Setting the Standard for Automation™

SCADA Standardization

Developing Effective
Process Automation Standards for your Facility

CASE STUDY: City of Guelph Water Services Dept.

Speaker:
Graham Nasby, Eramosa Engineering

Guest Lecture - B.Tech. Process Automation Program
McMaster-Mohawk Technology Partnership
www.learningin3d.ca/process.html

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About Your Speaker

Graham Nasby, P.Eng., PMP

- System Integrator with Eramosa Engineering
- Director-elect of the ISA Water/Wastewater Division
- General Chair for the 2012 & 2013 ISA Waster/Wastewater Symposium
- Member of the ISA18, ISA101 and IEC/CSC TC65 standards committees
- In 2011 received Control Engineering magazine's "Leaders Under 40" award
- Background in various industry sectors including municipal water/wastewater
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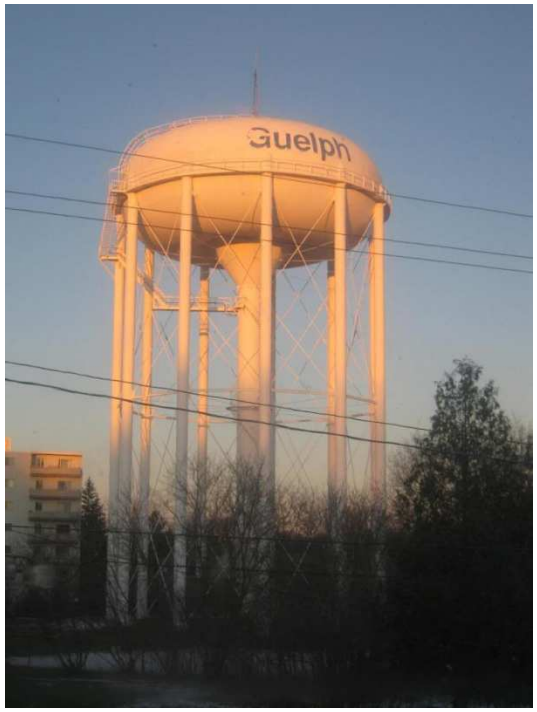
Note:

- This presentation is adapted from a paper entitled "Modernization of a Municipal Waterworks with SCADA Standardization" that was co-presented by Graham Nasby and Matt Phillips at the ISA 2011 Water/Wastewater and Automatic Controls Symposium on June 23, 2011 in St. Louis, Missouri, USA. It won the award for "best paper".
- Matt Phillips is the Water Security Coordinator (SCADA) for the Water Services Dept. of the City of Guelph in Guelph, Ontario, Canada.

Presentation Outline

- Introduction
- About the City of Guelph Water Services Dept.
- What do we mean by SCADA

- The Need for Standardization
- When to Standardize
- How to do It
- How to Write/Implement Standards
- Standardization Tips
- Case Studies
- Lessons Learned



What do Process Automation People Do?

You could work for:

- **Owner** – you help the owner automate their in-house equipment & facilities
- **Contractor** – you are hired as part of construction project to build/install automation
- **Vendor** – you design and build packaged equipment for a vendor to sell
- **Consultant** – you are hired to help design automation and coordinate installs/startups

Why automation is a challenging career:

- Automation is tricky to do well…which is what makes it fun!
- Automation can be hard for some people to visualize
- Lots and lots of details, which are all important

- You often work with many, many stakeholders/disciplines
- Automation is often installed and commissioned last in construction projects which can mean tight schedules

Construction Specifications

- Written specifications
  - Division 01 — General Requirements
  - Division 02 — Site Construction
  - Division 03 — Concrete
  - Division 04 — Masonry
  - Division 05 — Metals
  - Division 06 — Wood and Plastics
  - Division 07 — Thermal and Moisture Protection
  - Division 08 — Doors and Windows
  - Division 09 — Finishes
  - Division 10 — Specialties
  - Division 11 — Equipment
  - Division 12 — Furnishings
  - Division 13 — Special Construction
  - Division 14 — Conveying Systems
  - Division 15 — Mechanical
  - Division 16 — Electrical

- Drawings
  - Architectural / Civil Drawings
  - Structural Drawings
  - Layout Drawings
  - Mechanical Drawings
  - Electrical Drawings
  - Process Drawings / P&IDs
  - Instrumentation/Control Drawings
  - Network / Communications Drawings

