Elgin/Lake Huron SCADA Upgrades
SCADA Standards
Section 100 General

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101 SCADA Standards Manual Overview

1. Focus of Manual- Design Philosophy versus Tender Specifications

1. The focus of the Lake Huron & Elgin Area Primary Water Supply SCADA Standards Manual is to define the Lake Huron & Elgin Area's design philosophy and preferences. Any references to specifications will discuss only the format and tender document structure. The consulting engineering firms are still expected to use their individual tender specifications and drawings for all Lake Huron & Elgin Area tenders. Therefore the overall responsibility for the quality of the design squarely remains with the designers.

2. The Standards Manual has been defined as a design "guideline" to provide room for innovation and potential, project specific modifications. Various project constraints, such as the physical space available for new equipment, may force the designers to deviate from the Lake Huron & Elgin Area Regional Water Supply's preferences. The concept proposed is for the designers to follow the Regional Water Supply's guidelines as much as possible. They must also use good engineering judgment to provide a cost effective solution.

3. In situations where the designers have intentionally deviated from the Regional Water Supply's guidelines, they should provide a memo with their design submission indicating the deviations that were taken, and their justification. This will aid the design reviewers by focusing their review efforts in the high priority areas. The "design deviations" memo also serves as an effective tool for defining and recording the deviations as part of the project documentation process. This memo is one of the Regional Water Supply's template documents.

2. Intended Audience

1. The intended audience for this manual includes the following stakeholders.
   a. SCADA Designers working for the Regional Water Supply
   b. SCADA Programmers working for the Regional Water Supply
   c. Regional Water Supply staff and members

3. Creating and Updating the Content

1. The business process for creating and updating the content of the SCADA Standards Manual includes identifying the stakeholders, targeted benefit of the new/updated standard, proposed content, and published decision. Refer to Figures 1-1 and 1-2 at the end of this section. The key stakeholders are the Regional Water Supply staff, plant operations staff, SCADA designers, and selected external "experts". The targeted benefits should include, where possible, quantitative measures that are defensible, versus subjective analysis and recommendations. The proposed content should capture the design guideline as concisely as possible, to minimize the overall volume of information, and potentially information overload. Once a standard is developed, it must be published to potential designers to be effective. This includes both the complete document, plus any amendments.

2. Keeping the information up to date is critical to the long-term success of the manual. If the designers and reviewers consider the content to be significantly out of date, then the usage of the manual will drop significantly. It will also be very difficult for the Regional Water Supply to enforce the manual if the designers are provided with inaccurate information upon which to base their designs. Ongoing content improvement committees/working groups have been established for developing a program of updating the manuals every 12 months. These committees include the major stakeholders from the Regional Water Supply staff, plant maintenance, plus other staff as required. Including all of the key stakeholders ensures that all potential content changes are evaluated from different perspectives, plus promotes buy in/acceptance from all.

3. The memo for suggesting new or improved standards is appended to the end of this section.

4. Publication Procedures

1. The current publication procedure is to post the standards on the Regional Water Supply web site. They can also be downloaded in Adobe format. These standards also include WORD, Excel, and other template files that are to be used by the designers and programmers. These are available for downloading in their native file format.

2. Temporarily, all registered Regional Water Supply SCADA standards users will receive an email when any upgrades are made to the standards.

3. Only the on-line version is considered to be the legally accurate document.

5. Enforcement of the SCADA Standards

1. Enforcement of the standards is a key component of the standards management process. As such, the design standards are separated into “must have” versus “preferred” approaches so that the designer is aware of the difference, and their level of design flexibility.

2. For each project, a key issue is to define, within the Regional Water Supply organization, the point person(s) for enforcement on each project. The responsibility for enforcement will be lead by the Regional Water Supply project coordinator, with support from one common SCADA Standards Leader within the Regional Water Supply organization.

3. The Regional Water Supply staff recognized that it is a very onerous task to attempt to identify differences between a design submission of perhaps 100-300 drawings and a 200-400 page specification versus a +200 page SCADA Standards Manual. For this reason, it is recommended that the designers submit, attached to their design submissions, the Regional Water Supply’s design deviations memo. This approach will substantially reduce the effort required by the Regional Water Supply staff when reviewing design submissions, and enable them to focus on the critical review areas. It will also ensure that the designers are aware of, and have considered, the Regional Water Supply’s manuals. Refer to the Design Deviations memo template at the end of this section.

4. To reduce the effort for enforcement, the standards content has been organized in the same format as the design deliverables- predesign report, tender drawings, and tender specifications.

6. Web Based Publication

1. Electronic management of the information- using web technologies and email, would provide significant additional benefits with minimal additional effort. Storing the information on a web site provides easy access to all external and internal designers. A search engine has been developed so that the designers and reviewer can quickly locate the relevant material on a specific topic.

2. The intent is to utilize this one manual for both large and small projects. As such, the content and search capabilities should assist the designers of small projects in locating their relevant information efficiently.

