SCADA – Making it Work for Your Utility

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COMMITMENT & INTEGRITY DRIVE RESULTS

Agenda

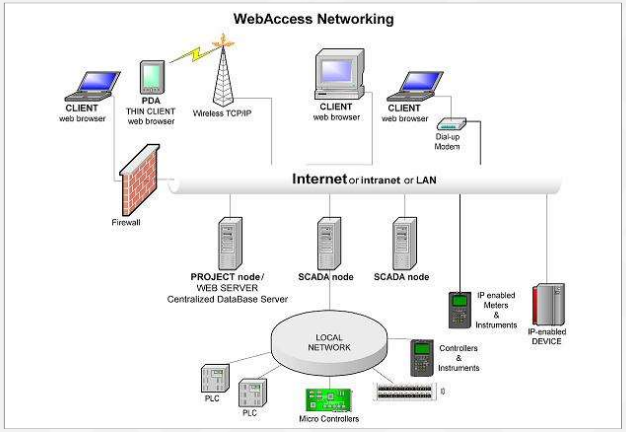
- Introduction
- Collaboration/Participation
- Design Considerations
- Implementation Considerations
- Tips/Best Practices
- Takeaways
- Questions

Treatment Operations Today

- 40-50% of current operational workforce will be retiring in the next 5-10 years
- Replacing the headcount is challenging; replacing the institutional knowledge is even harder
- Automation (SCADA) will be leaned on to pick up the slack
- More critical than ever that your SCADA system ‘does what it’s expected to do’

Focus on Collaboration

- Design consultants/integrators bring expertise and experience from many projects and situations
- Operations/management staff provide deep perspective and a wealth of hands-on experience with the system in question
- Make sure your voice is heard during the design and implementation phases
  - Because you will be living with the finished product



Personnel Perspectives

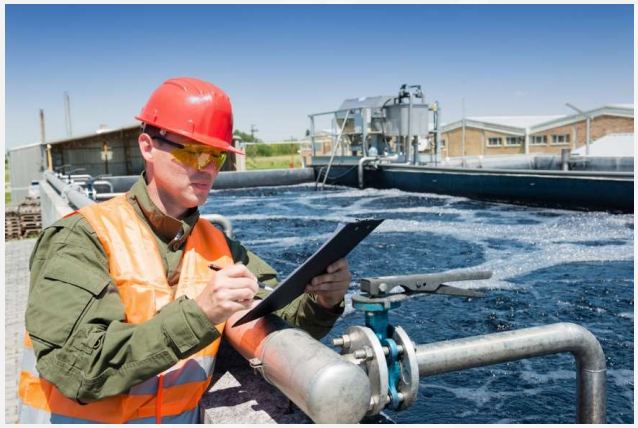
- For a SCADA system to be both successful and effective in the long term, the needs of all levels of the organization must be considered
  - Operators
  - Supervisors
  - Directors/Commissioners
- All levels should ‘buy in’ to the approach for the system

Operations Staff

- Have the most hands on time with both the process and the SCADA system
  - Valuable resource in the planning process
  - Know what works and what doesn't
  - Wealth of institutional knowledge
- Live in the moment; focused on the immediate status and issues of the process
- Automating process tasks frees them up for higher level activities (preventative maintenance, process improvements)

Supervisors/Chief Operators

- Have a broader perspective of the overall operation
- May be less hands on than operations staff, but still connected to day-to-day operation of the system
- Use data collected by SCADA system to identify areas of process improvement, efficiencies, etc.



Directors/Commissioners

- Responsible for the departmental budget, fiscal operations and performance; accountable to municipal leadership
- Much less direct interaction with the system on a regular basis
- Looking for data collected by system to inform decisions on staffing, annual budget development and capital planning
- Contributes to asset management planning

Case Study – Chlorination System

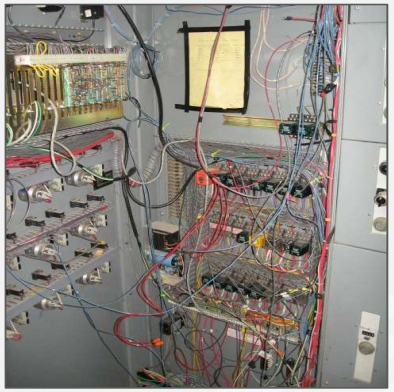
- Chlorination/dechlorination system fully connected and able to be controlled by SCADA system
- Operators continued to run the system manually for years, ignoring the SCADA controls (no confidence in system)
- Study of the issue (and consult with operations) resulted in adding sensor and automating process, freeing up operators to focus on other tasks

