NEORSD
Process Control
System Standards
and Conventions Manual

Volume 3 – Interface Development Standards

Revision 4
December 2019
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<td>0</td>
<td>02/21/2017</td>
<td>HDR</td>
<td>All</td>
<td>DRAFT • Modification as part of APM Program. Restructured to 5 volumes and update to current industry best practices. • All sections contain updates from ASCM • Note optional text in { } for recommended options to incorporate</td>
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<td>HDR</td>
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<td>5.2 &amp; Appendix A</td>
<td>DRAFT • Network Diagram Updates</td>
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<td>3</td>
<td>04/16/2019</td>
<td>HDR</td>
<td>9.5</td>
<td>Updated Facility Manager’s role.</td>
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<td>3.0</td>
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<td>4</td>
<td>12/30/2019</td>
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<td>12.1, 12.1.1</td>
<td>Fixed typos for BTL abbreviation</td>
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<td>4</td>
<td>12/30/2019</td>
<td>NEORSD/PJM</td>
<td>15.1</td>
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<td>NEORSD/PJM</td>
<td>22</td>
<td>Throughout Section 22: • Updated OIT from “PanelView Plus” to “PanelView Plus 7 Performance model with touch screen” • 7” PV for vendor packages only with approved deviation request. • Deleted references to 12” PVs. • Deleted references to PV keypads.</td>
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<td>4</td>
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<td>NEORSD/PJM</td>
<td>22.1</td>
<td>Revised title of Process Control Narrative to Process Control Description.</td>
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<tr>
<td>4</td>
<td>12/30/2019</td>
<td>NEORSD/PJM</td>
<td>22.3.1</td>
<td>Added E&amp;C SharePoint location for NEORSD Asset Tag Abbreviations File • First bullet item for “Location” – clarified that the two-digit process area assigned to OITs (and other PCS assets) represents the physical location of that asset.</td>
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<tr>
<td>4</td>
<td>12/30/2019</td>
<td>NEORSD/PJM</td>
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2.0 Introduction

This manual is a compilation of The Northeast Ohio Regional Sewer District's (NEORSD) standards for Process Control System (PCS) programming, configuration and design. It is intended to be applied by the District’s contractors, consultants and in-house personnel when developing or modifying any portion of the District's PCS. The PCS is a utility-wide system of hardware and software that spans the wastewater collection system and all three wastewater treatment facilities. This document must be treated as both requirements and guidance for PCS work.

This manual is divided into five main volumes:

**Volume 1** contains an introduction to the Process Control System Standards and Conventions Manual. It also comprises District policies and procedures that apply to the use and management of the PCS, including approvals and practices for applying and documenting changes to hardware and software, code changes, alarm management requirements, contractor’s responsibilities related to work performed on the PCS and other related topics. This volume also contains the standards deviation request form.

**Volume 2** addresses practices for development and programming of control processors, primarily programmable logic controllers (PLCs) of various types, including requirements for programming software, databases, alarm processing, networking, control loops, control logic structure, I/O layout and signal processing, tagging and naming conventions.

**Volume 3** is similar in scope to Volume 2 but focuses on operator interfaces and the PCS subsystem that provides Human-Machine Interface (HMI) functionality. Volume 3 includes the requirements for programming and configuration of the Area Control Stations (ACSs), historians, servers and the related network infrastructure. Standards for programming and display development for Operator Interface Terminals (OITs), industrial operator interfaces typically located in the field PLC panels, are included in this volume.
**Volume 4** is similar in scope to Volumes 1 and 2 but focuses on reports, databases and other PCS interconnected software,

**Volume 5** includes design standards for PCS including panel design, Process and Instrumentation Diagrams (P&ID), network architecture, and security.

Compliance with the standards and conventions outlined in the manual are required for all projects that add to or modify the PCS. If a contractor or District staff member identifies a need for an addition or modification to the standards for a specific project, or if in the course of the work it is found that some part of the standards cannot be adhered to, a Standards Deviation Request may be submitted in accordance with the requirements of that section.

Refer to section 14.0 for a complete list of all NEORSD standards and forms, and industry standards and best practices referenced in this manual.

### 3.0 Abbreviations

The following is a list of applicable acronyms and definitions which are utilized throughout the Automation Standards and Conventions Manual.

<table>
<thead>
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<th>Abbreviation</th>
<th>Definition</th>
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<tr>
<td>A2ALMDB</td>
<td>Wonderware Alarm and Event Database</td>
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<td>ACS</td>
<td>Area Control Stations</td>
</tr>
<tr>
<td>AOI</td>
<td>Add-On Instruction (RSLogix PLC)</td>
</tr>
<tr>
<td>AOS</td>
<td>Application Object Server (Wonderware)</td>
</tr>
<tr>
<td>APM</td>
<td>Automation Program Management</td>
</tr>
<tr>
<td>BTL</td>
<td>Base Template Library (Wonderware Scripting)</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer-Aided Drafting</td>
</tr>
<tr>
<td>CAT</td>
<td>Category - relates to communication cable types such as CAT5, CAT6, etc.</td>
</tr>
<tr>
<td>CIP</td>
<td>Capital Improvement Project</td>
</tr>
<tr>
<td>CLX</td>
<td>Allen-Bradley ControlLogix PLC</td>
</tr>
<tr>
<td>CPU</td>
<td>Central Processing Unit</td>
</tr>
<tr>
<td>DAS</td>
<td>Data Acquisition Server (Wonderware)</td>
</tr>
<tr>
<td>DASABCIP</td>
<td>Data Acquisition Server – Allen Bradley IP Driver</td>
</tr>
<tr>
<td>DASABTCP</td>
<td>Data Acquisition Server – Allen Bradley TCP driver</td>
</tr>
<tr>
<td>DASMBTCP</td>
<td>Data Acquisition Server – Allen Bradley Modbus TCP driver</td>
</tr>
<tr>
<td>E&amp;C</td>
<td>Engineering and Construction</td>
</tr>
<tr>
<td>EMSC</td>
<td>Environmental and Maintenance Services Center</td>
</tr>
<tr>
<td>FAT</td>
<td>Factory Acceptance Test</td>
</tr>
<tr>
<td>FBD</td>
<td>Function Block Diagram</td>
</tr>
<tr>
<td>GUI</td>
<td>Graphical User Interface</td>
</tr>
<tr>
<td>HART</td>
<td>Highway Addressable Remote Transducer (Communication protocol feature on some instrumentation)</td>
</tr>
<tr>
<td>HMI</td>
<td>Human Machine Interface</td>
</tr>
<tr>
<td>ID</td>
<td>Identification</td>
</tr>
<tr>
<td>IO or I/O</td>
<td>Input/Output - refers to process signals or signal processing equipment</td>
</tr>
<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
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4.0 Overview

The following sections detail the required standards and provide development guidance for the HMI and OIT platforms components of the PCS. These screens allow process operators to perform the required process control and monitoring functions from Area Control Stations (ACS) located throughout the plant.
5.0 Network Architecture

5.1 Server and Software Architecture

Figure 5-1 diagram illustrates the PCS Software features and installation locations.

System features include:

- Single Galaxy repository server
- Redundant Application Object Servers (AOS) for each processing site
- Redundant data acquisition servers (DAS) for each processing site
- Redundant thin client servers for each processing site
- Historian store and forward (prevents data-loss by locally buffering data in the event the historian connection is lost)
- Historian for each processing site
- Single process data management system (PDMS)

5.2 PCS Network Architecture

Figure 5-2 depicts the PCS network architecture from a Wonderware DAS to an I/O Device. For simplicity, a single PLC is shown here to represent a typical installation; full network architecture examples are provided in Appendix A.
5.3 Virtual Local Area Networks

Each processing site contains two virtual local area networks (VLANs); the primary VLAN is utilized for all PCS communications. A secondary VLAN is installed for network switch management. IP address and VLAN assignment requests shall be submitted to the PC&A manager.

Table 5-1 - Existing VLAN

<table>
<thead>
<tr>
<th>Location</th>
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<tbody>
<tr>
<td>Westerly</td>
<td>VLAN12</td>
</tr>
<tr>
<td>Easterly</td>
<td>VLAN16</td>
</tr>
<tr>
<td>Southerly</td>
<td>VLAN20</td>
</tr>
<tr>
<td>REF</td>
<td>VLAN28</td>
</tr>
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</table>

Table 5-2 Typical VLAN Subnet

<table>
<thead>
<tr>
<th>VLAN</th>
<th>Subnet</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCS</td>
<td>192.168.14.XX</td>
</tr>
<tr>
<td>Network Management</td>
<td>192.168.12.XX</td>
</tr>
</tbody>
</table>
5.4 Network Management

The District has deployed LANSweeper for network inventory management at each processing facility. All new network devices must have simple network management protocol (SNMP) information configured for integration with this software.

Using the network switch configuration software, enable SNMP. All available alarms shall be set for SNMP trap and SNMP system location name shall be set to match the name of the enclosure in which the switch is installed.

Example: ENCLOSURENAME_SW_#, where the number is unique for each switch in the enclosure. Refer to Process Control System Standards and Conventions Manual, Volume 5, Section 7.3 for Control Panel (Enclosure) Identification conventions.

6.0 Applications

All new HMI screens are required to be developed using the latest available NEORSD provided Galaxy .cab file (or equivalent). This file will contain all the currently available (released) standard library objects from the Wonderware System Platform application to support development activities.

This export will be re-created periodically as functional elements are added and/or enhanced. Additionally, other exports will be created as required in order to maintain an appropriate level of application consistency between the NEORSD master galaxy and any standalone in development.

Each project shall request, via email to District project manager (or assigned District Process Controls and Automation (PC&A) contact), a copy of the current Galaxy .cab file immediately prior to initiating programming activities. Programmer will be directed to a specific file and location on the District Galaxy server for use. Although updates to the standard may occasionally occur, the file provided on request date shall be utilized throughout the project. Only those updates which are determined mission critical (have severe consequences to operations, life or equipment safety) will be handled on a case by case basis through direct notice to programmers by PC&A.

The NEORSD Wonderware System Platform HMI is a managed InTouch application which has been developed using custom NEORSD developed library template objects. Refer to the NEORSD Standard Object Library Programming Guideline for details on the currently available object template library or submit an email request to the District project manager.

Note: No InTouch tags (placeholders) are to be used without NEORSD pre-approvals. All operator screens shall be constructed using NEORSD template objects and graphic symbols.

All new applications must be developed within software environments that use matching application software revisions, service packs, patches etc. to those at NEORSD. Software developed using outdated revisions will not be accepted for import into the NEORSD galaxy.
Current supported version list is available on PC&A SharePoint site or by request to PC&A manager.

