



Case Study: Energy and Water Quality Management System (EWQMS) Saves Electricity Dollars – 10/18/2005

The Issue

The publicly owned East Bay Municipal Utility District (EBMUD) delivers drinking water to more than 1.3 million people in 20 cities and 16 unincorporated communities in parts of Alameda and Contra Costa counties in the eastern part of the San Francisco Bay Area. The average water consumption in this service area is 220 million gallons per day (mgd) and consumption peaks at 341 mgd. EBMUD operates six water treatment plants, nearly 4,000 miles of water mains, and 135 pumping stations. Two EBMUD hydroelectric plants generate 185 gigawatt hours (GWh) of electricity in a median year. The electricity generated is sold into the wholesale market.

Delivering water on this scale requires enormous amounts of energy, mostly in the form of electricity. In 2004 EBMUD spent about \$12 million purchasing electricity; approximately two-thirds, or \$8 million, of that amount was required for pumping water through the distribution system. The consumption of electricity represents the single largest, non-labor expense in EBMUD's operations and maintenance department. Thus, this expense has been targeted for cost-reduction efforts.

In the early 1990s, the Total Coliform Rule (TCR) drove efforts to monitor and improve water quality within the distribution system. Energy costs were increasing. The deregulation of the California electric utility industry in the mid-1990s created the potential for energy-cost volatility. The introduction of time of use (TOU) electricity rates added to EBMUD's incentives to manage the factors it could control.

EBMUD's ongoing efforts to manage water quality in the distribution system included a 1993 internal study that led to development of new operating techniques to maintain water quality in the distribution system. EBMUD incorporated these water quality operations into its energy optimization procedures – essentially, manual pump scheduling based on the local electric utility's three different energy-cost periods. Initially, distribution system pumping was virtually eliminated during the peak energy-cost period. At first, annual cost savings were estimated at \$500,000 to \$700,000, but these savings dwindled as water demand increased and EBMUD maintained practices that met its standards for water quality.

In 1995 and 1997, respectively, EBMUD joined two research projects that sought to integrate the goals of maintaining water quality and managing energy use. The first project, co-sponsored by Water Research Foundation and the Electric Power Research Institute/Community Environmental Center (EPRI/CEC), developed the concept of an energy and water quality management system (EWQMS) and resulted in a report, *Energy and Water Quality Management System* (order # C0002). The second project, also in tandem with the Foundation and EPRI/CEC, achieved functional specifications for EWQMS software that could serve a variety of drinking water utilities. That project resulted in the report, *A Total Energy and Water Quality Management System* (order # TR-113528). The "universal" EWQMS conceived by this process, however, was complex and prohibitively expensive to develop. Subsequently, a Foundation Tailored Collaboration project with Colorado Springs Utilities (CSU) developed a

prototype for a portion of the EWQMS, resulting in the Foundation report, *Implementing a Prototype Energy and Water Quality Management System* (order # 90948F).

The Solution

Using knowledge gained from the development of functional specifications, EBMUD pursued a modified, operational EWQMS. EBMUD focused its software development efforts on optimizing distribution system operations to manage energy costs, while applying its own operational rules for water quality in the distribution system. The utility issued a request for proposals (RFP) in April 1999. To limit the potential financial risks inherent in developing state-of-the-art software, EBMUD imposed a compensation formula for its vendor partly based on documented savings. The first vendor was unsuccessful. The second vendor, Derceto Inc., started in 2003 and completed development and installation of an EWQMS-type system in September 2004.

The Derceto EWQMS generates an optimized pump schedule for the ensuing 24 to 48 hours. It is based on water-demand forecasting, pump scheduling, a water quality component, an energy-cost calculator, a data "scrubber," and an interface with the utility's Supervisory Control and Data Acquisition (SCADA) system. The EWQMS takes into account daily zone demands, available supply, system constraints, and energy costs. For more detail, refer to a paper on EBMUD's EWQMS delivered at ACE in June 2005.

EBMUD has implemented its EWQMS in a pilot program in its San Ramon Valley service area, which represents about one-third of the utility's cost for distribution system pumping, though that service area represents only one-fifth of its water demands.

To ensure that EBMUD personnel could present their concerns and the vendor would gain understanding of the utility's distribution system, relevant operational and engineering groups from EBMUD joined the vendor's design team in a Hazards and Operability study – a technique borrowed from the oil and gas industry.

In order to accommodate a planned upgrade of EBMUD's SCADA system, the vendor created two distinct EWQMS/SCADA interfaces allowing EBMUD to swap back and forth between each during the SCADA upgrade project.

To measure savings and therefore implement a payment schedule to the vendor based on shared savings, the vendor as part of its contract provided a baseline energy-cost measuring tool.

The EWQMS went online in late July 2004 and was fully operational by mid-August, a few weeks later. During the first 11 months of operation the savings have been estimated at approximately \$300,000, or 11 percent of the energy bills. Winter savings are estimated at about 9 percent.

EBMUD is investigating the economics of expanding the EWQMS to other portions of its distribution system.

Lessons Learned

- Benchmarking proved to be a difficult and labor-intensive task.
- Shared savings/performance base contracts provide customer protection from first-time software installations.

- Training emphasizes that EWQMS is a tool for optimizing distribution operations, not a replacement to the SCADA system.
- The utility needs to address distribution operators' concerns over potential loss of jobs due to the perceived threat of total automation of the distribution system.
- It is difficult to operate a software system designed for full automation in semi-automatic mode.

- It is important to immediately initiate a productive dialogue with operations personnel and include them in all stages of system design, development, and implementation to assure their "buy-in."

Utility Profile:

- East Bay Municipal Utility District
- EBMUD serves 1.3 million people in parts of Alameda and Contra Costa counties in the eastern part of the San Francisco Bay Area
- The average water consumption in this service area is 220 million gallons per day (mgd) and consumption peaks at 341 mgd
- EBMUD's source is surface water derived from a network of reservoirs, aqueducts, treatment plants, and distribution facilities extending from the Mokelumne River basin in California 's Sierra Nevada range.
- Basic treatment approach: EBMUD has both inline filtration plants with sodium hypochlorite disinfection and conventional filtration plants with ozonation and sodium hypochlorite disinfection.
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