Farmoor WTW

combined upgrades to meet SOSI compliance

by
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As part of Thames Water's ongoing AMP4 works a number of sites of strategic importance were upgraded. Farmoor WTW, located just outside Oxford, provides potable water to Oxford and the surrounding area. The scope was to upgrade a number of process units including the Rapid Gravity Filters (RGF's), Granular Activated Carbon filters (GAC's), high lift pump station, chemical dosing and sludge system, all as summarised below. The timescale for the upgrades was very tight. Contract award was December 2007 and the plant had to have all major work complete by 31st March 2009 in order to meet SOSI compliance. Due to the operational criticality of the Farmoor site, throughout the contract water into supply had to be maintained at 72Mld. As a result of this access to the RGF and GAC filters was limited to no more than two out of operation at any one time. Shutdowns for major pipework modifications and electrical connections were limited to a few hours so detailed planning and close coordination with Operations was essential.

Site conditions were not always ideal *Courtesy of Enpure Ltd*

Enpure were engaged by Costain as process designer and MEICA subcontractor to provide the design, supply of equipment, installation & commissioning associated with a number of process stage upgrades around the site, to ensure that the works is capable of treating 98 Mld into supply. Total contract value for the project was approximately £9m with the Enpure value being £5.3m. Costain undertook the Main Contractor/Principal Contractor role and provided all site facilities and associated civil works with Enpure providing all process and MEICA works. Under a previous contract on the site Costain/Enpure had already undertaken a major upgrade of the Dissolved Air Flotation (DAF) plant.

Rapid Gravity filters

The purpose of the upgrades was to improve the backwashing performance of the existing RGF's within the constraints of the existing structures. The existing structures were built in three stages in 1963, 1975 and 1990 and due to the layout of the filters there was no opportunity to extend the structures to provide additional filtration. The upgrades were therefore limited to improvements in the backwash performance and also to enhance the design to allow the potential use of alternative media in the future.

The scope of the refurbishment included:

- Replace / clean the filter media
- Installation of new air scour blowers
- New air scour pipework and control to achieve a collapsed pulse wash
- Change the backwash philosophy to collapsed pulse with concurrent decanting
- Install launders to improve rinse efficiency

Rapid Gravity Filters. Right photograph shows media being loaded into RGFs *Courtesy of Enpure Ltd*

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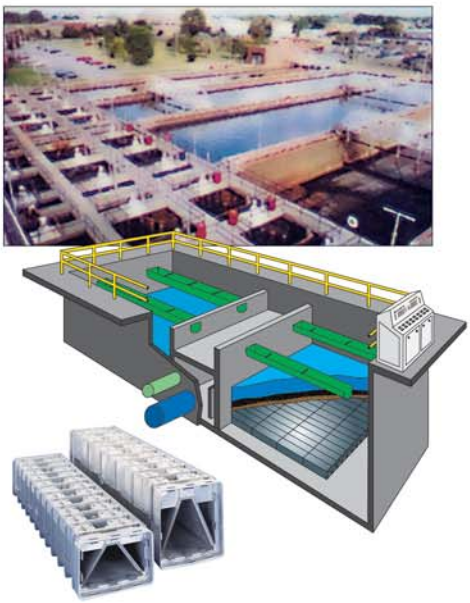

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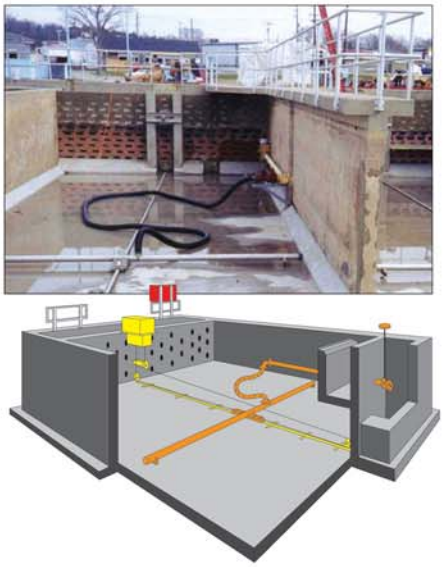

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- Fit media retention wings on the launders to prevent loss of media due to the backwash approach
- Adjust the backwash control programme sequence and durations
- Undertake essential structural refurbishment
- Installation of new isolation penstocks and associated actuation

Granular Activated Carbon filters

This proposed work was to improve the performance and filtration of the GAC Contactors. There were concerns regarding media loss via broken nozzles in the existing plenum floor and insufficient freeboard between the top of the media and the backwash trough. This was compromising backwash efficiency (low media expansion or media loss). In addition there were a large number of leaking penstocks.

The agreed solution was to remove the existing plenum floor and replace with a Leopold floor with IMS cap. This modification gave much improved filtration and filter cleaning, released additional straight wall height (lower profile floor) that was used to increase the freeboard between the media & backwash trough thereby permitting higher expansion backwashes without the consequent media losses (Note: the line of the original floor can be seen in the photograph to the right, which shows the filter following refurbishment).