7.0 Wonderware Key Concepts

The Wonderware System Platform product contains key concepts that need to be understood in order to plan, design, and implement an application. Some key concepts include DAS (supply data to client nodes), alarm DB logger manager, application servers, Galaxy repository, historian, information server, and HMI clients.

At NEORSD there is a SuiteLink client instance for each PLC in the system (ControlLogix, PLC5/SLC500, or ModbusTCP).

- For PLC5 or SLC500, the specific SuiteLink client instances contain a mapping conversion table that provides the link between standard object attributes and the PLC data registers. The DASABTCP I/O server is used.
- For ControlLogix, the SuiteLink communicates via DASABCIP I/O server directly to the tag names in the processor without the need for the mapping conversion table or PLC5 SuiteLink client instances. The DASABCIP I/O server is used.
- For ModbusTCP, the specific SuiteLink client instances contain a mapping conversion table that provides the link between standard object attributes and the PLC data registers. The DASMBTCP I/O server is used.

In order to successfully connect a PLC to Wonderware, the DA servers must be set up to poll the PLC using the appropriate protocol (DASABTCP or DASABCIP), and the PLC must have a properly configured SuiteLink instance within the NEORSD Galaxy.

Wonderware System Platform objects run within engines that are hosted on application servers. The application servers are load sharing redundant servers (two per site hosted in different physical locations for physical equipment redundancy) and are capable of completely running the system in the event of a server failure. InTouch applications providing the runtime process screens are deployed to individual clients within the galaxy. The system runs in a server-client configuration where the application servers host the galaxy objects (Wonderware System Platform database) and the clients display the information.

8.0 Graphics Display Hierarchy

Graphics display hierarchy includes multiple levels. The graphics hierarchy shall be maintained such that no more than two clicks are required to navigate to any process screen from any location. The graphics provide progressive layers of system details ranging from plant and area overviews to specific equipment details; each of these layers are described in subsequent sections of this volume.

Figure 8-1 shows an overview of the graphic display hierarchy.
8.1 Overview

The overview provides a bird’s eye view of the entire plant/facility and all sub-areas (unit processes) are accessible from this level. The overview screen has graphic pushbuttons which the user can navigate to a specific sub-area or unit process area. The user cannot monitor or control any equipment belonging to the sub-areas from the overview screen. The overview is a means to display a static descriptive image of the plant/facility and a means to navigate down to any specific sub-area.

Figure 8-2 is an example of an overview graphic screen for the Southerly Wastewater Treatment Plant (WWTP) which is the first graphic displayed when the HMI application is initiated.
8.2 Graphic Screen (Process Unit)

This view displays the process unit screen. The plant/facility will be subdivided into various process units and components of these process units will be displayed on the process unit screen. Depending on the equipment in each process unit more than one graphic screen may be required for a single process unit.

Figure 8-3 is an example of a process unit screen at the Southerly WWTP.
Figure 8-3 Process Unit Screen Example

The unit process screens shall be developed using the P&IDs to define the layout of the displays. All PCS controlled processing equipment shall be shown on the screens. Hand valves and other ancillary equipment should only be shown when necessary to clarify the process flow. NEORSD Standard Object Library shall be used for all animated display components. All process pipes shall be colored to match color standard defined in Section 22.4.3 of this volume.
8.3 Faceplate Display

Faceplate display provides an equipment control level to enable management of all statuses, alarms and operating modes for the concerned equipment. This view enables the operator to take control action on the associated equipment. From the graphic screen for a particular process unit the operator can click on the equipment object to bring up its associated window. Interactions with faceplate control elements is restricted by security group as described in Section 9 of this volume.

Faceplates are further described in Section 12 of this volume.

9.0 Graphics Display Security

Security settings let you control access to:

- User interfaces in the ArchestrA environment
- Object attributes and associated data
- Connection to the SQL Server database used for the Galaxy Repository.

The security schema managed in a Galaxy is a three-level configuration model to create and maintain the following:

- Users associated with specific roles
- User roles associated with specific system administration, configuration and run-time (operational) permissions, which map to security groups;
- Security groups associated with specific objects in the Galaxy. Every object in the Galaxy belongs to only one security group. These security groups are mapped to roles.

9.1 Platform/Application Security

The application security has been configured as follows:

- Authentication mode = OS group based (security model)
- Configurable intervals
  - Security groups
    - 18_Opers
    - 2798_Opers
    - Admin
    - Managers
    - Default
  - Users and roles
    - Administrator
- Default
- NEORSD\HMI Programmers
- NEORSD\18_Opers
- NEORSD\2798_Opers
- NEORSD\Facility_Managers
- NEORSD\Domain_Programmers
- NEORSD\REF_Programmers
- NEORSD\Administrators
- NEORSD\Automation_Admins

- User ID and password authentication = OS group based
- By default, setpoint changes are allowed by normal operator access

9.2 Galaxy Security Role – Default
By default, all currently used objects are assigned to a security group called Default. A user who is a member of a role assigned to Security Role “Default” has permission to:

- View only, no Wonderware System Platform or InTouch permissions
- Print displays
- Access level = 0
- General permissions = None
- Operational permissions = None

9.3 Galaxy Security Role – 18_Opers (Incinerator Group)
The 18_Opers role is comprised of the union members of the Incinerator operations group. A user who is a member of a role assigned to Security Role “18_Opers” has permission to:

- Restrict Wonderware System Platform permissions
- Enable basic controls within InTouch (turn pumps on/off, open/close valves, change from auto/man, etc.) and specific setpoints required for operations
- Enable only to control equipment within specified areas (details provided by District/Wonderware System Platform)
- Access level = 500
- General permissions = None
- Operational permissions
  - 18_Opers
    - Enable acknowledge alarms
    - Enable modify configure attributes
    - Enable modify operate attributes
    - Enable modify tune attributes
9.4 Galaxy Security Role – 2798_Opers (General WWTP Operator Group)

The 2798_Opers role is comprised of the union members of the General WWTP operations group. A user who is a member of a role assigned to Security Role “2798_Opers” has permission to:

- Restrict Wonderware System Platform permissions
- Enable basic controls within InTouch (turn pumps on/off, open/close valves, change from auto/man, etc.) and specific setpoints required for operations
- Enable only to control equipment within specified areas (details provided by District/Wonderware System Platform)
- Access level = 500
- General permissions = None
- Operational permissions
  - 2798_Opers
    - Enable acknowledge alarms
    - Enable modify configure attributes
    - Enable modify operate attributes
    - Enable modify tune attributes

9.5 Galaxy Security Role – Facility_Managers

The Facility_Managers role is comprised of Supervisors, Managers and Superintendents. A user who is a member of a role assigned to Security Role “Facility_Managers” has permission to:

- Restrict ArchestrA permissions
- Enable basic controls within InTouch (turn pumps on/off, open/close valves, change from auto/man, etc.) as well as setpoints restricted to the operators
- Reset the runtime values and start counts for motorized equipment
- Access level = 1000
- General permissions = None
- Operational permissions
  - 18_Opers
    - Enable acknowledge alarms
    - Enable modify configure attributes
    - Enable modify operate attributes
    - Enable modify tune attributes
  - 2798_Opers
    - Enable acknowledge alarms
    - Enable modify configure attributes
    - Enable modify operate attributes
    - Enable modify tune attributes

The Programmers role is comprised of PC&A and Contractors. A user who is a member of a role assigned to Security Role “Programmers” has permission to:

- All permissions of Facility_Manager plus restricted Wonderware System Platform permissions.
- Within Wonderware System Platform, enable derive new instances, create/edit windows, etc.
- Restrict edit/create templates
- Access level = 9000
- General permissions
  - IDE Permissions
    - Enable start the IDE
    - Importing and exporting
      - Enable utilize Galaxy load/Galaxy dump
    - General configuration
      - Enable modify deployed instances
      - Enable ability to disable change comments
      - Enable override checkout
      - Enable upload from runtime
    - System configuration
      - Enable create/modify/delete system object Instances (platforms and engines)
      - Enable create/modify/delete area objects
    - Device integration objects
      - Enable create/modify/delete device integration object instances
    - Application configuration
      - Enable create/modify/delete application object instances
    - Deployment permissions
      - Enable deploy/undeploy system objects
      - Enable deploy/undeploy area objects
      - Enable deploy/undeploy application objects
      - Enable deploy/undeploy device integration objects
      - Enable mark an object as undeployed
    - Graphic management permissions
      - Enable create/modify/delete view applications
      - Enable deploy/undeploy view applications
  - System management console (SMC) permissions
    - Enable start the SMC
    - Enable start/stop engine/platform
    - Enable write to GOBJECT attributes using object viewer
- Operational permissions = All
9.7 Galaxy Security Role –
Administrator/Administrators/Automation Admins

The Administrator role is comprised of specific PC&A personnel. A user who is a member of a role assigned to Security Role “Administrator” has permission to:

- Default Wonderware user with full control of the Wonderware System Platform and InTouch.
- Access level = 9999 (unchangeable)
- General permissions = All
- Operational permissions = All

9.8 Wonderware System Platform – Common Functions (InTouch)

This section contains common functions that secure InTouch include Inactivity triggers and Windows key blocks.

- Inactivity Warning – If someone is logged into the system for more than 59 minutes without any activity on the HMI node, the system will warn the user of a pending inactivity automatic logout
- Inactivity Timeout – if someone is logged into the system for more than 60 minutes without any activity on the HMI node, the system will automatically log the user off the system
- Disable ALT, ESC and Windows keys if the currently logged in user is not an administrator

9.9 Wonderware System Platform – Electronic Records

- A2ALMDB database stores events and alarms with user information within SQL on the historian
- Analog values are stored in the runtime database within SQL on the historian
- All event and alarm records are stamped with date and time in coordinated universal time (UTC)
- Electronic signatures are based on a combination of an identification code (user name) and password
- Preserving user name uniqueness can be maintained assuming users are disabled and never deleted. The PC&A group manages this function with procedural controls

10.0 Graphics Logic State Descriptors and Text

Static text and static objects are objects that do not change in response to change in input or output statuses. They retain their text color irrespective of their associated equipment run-time, alarm or maintenance status. Static text identifies the graphic screen title and static objects. All text must be in US English and all units must be in US Imperial system.
For equipment tags, all text must be uppercase. For all other text, each word in a text string must begin with an uppercase letter and the subsequent letters must be lowercase. All new words must begin in uppercase letters. All equipment must carry the same tag name as shown on the P&IDs.

All static text shall adhere to the settings shown in Table 10-1.