3. The project timeline for many water and wastewater projects is often 2-3 years. As such, it is important to document which version of the manual was defined as the baseline at project commencement. The published revisions need to be flagged so that the currently active designers can assess the impact on their ongoing designs. To assist in managing this issue, normally the current, and past versions published within the last three years will be stored on the web site. Past versions are be stored separately, in an archival area.

102 SCADA Cyber Security Practices

1. Overview

1. The current industry best practice for SCADA cyber security includes three primary objectives.
   a. Physical barriers
   b. Software barriers including virus protection
   c. Documented SCADA cyber security practices

2. Physical Barriers

1. The following physical barriers are to be implemented.
   a. All network hardware should be contained in secure, locked panels across the plant, as well as at the remote facilities.
   b. For the three main networking areas at the plants, all networking hardware should be located in locked, secure areas.
   c. The computer CPUs should be stored in locked cabinets to prevent anyone from inserting an unauthorized disk or USB memory stick.
   d. The shared SCADA and Operations Admin data and electronic files should be stored on servers within a Neutral Zone, located between firewalls. This should be the only link between the others networks and the SCADA network, so that it can be easily and clearly disconnected if a virus or hacker penetrates one of the networks.
   e. Staff should only be able to monitor, but not control, the SCADA System from the Regional Water Supply Offices in London.
   f. Power supplies, UPS's, and other power feeds must be secured behind locked cabinets.

3. Software Barriers

1. Previously there was no virus protection software installed on the old SCADA Servers and workstations. Historically, the virus protection software did not work properly with the SCADA software. It caused more problems than it solved. However, as the SCADA software has evolved into more standardized MS Windows products, running on standard network servers, it is now possible to install the virus protection software. Currently there is virus protection software installed. The antivirus is the Symantec Endpoint Protection 11.0. The software has three software components: the Client, the Manager and the Console. All computers to be protected will have a license installed. After uploading new virus definitions to SDMS/TS servers by the Manager, all computers will be able to get updates.

2. The other key issue is how to keep the virus files current. Since the SCADA System does not have a direct access to the Internet the IT Manager updates the virus definition on all the Servers and Workstations manually on regular basis. The virus definitions are uploaded subsequently to the SDMS server, where other SCADA computer can get access to them. The Manager software will be located in the SDMS server, while the administration console component could be located in the same SDMS server or some other computer used by the designated antivirus administrator (IT Manager). Other active software barriers include the following.
   a. The SCADA firewall should be programmed to limited corporate access, and monitor for worms and unusual activity.
   b. The routers should be programmed to limit routing substantially.
   c. The switches and routers should be set up to "throttle" network traffic caused by the lower priority networks, so that the real time date continues uninterrupted.

4. SCADA Security Practices

1. The following is a preliminary list of the recommended security practices.
   a. Produce a SCADA Security Standard paper and distribute to train staff.
   b. Test all external consultant/contracts hardware (i.e. portable computer and memory sticks) prior to allowing them to connect to the SCADA network.
   c. Create a secure SCADA Test Bench area for performing on site FATS, testing software updates, and troubleshooting SCADA problems. Isolate this area from the plant SCADA network.

103 SCADA Expansion Protocol

1. Introduction

1. The purpose of this SCADA Expansion Protocol is to assist the designers, contractors, Regional Water Supply staff, and the Operating Authority in smoothly transitioning expansions and upgrades into one integrated fully functioning SCADA system with ongoing, properly planned maintenance procedures.

2. This protocol establishes the deliverables required for each SCADA expansion, identifies key stakeholders and their responsibilities, standardizes work procedures that overcome the normal project challenges, and provide the user with standardized WORD and Excel templates that reduce the effort involved.

2. Project Types

1. The SCADA Expansion projects can be organized into three main types- maintenance upgrades, minor SCADA expansions, and major SCADA expansions.

2. Maintenance upgrades are the responsibility of Operating Authority (currently AM Water) under the Plant Operations Contract. These are minor improvements to the existing SCADA system and are planned, completed and documented by the Operating Authority. Both the Regional Water Supply and Operating Authority retain current backup copies of the PLC programs, RS View SE HMI configurations, and other software configurations. These updated versions will also be required for implementing the changes related to minor and major SCADA upgrades. As the maintenance upgrades only involve the Operating Authority and the Regional Water Supply, the protocol and procedures are addressed in a separate SCADA Maintenance Protocol document.

3. Minor SCADA upgrades have been defined as projects where an external design and contractor builds/installs new field equipment and wiring. The general, but not the only, criteria for defining a project as “minor” is that the expansion involves less than 50 field I/O (input/output) points that must be added to the SCADA System. For these minor upgrades, the Operating Authority will act as the HMI system integrator and complete the HMI software programming. An external party will complete the PLC programming.

