SCADA Solutions for Water and Wastewater Treatment Plants

Features

- Centralized control
- Increased reliability
- Improved management of treatment processes
- Reduced costs
- Preserved equipment investments
- Flexible system designs

Overview

Water and wastewater treatment plants depend upon reliable operation of remote equipment to continuously and safely move effluent throughout the service area to the main station. There are several areas of management that could be improved through the use of the Emerson SCADA solution:

- **System monitoring** – provides continuous up-to-date information from remote facilities.
- **Detection of failures** – early detection of equipment failures can eliminate potential environmental problems and avoid payment of fines.
- **Flow adjustments** – set points can be automatically adjusted to compensate for seasonal flow and wet weather.
- **Control decisions** – decisions can be made for the entire plant instead of individual processes.
- **Manpower costs** – centralized monitoring and control can reduce resources assigned to auxiliary equipment operation and maintenance.
- **Maintenance costs** – reduced amount of regularly scheduled maintenance visits.
- **Utilization of field crews** – field crews can concentrate on preventative maintenance.

Innovative Water and Wastewater SCADA Solutions

Emerson's SCADA solution provides effective management of wastewater collection and water distribution systems as its strategies and architecture offer safe, cost-effective and reliable control over plant processes. Implemented as either a standalone server or incorporated with Emerson control technology, the SCADA solution ensures continuous monitoring and control of treatment operations, such as:

- Wastewater collection systems
- Water distribution systems

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- Pump stations
- Remote operations
- Programmable logic controllers (PLCs)
- Sewer diversion
- Wet weather overflow protection
- Water irrigation systems
- Weather monitoring

Cost Saving Benefits

Centralizes Water/Wastewater Treatment Control

The Emerson SCADA server effectively monitors and controls the activity of water/wastewater systems from a single location. Immediate detection of problems through diagnostic displays enables quick intervention for fast resolution. Operators can easily compensate for seasonal flow and wet weather by automatically adjusting set points. Centralized control and monitoring of distribution and collection systems provides data for water modeling and energy use optimization, as well as predictive maintenance of distributed equipment.

Increases Reliability

Emerson's SCADA system design is centered on reliability, ensuring constant communication from the server to the remote terminal units. Its configuration supports dual servers, which provide primary and backup monitoring and control with complete bumpless automatic fail-over should a fault occur. Dual communication circuitry within each dedicated radio grouping provides an additional level of increased reliability.

Improves Management of Treatment Processes

Effectively managing collection and distribution activities is an important part of efficient water and wastewater treatment. The SCADA solution provides continuous 24 hour, 7 days per week monitoring of remote systems to help identify overflow situations or possible ground contamination. The SCADA communication server utilizes the power of Emerson control technology. Engineering tools enable quick and easy configuration and maintenance of SCADA information. High-resolution operator windows present control graphics, diagnostics, trends, alarms and status displays. Access to dynamic system points, historical data, general messages, standard function displays, event logging and a sophisticated alarm management program is available through intuitive operator navigation tools. Historical SCADA process data can be collected by the system historian for online storage, off-line archiving, sorting, data analysis and generating reports.

Reduces Costs

Implementation of Emerson's SCADA solution can help reduce operation and maintenance costs. A centralized SCADA system minimizes resource and maintenance expenditures by using fewer personnel to monitor field activity and reducing daily maintenance trips. Field crews will be more readily available for preventive maintenance and emergency situations. Spare parts expenses will be minimized through the inventory of a single set of spares versus parts associated with multiple pieces of monitoring and control equipment. In addition, training costs will be decreased due to control instruction on one system as opposed to several.

Preserves Equipment Investments

Emerson open system design protects against control system obsolescence. The SCADA servers' flexibility allows it to operate with a host of standard open protocols supported by multiple hardware and software vendors with custom drivers. Emerson solutions incorporate migration paths to provide improved technology with better performance without the cost of a total system replacement. In addition, the SCADA system can easily be expanded to meet growing demands on plant operations.

Implementation of the Emerson SCADA server solution will provide maximum return on the SCADA investment by supplying effective control to keep plant systems operating at optimum performance levels, while allowing customers to minimize costs.

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SCADA System Design

An Emerson SCADA design can utilize either an existing communication infrastructure or a new communication network. This flexible solution can be configured with leased lines, licensed radio, unlicensed radio or a combination of the three.

Leased Line Configuration

Leased line SCADA systems communicate process information through existing telephone or other landlines. As a minimum, leased line designs consist of a SCADA communication server, modems, telephone lines and remote terminal units. Options for more reliable data exchange include redundant SCADA servers and wireless radios for backup communication. Two configurations can be implemented depending upon design of the phone line system and customer preference. A point-to-point SCADA system enables the server to communicate directly to one RTU. A point to multi-point scheme has the server communicating to multiple remote sites. Clustered configurations, as well as peer to peer (RTU to RTU) communication, can also be provided.