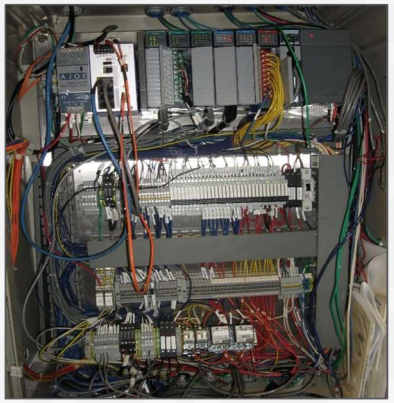
SCADA Design Considerations

- New System (Greenfield)
  - Clean slate
  - Design professional has more control over the system
  - Choice of technologies
  - Free to select locations
  - New equipment reduces unexpected failures
  - Easier documentation process

SCADA Design Considerations

- Existing System (Brownfield)
  - Have to deal with existing system, constraints and limitations
  - Existing wiring routing and reuse
  - Careful consideration to downtime and sequencing
  - Complete replacement vs. ‘brain transplant’
  - Documenting changes
  - Physical equipment savings vs. design efforts





SCADA Design Considerations

- Vendor Controls
  - Coordination in the design documents to ensure vendor controls communicate effectively with Owner's SCADA system
  - Use specifications to dictate PLC type, communication protocols and request interface information (critical signals, process variables, alarms, etc.)
  - Greatly reduces issues in the field when coordinated through the design

SCADA Implementation Considerations

- Control Narrative
  - AKA process description, functional description, process narrative, functional specification
  - Describes how the system should operate; illustrates the critical interlocks, operator selectable setpoints, alarms, etc.
  - Critical to define integrator's scope; difficult to get desired operation without one
  - Develop collaboratively with operations staff to address specific needs