4. Major SCADA upgrades consist of projects that are not included within the current Plant Operations Contract. These are generally large plant expansions/upgrades, which are completed by an external designer and contractor. In these situations, the PLC and HMI programming will be completed as part of the design/construction services. Once construction and Site Acceptance Testing is complete, the Operating Authority will integrate the upgrades within the existing SCADA System.

3. Stakeholders and Responsibilities

1. The SCADA Expansions potentially include the following stakeholders.
   a. Regional Water Supply
   b. Operating Authority
   c. Design (and Construction Supervision) Engineer
   d. Facility Expansion Contractor
   e. PLC Software Programmer
   f. HMI Software Programmer

2. The Regional Water Supply is responsible for the administration of the Plant Operations Contract, which includes the ongoing maintenance and minor upgrades to the Lake Huron & Elgin Area Water SCADA System. Therefore the Regional Water Supply is the official communication channel between all other parties. All project information provided to/from the Operating Authority is to be transmitted through the Regional Water Supply. The Regional Water Supply will manage any cost impacts related to the Operating Authority.

3. The Operating Authority is responsible for the ongoing operation and maintenance of the Lake Huron & Elgin Area water facilities. All work that affects that operation of the water facilities must be coordinated with the Operating Authority, through the Regional Water Supply, to ensure reliable water treatment and distribution services. The Operating Authority will be involved in the testing and commissioning of all SCADA expansions and adjust the operations as required to accommodate the testing.

4. The Design (and Construction Supervision) Engineer is hired by the Regional Water Supply. In all situations, the Design Engineer is responsible for completing all design in accordance with the standards, and providing the Software Programming Requirements documentation package for SCADA expansions. For major SCADA expansions, the Design Engineer is also potentially responsible for the SCADA programming. Once construction and Site Acceptance Testing is complete, the Operating Authority will integrate the upgrades with the existing SCADA System.

5. The SCADA Contractor is hired by the Regional Water Supply. In all situations, the Contractor is responsible for completing all construction and testing in accordance with the standards, and providing the specified testing documentation for SCADA expansions. They might also complete the software programming. Their work is to be reviewed by the Design Engineer.

6. The PLC Software Programmer is responsible for the successful programming and testing of all PLC programs, including the field I/O interfaces. They must also provide the necessary PLC I/O interface table and other details required by the HMI Programmer.

7. The HMI Software Programmer is responsible for the programming and testing of the HMI database, trends, alarms, graphics, InSQL, and SQL databases. In some cases, the work may be distributed between different groups.

4. Summary of Deliverables

Each stakeholder is responsible for specific tasks and deliverables.

Stakeholder	Key Tasks & Deliverables
Regional Water Supply	• Maintaining all SCADA standards • Forwarding all necessary information to/from the Operating Authority • Review all draft and final documents prepared by the designers • Confirm all work is completed in accordance with the SCADA standards • Final approval for all FAT and SAT testing • Final approval and acceptance of expansion projects, for turnover to the Operating Authority
Operating Authority	• Preparation of a work quotation for each specific project, for all work not included under the Contract, based on the SCADA Maintenance/Expansion Synopsis • Specification, coordination, and management of the installation of any new telephone circuits and other related communication components • Operations staff to participate in the testing and commissioning of new SCADA expansions, in order to coordinate changes in plant/pump station operation required to accommodate the testing • Updated documentation for all work completed • Updated SCADA maintenance program to include the new components • All work and documentation to be completed in accordance with the SCADA standards • Attendance at schedule coordination meetings as required

Stakeholder	Key Tasks & Deliverables
Design Engineer	• Preparation of the P&ID's, field wiring drawings, and Process Narratives – both Detailed Design and Record (as-built) versions • Preparation of the Software Programming Requirements document • In some cases, the drawings will consist of updating existing drawings • In most cases, the process narrative will consist of updating the existing narrative or using an existing narrative as the template for the new narrative • Site inspection confirming that all construction is completed in accordance with the SCADA standards • Quality control check of field work to ensure that all I/O wiring has been verified and field instruments have been verified, calibrated, and are operational • Attend the FAT and SAT to verify that the software meets the intent of the Software Programming Requirements document • Via the Regional Water Supply schedule testing and commissioning of the new system • Completion of the SCADA Equipment Maintenance Requirements form for all new components that should be added to the SCADA preventative maintenance program – such as control panels and field instruments. Most of this detail can be collected from the Contractor
SCADA Contractor	• Construction of SCADA expansion in accordance with the design documents • Construction of the SCADA expansion in accordance with the SCADA standards • Inspection and confirmation that all field work is completed and finalized prior to initiating the SAT activities
PLC Software Programmer (generally within the Scope of the Design Engineer or the SCADA Contractor)	• Programming of PLCs, networking equipment • Lead the FAT and SAT activities
HMI Software Programmer (generally the O.A. for minor expansions)	• Programming of SCADA database, trends, historical data collection, paging, InSQL, SQL database, and web site. • Heavy participation in FAT and SAT activities.

104 Key Contact Persons

The current key contact persons for the roles defined above are listed below.