BACKGROUND INFORMATION

City Water Services Department and some SCADA Terminology

City of Guelph

- Guelph is a city of 132,000 located in Ontario, Canada
- Located 45 minutes northwest of Toronto (across the lake from Rochester, NY, USA)
- Founded in 1827
- Situated at the confluence of the Speed and Eramosa Rivers
- Home to the University of Guelph and a major manufacturing centre

Guelph Waterworks

- Municipal waterworks began in 1878 with a “Holly System” for fire protection
- In 1880 the first artesian spring is discovered in city limits
- More wells were added as the city grew

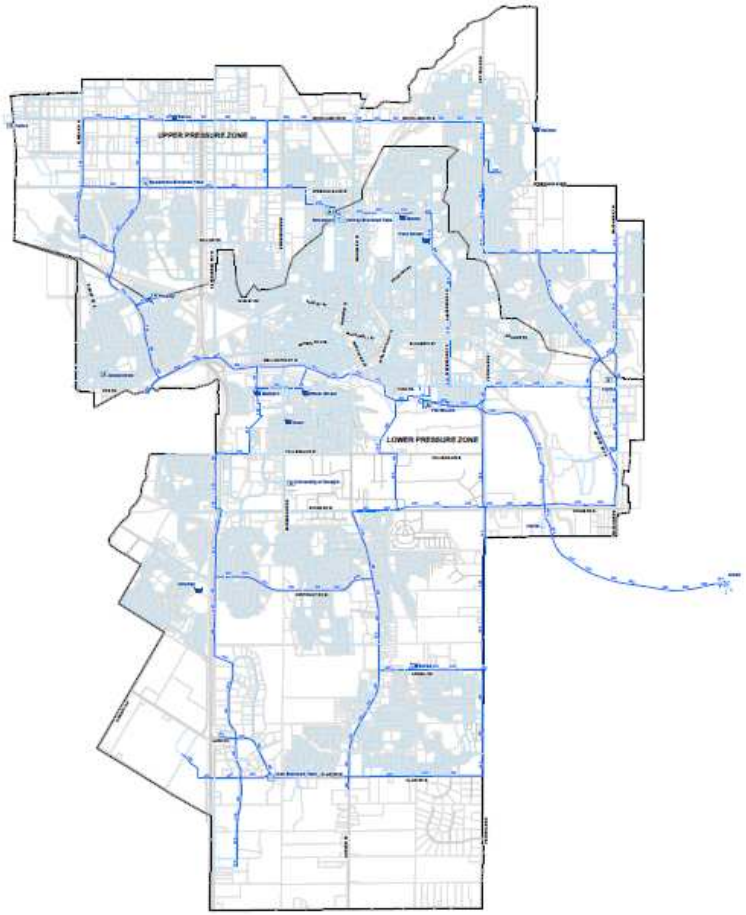
- In 1908 the Arkell Spring Grounds first used as a water source
- Arkell Springs were further expanded in 1963, 1970s and 2010
- 45-60% of city water comes from Arkell Springs
- Currently conducting a study shift more production to Arkell Springs

Guelph Waterworks System

- 6 active wells at Arkell Springs
- Glen Collector at Arkell Springs
- Arkell Springs water flows by gravity to city

- 13 active Urban Wells (with Reservoirs)
- 3 Water Towers
- 4 Booster Pumping Stations
- 2 pressure zones (high and low)

- Population of 132,000 as of 2010
- Residential and industrial customers
- 334 miles (534 km) of pipe, largest being 600mm
- 12-14 MGD (45,000+ m3/day) of delivered water



What do we mean by SCADA

- SCADA = Supervisory Control And Data Acquisition
- Includes:
  - PLCs that connect to equipment and sensors
  - OITs (for the PLCs) on local control panels
  - Automated control of equipment using PLC program logic
  - SCADA network which connects the PLCs and servers together
  - HMI screens on SCADA servers/computers (remote user interface)
  - SCADA servers that provide connectivity for HMI and data collection
  - Historian, Alarm Management System, Alarm paging, Report generation
  - All programming code that resides on PLCs, OITs, and HMI
- Does not include:
  - MCCs and motor starters
  - Back up electric relay logic

A Few More Definitions

- PLC = Programmable Logic Controller
  - Sometimes called a PAC, RTU, RPU, Controller, or Solver
  - Provides connection between SCADA network and raw equipment I/O
  - Contains the automatic control logic for equipment
  - Can be remotely controlled via SCADA

- HMI = Human Machine Interface (viewable on a SCADA terminal)
  - Resides on personal computers in the SCADA system
  - These are the “screens” that provide remote user interface for Operators