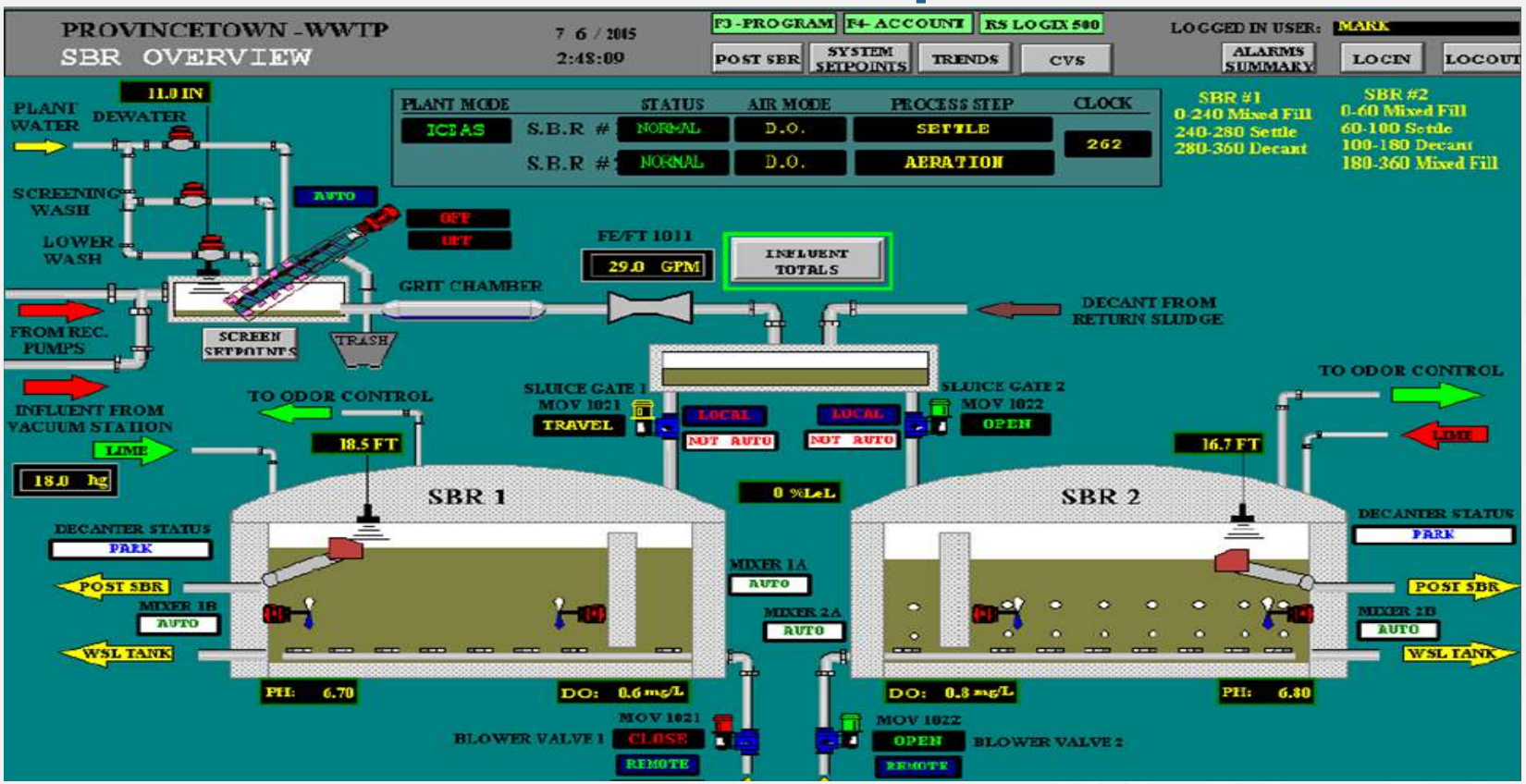
Case Study – Aeration Process Revamp

- Control narrative developed during the design process; complex sequence of operations
- PLC program created based on this narrative; significant time invested
- Once onsite for SAT, operations staff raised question about the narrative and process (too complex)
- Controls changed to a simple timing based system
- Lesson Learned – Make sure all parties are represented in the collaborative process

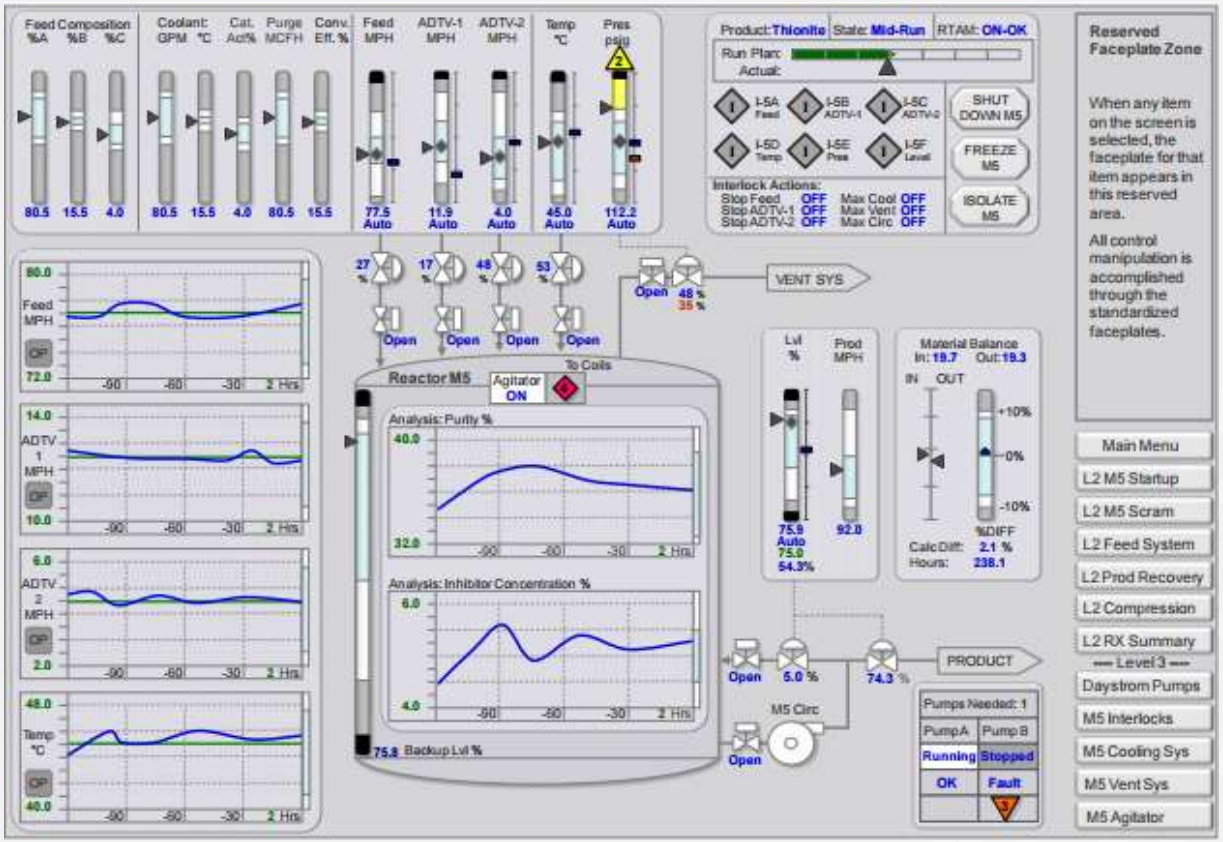
SCADA Implementation Considerations

- Human Machine Interface (HMI)
  - Integrator to hold workshops to demonstrate screen layout and functionality
  - Important to match existing screen layout and functionality to reduce retraining requirements
  - Review and approve draft screens before startup
  - Critical to achieve buy-in from the staff that interact most with the screens