Regional Water Supply	Mr. John Walker Operations Manager, Regional Water Supply Lake Huron & Elgin Area Water Supply Systems c/o City of London Regional Water Supply Division 235 North Centre Road London, Ontario N5X 4E7 T: 519.930.3505x7301 F: 519.474.0451 E: jwalker@london.ca www.watersupply.london.ca Dave Scott, A.Sc.T. Capital Projects Coordinator, Regional Water Supply Lake Huron & Elgin Area Water Supply Systems c/o City of London Regional Water Supply Division 235 North Centre Rd. Suite 200, London, Ontario N5X 4E7 T: 519.930.3505 x2714 T: 519.930.3505 x5899 (Direct) F: 519.474.0451 Cell: 519-630-7050 E: dcscott@london.ca
Operating Authority (American Water Canada Corp.)	Terry Bender General Manager, Lake Huron & Elgin Area Primary Water Systems Ontario Clean Water Agency P.O. Box 1409, Grand Bend, ON, N0M 1T0 519 238 8466 (Huron WTP Office) 519 384 3045 (Cell) 519 238 5396 (Fax) tbender@ocwa.com
Alternate Contact	Mr. Andrew J. Henry, P.Eng. Division Manager Regional Water Supply Lake Huron & Elgin Area Primary Water Supply Systems c/o The City of London Regional Water Supply Division 235 North Centre Rd. Suite 200, London, Ontario N5X 4E7 Phone: 519-661-2500 ext. 1355 Fax: 519-474-0451 Email: ahenry@london.ca

The Design (and Construction Supervision) Engineer key contact is specified on a project specific basis.

The Facility Expansion Contractor key contact is specified on a project specific basis.

105 SCADA PROJECT DOCUMENTATION

1. General

1. The following standard is to provide an outline of the requirements of a complete documentation system, from the aspects of document storage (both paper and electronic), as well as file management. The purpose is to ensure that complete documentation for instrumentation and control is obtained and maintained. (This standard also applies to mechanical, electrical and civil).

2. This standard summarizes the documentation requirements of various other standards, including:
   a. Process Narratives & Software Programming Requirements
   b. Software Configuration
   c. Construction, Shop and Record Drawings
   d. Contract Specifications
   e. SCADA Operations Manuals
   f. SCADA Maintenance Manuals
   g. Other Manuals

2. Printed Document Format

1. Bind manuals in hard covered, loose-leaf, vinyl flat back binders for holding three-hole, 216 by 279 mm (8½ by 11 inch) paper stock.
   a. The manuals may be subdivided into as many volumes as required.
   b. Do not use binders more than 76.2 mm (3 inches) thick.
   c. Use binders that are the same in appearance except for contents labeling.
   d. Lithographically print the Owner's name, Facility Area (or Outstation), and volume number on the front cover and spine of each binder.
   e. Identify the manual title, and volume number on the back edge.

2. Print documents in accordance with the following requirements:
   a. Use a clear 19 mm (0.75 inch) margin on the top, bottom, left and right edge.
   b. Use either ANSI Size A 216 by 279 mm (8.5 by 11 inch) or Size B 279 by 432 mm (11 by 17 inch).
   c. Utilized two sided printing whenever possible.
   d. Use MS Word to develop the documents, with a font size of 10pt.
   e. Have no lettering, symbols or characters less than 1.6 mm (0.0625 inch) in height.
   f. Drawings – drawings & drawing files shall be reproducible in both A size (11" x 17") and D size format.

3. Organize documents to include the specified information. The order of the material in the manuals may differ from the specifications.
   a. Provide a table of contents in each binder for the contents of all volumes;
   b. Provide a table of contents specific to the material in the binder or manual. Identify subject matter by title and page number;
   c. Provide a list of figures, tables, and illustrations with each manual and include the number, title, and page number of each illustration.

4. Include a Glossary & List of Acronyms at the front of each document. Thereafter, abbreviations and acronyms may be used if their meaning is explained in the table. Do not use model or catalog numbers, or letters for identification, without additional written descriptions and/or documentation.

