1	300m/984ft	30m/98ft	NA	NA
OM2	600m/1968ft	150m/492ft	NA	NA
OM3	1000m/3280ft	300m/984ft	100m/328ft	100m/328ft
OM4	1100m/3608ft	550m/1804ft	150m/492ft	150m/492ft
OM5	1100m/3608ft	550m/1804ft	150m/492ft	150m/492ft

2) Per NECA/FOA 301-216 or Latest revision, page 22.

C) Use service loops to provide cable for future repair or rerouting.

3) CODB requires a minimum of 20’ for each service loop.

Appendix C

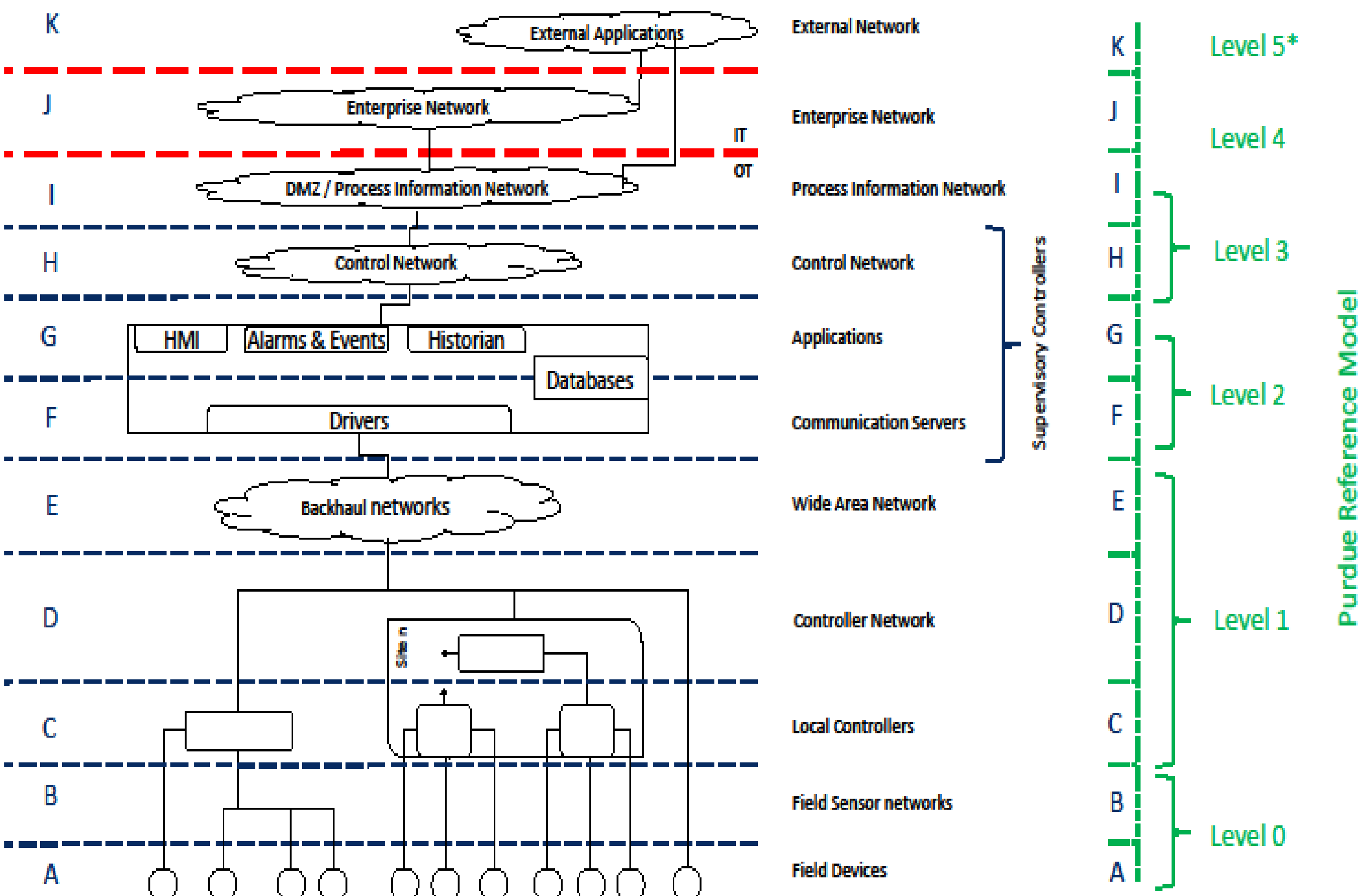
CODB's SCADA System Network Model Architecture Standard

ISA112 SCADA System Model Architecture Diagram ISA112 – SCADA Systems Standards Committee – International Society of Automation (ISA)

https://www.isa.org/standards-and-publications/isa-standards/isa-standards-committees/isa112

ISA112 SCADA System Model Architecture Diagram

ISA112 – SCADA Systems Standards Committee – International Society of Automation (ISA) – www.isa.org/isa112/



Notes:

1 Letters are used to avoid potential conflict with ISA-95 and other "Layer" models.
2 Routers and Firewalls between layers as well as other system-specific servers, applications ,and workstations are not shown.
3 Individual architectures may vary from the above general model. For example, if only local systems are used Level E may not be required
4 Communications for any remote-hosted external applications (Cloud) with lower levels must be done using extreme care.
5 The use of direct-connections for remote applications is strongly discouraged. Refer to ISA/IEC-62443 for guidance on an appropriate zone/conduit implementation.
* We show a Purdue Level 5. The true Purdue Model only has levels 0-4 because it did not anticipate external applications.