Traditional HMI Screen Example

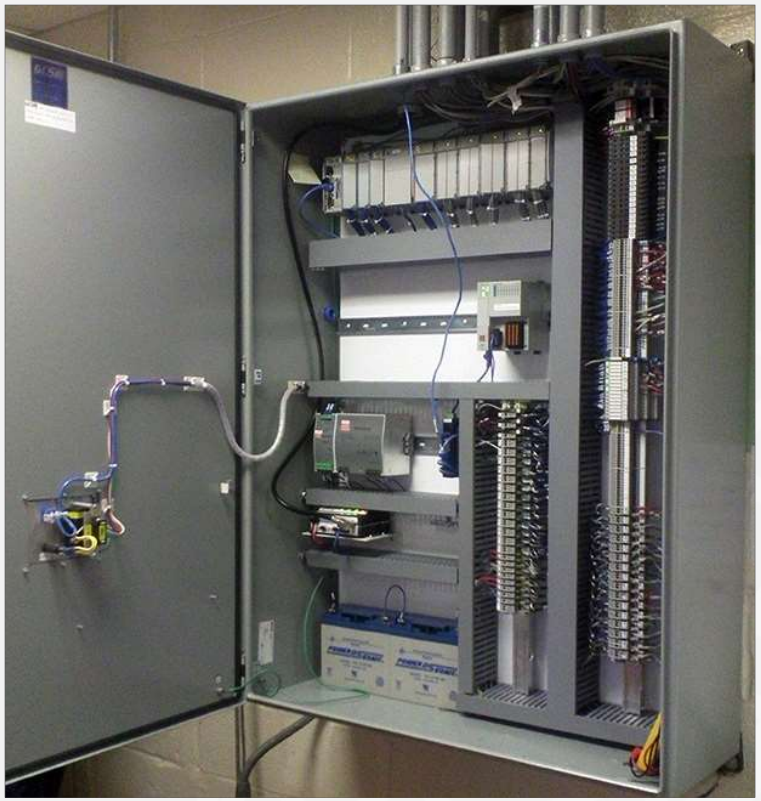


High Performance HMI Screen Example



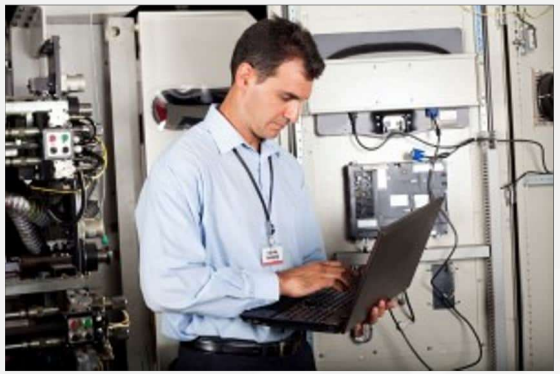
SCADA Implementation Considerations

- Factory Acceptance Test (FAT)
  - Test to verify equipment is fabricated and/or procured as required by contract documents
    - Control Panels (wiring, assembly, terminations)
    - Computers
    - Telemetry Equipment
  - Opportunity to test functionality in a controlled environment
  - Easier to resolve issues in the shop rather than mounted on the wall



SCADA Implementation Considerations

- Site Acceptance Test (SAT)
  - Accurate documentation is critical to complete this step
  - Confirm that components have been connected to the SCADA system correctly (I/O checkout)
  - Start up and control the process with the SCADA system to confirm proper operation
  - Detailed plan for cutting over live equipment/processes
  - Must be thorough to not miss hidden ‘gotchas’ in configuration or code
  - Coordination with the installing contractors is imperative