3. Printed Document Locations

1. The following table identifies the required locations for printed documents.

Document	Location	Number of Copies
Elgin Area & Lake Huron WTP		
1. Process Narratives and Software Programming Requirements 2. Software Configuration 3. SCADA Operations Manual 4. SCADA Maintenance Manual 5. P&IDs (11 x 17) 6. Control Schematics (8.5 x 11) 7. Electrical Drawings (11 x 17) 8. Tender Drawings (11 x 17) 9. Tender Specifications 10. As-Recorded Drawings (11 x 17) 11. Shop Drawings	Regional Water Supply Office Library Elgin WTP Library Lake Huron WTP Library	1 2 2
Water Pump Stations and Reservoirs		
1. Process Narratives and Software Programming Requirements 2. Software Configuration 3. SCADA Operations Manual 4. SCADA Maintenance Manual 5. P&IDs (11 x 17) 6. Control Schematics (8.5 x 11) 7. Electrical Drawings (11 x 17) 8. Tender Drawings (11 x 17) 9. Tender Specifications 10. As-Recorded Drawings (11 x 17) 11. Shop Drawings	Regional Water Supply Office Library Elgin WTP Library Lake Huron WTP Library Related Facility Library	1 2 1 2
Valve Chambers, Meter Chambers and similar locations		
1. Process Narratives 2. Software Programming Requirements 3. Software Configuration 4. SCADA Operations Manual 5. SCADA Maintenance Manual 6. P&IDs (11 x 17) 7. Control Schematics (8.5 x 11) 8. Electrical Drawings (11 x 17) 9. Tender Drawings (11 x 17) 10. Tender Specifications 11. As-Recorded Drawings (11 x 17) 12. Shop Drawings	Regional Water Supply Office Library Elgin WTP Library Lake Huron WTP Library	1 2 2

2. All of the locations that include 11 x 17 documents, must contain printers and photo copiers capable of printing/copying this size of paper.

4. Electronic Document Locations

1. The following table identifies the required locations for storing electronic versions of the specified files/documents.

Electronic File	Location
Lake Huron and Elgin Area WTP and other locations	
1. Smart Device Software Programs and Settings 2. PLC Programs Plus Documentation Filter 3. SCADA Server Configurations 4. SCADA Workstation Configurations 5. Network Switch, Router, Firewall, plus similar Configurations	LH & EA SDMS Server Offsite Data Backup Server
Lake Huron and Elgin Area WTP and other locations – Adobe Format	
1. Process Narratives and Software Programming Requirements 2. Software Configuration 3. SCADA Operations Manual 4. SCADA Maintenance Manual 5. P&IDs (11 x 17) 6. Control Schematics (8.5 x 11) 7. Electrical Drawings (11 x 17) 8. Tender Drawings (11 x 17) 9. Tender Specifications 10. As-Recorded Drawings (11 x 17) 11. Shop Drawings	LH & EA SDMS Server Offsite Data Backup Server
Lake Huron and Elgin Area WTP and other locations – Native File Formats	
1. Process Narratives 2. Software Programming Requirements 3. Software Configuration 4. SCADA Operations Manual 5. SCADA Maintenance Manual 6. P&IDs (11 x 17) 7. Control Schematics (8.5 x 11) 8. Electrical Drawings (11 x 17) 9. Tender Drawings (11 x 17) 10. Tender Specifications 11. As-Recorded Drawings (11 x 17) 12. Shop Drawings	LH & EA SDMS Server Offsite Data Backup Server

106 SCADA Document Management System

1. General

2. The Regional Water Supply has developed a SCADA Document Management System (SDMS) to efficiently store and manage the facility electronic information.

3. The SDMS has three major sections. One section is an internal, Electronic Library containing published, Adobe versions of the facility manuals, drawings, standards and other details. The template files can also be downloadable in their native formats.

4. The working files section, with restricted access, contains current copies of all PLC programs, SCADA server configurations, network switch configurations, computer "images", ACAD drawings, process narratives, software requirements documents, plus related files, in their native format. This section includes version control, check in/out privileges, and the other features related to standard electronic file management.

2. Electronic Library

1. The web based electronic Library includes the facility drawings, Operations Manual, Maintenance Information, Software Programming Requirements document, Process Narratives, QMS documents, EMS documents, plus other files. All of this information is in HTML or Adobe format.

2. At the end of each capital project, the "project centric" data must be converted into "facility centric" data and loaded into the Web Library.

3. Working Files

1. At the end of each capital project, the final, electronic project deliverables are to be stored in the Working Files, in their native format.

2. The "project centric" information is also used to update the "facility centric" data, which must also be stored in the Working Files.

3. On a weekly basis, the Cimplicity version control software automatically collects all PLC and SCADA computer programs, and flags any modification.

4. All version control and file naming standards must be followed.

4. Electronic File Naming Conventions

1. General
   a. All electronic files must be adhere to this naming convention to simplify converting the documents over to the Web Library.

2. ACAD Drawing File Naming Convention
   a. All ACAD drawings must adhere to the following file naming convention, for submission as the final project deliverables.

Tag Fragment	CCC	CCCCC	CCCC	C-C		
Fragment No.	1	2	3	4		

Explanation of Characters:

1. 3 Characters: Utilize facility codes
2. 5 Characters: Use "FCLTY" for facility centric drawings, or the related capital project number
3. 4 Characters: Drawing number, such as E001
4. 24 Characters: Drawing descriptions, such as HLP01_control_schematic

107 Electronic Document Templates

1. List of Documents

The following electronic documents are available for use.

1.1 Request for SCADA Design & Construction Standard Upgrade Form

1.2 Design Deviation Form

1.3 Factory Acceptance Test Form

1.4 Site Acceptance Test Form

108 Glossary & List of Acronyms

Note: Bold terms in the definitions can themselves be found in the glossary.