- OIT = Operator Interface Terminal (located on local Control Panel door)
  - Typically a proprietary industrial computer with a touch screen
  - Sometimes it is a full-featured PC-based computer with a touch screen
  - Often uses different programming environment than HMI

The Issue
& Why We Need Standardization

- SCADA continues to be a rapidly evolving field
- Cost vs. Functionality ratio continues to improve
- We can now do things that were cost prohibitive in the past

- Large projects are usually tendered, so it can be different integrator each time

- The tendency is to install the “latest and greatest” equipment each time
- When done over 10-20 years, the resulting systems can be very complex
- Complexity in SCADA is magnified because everything has to communicate

- Standards provide guidance throughout entire engineering design process
- Can significantly reduce design/review time
- Clear standards make construction contract administration easier

Hidden Costs of SCADA Complexity

- SCADA systems that are built over time can become very complex due to components having varying feature sets, connectivity, programming, and vendor support.

- Some of the many hidden costs of complexity
  - Harder to maintain & troubleshoot
  - Broader skill sets needed for operators, maintenance, engineers, programmers, etc.
  - More training to keep your staff up to date
  - More use of external consultants to cover skills not available in-house

  - Additional site visits by staff needed since equipment status reporting on SCADA varies
  - More possibility for mistakes since not all systems have same status detail over SCADA
  - Multiple vendor support contracts (one for each type of equipment/network)

  - Additional costs from extra time/effort needed to add new equipment to system
  - Ongoing difficulties trying to get incompatible equipment/networks to talk to each other
  - Signal converters, bridges, and protocol converters are often not as robust as native communications

The Decision to Standardize

- When to Standardize
  - You, and your organization, have enough experience with SCADA technology to understand what it can and cannot do
  - Know what you want
  - Know what you don't want
  - Understand the technical requirements of your region/facilities
  - Understand the needs of your user groups (operators, maintenance, engineering, etc.)
  - Understand the capabilities of vendors, integrators and in-house staff

- Resources Required
  - Must have the support of your management and procurement dept.
  - Need users who want to participate (operators, maintenance, engineering, etc.)
  - Need to have an overall long term Master Plan for your waterworks already
  - Be prepared to do some work before you see it pay off
  - Be patient as developing standards takes time and is an iterative process
  - Have a vision

DEVELOPING STANDARDS

"IF YOU DON'T SPEC IT, YOU DON'T GET IT"

Developing Standards

Steps towards Standardization

- Step #1: SCADA Master Plan

- Step #2: Decide what documents to use
- Step #3: Pick your SCADA Platform
- Step #4: Create the Documents/Templates

- Step #5: Test them out on Pilot Sites
- Step #6: Adopt as part of project workflow

- Step #7: Revisit/revise standards regularly

Step 1: Develop a Vision
SCADA MASTER PLAN

- You need to have a long-term vision to standardize towards

- Before you can standardize, you need to create a SCADA Master Plan
- Look to your overall Waterworks Master Plan for ideas
- If you already have a SCADA Master Plan, when did you last update it?

- Do a survey of your current SCADA system
  - Is it fulfilling the needs of Operations, Maintenance, Engineering, etc.?
  - Are there features you wish you had?
  - Are there organizational goals that the SCADA system could help with?
  - Is your SCADA system easy to use or a pain?
  - Is the technology you are using becoming obsolete?
  - Are there any new or upcoming regulatory requirements?

- Where do you want to be in 5, 10, 15, 20 years?
- Write a plan on how to get there

Step 2: Decide How To Communicate
SELECT YOUR DOCUMENTS/TEMPLATES

- Standards are how you communicate and implement your SCADA Master Plan
- Documents to consider:
  1. Tagging Standard (Sites, Equipment, Electrical, SCADA points)
  2. SCADA Network Equipment and Addressing Standard
  3. Control Panel Specification (equipment, layout, wiring methods, etc.)

  4. List of Approved PLC Hardware
  5. PLC Programming Standard
  6. Standards for the OIT – Purpose, Hardware, Configuration and Programming

  7. Standardized SCADA software platform specification
  8. HMI Programming Standard
  9. Alarm Management Strategy/Standard (bonus points for using ISA18.2)
  10. Data-Logging, Historian, and Data Redundancy Implementation Guide
  11. Other aspects of your workflow

Step 3: Select your Standardized Platform
HARDWARE, SOFTWARE & NETWORK

- The usual selection criteria for any automation solution applies...