<table>
<thead>
<tr>
<th>Text</th>
<th>Font</th>
<th>Style</th>
<th>Size</th>
<th>Alignment</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphic screen title</td>
<td>Arial</td>
<td>Bold</td>
<td>18</td>
<td>Centered</td>
<td>Black</td>
</tr>
<tr>
<td>Equipment tag</td>
<td>Arial</td>
<td>Bold</td>
<td>14</td>
<td>Centered</td>
<td>Black</td>
</tr>
<tr>
<td>Static text</td>
<td>Arial</td>
<td>Regular</td>
<td>14</td>
<td>Justified</td>
<td>Black</td>
</tr>
<tr>
<td>Alarm summary</td>
<td>Arial</td>
<td>Regular</td>
<td>14</td>
<td>Right aligned</td>
<td>Dynamic</td>
</tr>
</tbody>
</table>

Animated or dynamic objects are associated with an equipment specific status such as on or off or in maintenance (offline), etc., or with analog values such as flow, level, pressure, temperature, etc. Dynamic objects can also be a graphic pushbutton, touch area (applicable for touchscreens only), or static text highlighted against a dynamic object (to indicate alarms or statuses).

District approved dynamic objects are contained in the NEORSD Standard Object Library; any exceptions shall submit a PCS Deviation Request Form (Reference Volume 1, Section 12) for District review and approval prior to implementation.

11 Graphics Tags
This section contains the requirements for HMI tags and is intended to provide consistent usage throughout the District.

11.1 Tag Name Standard

11.1.1 Direct Reference Tags
All references to ControlLogix tags made within a project shall be made using direct (device) reference.

Direct reference tags are used to maximize the runtime performance of tag read/write operations, minimize tag memory consumption, and remove the added HMI layer for configuration of basic display read and write operations.

11.1.2 HMI Tags
HMI tags in general shall not be used to link application elements (tag displays, trends, data log models, etc.) with ControlLogix controller tags. Instead, direct reference tags shall be used wherever possible.
11.2 Tag Configuration Standard
Reference Process Control System Standards and Conventions Manual, Volume 2, Section 12.1 for tag naming requirements.

12.0 Graphic Symbols and Object Library
The ISA 101 HMI standard is an industry standard developed by the ISA 101 HMI committee which establishes standards, recommended best practices and guidelines pertaining to HMI interfaces in manufacturing applications. The ISA 101 HMI standard serves as a guideline to help organizations design, build and operate effective HMI applications. The NEORSD Object Library incorporates recommendations from ISA 101. All new objects and displays shall follow the current ISA 101 recommendations at time of development to maintain system with latest industry standards.

The NEORSD Standard Object Library provides a set of ready to use HMI objects for use in the development of HMI graphics. The object library makes it easy to create an interface that is more consistent in both appearance and function. Some standard HMI objects include:

- Pushbuttons
- Selector switches
- Pilot lights
- Tanks and hoppers
- Pumps
- Motors
- Valves

These preconfigured objects are animated to District color standards:

- Red = Running
- Green = Stopped
- Yellow = Alarm

Graphical user interface (GUI) elements such as tooltips shall be used to display mouse-over text. When the mouse is hovered over an object, the associated tooltip shall be visible with a text describing the objects function. All equipment objects shall be configured to display device tag name on mouse-over event (see example in Figure 12-2).

![Figure 12-1 Display Example](image-url)
12.1 Scripting
Scripting is generally available within the HMI development environment. The District does not utilize scripting unless it is part of the base template library (BTL). Control logic should be completed within the PLC only. The HMI shall not calculate values or make decisions based upon multiple inputs. All logic outside of basic scripting must be completed within the PLC. Refer to PCS Standards and Conventions Manual, Volume 2 for PLC programming standards and requirements.

12.1.1 Base Template Library
The BTL is provided by Wonderware as a free utility that contains preconfigured application server objects for development use. The objects provide common HMI functions that are built using Wonderware best practices for template derivation, modeling, and scripting. The BTL serves as the framework for NEORSD application development.

Detailed information can be found in the BTL User’s Guide provided by Wonderware with the utility. Not all of the provided BTL functionality is utilized in the templates derived in the NEORSD application. In particular, the NEORSD application leverages the following:

- Automatic I/O Binding - By configuring attributes with “---”, the BTL scripting will automatically link the attribute to the device integration object or SuiteLink. This aids with linking Wonderware application data to tag information provided by the PLC.
- Object & Model Meta Data Exposure - Helps expose or pass information across the model hierarchy so that individual components can access related components in the galaxy. For example, a generic trend object called from a graphical faceplate has access to historical values and scaling needed to draw the trend for that specific faceplate instance.
The BTL scripts and attributes are found on the “m” (master) and “a” (user) levels of the derived templates. These have been developed and are maintained by Wonderware as part of the BTL. Template levels are derived from these base levels, which is where development specific to the NEORSD application occurs. These templates have the prefix of NEORSD to show they are created and maintained by the District. This template architecture allows for changes made at the NEORSD level to be cascaded to all further derived templates and instances.

Developers must avoid making any modifications to the Wonderware developed and supported “m” and “a” templates and scripts. Where unavoidable, developers must submit and receive approval of PCS Deviation Request (Reference Volume 1, Section 12). **ANY** changes made to the templates **MUST** be documented and preserved such that they can be reapplied when the next version of the BTL is imported; otherwise, the modifications will be overwritten.

### 12.1.2 General Coding Practices

Accepted best coding practices should always be applied to any code development. The District has the following general practices that should also be applied during development.

- **Native InTouch or ArchestrA button commands, object animation, macros, events, etc., should be used to perform HMI functions. When using scripts the following practices apply to InTouch, Wonderware System Platform and ArchestrA graphic scripts.**
  - All scripts should be annotated to clearly describe the functionality of the script. Make use of the native comment capabilities of the software development environment. To facilitate understanding and readability of the comments, make use of upper and lower cases when commenting.

- **Each written code module should contain a script header unless the script itself is basic in nature using standard commercial off-the-shelf functionality. When possible, create a header per the standard indicated in Figure 12-4 and contained in the supplied developers galaxy:**
  - Module name
  - Author name including company name supplying the code module
  - Brief description of the module function
  - Revision history
  - Date the module was changed
  - Name of the person making the change
  - The example below shows a typical script header

```plaintext
{***************************************************** Revision History ********************************************************
*Module Name: Script Name
*Author: First Name & Last Name (Company)
*Description: Enter a meaningful description that summarizes the functionality (purpose) of the script
*History:
```
Figure 12-4 Script Header Template

While writing scripts, it is important to apply consistent formats and structure. All scripts should apply the following recommended practices:

- Large scripts should be separated into smaller functional elements with each major part commented to indicate what it is doing.
- Show nesting structures clearly by making use of multi-line IF THEN ELSE coding practices.
- Use consistent indentation to show nesting structures clearly. For example make use of multi-line IF-THEN-ELSE and For-Next loops.
- If in-line comments are used make sure they line up to the right of the executable code.
- Add a blank line after the header, after variable declarations, and above and below nested structures (IF-THEN_ELSE, For-Next etc.)

Dead code shall not be left in place. Dead code is defined as code that is resident in the program but cannot execute. Code that has been commented out is considered dead code. Comments that explain the function of the code are not considered dead code.

13.0 Graphics Faceplates

Each process display graphic screen provides statuses, alarms and operating modes for all equipment associated with that graphic screen. From the process display graphic screen, the operator shall be able to take control action for equipment associated with the faceplate. Clicking on the equipment object shall bring up a specific faceplate associated with that equipment.

Faceplate display should allow the operator to monitor and control the action of a pump, motor, valve or analog value for operational, maintenance, engineering, alarming or trending purposes.

When the equipment has been designated as out of service its faceplate should highlight an out of service status. When the equipment is locked and tagged out, the associated start/stop or auto/manual buttons should be rendered unavailable (greyed out) for the operator to avoid accidentally energizing the associated circuit.
13.1 Naming Convention
The District’s defined naming conventions shall be followed for all program development including Wonderware HMI screen names.

The filename format is as follows:

[Location][Building number]_[System/Process]_[Description]

Example: W84_PEPS_OVERVIEW

Where:

- W = Westerly
- 84 = Building number
- PEPS = system process, primary effluent pumps
- Overview = description

Reference Process Control System Standards and Conventions Manual, Volume 2, Section 12.1 for naming requirements including plant descriptors, area names and abbreviations.

14.0 Graphics Display Alarms

14.1 Alarm Displays by Priority Level
The NEORSD Standard Object Library contains objects with pre-defined alarm attributes and animations. Currently, there is no differentiation within the process displays for alarm levels.

14.2 Alarm and Event Messages
Alarm and event messages shall be configured utilizing plain English to describe the alarm clearly to an operator. Alarm message shall not contain the tag name in the message. Alarm messages are limited to 50 characters to fit within the configured alarm banners.

Example: “Polymer Pump 1 Overload” or “Effluent D.O. High High Level”

All alarm messages shall be submitted for District approval prior to implementation.

14.3 Alarm Acknowledgement, Suppression and Shelving
Alarm handling methods and user privileges are detailed in District Alarm Management Strategy Volume 5, Section 10.
15.0 Alarm Configuration

15.1 Overview
Alarm configuration requirements are contained in District Alarm Management Strategy, Volume 5, Section 12. Any alarm modification, addition or deletion must follow alarm definition and rationalization procedures discussed in the alarm management strategy prior to implementation.

It is important to note that although OIT and HMI system functions can be used to monitor and generate alarms, in the District’s PCS process alarms shall be generated in the PLCs which will be logged and displayed on the HMI and OITs. HMI application shall not be configured to perform alarm calculations. HMI generated alarms will be utilized only for alarms and events initiated from within the HMI software such as software status alarms, loss of communications with a PLC and other system level alarming.

Where necessary, alarm limits must be adjustable through the HMI graphics screens; however, those alarm limits will be used by the PLC in determining if there is an alarm condition. The nature of the distributed PCS is such that the PLC-based process control logic can and will continue to operate, even if one or more HMIs become unavailable. As a result, the PLC must be able to determine alarm conditions and act accordingly without the need for continuous communication with the HMI system.

The NEORSD Standard Object Library and add-on instruction (AOI) standard library objects shall be utilized for configuration of PLC and HMI.

15.2 Nuisance Alarm Suppression Techniques
All nuisance alarm suppression shall be by approved methods documented in District Alarm Management Strategy (Reference PCS Standards and Conventions Manual, Volume 5, Section 10.0) including, but not limited to, state-based or state dependent alarms, time delay, filtering, and first-out logic.