0	A symbol used to represent an "Off" state in a binary (two-state) system.
1	A symbol used to represent an "On" state in a binary (two-state) system.
4-20 mA	A signal transmission standard which is used to transmit, over two conductors, an electrical representation of a physical quantity such as pressure, level, or temperature.
A-B	See Allen-Bradley.
Address	The location of a small portion of data within a programmable device or the location of a device on a network. An address in data terms can be thought of as a cell in a spreadsheet; an address in network terms can be thought of as similar to a street address or destination.
AI	See Analog Input.
Alarm	A condition which is abnormal and which requires correction, usually by the operator. The alarm may be minor in nature, in which case some repair work or action may be scheduled, or it may be major, in which case urgent action is called for.
Allen-Bradley	An equipment manufacturer that produces Programmable Logic Controllers as well as other products.
Alphanumeric	Composed of letters of the alphabet A-Z and the digits 1-10.
Analog	Representing a quantity that cannot be precisely determined, but must be measured with some degree of accuracy, as opposed to counted with complete accuracy. Examples of analog values include temperature, pressure, flow rate, and level. These values vary continuously over a range and can never be precisely determined.
Analog Input	An input to a control system or control device that accepts a signal representing an analog quantity, that is, a quantity that must be measured, such as pressure, level, or temperature.
Analog Output	An output from a control system to a controlled device that instructs the device to respond in degrees (as opposed to On or Off). Such control devices typically include proportioning valves and variable-speed drives.
ANSI	American National Standards Institute.
AO	See Analog Output.
Archive	A collection of data records assembled either by personnel or by a computer system. An archive is usually not modified once created; it is read-only.
Binary	Existing in either of two states, in computer terms generally On and Off.
Cabinet	A general term for an enclosure, usually constructed of steel or aluminum, used to house equipment. It generally provides a degree of protection to the equipment inside against dust and water, and to personnel outside against dangerous voltage or moving equipment.
Calibration	The process of adjusting a device so that output signal represents a physical quantity (such as temperature, pressure, or level) within a tolerable degree of error.
CD-ROM	Compact Disk Read-Only Memory. A form of high-density information storage using disks. Most CDs are written only once, although re-writeable disks are available.
Command	An instruction to a device that causes it to respond.
Configure	To program or set up a device, or to install parameters and information into a device such that it operates correctly.
Control Variable	A device or quantity that responds in degrees to the output signal from a controller that tries to maintain a pre-set value. Typical control variables are pressure, temperature, and flow rate. Control systems are often called upon to maintain these variables within pre-set limits.
CompacLogix	A family of PLC's produced by Allen-Bradley.
Contrologix (CLX)	A family of PLC's produced by Allen-Bradley.
CPU	Central Processor Unit. That portion of a controller or computer that performs mathematical operations and executes instructions in order for the entire controller or computer to carry out complex tasks.
CSA	Canadian Standards Association.
CV	See Control Variable.
Data Highway	A communication protocol developed by Allen-Bradley. Most Allen-Bradley PLC's and some from other vendors, use this protocol. More generally used to refer to any communication network linking controllers, regardless of communication protocol.

Derivative	One of the values used to program a PID controller for proper operation. See PID.
DI	See Discrete Input.
Digital	Comprised of digits. In terms of control systems, often used to mean discrete.
Discrete	In the context of control systems: existing in either of two states: On or Off, often represented as 1 or 0 respectively.
Discrete Input	An input which represents either of two states, On or Off, and which cannot be used to represent a continuously variable range such as a temperature span. Note that a discrete value could be used to indicate whether the variable is above or below a pre-set limit however.
Discrete Output	An output which represents either of two states, On or Off, and which can not be used to represent a continuously variable range such as the speed of a motor.
DO	See Discrete Output.
EEMAC	Electrical Equipment Manufacturer's Association of Canada.
Ethernet	A communication implementation using twisted shielded two-conductor wire, coaxial cable, fibre optic or modems.
Failsafe	Constructed or arranged in such a way that if it fails, then the failure will be obvious and the failure will not create more harm. For example, an Emergency Shutdown circuit which is arranged so that if the circuit wiring is damaged, the controlled equipment will be shut down can be considered fail-safe.
Feedback	A signal from a controlled device that is transmitted back to the controlling device, with the intent that the controller can monitor the operation of the device. The feedback signal can be used to generate an alarm if the controller runs the device out of bounds, and is a good indication of equipment failure that the controller might not otherwise be aware of. Feedback is frequently used in motion- and speed-control system.
Field Device	A device installed in the process area of a plant as opposed to the control room.
GE (General Electric)	An equipment manufacturer that produces Programmable Logic Controllers as well as other products.
GIS	Geographic Information System. A computerized means of recording and indicating the position of features, usually on the surface, or underneath the surface, of the earth. Frequently used in the installation and maintenance of pipelines, roads, and distribution systems of all types.
Ground	In electrical terms: a connection to the earth, intended to divert potentially dangerous currents in case of an electrical fault, preventing or limiting damage to equipment and personnel.
Hi	A process value that is at the permitted maximum. Example: a Hi level signal is typically generated when a tank is near the full level.
Hi Hi	A process value that is beyond the permitted maximum. Example: a Hi Hi level alarm is typically generated when a tank is above the normal full level and in danger of over-flowing.
HMI	Human-Machine Interface. Any means of communicating between personnel and a machine, but more specifically used to refer to a computer or graphical display of system information that an operator refers to in controlling a process. The term HMI is now generally restricted to computer displays and alphanumeric displays, but any means of conveying information between operator and machine can be considered a man-machine interface. The HMI can communicate with PLC's over a data highway, and can communicate with other plant management information system computers over a LAN.
HOA	Hand-Off-Auto. A three-position switch that is installed to control equipment that can be operated either by an automatic mechanism or manually. With the switch in the Hand position, the equipment runs without action on the part of the automatic controller. With the switch in Auto, the equipment runs as directed by the automatic controller. With the switch in Off position, the equipment doesn't run.
I/O	Input/Output. See Analog Input, Analog Output, Discrete Input, and Discrete Output.
I/O Point	One input or output in a system. See Discrete Input, Discrete Output, Analog Input, and Analog Output.
IEEE	Institute of Electrical and Electronic Engineers
Integral	One of the values used to program a PID controller for proper operation. See PID.
Interlock	A means of preventing the operation of, or stopping the operation of equipment in case of