- **but** you should also consider
  - Are you avoiding vendor lock-in? If not, is it worth it?
  - Standardization does not necessarily mean picking one vendor!
  - Pick the mix of equipment and software that best fits your needs

  - Will this equipment/software be still available 5, 10, 15, 20 years from now?
  - What is the vendor's roadmap for future product releases: is there continuity in connectivity, compatibility, and support?
  - Is there local vendor support available? Will it be available in the future?
  - What is the replacement plan when this equipment reaches end-of-life?

  - How does it affect your staffing and staff training plans?
  - Are there enough local system integrators with this skill set available?
  - Short term cost savings sometimes do not make sense in the long term

Step 4: Writing Standards
1. TAGGING STANDARD

- Use a universal tagging standard across your entire waterworks

- ISA-5.1 only provides basic guidance – you will have to write your own facility standard
- Use the same tagging system on everything to prevent confusion!
  - P&ID's, Equipment, Electrical Drawings, PLC hardware, PLC Internal Tags, SCADA tags, reports, etc.
- Must have a written procedure for adding new codes for new types of equipment

- Guelph uses a "five fragment" tagging system: aaa-bbbb-cc-d-ee
  - 1st Fragment "a": site code
  - 2nd Fragment "b": equipment code, with trailing numbers as needed
  - 3rd Fragment "c": device type, with trailing numbers as needed
  - 4th Fragment "d": signal direction (SCADA only)
  - 5th Fragment "e": signal type (SCADA only)
- Examples
  - A14BLG1TIQ01 = Arkell Well 14, Building 1, Temp Indication, Quantity In, 4-20mA Signal (Scaled)
  - AKWDTY5ALQLS = Arkell Well System, Well Duty 5, Auto Low Start (Level), Quantity In, Lo Setpoint

Guelph uses an Excel spreadsheet (8 printed pages) for their Tagging Standard

Step 4: Writing Standards
2. SCADA NETWORK STANDARD

- The SCADA network is the backbone of your system. Choose carefully!

- Things to consider:
  - Network technology to use
  - Connection medium: copper lines, fibre optic, and/or radio communication
  - Who owns/manages the communication medium
  - Failure modes when a network segment goes down
  - Can nodes be added/removed without having to take the network offline

- Guelph's network:
  - Ethernet so there is no vendor lock-in
  - Fibre optic network with redundant connections and auto-failover routing
  - Static IP addressing with small subnets for performance
  - Configuration of network routers/switches is done by their fibre optic network provider

Guelph has a 1 page preferred network equipment list
and an Excel spreadsheet of assigned/anticipated network addresses

Step 4: Writing Standards
3. Control Panel & Field Wiring Spec

- This is for the 120V control panels that your PLCs and OIT's go into
  - Let your electrical dept look after the 480/600V panels, Motor Starter and MCC standards
- Standardized panels make maintenance and troubleshooting easier

- Things to consider:
  - Size of panel, Internal layout, Pocket on inside of door for drawings
  - CAD files as electrical design templates
  - Approved equipment list
  - Terminal blocks between PLC I/O cards and field connections (you would be surprised!)
  - Room for future expansion – unused space, terminals, ducts, etc.
  - Having a light with a door switch
  - Courtesy outlet for programming, even better put a programming jack on the front door
  - Standard pilot lights on every panel (power ok, fault, communications ok)
  - Standardized alarm beacon, horn, and/or horn silence button on every panel
  - Idea: Put a see-through window on front door so staff can see the I/O card status lights

Guelph includes this in their PLC Hardware Standard (3 pages of text, 4 electrical drawings)

Step 4: Writing Standards
4. PLC HARDWARE SPEC

- Decide on what you are going to call this thing!
  - PLC, PAC, RTU, RPU, Solver, Controller, etc.
- Have an approved list of hardware that is periodically updated

- Things to consider:
  - Specify a PLC platform/configuration for “small”, “large”, and “tiny” sites
  - Controllers, Controller firmware version
  - Standardized rack/chassis size, minimum size of power supplies
  - List of approved I/O Modules
  - List of approved Communications Modules
  - Card/module placement
  - Certain cards that you want installed in every PLC whether they are used or not
  - Remote I/O racks – hardware to be used and how they connect to the PLC
  - Remote I/O networks should be localized and separate from the main SCADA network

Guelph has a PLC Hardware Standard which covers this in 4 pages

Step 4: Writing Standards
5. PLC Programming Spec (1 of 2)

- This must consist of both a written specification and code template files

- Why the template files?
  - Programmers often don't like to read!
    - help them out and avoid disputes by providing template files for them to use
  - Modern PLCs and I/O cards have a myriad of settings – put them in the template file
  - Provide an "empty" template file along with several "finished example" template files
  - Make sure the template files will "compile" – don't provide broken programs!