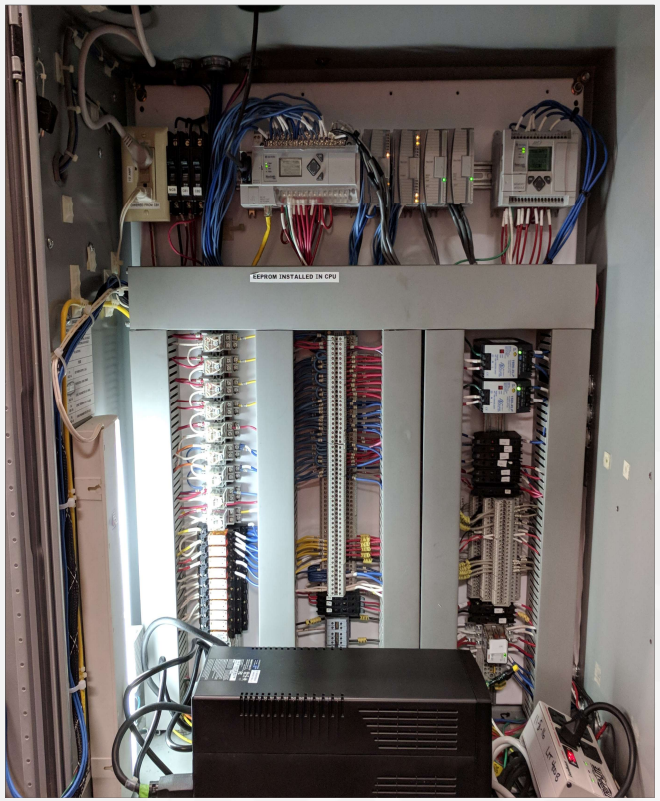


Case Study – Pump Station

- Pump station controls ‘cut over’ to new SCADA panel
  - Tested and operational
  - Radio communication not yet established
- Radio communication to master established next day
  - System not retested to ensure proper operation
  - Inadvertent signal caused pump station to inhibit pump operation
- Pumps unavailable overnight, resulting in overflow
- Cause quickly identified and resolved
- Lesson learned – more thorough testing of all conditions

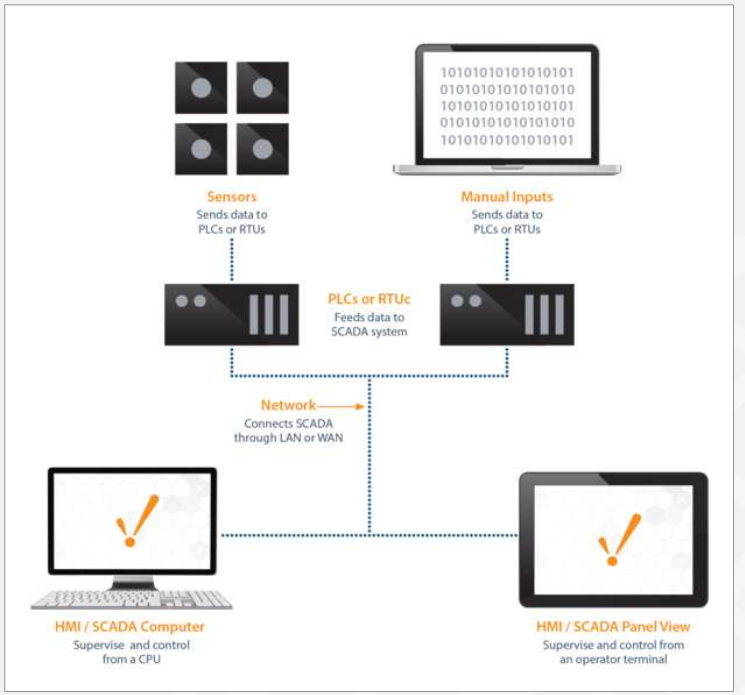
SCADA Implementation Considerations

- Backup & Redundancy
  - Provide backup or redundant measures on most critical functions or controls
    - Backup instruments
    - Backup/redundant PLCs
    - Backup Power
    - Redundant/resilient communications
  - Buy time for human intervention and resolution of problem
  - Disaster recovery
    - Backup programs
    - Plan for recovery