	an erroneous condition. For example, pumps are frequently interlocked with a level sensor to prevent the pumps from running with insufficient water in a well. Interlocks are frequently installed to prevent injury to personnel, such as when access covers are removed.
ISA	The Instrumentation, Systems, and Automation Society. Formerly named the Instrument Society of America.
Ladder Logic	A means of programming a device such as a PLC, using rules of logic. So-called because the resulting program resembles the rungs of a ladder. Ladder logic is particularly well suited to On-Off control of equipment and to batch processes, but not well suited to continuous control such as pressure, temperature, or speed control.
LAN	Local Area Network. A communication network which covers only a small physical area such as an office or plant, and to which numerous devices are connected in order to communicate. The number of users is generally small, and limited to the personnel in the plant or office.
LIMS	Laboratory Information Management System. A system designed to record information and produce reports detailing the operating of a system. The information in the LIMS is usually accessible to a large number of people but the rights to modify that information is quite restricted in order to preserve its integrity.
Lo	A process value which is at the permitted minimum. Example: a Lo level signal is typically generated when a tank is nearly empty.
Local	In terms of control system components: located in the plant near the equipment being controlled, rather than at a distance, such as in a control room some distance away. A temperature transmitter is normally installed locally to the process being measured, but its display may be remotely mounted if required.
Logical Name	A name or tag assigned to a device. The name may be meaningful only to one controller in some instances.
LoLo	A process value which is below the permitted minimum. Example: a Lo Lo level alarm is typically generated when a tank level is so low that a process is in danger of running out of water.
Mapping	The process of assigning addresses and tags to the many individual signals and data values in a system such as a controller.
MMI	Man-Machine Interface. See Human-Machine Interface.
MicroLogix	A family of PLC's produced by Allen-Bradley.
Modbus	A communication protocol developed by Modicon. Most Modicon PLC's, and some developed by other vendors, use this protocol.
MultiRanger	A type of ultrasonic level transmitter produced by Milltronics.
NC	Normally closed. In particular it refers to a contact or switch that is normally conducting, and only opens the circuit when pressed.
NO	Normally open. In particular it refers to a contact or switch that is normally not conducting, and only closes the circuit when pressed.
Noise	Any signal that is un-wanted, such as electrical interference that is added to an electrical control signal.
Offset	A value that is either intentionally or un-intentionally added to a value to produce a new value. A transmitter may un-intentionally add an offset to a measured value, in which case the transmitted value will be (slightly) in error. An operator or a PLC may deliberately add an offset to a value to correct for a known error in a system.
Over Range	A measured value that is found to be above the high end of its span. Generally considered an error, an over range signal can indicate either a process upset or transmitter failure.
Permissive	A signal which allows an event to take place or equipment to operate, and which is generated when the established conditions are met. See Interlock.
PID	Proportional-Integral-Derivative. Refers to a type of analog controller that controls an analog quantity, such as the speed of a pump or the position of a valve, in order to maintain a second physical quantity, such as the pressure or the flow rate in a pipe, at an operator-entered Setpoint. The PID controller accepts a Setpoint from an operator and compares it to the Process Variable that represents the physical process being controlled. If required, it adjusts the Control Variable to produce a change in the Process Variable.
PLC	Programmable Logic Controller. A form of computer that is programmed to operate equipment. PLC's are typically installed in plants near the equipment to be controlled and