Wireless Configuration

A wireless SCADA system can be implemented with either a licensed or unlicensed spread spectrum radio design. Remote systems are grouped according to location and assigned an individual radio system operating on a unique frequency. Each radio system is made up of a tower-mounted central radio repeater, a polling remote at the SCADA server and remote radios at each remote system location. Repeater radios transmit information between the server and remote sites, communicating through an omni-directional antenna with data rates up to 19.2 kpbs. A “band pass” filter is used to avoid interruption of additional signals within range of the antenna tower. Repeater radio design includes a full duplex redundant configuration with automatic fail-over and surge protectors.

Frequency planning is key to guaranteeing accurate SCADA system operation. A comprehensive survey is conducted, noting service area topologies, communication distances, equipment locations and FCC frequency band. The study is also used to verify that message exchange can occur between each remote site, its respective radio repeater, and polling remote, as well as determining current data traffic within the frequency bandwidths. Results of the survey will be used to establish the best method for deploying the radio communication scheme.

Remote Site Architecture

Emerson’s SCADA design incorporates RTUs or PLCs located at the remote facility. The SCADA server can operate with either type of equipment; however, RTUs include a wider range of communication capabilities. The SCADA solution can link to existing remote units to preserve previous equipment investments or Emerson can supply the remote site equipment as well as the UPS system with the SCADA server as part of the design. Emerson has an extensive evaluation program to best match control and communication functions of various PLC and RTU manufacturers with each customer requirement.

The assessment of remote terminal units consists of reviewing I/O, control, communication requirements, determining the appropriate size of the unit and then choosing the device that provides the best fit. Emerson has evaluated several manufacturers’ equipment to use as standard remote units, however we will review other devices if requested. Using pre-approved units with standard communication protocols associated with the equipment ultimately minimizes engineering costs.

SCADA Communication Logic

Remote site data transmission is configured based upon the requested messaging scheme and required communication timing. Four polling messaging modes are available:

- Periodic mode exchanges data with remote sites based on frequency or event configurable polling rates. Large amounts of data traffic are typically associated with this mode of operation.
- On demand mode requests data based on an operator action.

- Report by exception receives information from remote sites only when a change of data has occurred. Employing this mode reduces the communication bandwidth and potential for data collision.
- Spontaneous unsolicited mode maximizes data throughput. Messages are generated spontaneously by the remote, initiated by a change of state or sent based on a user-configured rate.

The Emerson SCADA server continuously monitors communication from the remote sites to ensure data transmission. Handshaking signals sent by the remote radios are frequently checked to prevent data collisions on the communication network. A watchdog signal at each remote device monitors communication status with the server. Defined as an input to the SCADA server, the watchdog is configured to change state at a user-specified frequency, forcing the remote device to periodically send data. After a specified number of failures, the remote device is instructed that communication with the server has been lost, the site is tagged out of service, and appropriate action is taken. Polling is continued until communication is re-established with the remote device.

Bandwidth Optimization

Bandwidth optimization reduces unnecessary exception traffic by the following methods:

- Adjust analog deadbands and widths during system tuning to minimize unnecessary exception events.
- Implant suitable filters into the remote device logic to reduce erroneous and spurious exception events.
- Implement a small time delay function to filter out contact bounce on digital inputs.
- Optional diagnostic tool identifies radio network degradation that would cause lost messages.

System Performance and Timing

SCADA system performance is dependent upon message polling, response communication, data traffic, signal strength, baud rate, and noise. Emerson uses radios with higher baud rates and effective throughput to provide transparent data communication without adding negligible overhead information to the SCADA payload data. As a result, Emerson can ensure exceptionally fast radio system operation.

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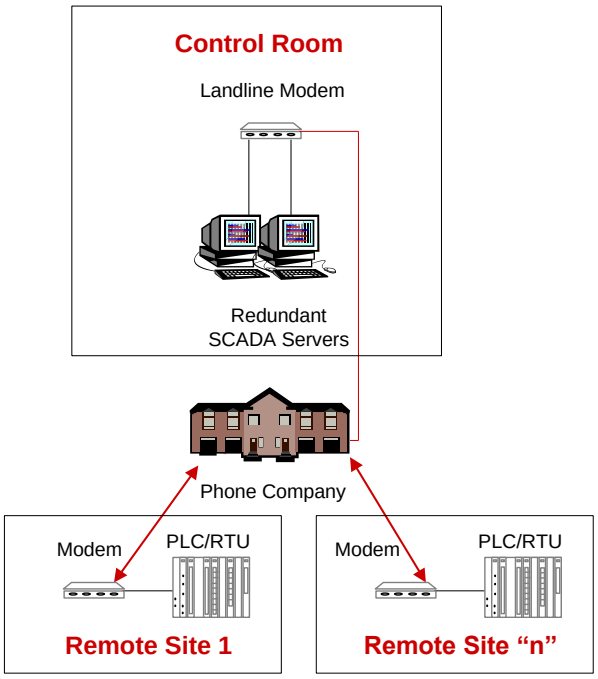
SCADA Design Examples

Sample Leased Line SCADA Design



Sample Wireless SCADA Design