With a combined treatment capacity of 675 million gallons (U.S.) per day, the five water treatment works of the London Water Control Centre are some of the largest in Europe. Photo courtesy of www.freeimages.co.uk.

Replacing the London Water Supply SCADA System

By Neil Parker, B.Sc., C.Eng., MICE, CIWEM

For Thames Water, managing the process of water abstraction through to delivering treated water to more than five million customers in London involves plant control at more than 150 locations. Most of these are unmanned as the London Water Supply (LWS) supervisory control and data acquisition (SCADA) system carries remote control signals to operate the plant and to monitor its status.

The existing system was developed in the late 1980s in parallel with the implementation of the London Water Control Centre (LWCC) to manage the operation of the Thames Water Ring Main (TWRM). The system includes 14 pump out shafts delivering drinking water to 60 service reservoirs. The LWCC also manages the two area control centres (ACCs) at Hammersmith and Merton along with 12 sub-control centres that collectively control more than 200 pumping stations, boreholes and unmanned treatment sites. Furthermore, it monitors output from the five major surface Water Treatment Works (WTWs). These are some of the largest in Europe with a combined treatment capacity of 675 million gallons (U.S.) per day.

The Need to Upgrade

The move to a new system was driven by the increasing business need to be able to share data within the SCADA system with other operational and management information systems. The new system would try to capitalize on the open system architecture philosophy, building on Microsoft application technology already introduced within Thames Water. There also was the need to introduce a long-term historic database, automatic report generation and an ad-hoc query system not provided by the system in use.

These wishes were coupled with performance problems on the existing system in terms of hardware and software redundancy, workstation restrictions and hardware reliability resulting in increasing system down time. The system also was reaching its database capacity and had a limited ability to add new areas to the system. Finally, the old system was not year 2000 (Y2K) compliant.

Replacement

The search for a replacement system was based on the principle guidelines that it should improve flexibility, scalability and functionality without compromising system performance. This process included rationalizing the system hardware and reducing the number of graphics and system alarms. To meet these objectives, it was decided the system's real-time database should be built on the concept of object oriented technology. This idea groups

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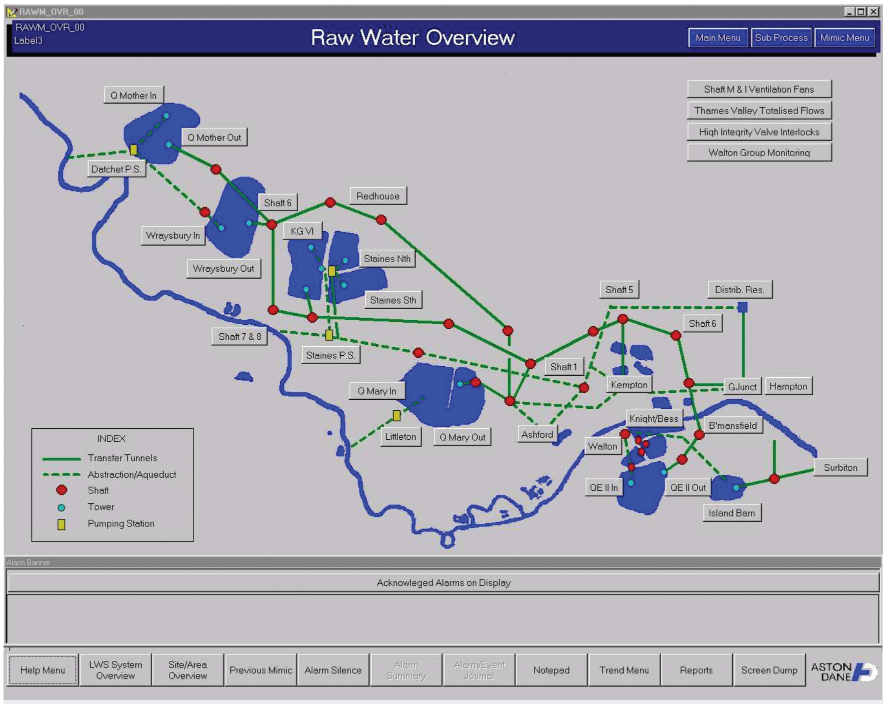

