Supervisory Control and Data Acquisition Master Planning: How One Utility Focused Planning Efforts to Improve the Return on Investment of Its Existing System

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Mount Pleasant Waterworks (MPW) provides water and sewer services for more than 90,000 customers in Mount Pleasant, S.C. The population has steadily increased since 1980 and MPW has kept up with the rising population by proactively managing expansion and improvements to its treatment works and improving operational efficiencies.

Utility Overview

The MPW operates and maintains four reverse osmosis (RO) water treatment plants and two wastewater treatment plants. The Rifle Range Road Wastewater Treatment Plant is currently undergoing an expansion and rehabilitation project that will increase the capacity from 6 mil gal a day (mgd) to 9.2 mgd, at a cost of approximately $71 million.

The treatment plants, and over 200 remote locations, including lift stations, booster stations, and deep well pump stations, are monitored by MPW using the VTScada system. This supervisory control and data acquisition (SCADA) system is configured as a single application to allow the operations, maintenance, and technical services teams to monitor the system from any location where the SCADA network is available, and on secured mobile devices.

Master Plan Project

To ensure that the SCADA system continues to meet its evolving needs, MPW undertook a master plan to identify projects to upgrade and improve the existing SCADA system.

When MPW engaged EMA to perform its master planning effort, it was confident in the recent improvements it had made with its system's components, including the programmable logic controllers (PLCs), communication system, and human machine interface (HMI) software. It chose to go through the typical planning phases; however, it wanted to focus on improving how it uses the data collected, identifying additional data sources to enhance operations and other improvements.

In order to achieve that focus, MPW opted to take an approach slightly different from a conventional master plan, as discussed further.

Mount Pleasant Waterworks Versus Conventional Master Planning

The SCADA master planning effort consisted of several phases (Figure 1). They were similar to the conventional approach, with the addition of the cybersecurity analysis.

Phase 1: Current State Assessment

In a conventional SCADA master plan, the project team gathers information on the major components of the SCADA system and the processes it monitors and controls. The components include PLCs, servers, workstations, communications equipment, process control narratives, and operational objectives.

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In MPW's SCADA master plan, EMA used the same approach, but the process was much faster. The infrastructure was generally in good shape, and few components required an upgrade or replacement.

Phase 2: Cybersecurity Analysis

This phase is not always included in a SCADA master plan. The MPW information technology (IT) staff had related projects already started and wanted to align those projects and any other cyber-related SCADA projects to the master plan.

A workshop was conducted by EMA with the IT and SCADA teams to review current projects and discuss enhancements to those projects and other recommendations.

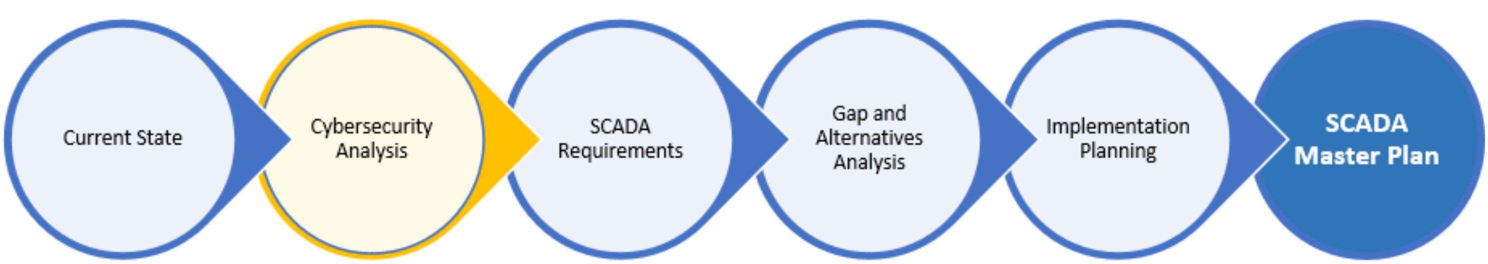

Figure 1. Supervisory Control and Data Acquisition Master Plan Phases

Figure 2. Portable Generator

Figure 3. Solar-Powered Remote Terminal Unit Ready for Deployment

The recommendations consisted of cybersecurity controls drawn from a number of sources, including the following:

- National Institute of Technology (NIST) SP800-82, Guide to Industrial Control Sysytems
- NIST SP800-53, Security and Privacy Controls for Information Systems and Organizations
- International Society of Automation/ International Electrotechnical Commission (ISA/IEC) 62443, Cybersecurity Framework

Phase 3: Supervisory Control and Data Acquisition System Requirements

In this phase, the project team met with the SCADA system stakeholders in a series of workshops to discuss what they liked and disliked about the current SCADA system and what new features or improvements they would like to see made. At the end of the workshops, the project team documented the requirements in a prioritized list.