IT = Information Technology

OT = Operational Technology

Note: This is an interim working draft from the ISA112 SCADA Systems standards committee, as of 2022-01-26. (A previous version was posted on 2020-06-15). This diagram is still subject to change.

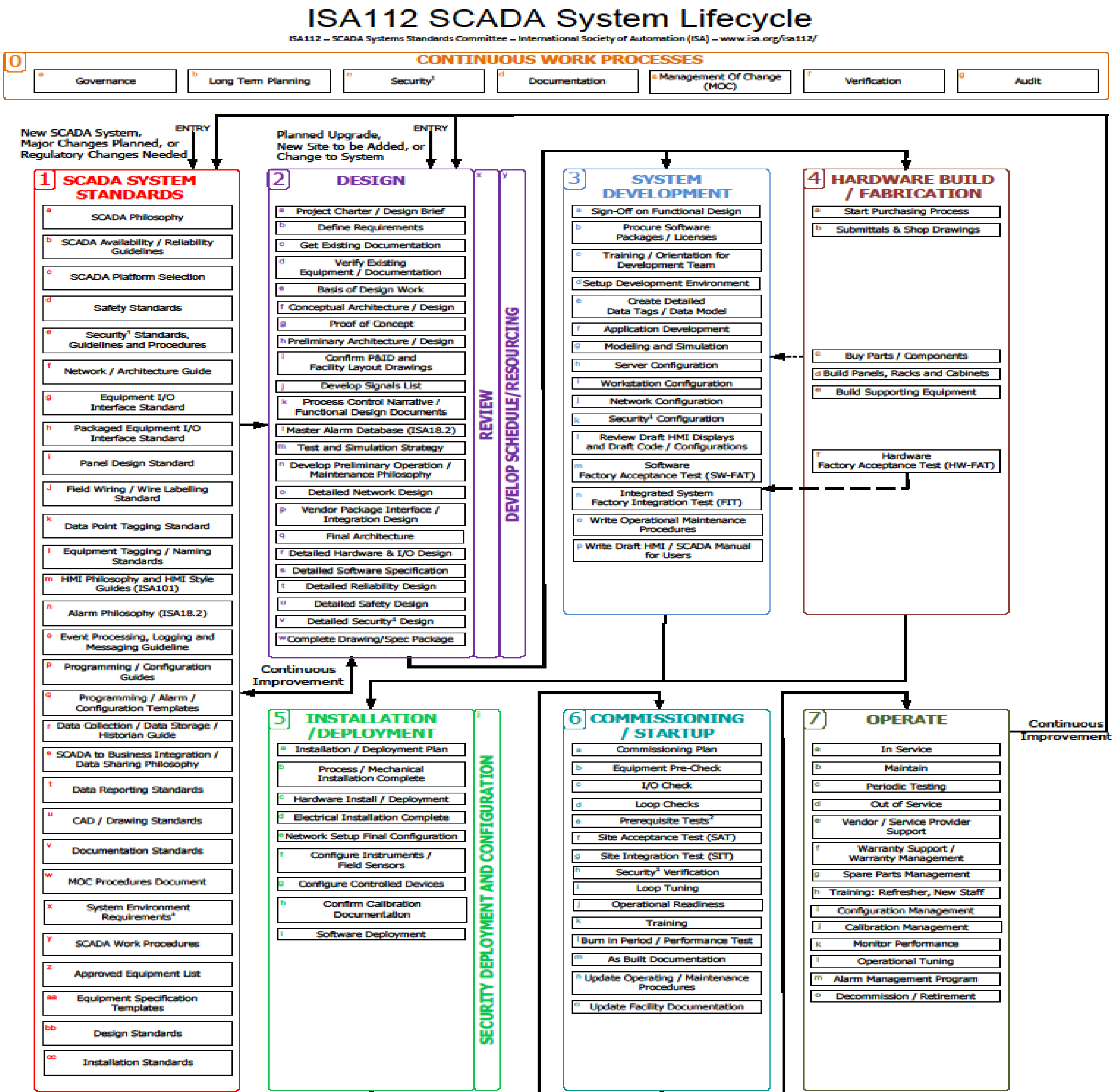
Appendix D

CODB's SCADA System LiveCycle Standard

(ISA112 SCADA System LifeCycle)

ISA112 SCADA Systems Standards Committee International Society of Automation (ISA)

https://www.isa.org/standards-and-publications/isa-standards/isa-standards-committees/isa112



Notes
1) Security includes physical security, operational security, and cybersecurity.
2) Prerequisite tests typically include both cold and hot commissioning or dry / wet commissioning as applicable.
3) System Environment Requirements can include separate systems for development, testing, training, production, backup, disaster recovery, digital twins, and other uses, as part of development and Management Of Change (MOC) procedures

Note: This is an interim working draft from the ISA112 SCADA Systems standards committee, as of 2022-07-08. (A previous version was released on 2020-06-15.) This diagram is still subject to change.

Appendix E

Guide to Industrial Control Systems (ICS) Security

NIST Special Publication 800-82

Click on link below to open Standards Document.

https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-82r3.pdf

Appendix F

1) ISA101 Human-Machine Interfaces
2) ISA18 Alarm Management Standard
3) ISA/IEC62443 Cybersecurity for Industrial Automation Control Systems

https://www.isa.org/standards-and-publications/isa-standards/list-of-all-isa-standards

Appendix G

EtherNet/IP Network Example.

https://literature.rockwellautomation.com/idc/groups/multi_media/documents/multimedia/files/virtualbrochure/ethernet-intellicenter/index.html