15.3 Commissioning Requirements
Commissioning activities create abnormal alarm situations; this section contains requirements for alarm and event system during commissioning activities.

15.3.1 Operational Readiness Review Meetings
Alarms and events risk review shall be reviewed at operational readiness meetings to determine alarm owner (contractor or operations) based on risk to process and processing equipment.

15.3.2 Alarms in Active Commissioning State
Alarms and events which are not turned over to operations at operational readiness review are required to be suppressed by means of PLC logic suppression outside of testing hours to avoid presenting operators with nuisance and/or unknown alarms.
15.3.3 Alarm and Event Acceptance Matrices
The District utilizes the defined average alarm rate of less than six alarms per hour period as defined in alarm management strategy as maximum allowable alarm rate for acceptance of modifications to alarm system. After commissioning activities have been completed, system shall run for 30 days in hands-off mode to document alarm rates for modified alarms.

16.0 Alarm Graphics

16.1 Colors
Alarms of different priorities are displayed on the alarm footer and alarm summary using different colors and animations to aid in their identification. Color configuration for alarms is shown in Table 16-1.

<table>
<thead>
<tr>
<th>Alarm Priority</th>
<th>Alarm Level</th>
<th>Text/Foreground</th>
<th>Background</th>
<th>Text/Foreground</th>
<th>Background</th>
<th>Text/Foreground</th>
<th>Background</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High</td>
<td>White</td>
<td>Red</td>
<td>Red</td>
<td>White</td>
<td>White</td>
<td>Gray</td>
</tr>
<tr>
<td>2-500</td>
<td>Med</td>
<td>Black</td>
<td>Yellow</td>
<td>Yellow</td>
<td>Black</td>
<td>White</td>
<td>Gray</td>
</tr>
<tr>
<td>501-750</td>
<td>Low</td>
<td>White</td>
<td>Blue</td>
<td>Blue</td>
<td>White</td>
<td>White</td>
<td>Gray</td>
</tr>
<tr>
<td>950-998</td>
<td>Nuisance</td>
<td>White</td>
<td>Green</td>
<td>Green</td>
<td>White</td>
<td>White</td>
<td>Gray</td>
</tr>
<tr>
<td>999</td>
<td>Comm</td>
<td>White</td>
<td>Green</td>
<td>Green</td>
<td>White</td>
<td>White</td>
<td>Gray</td>
</tr>
</tbody>
</table>

*Note: Priorities 751 to 949 are being reserved for potential future development.

Alarm priorities 950-999 are not shown on the alarm footer and by default are not shown on the alarm summary window. These alarms are viewable on the alarm summary window by selecting the appropriate filter.

16.2 Graphics
This section discusses how the alarm graphic displays are configured. These screens shall not be modified without District Approval.

16.2.1 Alarm Indications
- Active alarms that are unacknowledged will blink with the alarm priority color (Flash Unack Alarms)
- Active alarms that are acknowledged will stop blinking when acknowledged
- Inactive alarms that are unacknowledged remain in the alarm summary queue until cleared by acknowledgement

16.2.2 Alarm Footer
The footer displays all of the alarms with priorities 1-949. Alarms are sorted by the time of the alarms. The column details of the footer are state, time, name, value, alarm comment, and priority (through displayed alarm color). Figure 16-1 displays an example footer.

This graphic is also called:
Figure 16-1 Alarm Footer Example

16.2.3 Alarm Summary

The alarm summary allows the user to see current alarms as well as historical alarms and events. The user may acknowledge an individual alarm, a group of alarms, or all alarms and add an alarm comment. Filtering is also available to allow the user to sort by state or priority. Figure 16-2 is a screenshot of the alarm summary with a description of each of the functions. This graphic is called:

- AlarmSummary_Easterly
- AlarmSummary_Southerly
- AlarmSummary_Westerly
- AlarmSummary_EMSC

Figure 16-2 Alarm Summary – Facility Screen Example
Table 16-2 describes the functions with numerical index in Figure 16-2.

Table 16-2 Alarm Element Descriptions

<table>
<thead>
<tr>
<th>Graphic Number</th>
<th>Design Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type</td>
<td>The type section allows the user to choose whether current or historical alarms and events are displayed. When historical options are selected, a time picker will appear to the user to choose the date range.</td>
</tr>
<tr>
<td>2</td>
<td>State</td>
<td>The state section allows the user to choose whether acknowledged and/or unacknowledged alarms are displayed.</td>
</tr>
<tr>
<td>3</td>
<td>Priority</td>
<td>The priority section allows the user to choose whether critical, high priority, low/nuisance, maintenance, or all alarms are displayed.</td>
</tr>
<tr>
<td>4</td>
<td>Apply button</td>
<td>The apply button, when pressed, will apply the state and priority selections to the alarm summary.</td>
</tr>
<tr>
<td>5</td>
<td>Comment</td>
<td>The comment section allows the user to acknowledge a single alarm or all alarms. The user can elect to leave a comment in the input box to clarify the reasoning for the alarm and its acknowledgment. The user must be logged in and have sufficient access level to acknowledge the alarm.</td>
</tr>
</tbody>
</table>

16.2.4 Alarm Summary_System

Figure 16-3 contains an example alarm summary graphic which displays all the current system alarms in the system. This graphic is also called:

- Alarm Summary_Easterly_System
- Alarm Summary_Southerly_System
- Alarm Summary_Westerly_System
- Alarm Summary_EMSC_System

![Alarm Summary System Screen Example](image)

Figure 16-3 Alarm Summary - System Screen Example

Table 16-3 describes the functions with numerical index in Figure 16-3.

Table 16-3 Alarm Element Descriptions

<table>
<thead>
<tr>
<th>Graphic Number</th>
<th>Design Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>System alarm query</td>
<td>This graphic displays all of the system alarms, sorted by the time of the alarms. The column details of this section are state, timeLCT, name, value, alarm comment, and priority (thru alarm color).</td>
</tr>
<tr>
<td>2</td>
<td>Type</td>
<td>This graphic displays the type of the selected alarm from the distributed alarm query.</td>
</tr>
</tbody>
</table>
### Alarm Banner (Alarm Screamer)

The Wonderware Alarm Screamer faceplate, shown in Figure 17-1, reopens/positions itself over every screen in the plant to notify operators of the highest priority alarms that require immediate action. The naming format is as follows:

- `AlarmScreamer_plant`, where `plant` is Easterly, Westerly, Southerly.

<table>
<thead>
<tr>
<th>Graphic Number</th>
<th>Design Element</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>ACK button</td>
<td>This graphic button allows the user to acknowledge a select alarm.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>ACK ALL button</td>
<td>This graphic button allows the user to acknowledge all unacknowledged alarms.</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 17-1 Alarm Screamer - System Screen Example**

Table 17-1 describes the functions with numerical index in Figure 17-1.
### 18.0 Alarm Engine and Historian Configuration

This section contains specific requirements for alarm and event, and historian software configuration. These settings shall not be modified by anyone other than Administrator.

#### 18.1 Engine For Alarm Log Service

##### 18.1.1 Description

The District’s EngineForAlarmLogService activates and disables the alarm logging service on each application object server (AOS) node and prevents both alarm loggers from running simultaneously. This is necessary to make the alarm logging redundant and prevents historical alarms from being lost.

##### 18.1.2 Functional Details

- Activates the redundant alarm logging engine on the backup AOS platform when a failover event occurs. This script starts the alarm logging engine because there is not any support in Server 2008 for this to run as a service.
- Based on location, the engine name in the engine user-defined alarm (UDA) must be updated.

##### 18.1.3 General

Table 18-1 contains the required alarm logging parameter settings.

#### Table 18-1 Alarm Logging Service Element Descriptions

<table>
<thead>
<tr>
<th>Design Element</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine startup type</td>
<td>Auto</td>
</tr>
<tr>
<td>Engine restart</td>
<td>Checked</td>
</tr>
<tr>
<td>Scan period</td>
<td>1000 ms</td>
</tr>
<tr>
<td>Enable storage to historian</td>
<td>Unchecked</td>
</tr>
<tr>
<td>Maximum time for scripts to execute</td>
<td>1000 ms</td>
</tr>
<tr>
<td>Maximum asynchronous thread count</td>
<td>5</td>
</tr>
<tr>
<td>Checkpoint period</td>
<td>0 ms</td>
</tr>
<tr>
<td>Checkpoint directory location</td>
<td>C:\Checkpoint</td>
</tr>
<tr>
<td>Alarm throttle limit</td>
<td>2000 alarms/s</td>
</tr>
<tr>
<td>Statistics average period</td>
<td>10000 ms</td>
</tr>
<tr>
<td>Maximum queue size</td>
<td>16 MB</td>
</tr>
<tr>
<td>Engine failure timeout</td>
<td>10000 ms</td>
</tr>
<tr>
<td>Maximum number of consecutive data notification failures allowed</td>
<td>0</td>
</tr>
</tbody>
</table>
18.1.4 Redundancy
Table 18-2 contains the required redundancy settings.

Table 18-2 Redundancy Element Descriptions

<table>
<thead>
<tr>
<th>Design Element</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enable redundancy</td>
<td>Unchecked</td>
</tr>
</tbody>
</table>

18.1.5 R/W Interrupts
Table 18-2 contains required read/write interrupt settings.

Table 18-3 R/W Interrupt Element Descriptions

<table>
<thead>
<tr>
<th>Design Element</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of read/write interrupts</td>
<td>5</td>
</tr>
<tr>
<td>Enable standard interrupts</td>
<td>Unchecked</td>
</tr>
</tbody>
</table>

18.1.6 Attributes
Table 18-4 contains attribute settings for the alarm services.

Table 18-4 Attribute Element Descriptions

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almdb_setservice</td>
<td>Boolean</td>
<td>Turns the alarm logging service on through the setservice script</td>
</tr>
<tr>
<td>AlmDBLogRunning</td>
<td>Boolean</td>
<td>Checks to see on which node the alarm logger is running</td>
</tr>
<tr>
<td>Engine</td>
<td>String</td>
<td>Provides engine name for setservice script. Based on location, engine name must be changed</td>
</tr>
</tbody>
</table>

18.1.7 Scripts
Table 18-5 contains a listing of scripts and execution types.

Table 18-5 Script Element Descriptions

<table>
<thead>
<tr>
<th>Script</th>
<th>Execution Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALMDB</td>
<td>Execute</td>
<td>Restarts the engine when the platform changes</td>
</tr>
<tr>
<td>onscan</td>
<td>Execute</td>
<td>Triggers the setservice script when the object is on scan</td>
</tr>
<tr>
<td>Setservice</td>
<td>Execute</td>
<td>Starts and Stops the alarm DB logger depending on which platform the object is hosted</td>
</tr>
<tr>
<td>Setservice</td>
<td>Shutdown</td>
<td>Kills the Logger Service when the object is shutdown</td>
</tr>
</tbody>
</table>
18.1.8 Graphics - DBLoggerConnection
The database (DB) logger connection graphic displays a constant string of DB logger status followed by a dynamic string value that says ‘Running’ in black when the DB logger is running and has a connection with the PLC and ‘Stopped’ in black when it is not.

