Chingford South WTW

record race against time to secure London's water supply

by
Duncan Stewart BSc (Hons), MIMechE, MIPS

To construct and commission a £43 million water treatment works in under 12 months, in a restricted space, needed a fast track solution - with top level project management backed by exceptional team-working, plus contractors willing to meet the challenge. The construction of this project, to deliver 58 million litres of water a day, started on 19th April 2004. First water into service flowed on 18th April 2005, a month ahead of schedule and within budget, securing supplies to half-a-million people in North London. This project formed part of the strategy to resolve the deficit in water treatment capacity and increase supply resilience to London by providing a new water treatment works for North London, sited at Chingford South, where Thames Water only have an existing raw water pumping station for the adjacent William Girling reservoir.

Chingford South WTW: View of main treatment building & GAC plant - 4 months from project start *courtesy Thames Water Utilities*

Background

In March 2003, reviews of London's future water supply and demand balance forecast a deficit in treated water capacity, in North London, by May 2005 at times of peak demands. This was despite planned treatment projects,active leakage management and mains renewal programmes. In order to comply with our regulatory obligations, the deficit had to be addressed.

A number of options were considered to meet the treated water capacity deficit and to increase resilience in the North London area, ranging from the upgrading of existing mains to the increase in output capacity at various London treatment works.

Through the appropriate use of value management techniques and investment appraisals all the other options were discounted financially or for significantly overrunning the required timetable for delivery.

Procurement strategy

A review of the procurement options for the project confirmed that project implementation through Thames Water Utilities existing AMP3 Capital Programme Alliance Contractors was the only means to achieve a tight programme.

Advantages and disadvantages were considered for each of the Alliance contractors but to meet the complex demands of this project Thames Water brought together, for the first time on a single project, the expertise of three of its AMP3 Capital Programme Alliance Contractors:

Trident West Alliance; Thames Water Engineering (TWE); MJ Gleeson; MWH.

Network South Alliance: TWE; Morrison Construction; WS Atkins.

Network North Alliance: TWE; Barhale; Faber Maunsell.

Supply chain manufacturers for the main process treatment: (Purac), Ozonation (Ozonia), and systems integrator (Aston Dane) were fully integrated within the design team, linked by a project Extranet.

All areas of the plant and construction techniques were rigorously challenged on time, cost quality, and where benefits were identified ,these were incorporated in the project delivery strategy. This approach allowed the expertise and previous experiences of sub-contractors to be discussed and shared between the core project team. From the earliest stages of the project a sound procurement strategy had been established and endorsed by the client. This helped to maximise the synergies available on such a large project and reduced the time for formal approval by the client.

Project scope
The project included the construction of a new water treatment works, on land adjacent to two existing strategic raw water reservoirs and raw water pumping station, capable of delivering up to 58Mld of treated water into the distribution network during periods of high demand. 40Mld would be supplied from the surface waters of King George V or William Gurling reservoirs, available throughout the year, and 18 Ml/d from four of the North London Abstraction and Recharge scheme boreholes for up to six months of the year (during peak demand periods).

Project challenges
The network modifications, pipelines and building of a water treatment works were the type of work usually undertaken by contractors for Thames Water Utility's Capital Programme. However, building a new water treatment works adjacent to a reservoir and within such a short time frame was unprecedented. A huge challenge overcome by the team was the very small (1.5ha) and triangular construction site, confined on every side. It has the embankment of the giant William Girling Reservoir on the western boundary, the River Lea diversion channel to the east, and an existing pumping station and the A110 Lea Valley Road to the north.

Such close proximity to the reservoir embankment required close liaison with Thames Water's Geotechnical Group responsible for reservoir safety - plus the approval of a qualified civil engineer. As the site was also within a flood plain and a Site of Special Scientific Interest, close consultation was needed with regional and local planning authorities and the Environment Agency throughout site validation, planning and implementation stages. Sustainability was a watchword for the team with a number of excellent environmental initiatives, including brown roof habitats to attract the Black Redstart, a rare and protected species of bird, the subject of a London Biodiversity Action Plan. The project has worked closely with the Environment Agency and is part funding a flood defence scheme to mitigate the effects of building within the floodplain.

Pre-fabrication
Because of space restrictions, a critical decision was taken at an early stage to drive for off-site pre-fabrication wherever possible. In fact, over 40% by value of the civil/structural input was constructed off-site, including 1000 tonnes of mating rebar and 450m^3 of precast concrete. Also, to keep the site free of unnecessary congestion, the administration offices and car park were located across the A110 road and linked to the site by temporary footbridge.

Five major buildings were constructed to house the low lift pumping station, ozone generator and contactor, main process plant, high lift pumping station/electrical incomer, and lamella plant. With time being of the essence, early constructability reviews and critical path analysis identified the main process plant building and contact tank as the pivotal activities, with the process tanks requiring completion before erection of the main process plant building.

Time and risk based Value Planning team events identified that advanced procurement of prefabricated steel; tanks for the main process units (DAF and RGF) would massively shrink the time scale and on-site works. A process change to pressurised Granular Activated Carbon reduced both the building size and excavation works needed for the contact tank, and driving construction time below the magical 12 months.

Each of the five buildings has a reinforced concrete sub-structure and structural steel frame clad with blockwork up to door height and profiled metal sheeting above. At 70m by 40m, the main process plant building is by far the largest. Precast concrete panels for the lower walls came in 6m by 3m sections of 9.5t. Rapid installation between the steel uprights was aided by cast-in bespoke fittings to reduce wet trade operations. This cladding method was used for all buildings to provide a swift weatherproof envelope for internal trades. Buff blockwork facing was added after all process equipment had been installed.

Construction planning
The construction philosophy was to build less, to reduce and simplify the critical path and to maximise production on a number of fronts, including the use of offsite fabrication. This approach by the whole team to ripping up conventional thinking, enabled us not only to set challenging targets but to outperform them. Utilising pre-fabricated process tanks and pre-cast concrete panels for the buildings saved weeks on conventional build techniques.Based on a high level overall construction and commissioning comparison of outline programmes for traditional in-situ concrete build, the pre-fabrication option adopted on this project, would imply that a 25% improvement in productivity has been achieved, compared to previous experiences.

Installation was sequenced to maximise the overlap of civil, construction and M & E phases. The Project Team blew away logistical constraints, with major tanks and vessels delivered at weekends and Bank Holidays, to minimise impact on construction works. A hawk like review of the programme confirmed those areas of construction critical to the commissioning team and the sequence of commissioning.

To emphasise the civil and structural input: 335t of structural steel, 1550t of reinforcing bar and 9000m^3 of concrete were installed in under 6 months to facilitate M & E work, Also, 15,000m^3 of spoil was removed - half of it for sustainable re-use. **Over 100 sub-contracting firms worked on site over the 12 months period and approximately 225 construction personnel were involved at the peak of construction.**

Customer satisfaction
Chingford South WTW was a business critical output for Thames Water, especially considering the water resource situation last year. The summer of 2005 saw the highest demand for water in London for over ten years. The additional treated water from Chingford South WTW ensured that our customers continued to receive water

Thames Water Operations took operational responsibility for the new works in September. 2005, with full handover being achieved in November 2005 following a full 28 day reliability trial.

This immensely demanding project could never have been successfully completed without the extraordinary team working embodied within the three Thames Water Alliance teams, and the willingness of manufacturers, sub-contractors and all parties to meet the challenge of constantly updated schedules to deliver **this exceptional project, which was the British Construction Industry Awards 2005 winner for Civil Engineering.** ■

Note: *The author of this article, Duncan Stewart, is Senior Project Manager, Thames Water Utilities Ltd*