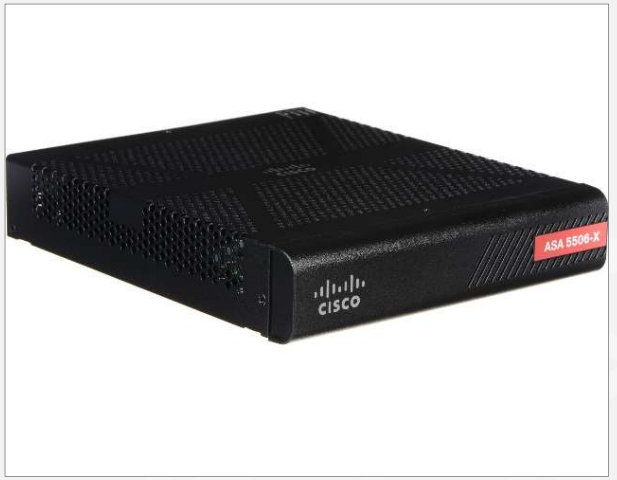
Tips & Best Practices

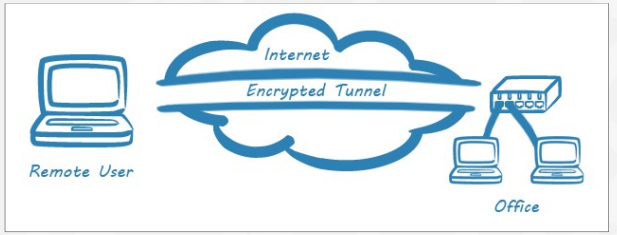
- SCADA Networks
  - In the past…
    - Large, flat networks
    - Maximizing availability, minimizing security
    - Proprietary network protocols
  - Now…
    - Ethernet has become standard
    - Adopting IT networking principles
  - Considered during the design process to maximize effectiveness



Tips & Best Practices

- Remote Access
  - Municipalities and utilities are embracing remote access to better monitor, control and maintain their SCADA systems
  - Firewall – monitoring incoming and outgoing traffic
  - Requires specific hardware and configuration to be secure and reliable
  - Risk vs. reward – each utility/municipality should consider their specific case



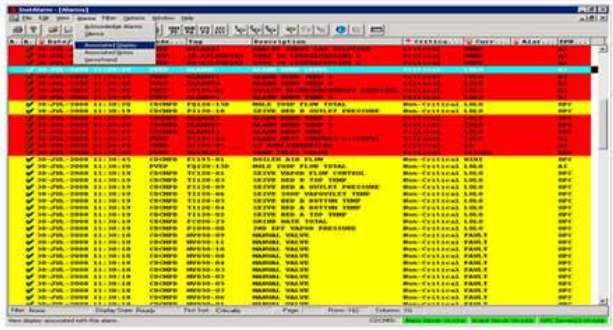


Tips & Best Practices

- SCADA System Telemetry
  - Include a communication status screen on the HMI
    - Displays all remote sites and communication details
  - PLC ‘heartbeat’ signals
    - Confirms that PLCs are active and communicating with one another
  - Inspect antenna installations annually
    - Check that grounding was properly installed and maintained
    - Look for signs of water infiltration or cable degradation
    - Foliage growth
  - Scale communication to media used
    - Be efficient with small bandwidth connections
    - Streamline communications to most essential data

Tips & Best Practices

- Alarms and Alarm Handling
  - Easy to get overwhelmed by nuisance alarms
  - Entire books and standards have been written on the topic
    - ISA-18.2, Alarm Management
    - “Alarm Management for Process Control”, Rothenberg
    - “The Alarm Management Handbook”, Hollifield
  - Use color coding for faster determination
  - Prioritize and group alarms for ease of understanding root cause
  - Collaboration between groups to properly prioritize alarms for their specific situation and system