![DB Logger Status Stopped](image)

Figure 18-1 DB Logger Graphic

Table 18-6 DB Logger Element Description

<table>
<thead>
<tr>
<th>Graphic Number</th>
<th>Design Element</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DB Logger Status</td>
<td></td>
<td>This graphic string displays the status of the DB logger. The string displays running and stopped to show when the DB logger is logging data.</td>
</tr>
</tbody>
</table>

Instances

- EngineForAlmLogService_E_AOS1
- EngineForAlmLogService_E_AOS2
- EngineForAlmLogService_S_AOS1
- EngineForAlmLogService_S_AOS2
- EngineForAlmLogService_W_AOS1
- EngineForAlmLogService_W_AOS2
- EngineForAlmLogService_C_AOS1
- EngineForAlmLogService_C_AOS2

18.2 Historian

18.2.1 Description
The historian object is used to trigger alarms based upon the historian’s condition.

18.2.2 Functional Details
Creates alarms in the galaxy if there are issues with the historian that are not generated by default within the galaxy. Examples include critical alarms (if more than x alarms generated), DataAcqRate, SysWarning, and SysFatalErrors.

18.2.3 Attributes
Table 18-7 describes the historian engine alarm attributes.
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Data Type</th>
<th>Description</th>
<th>Alarm Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>SysCritErrCnt</td>
<td>Integer</td>
<td>Total critical errors since startup. If above the value of three an alarm will occur.</td>
<td>500</td>
</tr>
<tr>
<td>SysDataAcqOverallItemsPerSec</td>
<td>Integer</td>
<td>Items per second received by the historian. If the value drops below nine an alarm will occur.</td>
<td>500</td>
</tr>
<tr>
<td>SysErrErrCnt</td>
<td>Integer</td>
<td>Total non-fatal errors since startup. If the value goes above six an alarm will occur.</td>
<td>500</td>
</tr>
<tr>
<td>SysFatalErrCnt</td>
<td>Integer</td>
<td>Total fatal errors since startup. If the value goes above one an alarm will occur.</td>
<td>500</td>
</tr>
<tr>
<td>SysWarnErrCnt</td>
<td>Integer</td>
<td>Total warnings since startup. If the value goes above 26 an alarm will occur.</td>
<td>750</td>
</tr>
</tbody>
</table>

Instances
- Southerly_Historian
- Westerly_Historian
- Easterly_Historian
- EMSC_Historian

19.0 Ancillary and System Status Screens

19.1 Overview
Any PCS system modification project that includes addition of a PLC is required to provide displays depicting PLC hardware health and status information. These screens are built using standard PLC module diagnostic global objects distributed by the District to provide maintenance personnel with real time module channel status and diagnostic information. These screens are designed to provide view only information and are primarily intended for maintenance and troubleshooting activities. Approved objects and their usage is covered in Section 8 of the NEORSD Standard Object Library Programming Guideline document.

19.2 Screen Requirements and Architecture
The Developer shall create and/or modify the standard maintenance and troubleshooting displays described in sections below:

19.2.1 Maintenance Overview
The maintenance overview display is a single screen that is intended to summarize the architecture of the viewed PLC system. The display graphically shows the number of and type of PLC racks, OITs, and network types (Ethernet, Modbus, etc.). Objects on the maintenance graphic are static; they are not animated and do not provide status information.

The District standard DIAGNOSTIC LIBRARY file contains symbols specific for generating the maintenance overview display.
19.2.2 PLC Rack Displays
A separate maintenance display shall be created for every PLC rack contained within the architecture. Each display shall display a single PLC rack detailing the chassis size, module configuration, and current module health (OK, FAULT).

The District standard DIAGNOSTIC LIBRARY file contains PLC rack and chassis elements as well as global object module symbols for use in generating the rack displays. Module symbols require configuration.

19.2.3 Module Faceplate Displays
Specific module information is provided on faceplates incorporated into the standard diagnostic symbols. Faceplates display module and loop information including channel state (on/off, analog %), channel faults, device tag (from P&IDs), device description (from I/O list), device units (analog inputs), and other relevant module configuration settings.

Most diagnostic templates read RSLinx Enterprise and ControlLogix module defined tag data to gather diagnostic information. Generally no ControlLogix AOI or programming is required.

If the diagnostic template for a specific module is not available in the District’s DIAGNOSTIC LIBRARY file, the contractor shall create a new template, using one of the existing templates as a model.

19.3 Navigation
NEORSD Wonderware application has been developed with a horizontal menu bar system for navigation between graphics display. Projects that require new screens to be added or screens to be removed are responsible for modification of the navigation menu bar. Menu bar groupings are by plant and then process area, if new displays do not fit within a logical process area then review and approval of proposed menu changes by District is required. Figure 19-1 contains an example menu bar.

![Figure 19-1 Navigation Graphic](image-url)
20.0 Graphics Display Trends

20.1 Trend Overview
NEORSD Standard Object Library contains preconfigured AOIs to interface with the Wonderware trend object. Developers shall utilize the base trend template contained in the galaxy’s global objects for configuration of new saved trend displays.

20.2 Trend Groups
All analog signals must include appropriate trending. All analog I/O shall be configured utilizing the analog object using district standard AOI. PCS modifications requiring removal of analog I/O are required to review saved trending groups and remove the deleted tag (abandon in place is not acceptable).

New processing equipment requires new saved trend groups and addition of analog instrumentation to existing equipment shall be incorporated into the existing equipment trending group.

Pre-configured trend groups are required to display both individual equipment performance as well as performance of the system. Trend groups shall be submitted to the District for approval prior to factory acceptance testing (FAT) and functionality reviewed at the FAT.

Example groups:

- Equipment: Blower 1
  - Blower Running
  - Blower Amps
  - Blower Temperature(s)
  - Blower Vibration(s)
  - Blower Discharge Pressure
- System: Blower System
  - Blower 1, 2, x – Discharge Pressures
  - Blower 1, 2, x – Discharge Temperatures
  - Air Header Pressure
  - Air Header Temperature
  - Branch Pressures

20.2.1 PID Control Loops
All configured PID loops shall have a saved trend group developed. Trend group shall include process variable (PV), setpoint (SP), and control variable (CV). Cascaded loops and interrelated signals for feed forward, trim and other modifications to the PID shall be included on the saved trend. Figure 20-1 provides one example PID group.
20.3 Trend Colors
The colors within the example trend in the base project shall be used for all trending within the application. The color standards are listed below:

- Background, Black
- Text Color, White
- Grid (X,Y axis), Dark Gray
- Pens, in increasing order, see below

Use of the default trend object pen colors established in the template (in increasing order: blue, light green, red, magenta, white, dark green, yellow, light blue) is required.

20.4 Refresh Rate
A refresh rate of two seconds shall be chosen for trending process data. The developer may select a slower refresh rate based upon the process.

20.5 Trend History
The application shall provide operators the ability to toggle between real-time and historical trends. Trend durations are limited by the historian server roll-up and processing speeds. Trends requiring data spans beyond 60 days shall be reviewed and approved by the District during pre-Programming Workshop.

20.6 Maximum Pens per Trend
Limit the number of pens per trend to eight or less.

20.7 Custom Trends
The application shall be configured to allow user groups at level of operator (18_Opers and 2798_Opers) and above the ability to generate ad-hoc trend displays and save for future use. Ad-hoc trend displays shall allow operator to choose pens to display (up to eight), colors per pen, time and range settings, and historical or real-time trend. All other settings shall be inherited from the parent. Reference Section 9.0 for user security groups.
21.0 Reporting
HMI (SCADA) data is transferred electronically from the Wonderware System Platform to the operations data management system (ODMS). Transfer of data occurs daily and automatically. Data transfer time of day shall be coordinated with the District Commissioning Manager. All reports are generated from ODMS. Specific reporting requirements are contained in Volume 4 of this standard.

22.0 Operator Interface Terminal

22.1 Introduction
For the OIT, NEORSD has standardized on the 15 inch Allen-Bradley PanelView Plus 7 Performance model with touchscreen. This section contains programming standards and conventions which are designed to promote consistency and familiarity in design and layout across all OITs installed within the District.

The practices outlined in this section shall be used in conjunction with the NEORSD Standard Object Library Programming Guideline and base PanelView Plus 7 reference project file.

OITs shall be installed on a local PLC network separate from the distributed PCS network. Installation on an isolated local network allows operations to control process equipment connected to the OIT’s designated PLC in the event of a PCS network backbone failure.

OIT graphics shall contain functionality required to run process equipment in a designated OIT mode as defined in the respective process control description (PCD) for the specific project.

All control functionality programmed on the OIT shall be duplicated at the HMI level.

22.2 PanelView Plus Framework

22.2.1 Overview
The District maintains a base PanelView Plus project to provide integrators with a starting point in creating new applications. The base project contains example displays that use the screen size, font, display colors, etc., and other application attributes that adhere to the standard as described in the sections below.

The District standard is for PanelView Plus 7 Performance with touch screen.

The base PanelView Plus project also contains a set of global objects that provide the foundation for PanelView Plus application development. The global objects templates are designed to simplify PanelView Plus application development as well as promote consistency on HMI interfaces both between systems and across PanelView Plus and Wonderware platforms.
22.2.2 Standardized Objects and Functions
The PanelView Plus global objects standard library contains object symbols that may be
dragged and dropped into PanelView Plus HMI graphics. These symbols are already configured
for animation, textual message displays, and faceplate links for operator interaction. It is the
application programmer’s responsibility for selecting the correct global object from the library
and configuring that particular instance for ControlLogix tag and description attributes.

22.3 Project Settings

22.3.1 PanelView Plus Application Name
The PanelView Plus application name shall incorporate the site, building, process, and
equipment information as defined below.

See the NEORSD Asset Tag Abbreviations File for site, location, and process abbreviations.
This file can be found at the NEORSD Engineering & Construction SharePoint web site at the
Consultant Contractor Resource Page. Use the link for “Equipment Tag Naming Standard”. The
first character in the three-character location code found in column B of the Asset Tag
Abbreviations File is the site designation. The next two characters are the location designation.
For the treatment plants, the location code component is typically a two-digit numeric. For
collection system sites, the location code is typically a two-character alpha. For example, for the
Superior Avenue Pump Station, the site designator is “P” and the “location code” is “SA” for
Superior Avenue. The three characters “PSA” represent the location code found in the Asset
Tag Abbreviations File for the Superior Avenue Pump Station.