London Water Supply's two control centers and 12 sub-control centers collectively control more than 200 pumping stations, boreholes and unmanned treatment sites.

all the otherwise separately listed attributes and components (e.g., a pump) into one object of the database. The new system also had to be able to support open database connectivity (ODBC). To comply with Thames Water's information technology strategy, Windows NT was chosen as the operating system. This system provided true 32-bit client server architecture installed as a distributed system with full dual redundancy, support for TCP/IP protocol standards, an interface to the three types of existing plant control equipment and integration into the existing telecommunications network.

In October 1997, following completion of the User Requirement Specification and outline design documentation, an open advertisement was placed in the *European Journal* based on a set of predetermined qualification criteria. The 13 companies that replied then were reduced to six by eliminating those that did not meet the all the necessary compliance requirements. A formal tender invitation was given in January 1998 to the remaining six companies. The contract was to be given under the Thames modified I. Chem. E. Green Book conditions with detailed design and implementation to be carried out by the successful contractor.

The emphasis of this upgrade was not only on getting the right system at the right value, but also awarding the contract to a contractor who could demonstrate its commitment to the project and to working as a partner. Following an evaluation and interviews, the contract was awarded in May 1998 to Aston Dane plc.

The requirement specification for the new system soon recognized that the ideal product was not readily available in the market. However, Aston Dane's approach as an independent systems integrator had enabled them to review a number of possible solutions before selecting Verano's (formerly part of Hewlett-Packard) RTAP NT as the preferred choice.

The LWS SCADA system was to be the first major worldwide RTAP application running in native NT. Therefore, it was recognized that there would be a significant amount of development work necessary to achieve the conversion from Unix to NT and provide the required functionality through a new Visualizer man/machine interface (MMI).

Initial user workshops were held to define the overall system design and architecture. This process led to the detailed design phase and subsequent completion in November 1998 of a Master Functional Design Specification (MFDS) that presented the standards for the overall system.

For implementation purposes the contract was broken down into project areas with individual Functional Design Specifications (FDS) for each one to reflect the five major WTWs (Kempton, Walton, Ashford Common, Hampton and Coppermills), the ACCs and Sub-Control Centres, the Thames Valley Raw Water Abstraction, the TWRM and the LWCC (the nerve centre for the entire operation).

Challenges

The replacement of the existing system posed many technical challenges. Not the least of these was the requirement to change from the old to the new system while keeping the Treatment Works and Distribution network fully operational. Mapping the existing flat file data into new "objects"

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was a major undertaking. Especially when considering the current system has 300,000 data points.

In order to satisfy the initial tight time constraints for the project and to meet some of the technical requirements imposed by such a large and complex system, Verano had to accelerate the development road map for RTAP NT. In parallel, Aston Dane concentrated its effort on the detailed design including data mapping, database design, historian configurations, web browser design for reporting and ad-hoc querying, alarm and security coding as well as the Visualizer MMI constructions.

Although a fully supported version of native RTAP NT including the Visualizer MMI was released prior to Christmas 1998, the project team made the decision in January 1999 that the project's overall completion would not be possible in time for the Millennium. Therefore, the decision was made to implement Y2K compliance measures on the existing system.

Implementation

The site installation program was to be implemented on a site-by-site basis, thus progressively changing the old system for the new. The new system would run in parallel with the existing system to avoid any potential impact on the day-to-day management of supplying water to London.

Implementation at the Kempton WTW commenced in late spring of 1999 and was completed by the end of November. Despite rigorous factory testing prior to shipping to the site, performance and stability problems began to surface. The problems related to the new Visualizer interface and system redundancy software causing workstation lock ups and a performance slowdown. The resolution became a major rewrite of the software and retesting to identify and eradicate all bugs. This process took more than a year to accomplish as problems encountered at the site often were difficult to duplicate in a factory test environment.