In the MPW project, EMA engaged stakeholders from all parts of the organization, including:

- Operations
- Maintenance
- Field operations
- Technical services (IT)
- Water quality
- Engineering
- Senior leadership

One of the initial goals expressed by stakeholders was combining data from the operational and business information systems. Some examples of these systems include SCADA, asset management, laboratory, meter reading, and weather data.

The MPW plans to provide users access to these data sources to perform ad hoc reports and analyze data previously not available. It also realized that a good data warehouse (or data lake) is the foundation for business analytics and artificial intelligence (AI).

The stakeholders at MPW also expressed the need for operational improvements above and beyond those that come from upgrading process control equipment. One such requirement was the desire to monitor portable generators (Figure 2). During an emergency, it's essential to deploy these generators where they are needed the most. Knowing each portable generator's location and status will allow MPW to manage its use effectively when needed.

This requirement and other requested improvements were documented by EMA for use later in the project.

Phase 4: Gap and Alternative Analysis

While the process used in this phase is the same for each project, the requirements are different. In this phase, the project team identified gaps between the current and future state of the SCADA system, and then grouped the requirements. The project team considered these groups of needs as potential projects. The project team then looked at alternatives to close the gap and choose the most viable option.

Phase 5: Implementation Planning

The project team developed a high-level scope of work and budget for each potential project and discussed them with the stakeholders. Next, the team prioritized the projects over three years, distributing the capital expenditures as evenly as possible. In a conventional project, the budgeting window typically extends over five years.

Phase 6: Develop the Master Plan

In the final phase, the project team summarized all the work performed in the previous stages in the SCADA master plan.

The outcome of a typical SCADA master plan is a roadmap to replace or upgrade the existing PLCs, replace or upgrade the HMI software, replace or enhance the communications network, make improvements to cybersecurity, and make changes to the HMI graphics. These outcomes are valuable improvements to the operation and maintenance of the system.

The MPW project included some of the conventional outcomes and also identified projects that can only come from forward-looking requirements.

The atypical projects included:

Development of a data management plan.

The project aims to create a plan for MPW to manage the operational and business information systems data. Specific data points will be identified by MPW and the aggregate data (hourly, daily, weekly averages, and high and low points) will be incorporated into the data warehouse.

Implementation of an operational data management system.

The operational data management system (ODMS) allows MPW personnel to run

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scheduled and ad hoc reports and create dashboards, with key performance indicators (KPIs) and trends, using operational and business data from a single application. The ODMS is the foundation for adding additional business analytics (BA) and AI tools.

Development of an internet of things checklist.

The SCADA team received multiple requests from MPW management to add internet of things (IoT) devices to the SCADA network. The biggest issue for leadership is not knowing if a device is compatible with the SCADA software and communications system. The goal is to develop an IoT checklist for managers to give to potential suppliers to provide devices that meet the requirements.

Development of programmable logic controller-based flow calculations.

Flowmeter data are valuable for inflow and infiltration studies and pump maintenance; however, the costs of adding flow meters to every lift station are substantial, so this project aims to compute the inflow data based on liquid levels and cut the cost of gathering the data.

Design of a solar-powered remote terminal unit.

There are areas of the conveyance system that are advantageous to monitor, but power is not available. This project developed a design for a solar-powered remote terminal unit (RTU) panel (Figure 3) that MPW can deploy throughout the service area.

Provide portable generator monitoring.

This project will allow MPW to monitor fuel levels, run status reports, and determine the location of a portable generator. One of the unique requirements is to build a panel that is resistant to the generator's vibration.

Development of peer-to-peer pump station control techniques.

This project aims to pump water in a more energy-efficient way and prevent force main breaks in aging infrastructure.

Development of cybersecurity policies.

The cybersecurity policies lay the groundwork for future MPW projects where cybersecurity is a concern.

Conclusion

When a utility performs a SCADA master plan at the end of the SCADA system's useful life, the planning effort focuses on replacing existing equipment and software. If the utility undertakes a master planning effort midcycle, the project can advance the SCADA system's use and the plan to replace components as they become deprecated. The utility can also spread the capital expenditures over more years because costs are identified further in advance.

When MPW focused on SCADA needs outside of upgrades and replacements, it was able to identify projects to improve the SCADA system and the overall operations of the utility.

There are projects to enhance operational effectiveness, like portable generator monitoring. The MPW recognized projects to get more value from existing systems, like developing a data management plan and implementing an ODMS; then, there were cost-cutting projects, like utilizing level-based flow monitoring.

These projects help MPW stay ahead of aging infrastructure and population growth.