[Location][System/Process][Train][Parallel]_OIT[Alpha][FTversion]

Where:

- **Location** = For the three treatment plants and EMSC, the initial letter represents
  the specific facility (E, W, S, M). The next two numeric digits
  represent the process area number/building number. The process
  area/building number represents the physical location of the asset.
  For the collection system, the initial letter represents the type of
  collections facility (e.g., “P” for pump station or “C” for control
  structure). The next two letters represents the geographic or street
  location. See the Asset Tag Abbreviations File, described above, for
  plant and collection system codes.

- **Process** = the character reference to the process or equipment area being
  monitored and/or controlled. See the Asset Tag Abbreviations File,
  described above.

- **Train** = the number associated with the equipment train (1, 2, 3, etc.), when
  applicable. _CMN may be used when multiple trains use a common
  PLC for auxiliary controls.

- **Parallel** = the alphabetical sequence (A, B, C, etc.) for parallel pieces of
  equipment associated with the train, when applicable.
- Alpha = Unique alpha character identifying PanelView Plus views that otherwise would have the same tag descriptor. Characters must be assigned alphabetically. The alpha code is not required for process or equipment with only a single PanelView Plus terminal.

- FTversion = The firmware revision of the target PanelView Plus terminal. Use “p” for the decimal point. Ex: Version 6.1 would be expressed as 6p1

Examples:
- S57_CNT1A_OIT_6p1 (The PanelView Plus terminal associated with Southerly building 57, train 1, first centrifuge, version 6.1)
- S47_WSC3_OIT2_6p0 (The PanelView Plus terminal associated with Southerly building 47, wet scrubber, train 3, panel 2, version 6.0)

### 22.3.2 Project General Settings

The project window size must correspond to the target PanelView Plus device.

FactoryTalk Studio ME automatically sizes the display to match the window size of the target PanelView Plus device designated in the project settings. Default window sizes are in Table 22-1.

#### Table 22-1 Default Window Sizes

<table>
<thead>
<tr>
<th>Device</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>7” Display models*</td>
<td>640x480</td>
</tr>
<tr>
<td>15” Display models</td>
<td>1024x768</td>
</tr>
</tbody>
</table>

*7” model allowed only with approved NEORSD deviation request

Custom window sizes for the application are not permitted.

### 22.3.3 Project Runtime Settings

The default project runtime settings within FactoryTalk Studio ME shall be used for project development. Specifically, projects must follow the format below:

- Disable title bar (uncheck)
- Disable border (uncheck)
- Project window position of Top: 0, Left: 0
- Enable auto logout
  - Inactivity period: 10 minutes
  - Uncheck Return to Graphic on Logout

### 22.3.4 Internal Clock Synchronization

In order to synchronize time displays across control network interfaces, the PanelView Plus internal clock shall be synchronized with the internal clock of the associated PLC.

PanelView Plus synchronization is achieved by configuring the global connections (see Table 22-2) within the application:
Table 22-2 Global Connection Synchronization

<table>
<thead>
<tr>
<th>Connection</th>
<th>Tag or Expression</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote date and time</td>
<td>${\text{[PLC]}\text{CLOCK}[3]}==0$</td>
<td>Sets clock on rising edge trigger at 12:00 am</td>
</tr>
<tr>
<td>Remote year</td>
<td>${\text{[PLC]}\text{CLOCK}[0]}$</td>
<td>Year Get System Value (GSV)</td>
</tr>
<tr>
<td>Remote month</td>
<td>${\text{[PLC]}\text{CLOCK}[1]}$</td>
<td>Month GSV</td>
</tr>
<tr>
<td>Remote day of month</td>
<td>${\text{[PLC]}\text{CLOCK}[2]}$</td>
<td>Day GSV</td>
</tr>
<tr>
<td>Remote hour</td>
<td>${\text{[PLC]}\text{CLOCK}[3]}$</td>
<td>Hour GSV</td>
</tr>
<tr>
<td>Remote minute</td>
<td>${\text{[PLC]}\text{CLOCK}[4]}$</td>
<td>Minute GSV</td>
</tr>
<tr>
<td>Remote second</td>
<td>${\text{[PLC]}\text{CLOCK}[5]}$</td>
<td>Second GSV</td>
</tr>
</tbody>
</table>

The default global connection maximum update rate of one second should be maintained.

CLOCK refers to a double integer (DINT) tag array of length seven within the PLC. The array must be populated through the use of the GSV WALLCLOCKTIME function within logic.

**22.3.5 Other Global Connections**

No other global connections are required for standard PanelView Plus applications. District approval is required prior to configuring additional global connections settings within the application.

**22.3.6 MER Files**

Only the current machine edition runtime file (.mer) may be stored on the PanelView Plus. All older versions of the application should be removed and archived in the District's Rockwell FactoryTalk AssetCentre software.

**22.4 PanelView Plus Display Development**

**22.4.1 Display Type**

“Replace type” displays shall be used for depicting process flow, measurements, and status. “Replace type” displays consume the least amount of memory and provide a simplified mechanism for closing the prior screen.

All onscreen functionality will be depicted within a single opened “replace type” screen. This includes local display time, logged in user indication, the graphical depiction of the process, real time tag values and control measurements, and screen navigation. Common functionality will be repeated on each “replace type” screen, as needed.

“On-top” display types shall be used for faceplates and other overlay graphics as required by the project. With the exception of faceplate graphics included as part of the standard template library, “On-top” display types should be limited within the project.

“On-Top Cannot Be Replaced” display types shall not be used.

**22.4.2 Display Name**

Refer to the diagram in Section 22.3.1 of this volume for additional clarity. Display names shall take the following format:
[COLUMN#][ROW#] - [AREA/LOCATION DESC] - [DISPLAY DESC]

Where:

- Column# = Based on the navigation layout on display 001 – MAIN, the 2-digit column number of the associated display button. Displays related to similar processes or functions should be grouped in the same column. Valid range is from 01 to 39
- Row# = Based on the navigation layout on display 001 – MAIN, the row number of the associated display button. Valid range is 1 through 9
- Area/Location Desc = Process or area description/abbreviation for the displays grouped within the same [COLUMN#]. Use the abbreviations in the Asset Tag Abbreviations File on the Consultant Contractor Resource Page on the NEORSD SharePoint web site for a complete listing.
- Display Desc = Description identifying the display graphic

Note: If the [AREA DESC] or [DISPLAY DESC] is exceedingly long, try shortening it by using standard abbreviations shown in the Asset Tag Abbreviations File for a complete listing.

Examples:

- 021 – FW – OVERVIEW
- 022 – FW – SOFTENERS
- 041 – DSP – OVERVIEW
- 044 – DSP – DSP STPTS

The display title shown in the upper left hand corner of each display should be updated with the display name as outlined above.

### 22.4.3 Color Standards

Table 22-3 contains a general guideline on the use of coloring object’s and animation:

<table>
<thead>
<tr>
<th>Object Description</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header Background, Nav and Other Display Buttons</td>
<td>Medium gray (use base project default)</td>
</tr>
<tr>
<td>Process Piping</td>
<td>Reference Figure 22-1 below.</td>
</tr>
<tr>
<td>Status Animations (On/Off/Event/Fault)</td>
<td>Reference Section 12.0 of this volume</td>
</tr>
<tr>
<td>Numeric Display, Numeric Input Disabled</td>
<td>Light gray background, black font</td>
</tr>
<tr>
<td>Numeric Input Enable</td>
<td>White letters, black background</td>
</tr>
<tr>
<td>Label and Desc Text</td>
<td>Black</td>
</tr>
<tr>
<td>Inanimate, Unknown, or Static Objects</td>
<td>Medium gray, or gray shaded/gradient as provided in FactoryTalk atudio ME libraries</td>
</tr>
</tbody>
</table>
22.4.3.1 PROCESS PIPING
Standard process piping colors are shown in Figure 22-1:

![Figure 22-1 Standard Piping Colors](image)

The District maintains an OIT graphic that contains the standard process piping colors, sizes, and process arrows for use with OIT applications. Developers shall use these standard objects; any deviations shall be submitted to District for approval.

Process piping shall run either horizontal or vertical and connect at right angles. Piping drawn diagonally is prohibited.

22.4.4 Font
Labels, descriptions, numeric values, and other textual displays should all be a small sized yet clearly readable font, Arial style, black, and bold by default. For 15” model PanelView Plus 7 terminals, font sizes 10-12 are acceptable. For PanelView Plus 7, 7” Model, sizes 8-10 are acceptable. Seven inch screen PanelView allowed only with NEORSD approved deviation request.

For titles or headings within the graphic display or other text that requires greater attention, the text size may utilize font size 14-16 and shall be underlined.

For navigation and other functional buttons use text size 8 font, Arial style, black, and bold by default.

22.4.5 Navigation
PanelView Plus applications shall follow the navigation standard set forth within the base project example. Figure 22-2 illustrates the standard row/column navigation approach:
Each column of buttons represents a process area or equipment. The first row button navigates to the specific area. The subsequent row buttons indicate what additional screens exist within that specific area. Only the first row of buttons has navigation functionality. The other screens are accessible from the bottom button bar, only after navigating to the overview screen (or similar), from the Main menu screen.

The last column of buttons are reserved for any system configuration or system settings screens. These screens will be accessible only when the user is logged in with proper security.

22.4.5.1 MAIN
Each PanelView Plus application will contain a main screen configured as the initial starting graphic (See Figure 22-3 Example Main Screen) when the application boots. The main screen will contain buttons to navigate to an overview or primary screen for each process area in the project. Additionally, the main screen will contain login/logout functionality (future), as well as a shutdown button to access the terminals native configuration mode for those logged in with proper access rights (See Section 22.6 for PanelView Security Privileges).
22.4.5.2 DISPLAY AREAS

All displays within a configured area will contain a similar navigation bar placed at the bottom of the screen (See example in Figure 22-4). The bar will contain buttons to navigate to all configured screens within that area. In order to navigate to a different area, the user will have to navigate back to the main screen.

Figure 22-4 PanelView Plus Standard Navigation

It is required to use an area overview screen as the first display for the area.

With the exception of calling faceplate and other on top display types, no other go to display buttons may be placed within the graphic.
22.4.5.3 ALARM SUMMARY, HISTORY, AND STATUS

All screen displays must contain a link to the alarm summary screen. This makes the alarm summary accessible from anywhere within the application.