Before

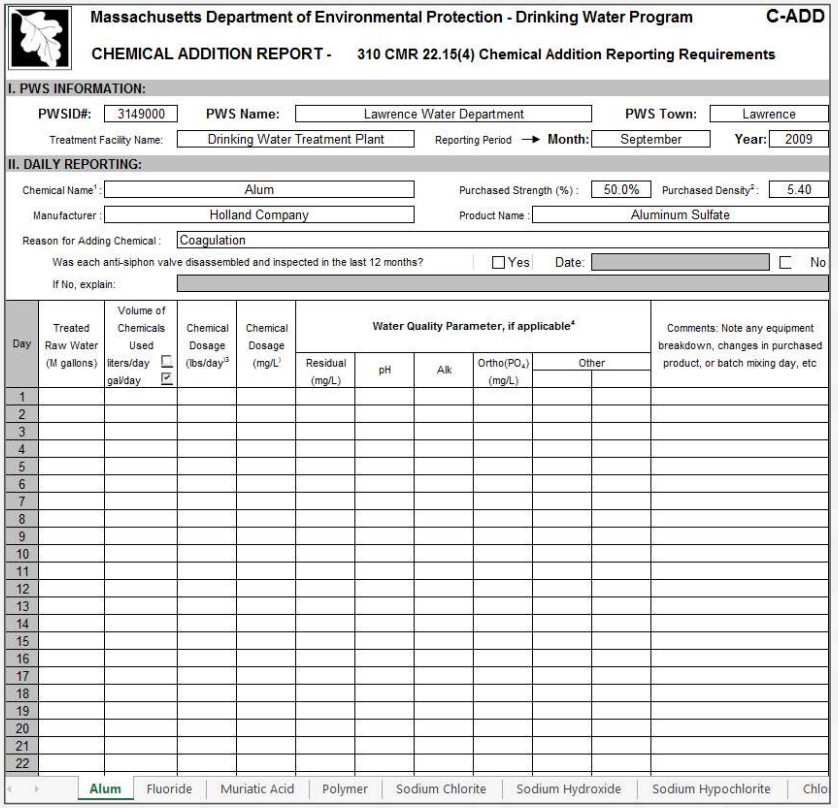
After

Tips & Best Practices

- Remote Alarm Notification
  - Regularly test your remote alarm notification system
    - Call lists
    - Phone line/cellular connection
  - If you use a software application for remote alarming, strongly consider a hardware backup

Tips & Best Practices

- Automated Reporting
  - Critical aspect of any SCADA system today
  - Formatted to match reports required for submission to regulatory agencies
  - Make sure to leverage the power of this tool to aggregate information to make informed decisions
  - Efficient and effective



Massachusetts Department of Environmental Protection - Drinking Water Program **C-ADD**

CHEMICAL ADDITION REPORT - 310 CMR 22.15(4) Chemical Addition Reporting Requirements

I. PWS INFORMATION:

PWSID#: 3149000 PWS Name: Lawrence Water Department PWS Town: Lawrence

Treatment Facility Name: Drinking Water Treatment Plant Reporting Period → Month: September Year: 2009

II. DAILY REPORTING:

Chemical Name[1]: Alum Purchased Strength (%): 50.0% Purchased Density[2]: 5.40

Manufacturer: Holland Company Product Name: Aluminum Sulfate

Reason for Adding Chemical: Coagulation

Was each anti-siphon valve disassembled and inspected in the last 12 months? ☐ Yes Date: ☐ No

If No, explain:

Day	Treated Raw Water (M gallons)	Volume of Chemicals Used liters/day ☐ gal/day ☑	Chemical Dosage (lbs/day[3]	Chemical Dosage (mg/L)	Water Quality Parameter, if applicable[4] Residual (mg/L)	pH	Alk	Ortho(PO_4) (mg/L)	Other		Comments: Note any equipment breakdown, changes in purchased product, or batch mixing day, etc
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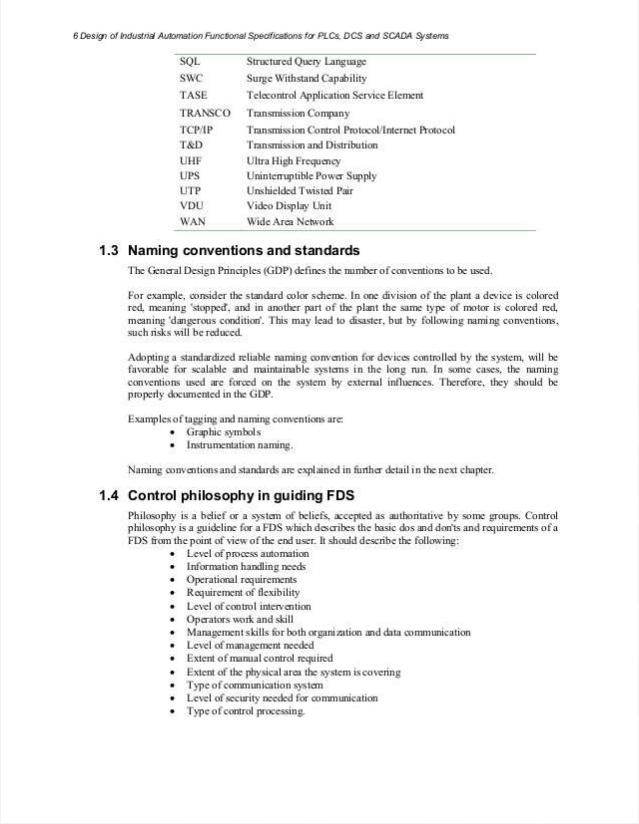
Alum | Fluoride | Muriatic Acid | Polymer | Sodium Chlorite | Sodium Hydroxide | Sodium Hypochlorite | Chlo