- Why the written specification?
  - Makes contract administration much easier
  - Provides a "big picture" overview description
  - Includes detailed information about the programming approach you want used
  - Cover important aspects/nuances that you feel are important
  - Include explanations of why you want the code structured a certain way

more on the next slide...

Step 4: Writing Standards
5. PLC PROGRAMMING SPEC (2 OF 2)

- In the written specification, some things to consider:
  - PLC controller firmware version and Programming Software version
  - Which IEC-61131 programming languages are permitted (Ladder Diagram, etc.)
  - Physical and Logical name of the PLC (in context of the Tagging Standard)
  - Code organization and naming: Tasks, Programs, Routines, Subroutines

  - Memory organization and naming (how it meshes with Tagging Standard)
  - Any standardized “abstract data types” or “add-on instructions” that are to be used
  - Guidance on special programming techniques specific to the PLC platform
  - Standard interfaces and functionality for the HMI/OIT to communicate with

  - Operating modes for SCADA-controlled devices: Local, SCADA-Manual, SCADA-Auto
  - How Raw Input/Output Registers from I/O cards to be mapped into main code
  - For PLC-to-PLC messaging, what message formats that are to be used
  - How alarms are to be generated on the PLC and how alarm bits are used

Guelph has a PLC Programming Standard (approx 30 pages)
and a set of sample template files for each type of PLC they use

Step 4: Writing Standards
6. OIT HARDWARE/SOFTWARE SPEC

- Define the purpose of the OIT
  - Viewing status/process data – everything or just critical points?
  - Provide a control interface? Limited control or full control? Data logging?
  - Do you really need an OIT if there is a computer with HMI screens on it nearby?
- Hardware
  - Dedicated hardware solution – often has its own programming environment
  - Industrial computer with touch screen – can sometimes use same code as the HMI
- Programming
  - Programming software name and version
  - Desired look/feel? Colours and symbols to use? Fonts? Icons? Navigation technique?
  - How are tags/communications in the OIT to be set up?
  - How is access security managed/controlled? Auto-logout after time delay?
  - Don't forget to provide code template files for the programmer !

Guelph uses OIT's to provide a view-only troubleshooting interface and secondary data logging. Due to the simplicity of the OIT, Guelph provides one standard template file to programmers.

Step 4: Writing Standards
7. SCADA SOFTWARE SPEC

- You need to specify exactly what software is being used on your SCADA servers
- Things to consider
  - HMI visualization (user interface) software
  - Tag Database that contains the “tags/points” the HMI uses
  - How the Tag Database gets data to/from the PLCs
  - Alarm Management Solution – including alarm annunciation, paging, and logging
  - Historian, and how the Historian collects data
  - Redundant Data Logging – do you need it? If so, how?
  - Make sure to specify version numbers!
- Guelph uses
  - Integrated software package for HMI screens, alarming, and data collection
  - Specific I/O driver for PLC to Tag Database connectivity, redundant Tag Databases
  - Third party alarm paging software that interfaces with the Tag Database
  - Centralized Historian, with OIT’s at remote sites acting as redundant data collectors

Guelph covers this using 2 pages in their HMI Specification

Step 4: Writing Standards
8. HMI PROGRAMMING SPEC

- This must consist of both a written specification and code template files
- Refer back to the slide on the "PLC Programming Spec" for reasons why

- Designing effective HMIs is tricky!
- Use your HMI programming spec and template files to help the programmer
- Happy well-informed programmer = Good HMI's

- How to help the programmer:
  - Clearly define what the color "red" means
  - You can never have too many screenshots
  - Every screen element you expect them to use should be mentioned in the written spec

  - Provide programmer with "pre-built widgets" for as many things as possible
    - Layouts, Icons, Pop-up windows/faceplates, Scripting, Navigation methods, etc.
  - Provide a list of screens, pop-ups and elements that every new site must have
  - Template files must include a "fully working HMI application" out of the box

Guelph has an HMI Specification (approx 50 pages) with a large collection of template files