Figure 22-5 PanelView Plus Alarm Summary Navigation

The alarm summary screen (See Figure 22-6) displays the currently active and unacknowledged alarms. Closing the alarm summary screen returns the user back to the last viewed process display screen.

Figure 22-6 PanelView Plus Alarm Summary
From the alarm summary, the user may navigate to the alarm history screen and, if logged in with proper rights, the alarm status screen. Closing these screen returns the user back to the alarm summary, from which they can return back to the last viewed process display.

22.4.6 System Testing, Debugging, and Commissioning Screens
PCS suppliers may include standards-free displays in their application to aid in system testing, debugging, and commissioning (e.g., creation of PID information displays to aid in loop tuning). These displays shall still follow the standard naming convention described in Section 13.1 of this document. This contingency is for OIT displays only.

These displays should still follow the standard naming convention, using a [COLUMN#] assignment of 30 and an [AREA DESC] description of “OEM”.

Examples:
- 301 – OEM – Setpoint limits
- 302 – OEM – Drive settings

System testing, debugging, and commissioning displays shall not be used for normal operation. Screens designed for normal system operation must conform to the graphics standards set forth in this volume. Access to system testing, debugging, and commissioning screens must be removed after commissioning. These displays shall configured to only be accessible to users in the “configuration” security group.

Other than the naming convention above, OEM graphics are not subject to the District standard. Standard navigation to OEM screens is provided in the base application and should be used when possible.

22.5 PanelView Plus Tag Reference and Usage

22.5.1 Direct Reference Tags
All references to ControlLogix tags made within a project shall be made using direct (device) reference.

Direct reference tags are used to maximize the runtime performance of tag read/write operations, to minimize tag memory consumption, and to remove the added OIT layer for configuration of basic display read and write operations.

22.5.2 OIT Tags
OIT tags in general should not be used to link application elements (tag displays, trends, data log models, etc.) with ControlLogix controller tags. Instead, direct reference tags should be used wherever possible.

22.6 PanelView Plus Security
PanelView applications submitted for approval shall have a single default user account set with full privileges. Additional user accounts and passwords will be configured onsite, during the
commissioning of the system, from a District provided engineering laptop to deploy correct user
accounts and associated District FactoryTalk Directory security settings. District
Commissioning Manager will provide coordination with PC&A for addition of user accounts.

The remainder of this section describes the final security settings. Developers are required to
develop applications/screens that will make use of the security privileges and account profiles
detailed below.

22.6.1 User Groups and Accounts
A standard set of user groups will be provided by the District for use within each PanelView Plus
application. One or more accounts under each group may be assigned to each PanelView Plus
application. The standard user groups are listed below:

- Default (view only)
- Operator
- Maintenance
- Supervisor
- Configure

22.6.2 General Account Privileges and Restrictions
This section outlines user groups, security codes, and runtime account privileges required in all
PanelView Plus applications. Each security role is granted those privileges listed in their
specific role in addition to all lower level roles.

22.6.2.1 DEFAULT (VIEW ONLY) – SECURITY CODE A
The default account is provided for leaving the PanelView Plus in a view only state.

- View all process monitoring screens
- Restrict entering values or changing setpoints
- Restrict ability to open control object faceplates
- Restrict ability to acknowledge alarms
- Restrict access to PanelView Plus terminal settings

22.6.2.2 OPERATOR – SECURITY CODE A, B
Operator accounts are provided for basic operator control and monitoring. Special exception for
operator setpoint manipulation may be granted on a case-by-case basis after review by District
operations.

- View all process monitoring screens
- Enable open and operate object faceplates for the purpose of device mode selection and
  manual control
- Enable view and acknowledge configured alarms
- Restrict ability to enter values or change setpoints for process control
- Restrict ability to enter or change configuration type values on faceplate objects (e.g.,
  alarm limits)
- Restrict access to PanelView Plus terminal settings
22.6.2.3 MAINTENANCE – SECURITY CODE A, B, C
Maintenance accounts take all of the operator’s abilities and add access to maintenance specific screens for extended diagnostic features.

- View all process monitoring screens
- Enable open and operate object faceplates for the purpose of device mode selection and manual control
- Enable view and acknowledge configured alarms
- Enable access to maintenance specific screens for diagnostic information
- Enable enter values or change setpoints for process control
- Restrict access to enter or change configuration type values on faceplate objects (e.g. alarm limits)
- Restrict access to PanelView Plus terminal settings

22.6.2.4 SUPERVISOR – SECURITY CODE A,B,C,D
Supervisor accounts have limited added privileges over operator accounts. Supervisors can access and change select process control setpoint limits as documented in PCN.

- Enable view all process monitoring screens and additional process setpoint/limit screens as configured
- Enable open and operate object faceplates for the purpose of device mode selection and manual control
- Enable view and acknowledge configured alarms
- Enable enter values and change setpoints for select process control points
- Enable enter or change configuration type values on faceplate objects (e.g. alarm limits)
- Restrict access to PanelView Plus terminal settings

22.6.2.5 CONFIGURE– SECURITY CODE A,B,C,D,E
Configure accounts have unrestricted access to the PanelView Plus runtime application. Configure accounts should be held only by District engineers for runtime editing of template block operation as well as configuring the PanelView Plus terminal settings.

- Enable view all configured screens
- Enable open and operate all provided objects on control faceplates
- Enable view and acknowledge configured alarms
- Enable enter values and change setpoints for all provided process control points
- Enable enter and change configuration type values on faceplate objects (e.g., alarm limits)
- Enable access to PanelView Plus terminal settings

22.6.3 Configuring Security Access
The global object template library is designed to meet most application runtime security needs. For example, during runtime, template objects with faceplates require operator or equivalent privileges to access. Faceplate configuration type settings similarly require configuration level access privileges.
For additional security needs, the application developer should make an attempt to segregate restricted controls or settings on screens accessible only to those with proper security levels. The use of visibility animation on navigation buttons is required by the District. Visibility animation should be evaluated using the `CurrentUserHasCode()` function.

The security code field part of display settings should not be used as a means to restrict access to displays. The default setting (‘-’ - all users) should be retained for consistency.

22.6.4 Account Login/Logout
All user accounts with the exception of view are password protected and require the user to provide both a username and password when logging in.

The logout option on the main screen will logout the current user and login to the default (view only) account. In order to switch to an operator, supervisor, or configure account, the user shall be required to select the login option on the main screen.

New PanelView Plus projects are prohibited from providing other user account control functions other than the default login/logout provided on the main screen in the base project. Set password functions for logged in users during runtime is prohibited.

22.6.5 Auto Logout
Each PanelView Plus application shall be configured for automatic logout after a period of inactivity. This setting is configured in the project settings dialogue and is referenced in Section 22.3.3 of this volume.

22.7 Alarming

22.7.1 Trigger Type
All configured alarm messages within the PanelView Plus application shall use the “bit trigger” type as opposed to the value and least-significant bit (LSBit) methods. The bit trigger method aids in reducing the number of alarm trigger tags, which can lead to optimized communications overhead and memory usage within the running program.

22.7.2 Trigger Tag
Developers shall use either a single ControlLogix DINT tag or single ControlLogix DINT array tag (DINT[X]), depending on the size of the application, to serve as a Boolean array for alarm trigger. Name the alarm trigger tag

```
PV_ALARM
```

22.7.3 ControlLogix Trigger Routine
PanelView Plus alarming shall be organized in the ControlLogix processor within one or more dedicated routines. Ladder routines are required.

Alarming bits on the trigger tag shall not be latched, but instead only held active as long as the alarm is active. Alarm messages within the PanelView Plus application shall be generated when the trigger bit value transitions from 0 to 1.
PanelView Plus to PLC acknowledgment handshaking is not required, but permitted.

22.7.4 Trigger Label
The label for each trigger tag shall carry over the name of the trigger tag name defined in ControlLogix for consistency and simplicity.

22.7.5 Message Guidelines
Each alarm trigger shall generate a unique message that is concise yet descriptive. Process area and equipment naming shall remain consistent across OIT, PLC and HMI platforms. For PanelView Plus applications with similar alarm sets for more than one set of equipment or process train, the alarm message shall be prefixed with the equipment or train number to be followed by the alarm in the message.

Several alarm message examples are shown below for a raw water softener skid with three units:

- Softener #1 Conductivity High
- Softener #2 Conductivity High
- Softener #2 Differential Pressure High
- Softener #3 Conductivity High

Use of embedded variables in the alarm message shall not be used.

Alarm messages must fully match across both the HMI and OIT displays as well as the comments provided in the tag description in the PLC.

In general, the PLC programmers shall decide the alarm message, place the message as part of the bit field comment of the alarm tag, and provide the same alarm message for OIT and HMI developers to configure.

22.7.6 Advanced Settings
Default values for the advanced alarm settings as defined within the base PanelView Plus project shall be used.

The default advanced alarm settings values are shown in Figure 22-8.

<table>
<thead>
<tr>
<th>Display</th>
<th>Alarm (PV default)</th>
</tr>
</thead>
<tbody>
<tr>
<td>History</td>
<td>128</td>
</tr>
<tr>
<td>Hold time (ms)</td>
<td>250</td>
</tr>
<tr>
<td>Max update rate (seconds)</td>
<td>1</td>
</tr>
<tr>
<td>Optional connections</td>
<td>(None)</td>
</tr>
</tbody>
</table>

22.7.7 Alarm Displays
The PanelView Plus default alarm display shall be used in all PanelView Plus applications. This display, by default, will open a pop-up when a new alarm is generated and displays an alarm banner object.
Active and/or unacknowledged alarms may be viewed from the alarm list object displayed on the alarm summary graphic, which is accessible via navigation from all screens.

A historical log of generated alarms is accessible from a similar alarm list object displayed on the alarm history graphic. This graphic is accessible from the alarm summary graphic.

The alarm status graphic displays configuration and diagnostic information regarding the alarm setup for the PanelView Plus application. Alarm status information is only accessible to user accounts with maintenance level or higher privileges.

No other alarm objects, including alarm lists or banners, shall be created within the PanelView Plus application.

**22.7.8 Alarm Filtering**

Alarm filtering shall not be incorporated into any alarm object within the PanelView Plus application. The alarm summary, alarm history, and alarm status displays by default must show all configured alarms.

**22.8 Trending**

**22.8.1 Trend Area Template**

Developers shall use the trend template graphic provided with the base PanelView Plus application for configuring trends within the trend areas. No other process object or other display information should appear on these screens. Only one trend should appear on each screen.