Tips & Best Practices

- SCADA Standards
  - Consider documenting standards for your system
  - Include them in contract documents for future projects
  - Improves uniformity of results
  - Reduces need for different spares or additional training



6 Design of Industrial Automation Functional Specifications for PLCs, DCS and SCADA Systems

SQL	Structured Query Language
SWC	Surge Withstand Capability
TASE	Telecontrol Application Service Element
TRANSCO	Transmission Company
TCP/IP	Transmission Control Protocol/Internet Protocol
T&D	Transmission and Distribution
UHF	Ultra High Frequency
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair
VDU	Video Display Unit
WAN	Wide Area Network

1.3 Naming conventions and standards

The General Design Principles (GDP) defines the number of conventions to be used.

For example, consider the standard color scheme. In one division of the plant a device is colored red, meaning 'stopped', and in another part of the plant the same type of motor is colored red, meaning 'dangerous condition'. This may lead to disaster, but by following naming conventions, such risks will be reduced.

Adopting a standardized reliable naming convention for devices controlled by the system, will be favorable for scalable and maintainable systems in the long run. In some cases, the naming conventions used are forced on the system by external influences. Therefore, they should be properly documented in the GDP.

Examples of tagging and naming conventions are:

- Graphic symbols
- Instrumentation naming.

Naming conventions and standards are explained in further detail in the next chapter.

1.4 Control philosophy in guiding FDS

Philosophy is a belief or a system of beliefs, accepted as authoritative by some groups. Control philosophy is a guideline for a FDS which describes the basic dos and don'ts and requirements of a FDS from the point of view of the end user. It should describe the following:

- Level of process automation
- Information handling needs
- Operational requirements
- Requirement of flexibility
- Level of control intervention
- Operators work and skill
- Management skills for both organization and data communication
- Level of management needed
- Extent of manual control required
- Extent of the physical area the system is covering
- Type of communication system
- Level of security needed for communication
- Type of control processing.

SCADA Cybersecurity – Why Now?

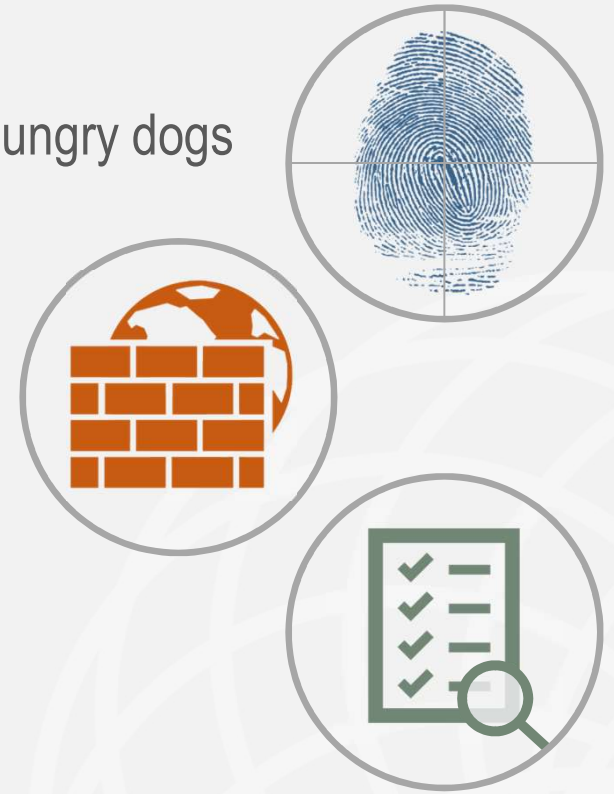
- In today's infrastructure environment, connectivity is king
- The 'Internet of Things' (IoT) is here to stay
  - More and more SCADA components will have the ability to connect over the Internet, either wired or wireless
- Remote access becoming more common and important
  - When you let the 'good guys' in, you need to make sure to keep the 'bad guys' out

SCADA Cyber Security

- As with many concepts in our industry, defined by risk management and mitigation
- The ‘good guys’ are always a step behind the ‘bad guys’
- Not **IF** but **WHEN**
- Much of cyber security is minimizing impact and hastening recovery

Aspects of Cyber Security

- Physical component
  - Doors, fences, cameras, locks, guards, guns, hungry dogs
- Technological component
  - Network switches, firewalls, routers, software
- Administrative component
  - Policy, procedures, training, audits



Takeaways

- Collaboration produces a better product
- Input and buy-in at all levels is key
- Have a (documented) plan for each step and stick to it
- Make sure to optimize the your system to gain the greatest benefit

Questions / Discussion

Thank You!

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