Step 4: Writing Standards
9. SCADA ALARMING SPEC

- Things to consider for alarming is a subject for an entire presentation by itself!
- You should provide
  - An “Alarm Philosophy” that details how you want alarming done
  - An “Implementation Guide” for the programming/configuration details for your platform
- How Guelph does alarming
  - All alarms are generated using logic on the PLCs
  - HMI receives alarm bits from the PLC via the Tag Database
  - HMI creates the alarm banners and provides the ack/reset/logging functions
  - 3rd party software is used to do alarm paging
  - Operators ack/reset alarms via the HMI, scripting sends the ack/reset bits to the PLCs
- How Guelph standardizes its alarming
  - Functional guidelines using PLC & HMI template files
  - Technical programming/configuration details in the HMI Specification
  - Currently looking into using ISA-18.2 to develop an Alarm Philosophy document

Step 4: Writing Standards
10. Data Collection, Logging, Reporting Spec

- Data collection, logging, and reporting are areas of growing importance
- Written specification/guidelines are needed for consistency

- Things to consider:
  - What to log – data points, alarm events, other events, notifications
  - Other items: HMI login/logout, setpoint changes, remote commands, security system
  - Do you log all analog/digital points, or just the critical ones?
  - How is the data going to be used? Which users need access to what?

  - Logging interval – time-based or change-on-value
  - Are there certain groups of points you wanted logged differently?
  - For each equipment type, is there a “default set” of data points you want logged?
  - If you use auto-generated reports, specify the formats – provide template files

  - How to set up and configure the historian

Guelph has 6 pages of Data Collection/Logging guidelines in their HMI Specification

IMPLEMENTATING STANDARDS

Guelph Waterworks
SCADA Standardization Timeline

- 2002 Discussions begin about developing a SCADA Master Plan
- **2003 Draft Standard Released**
  - Tagging, Control Panel Design, PLC Hardware, PLC Code Structure, Process Control Narrative Template
- **2003-2005 Draft Standard tested on pilot sites**, successful experience
- **2005 First Standard Released**
  - SCADA Master Plan, Tagging, Control Panel Design, PLC Hardware, PLC Code Structure, HMI Software Suite, HMI Screen Layouts, HMI colours and icons, HMI pop-up windows, HMI Scripting, Alarming Guidelines, Alarm Paging, Historian Specs, Redundant Data Logging Guidelines, Process Control Narrative Template
- **2005 Core network/server upgrades (Woods Pumping Station) to support standard**
  - Fiber optic networking infrastructure, new redundant SCADA servers
  - Upgrade program for SCADA network started
- **2005 Started using the SCADA standards as part of contract documents for all capital projects**
- 2005 Capital upgrades program for all SCADA equipment across city begins
- 2005-2009 Incremental updates to SCADA standard as needed
- **2009 Updated Standard released for PLC Programming (existing PLC platform)**
- **2009 Updated Standard released for PLC Programming (new PLC platform)**
- 2010 SCADA network upgrade complete, all sites now using fibre optic Ethernet network
- **2011-2012 Updated HMI Standard planned (once a major HMI server upgrade is completed)**
  - Standard to guide conversion of HMI screens and PLC communications to new HMI infrastructure
  - Developing a formal “Alarm Philosophy” (ISA-18.2) is currently being discussed

CASE STUDIES

Case Study #1:
Core Infrastructure Upgrade (2005-2006)

- Install new core infrastructure to build the new standardized SCADA system on top of

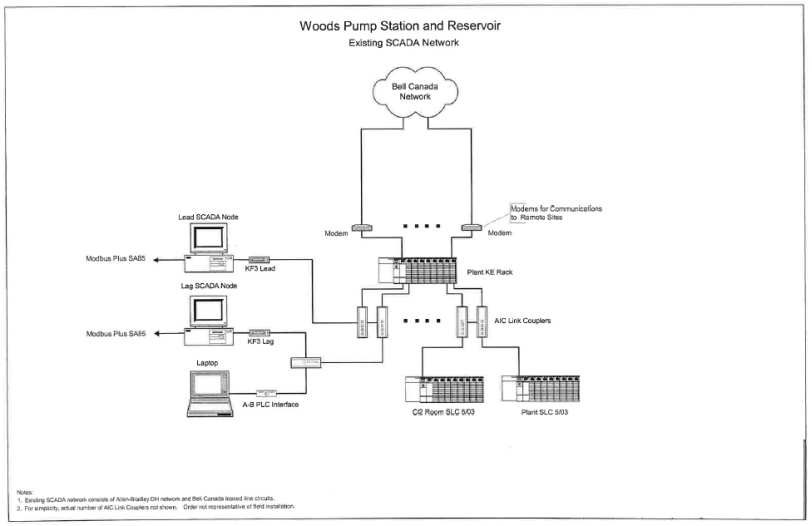
- Background / Motivation
  - Existing servers varied in technology/functionality
  - Equipment was nearing end of life and becoming expensive
  - New servers/network needed to support 5 year upgrade program