Implementation finally was able to progress last spring starting with the Raw Water Abstraction system followed by Walton WTW last summer. Despite some further software interface issues (unrelated to the previous major problems) that had to be overcome, positive progress has been made. These three sites are now fully running on Verano's RTAP NT with the old system decommissioned. Many of the benefits of the new system are now being realized and the operators' confidence in the system continues to grow.

Implementation also has finished at Ashford Common, the largest WTW, and is well under way at Hampton. The ACCs, TWRM and LWCC also have commenced installation in parallel with the WTWs. Coppermills followed in the early fall once Hampton was complete. Due to the sheer size and complexity of the system and the need to undertake acceptance testing in a controlled manner, overall completion is now expected by the end of June 2003. Along the way the project team also has had to amend and grow the system to incorporate the new drinking water regulations for *Cryptosporidium* and plumbosolvency and new engineering projects.

Despite the length of the project, the system and technology developed is still at the forefront of the SCADA industry. The project team has been able to benefit from the emerging web technology to develop a first class ad-hoc query system that now is being adapted for use elsewhere in the business.

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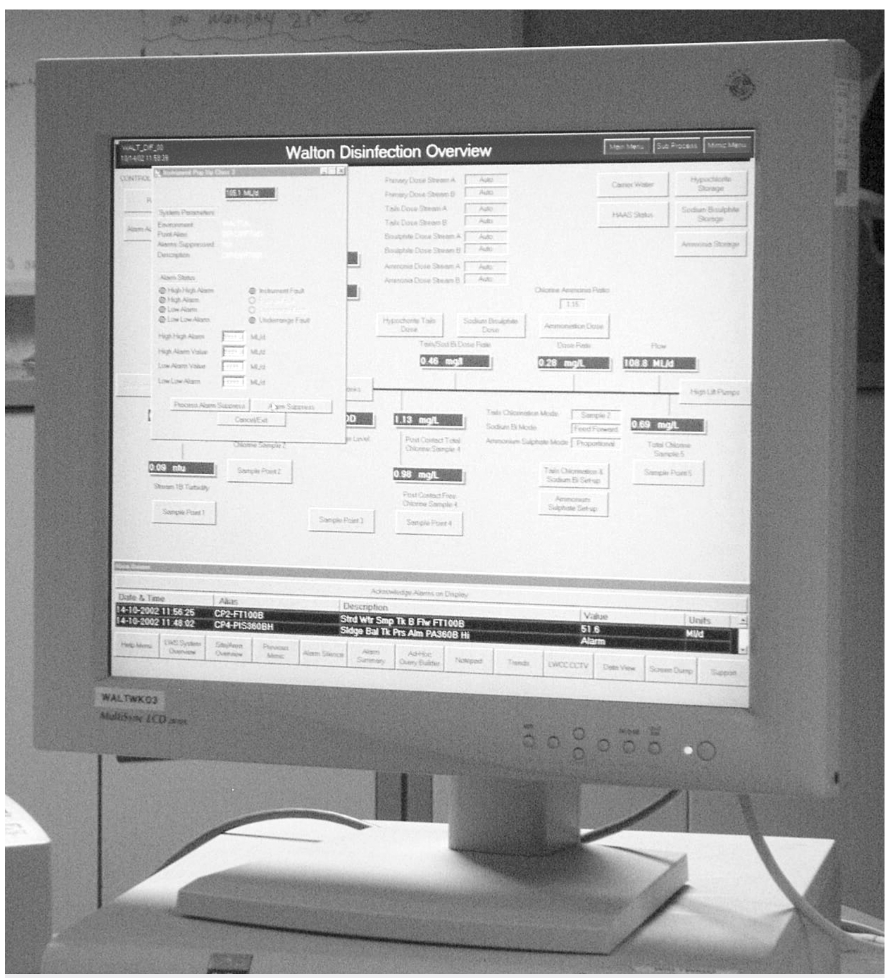

The new SCADA system was the first major worldwide RTAP application running in native Windows NT. A significant amount of development work was required to achieve conversion from Unix to NT.