	are sometimes provided with a Man-Machine Interface. They are generally constructed to withstand a high degree of vibration as well as heat, typical of many plants. See also Ladder Logic.
PLC5	A family of PLC's produced by Allen-Bradley.
Point	A term generally used to refer to any analog or discrete signal in a control system.
Poll Time	The time period for the SCADA node to poll the PLC for current I/O values.
Process Variable	An analog signal representing a physical quantity such as pressure, level, or temperature, and which is generally connected to a PID controller as a form of feedback so that the controller can monitor the process.
Proportional	One of the values used to program a PID controller for proper operation. See PID.
Rack	A frame that contains several modules in a PLC or RPU.
Range	The difference between the minimum and maximum values. In terms of process transmitters, the maximum difference in process values (such as temperature) over which the transmitter can be calibrated to respond. For example, a temperature transmitter may have an operating range of -50 to +70 C, and its output may be calibrated to produce a 4-20 mA signal representing 0-30 C. In this case, -50 to +70 represent the transmitter's range, and 0-30 C its span.
Remote	In terms of control system components: located in the plant far from the equipment being controlled, rather than nearby. A temperature transmitter is normally installed locally to the process being measured, but its display may be remotely mounted if required.
RIO	Remote Input and Output. An arrangement by which input and output signals are connected to a module, typically locally mounted, so that a PLC or other type of processor or controller which is remotely mounted, can read the inputs and operate the outputs.
RPU	Remote Processing Unit. A device that is locally mounted to provide inputs and outputs for a process being controlled, but with limited control capabilities of its own. Instead the RPU communicates with a remote mounted controller that contains a control program. RPU's typically have good communication options and a limited processor capacity. In the event of communication failure the RPU generally takes over control of the process in a limited capacity.
SCADA	Supervisor Control And Data Acquisition. A system that provides control functions for a process, usually with some operator input, and which also acquires data and logs it for the purpose of producing records.
Scan Time	The time period by which the RPU scans the field I/O cards for the current I/O status.
Setpoint	An operator-entered value representing the desired operating point of a process parameter such as pressure, level, or temperature. A PLC or PID controller is often installed to control the process and maintain it at the setpoint.
Shelf State	The state in which the device comes "off the shelf" or "as manufactured". Generally refers to the state of output contacts (open or closed) as well as user-adjustable settings that may have been set at the factory.
Shield	A conductive wrapping that surrounds the conductors in a signal cable and prevents the conductors from picking up extraneous electrical signals from nearby equipment. The shield is usually tied to system ground for safety and for better noise immunity.
SLC500	A family of PLC's produced by Allen-Bradley.
Slot	One of the positions into which a module can be inserted in a PLC or RPU rack.
Smart Device	A piece of equipment, often a transmitter, which contains a processor and is capable of some higher-level functions such as communication and self-diagnostics.
SP	See Setpoint.
Span	The difference between minimum and maximum values of a process variable for which a transmitter's output has been calibrated. For example, a temperature transmitter may have an operating range of -50 to +70 C, and its output may be calibrated to produce a 4-20 mA signal representing 0-30 C. In this case, -50 to +70 represents the transmitter's range, and 0-30 C its span;
	The difference between minimum and maximum values for which a transmitter or a process measurement is calibrated. See also Range.
Status	A condition that applies to a piece of equipment or a contact. In general the equipment status is one of "Running", "Stopped", "Failed", "Open", "Closed", etc. The status of the equipment is generally displayed on the MMI for the benefit of the operator.

Tag	In physical terms: label attached to a device in order to identify it, generally made of plastic, aluminum, or stainless steel, and engraved or stamped with identifying characters. In processor and control system terms: a similar label which exists in the system database and which identifies the device in the same manner.
TCP/IP	Transmission Control Protocol / Internet Protocol. A communication protocol frequently implemented in Ethernet networks, and also upon which the Internet is based.
Transmitter	A device that measures a physical parameter such as pressure, level, or temperature, and sends an electrical signal to a system or display elsewhere indicating that value. Transmitters may also contain an integral display indicating in engineering units such as degrees, kPa, etc. See Span and Range.
VFD	Variable-Frequency Drive. An electric controller that is used to vary the speed of a motor.
WAN	Wide Area Network. A communication network which covers a large physical area such as a city or region, and to which numerous devices are connected in order to communicate. A WAN often serves hundreds of users and carries a very large volume of data. Frequently the services of the local telecommunications company, such as Bell, are involved.

SCADA Design Deviation Technical Memo

Submitted by-	
Date of Submission (mm/dd/yy)-	
Related documents submitted	
Memo Reference Number- (added by Joint Board SCADA Leader)	

#	Joint Board Guidelines	Proposed Deviation and Justification	Final Decision (Accepted/ Rejected)
1			
2			
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Lake Huron Water Treatment Plant

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PROJECT NO. LH1330 & EA4029

INSYGHT SYSTEMS PROJECT NO. 07005

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AM Water Representative: _____ _____

Last Update : April 25, 2009

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