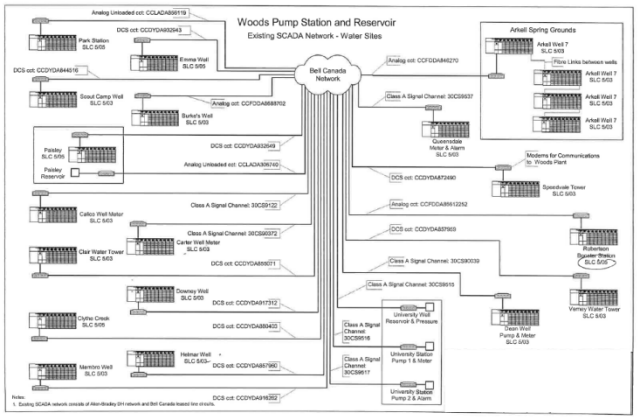
- Project Summary
  - New Redundant SCADA Servers
  - New Centralized Historian with backup system
  - Central networking infrastructure converted to Ethernet
  - First segments of fibre optic network installed
  - Temporary bridging hardware to old network
  - Imported existing HMI screens "as is" onto new servers
  - Updating individual HMI screens to be done as separate projects

- Result: Infrastructure put in place for SCADA upgrades program

Case Study #1:
Core Infrastructure Upgrade (2005-2006)

BEFORE





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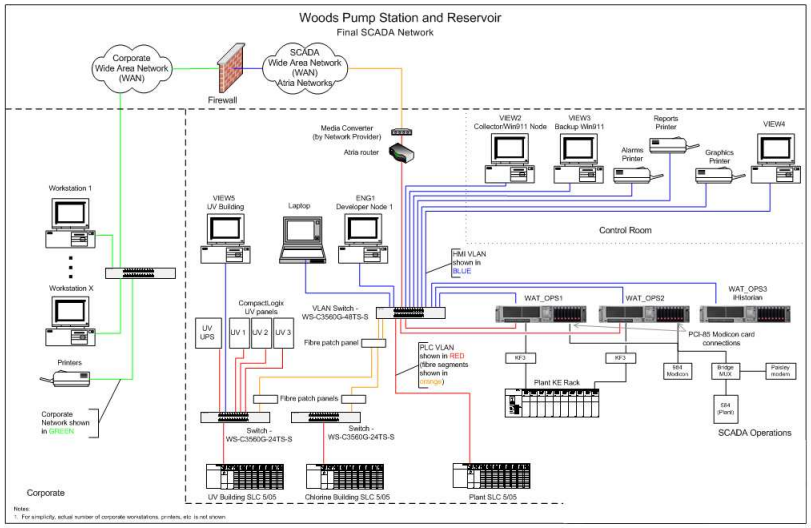
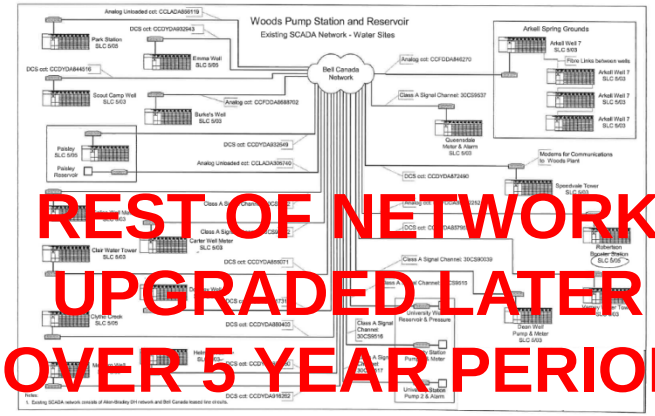


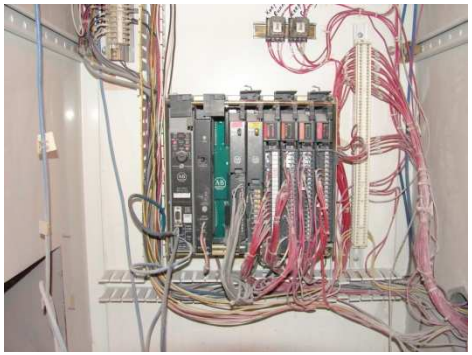


REST OF NETWORK UPGRADED LATER OVER 5 YEAR PERIOD

Case Study #2:
Replacing old non-standard PLC's (2007-2009)