The specific scope of work included:

- Remove the existing reinforced concrete plenum floor and underdrain system, and replace it with a Leopold underdrain system with IMS cap
- Remove and blank off the existing air, GAC removal and service water pipes within and local to each Contactor
- Install new air pipework from the filter frontal gallery into each Contactor
- Install new GAC outlet points and modify the GAC removal and service water pipework within the GAC removal gallery
- Replace the leaking penstocks
- Install individual turbidity instruments on each Contactor outlet

Installation of Leopold Floor in GAC Contactors *Courtesy of Enpure Ltd*

Sludge system

A full review of the existing sludge and wastewater processes was undertaken and in order to ensure the equipment could cope with the increased output from the works, a number of upgrades were required, principally to the wastewater plant, sludge thickening plant, sludge press room and polyelectrolyte plant.

The scope included:

- Install 2 No. 100m^3 sludge holding tanks complete with platforms and ladders
- Replace existing supernatant pumps with new 350m^3/hr pump units
- Install 2 No. positive displacement sludge pumps from storage tanks
- Provide new low level fill point polyelectrolyte plant and associated vacuum system to allow powder to be conveyed up to existing first floor poly make-up, storage and dosing system

Sludge Holding Tanks *Courtesy of Enpure Ltd*

As an alternative to the usual steel shelled sludge storage tanks it was proposed to use spiral wound polypropylene tanks which in addition to offering a cost saving over equivalent steel tanks also are less susceptible to corrosion and material deterioration from the sludge.

High Lift Pump Station
The existing arrangement and associated duties of the high lift pumps were inadequate to guarantee the required 98 Mld through to the new service water reservoir being built under a separate contract on Beacon Hill. In addition the MCC controlling the high lift pumps was in a dilapidated state with many antiquated components and therefore required replacement. Following a number of design reviews and capital cost challenges it was agreed that the most cost effective solution was to replace two of the older existing pumps with two new 20Mld pumps together with new suction and discharge pipework. In addition the electrical system was upgraded with two new HV transformers, associated cabling and new MCC to control all of the high lift pumps, both old and new.

High Lift Pumps *Courtesy of Enpure Ltd*

Due to very tight space restrictions and the need to both install a new MCC and at the same time maintain the operation of the existing MCC, a number of alternative locations for the transformers and new MCC were reviewed. Eventually it was agreed to site the MCC in an old internal parking bay utilised previously for forklift truck parking. Due to the odd shape of this space the MCC was specifically designed to be taller than normal to allow it to fit into the space without obstructing access.

Chemical dosing
In addition to the various process stream upgrades the associated chemical dosing plants also required replacement and/or upgrading. The chemical upgrades covered the acid, PACl and caustic dosing.

Sulphuric acids dosing - Two existing and previously abandoned storage tanks were examined and found to be fit for purpose for re-use for the sulphuric acid dosing. The inlet and outlet pipework was modified to suit acid storage and in addition new acid dosing skids were provided.

The proposed acid dosing skids had been previously designed in conjunction with Thames Water and utilised by Enpure on a number of clean water plants including Chingford, Wanstead and Hornsey projects. The use of standardised dosing packages results in minimal design costs, reduced supplier fabrication costs and ease of maintenance and operation due to familiarity with similar equipment.

PaCl dosing - The existing PaCl storage tanks were in a poor state. Three new 34m^3 capacity PaCl storage spiral wound tanks were provided with ultrasonic level detection and fixed high level alarm probes. The tanks were linked to a common supply manifold with manual and actuated isolation valves.

PACl spiral wound tanks *Courtesy of Enpure Ltd*

In addition to the storage tanks, two new dosing skids, operating as duty/standby, and associated pipework were also provided. The dosing skids and associated pipework were also provided with appropriate leak detection, isolation and monitoring systems linked to SCADA.

Caustic dosing – in addition to the acid and PACl dosing, two new 35m^3 storage tanks, dosing skids, water softener and associated dosing pipework was also provided.

Conclusion
This scheme was another fast-track project for Costain/Enpure and combined the skills and strengths of both companies and Thames Water in ensuring the successful delivery of the scheme and associated SOSI compliance.

Despite tight restrictions on the number of process units that could be worked on at any one time, and very limited shutdown periods, the contract was delivered in line with the programme. This was achieved as a result of careful and detailed planning, close liaison with Thames Operations and the professionalism and experience of the excellent combined team.

The completed improvements made will ensure security of water supply to the Oxford area, and coupled with the earlier work associated with the DAF plant, provide a robust and efficient process for years to come.

Note: ***The Editor & Publishers thanks Keith Knight, SE Delivery Team Manager with Enpure Ltd for providing the above article.***■