**22.8.2 Trend Display Naming**

Trend screen naming shall follow the standard PanelView Plus display naming conventions outlined in Section 22.4 of this volume. [COLUMN#] values of 11-19 of the standard PanelView Plus application should be used for historical trend screens. “TREND” should be used for the display name [AREA DESC]. This will create an easily recognizable and organized grouping of displays.

Examples:

- 111 – TREND – INC TEMPERATURES
- 121 – TREND – FA BLOWER
- 122 – TREND – PA BLOWER
- 131 – TREND – WHB TEMPERATURES
- 132 – TREND – WHB STEAM DRUM
- 133 – TREND – WHB FW

Navigation through the trend screen area follows in a similar manner as process displays described before. Display 101-Trend Main displays a directory of configured trends screens from which the user during runtime may navigate between trend areas. When inside a particular trend area, the user may navigate between trend displays in that area or return to the main trend directory.
22.8.3 Other Trends
Aside from trends configured in the trend area, trends may also be configured and placed on process displays as required. These trends must use the built in machine edition (ME) studio trend object and follow trend standard colors and attributes set forth within this document.

22.8.4 Trend Colors
The colors within the example trend in the base project shall be used for all trending within the application. The color standards are shown in Figure 22-9.

Table 22-5 Standard Trend Colors

<table>
<thead>
<tr>
<th>Trend</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td>White</td>
</tr>
<tr>
<td>Text color</td>
<td>Black</td>
</tr>
<tr>
<td>Grid (X,Y axis)</td>
<td>Dark gray</td>
</tr>
<tr>
<td>Pens, in increasing order</td>
<td>(See below)</td>
</tr>
</tbody>
</table>

Use of the default trend object pen colors established in the template (in increasing order: blue, light green, red, magenta, black, dark green, yellow, light blue) is required.

22.8.5 Refresh Rate
The maximum refresh rate that may be chosen for a trend is two seconds. In general, a refresh rate of two seconds shall be chosen for trending process data. The developer may select a slower refresh rate based upon the process, the time span, etc.

22.8.6 Trend History
The application shall provide historical logging for all trended values for a period of at least 12 hours.

22.8.7 Maximum Pens per Trend
Limit the number of pens per trend to eight or less.

22.8.8 Other Trend Settings
Table 22-10 details general trend settings:

Table 22-6 Standard Trend Settings

<table>
<thead>
<tr>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart style</td>
</tr>
<tr>
<td>Chart update mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DISPLAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart radix</td>
</tr>
<tr>
<td>Data point connection</td>
</tr>
<tr>
<td>Display milliseconds</td>
</tr>
<tr>
<td>Display pen icons</td>
</tr>
<tr>
<td>Font</td>
</tr>
<tr>
<td>Scrolling</td>
</tr>
<tr>
<td>Scroll mode</td>
</tr>
<tr>
<td>Buffer for extra data</td>
</tr>
</tbody>
</table>
22.9 Data Logging

22.9.1 Number of Models
Applications shall include a single data log file to collect all pertinent data. Only one data log can run at any given time.

Use of data log models is required to provide trend history for all configured application trends.

22.9.2 Maximum Data Points
The maximum data points must be set to achieve a 12-hour history of logged data for all configured trends.

22.9.3 Logging Path
The system default logging path shall be used for all data log models.

22.9.4 Log Triggers
Each log shall be set up to trigger periodically at an interval no faster than two seconds.

22.9.5 Tags In Model
All tags within the model shall be configured as direct reference tags. Tags within the same model may be polled from more than one PLC. There are no limits to the number of tags within each model.

22.10 PanelView Plus I/O Diagnostic Screens

22.10.1 Overview
All PanelView Plus applications are required to provide displays depicting PLC hardware health and status information. These screens are built using standard PLC module diagnostic global objects distributed by the District to provide maintenance personnel with real time module channel status and diagnostic information. These screens are designed to provide view only information and are primarily intended for maintenance and troubleshooting activities.

22.10.2 Screen Requirements and Architecture
The following paragraphs depict screen quantity and requirements:
22.10.2.1 MAINTENANCE OVERVIEW
The maintenance overview display is a single screen that is intended to summarize the architecture of the viewed PLC system. The display graphically shows the number of and type of PLC racks, OITs, and network types (Ethernet, Modbus, etc.). Objects on the maintenance overview graphic are static; they are not animated and do not provide status information.

The District standard DIAGNOSTIC LIBRARY file contain symbols specific for generating the maintenance overview display.

22.10.2.2 PLC RACK DISPLAYS
A separate maintenance display shall be created for every PLC rack contained within the architecture. Each display shall display a single PLC rack detailing the chassis size, module configuration, and current module health (OK, FAULT).

The District standard DIAGNOSTIC LIBRARY file contains PLC rack and chassis elements as well as global object module symbols for use in generating the rack displays. Module symbols require configuration.

22.10.2.3 MODULE FACEPLATE DISPLAYS
Specific module information is provided on faceplates incorporated into the standard diagnostic symbols. Faceplates display module and loop information including channel state (on/off, analog %), channel faults, device tag (from P&IDs), device description (from I/O list), device units (analog inputs), and other relevant module configuration settings.

Most diagnostic templates read RSLinx Enterprise and ControlLogix module defined tag data to gather diagnostic information. Generally no ControlLogix AOI or programming is required.

If the diagnostic template for a specific module is not available in the District’s DIAGNOSTIC LIBRARY file, the contractor shall create a new template, using one of the existing templates as a model.

22.10.3 Area and Navigation
Areas 20-29 of the standard PanelView Plus application are reserved for maintenance and diagnostic type displays. Typically, only one single area (20) is required for maintenance screens. The total number of screens will, at a minimum, consist of:

- 1 for the maintenance overview
- 1 screen per PLC rack (processor and remote I/O racks)

The main maintenance screen (200 – MAINTENANCE OVERVIEW) should contain navigation links to each PLC rack screen.

Use the following display names as applicable:

- 200 – MAINTENANCE OVERVIEW
- 201 – MAINTENANCE – RACK 0
- 202 – MAINTENANCE – RACK 1
- 203 – MAINTENANCE – RACK 2...
22.11 PanelView Plus Standard Control Templates

22.11.1 Global Object Templates
All PanelView Plus controls that provide read/write functionality to ControlLogix tags must make use of the NEORSD Standard Objects Library. Each template object is preconfigured to match on a one-to-one basis with ControlLogix AOI’s.

For a complete list of the objects and instructions on their proper use, refer to NEORSD Standard Object Library Programming Guideline.

22.11.2 General Usage Requirements
All global template object expressions and animations are pre-linked to the required member of the corresponding ControlLogix AOI tag. Programmers shall not to adjust or change field values or animation settings with the template object itself.

Object instances are created using a drag and drop method onto the desired graphic. Each instance requires, at a minimum, the associated object parameters shown in Tables 22-11 thru 22-15, generally presented in the following order:

Table 22-7 Discrete Valve and Motor Objects

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Tag address</td>
<td>PLC tag (direct reference)</td>
</tr>
<tr>
<td>#2</td>
<td>Tag name</td>
<td>Device tag for display on faceplate</td>
</tr>
<tr>
<td>#3</td>
<td>Device desc</td>
<td>Device/tag description for display on faceplate</td>
</tr>
<tr>
<td>#4</td>
<td>Keypad</td>
<td>Keypad assignment for display next to object</td>
</tr>
<tr>
<td>#4-#9</td>
<td>Intlk desc</td>
<td>Interlock 1 – 5 descriptions for display on faceplate</td>
</tr>
</tbody>
</table>

Table 22-8 Analog Objects

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Tag address</td>
<td>PLC tag (direct reference)</td>
</tr>
<tr>
<td>#2</td>
<td>Tag name</td>
<td>Device tag for display on faceplate</td>
</tr>
<tr>
<td>#3</td>
<td>Device desc</td>
<td>Device/tag description for display on faceplate</td>
</tr>
<tr>
<td>#4</td>
<td>Eng units</td>
<td>Units for display on faceplate</td>
</tr>
<tr>
<td>#5</td>
<td>Keypad</td>
<td>Keypad assignment for display next to object</td>
</tr>
</tbody>
</table>

Table 22-9 Discrete Objects

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Tag address</td>
<td>PLC tag (direct reference)</td>
</tr>
<tr>
<td>#2</td>
<td>State 0 text</td>
<td>Text displayed when discrete value is 0 (clear)</td>
</tr>
<tr>
<td>#3</td>
<td>State 1 text</td>
<td>Text displayed when discrete value is 1 (active)</td>
</tr>
<tr>
<td>#4</td>
<td>Fault text</td>
<td>Text displayed when fault active</td>
</tr>
</tbody>
</table>

Table 22-10 PID/PIDE Objects

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Tag address</td>
<td>PLC tag (direct reference)</td>
</tr>
<tr>
<td>Parameter</td>
<td>Field</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>#2</td>
<td>Tag name</td>
<td>Device tag for display on faceplate</td>
</tr>
<tr>
<td>#3</td>
<td>Device desc</td>
<td>Device/tag description for display on faceplate</td>
</tr>
<tr>
<td>#4</td>
<td>Eng units</td>
<td>Units for display on faceplate</td>
</tr>
<tr>
<td>#5</td>
<td>Keypad</td>
<td>Keypad assignment for display next to object</td>
</tr>
</tbody>
</table>

Table 22-11 Diagnostic Module Objects

22.11.3 Global Object Default Values

The PanelView Plus project shall retain the original settings for the global object default values as provided in the base project. The required settings are as follows:

- LinkAnimation default: Link with expressions
- LinkConnections default: True
- LinkSize default: True

23.0 Reference Documents

Table 23-1 contains a complete listing including live links to all referenced District standards and forms, and industry standards and best practices.

Table 23-1 Reference Documents

<table>
<thead>
<tr>
<th>Document Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control of Hazardous Energy (lockout/tagout) – 29 C.F.R. § 1910.147</td>
</tr>
<tr>
<td>ISA88, Batch Control Standard</td>
</tr>
<tr>
<td>ISA101, Human-Machine Interfaces Standard</td>
</tr>
<tr>
<td>NEORSD Asset Tag Abbreviations File</td>
</tr>
<tr>
<td>NEORSD Process Control Description Design Standard (See PCS Manual, Vol. 5, Sections 22.1 and 23.0 and Appendix A)</td>
</tr>
<tr>
<td>NEORSD Standard Object Library Programming Guideline</td>
</tr>
<tr>
<td>One Point Lesson (OPL)</td>
</tr>
</tbody>
</table>

End of Volume 3
Appendix A - PCS Network Architecture
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