- Replace old non-standard PLC hardware that is incompatible with new network

- Background / Motivation
  - Some "performance specified" sites had older/exotic PLCs
  - PLC's were obsolete and incompatible with new network
  - Two Pumping Stations to be converted



- Project Summary
  - One Station at a time
  - Phase 1: Install new control panel & PLC with unused I/O
  - Phase 2: Test new PLC programming in parallel
  - Phase 3: Cut-over I/O to the new PLC
  - Phase 4: Verification Period
  - Phase 5: Remove old equipment

- Result: Sites can now be maintained by in-house staff

Case Study #3:
Redundant Data Logging for Wells / MOE Request

- New regulatory requirement to have redundant datalogging for wells

- Background / Motivation
  - Communications outages were causing gaps in recorded data
  - SCADA Master plan was to transition to using redundant logging once new SCADA network was ready to support store/forward data logging
  - Regulator asked for redundant logging before network was ready

- Project Summary
  - Installed local OITs with that did store/forward logging
  - New network did not yet connect to these wells
  - Drove out with truck weekly to collect data
  - Connected OITs to new network when it was ready

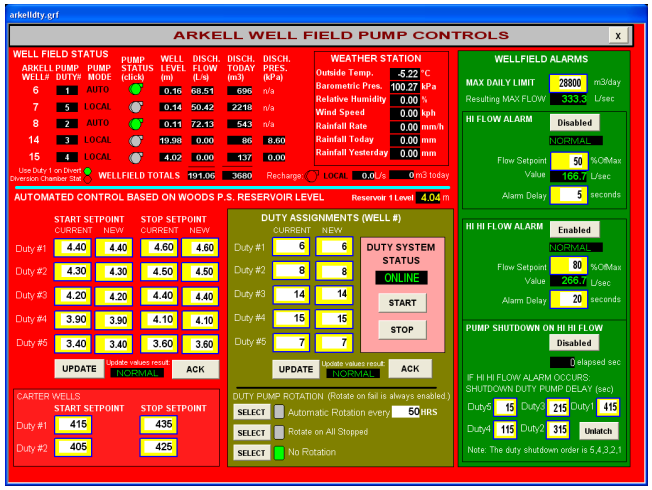
- Result: Master Plan helped city plan for and anticipate this

Case Study #4:
Arkell Springs Upgrade (2010-2011)

- Addition of two more wells to Arkell Springs
- Existing HMI and PLC programming did not conform to new standards

- Background / Motivation
  - 45-60% of city water comes from Arkell Springs
  - Wells could not be shut off during upgrade
  - Desire to operate as a well field instead of individual wells

- Project Summary
  - Phased approach to keep 2 wells running at all times
  - Phase 1: Bring fiber optic network to site
  - Phase 2: Bring 2 new wells online
  - Phase 3: Test new well field control with new wells
  - Phase 4: Upgrade 3 existing wells to new system



- Result: Improved uptime and easier operation/maintenance

Case Study #5:
New Build – Clair Rd. Pumping Station (2008-2010)

- New booster pumping station to accommodate south-end growth for next 20 years

- Background / Motivation
  - SCADA Master Plan called for eventual move to the “next gen” PLC
  - Opportunity test the new PLC platform from vendor

- Project Summary
  - Kept standards in mind as new PLC code was developed
  - Having documented strategy for old PLCs made new development easier
  - Savings in HMI development time (due to HMI standard)
  - Less time needed for FAT/SAT testing
  - Successful implementation

- Result: Knowledge gained was captured as a new standard
  - “PLC Programming Standard for platform X”
  - Adopted as part of the SCADA Standards package

TAKE AWAY POINTS

Standardization Lessons Learned

- Start by developing a SCADA Master Plan
- The SCADA Master plan will form the vision for your standardization program

- Developing the master plan and standards documents will require:
  - An initial time investment
  - Support from management and procurement departments
  - Active participation from users: Operators, Maintenance, Engineering, etc.

- Tailor the level of detail in your standards to the size and needs of your waterworks
- Regularly review/update your master plan and standards as “living documents”

- Once developed, use your standards for all capital projects – both upgrades and new builds

- Use your SCADA Master Plan to develop a prioritized and strategic timeline for upgrades

- **Make standardization work for you:**

  save design time, streamline integration, increase usability, boost reliability

Acknowledgements

- Special Thanks to
  - City of Guelph Water Services Department Staff
  - ISA Hamilton (Ontario, Canada) Section
  - McMaster-Mohawk B.Tech. Process Automation Program

Upcoming Conference

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