Abbey Mills Pumping Station

improved discharges from largest UK combined sewer P.S

by

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One of the most challenging requirements of Thames Water's AMP3 Capital Programme was to provide a 6mm fine screening and waste handling plant for river discharges from Abbey Mills pumping station – the largest combined sewer pumping station in the United Kingdom. This project, to improve litter discharges to the Thames tideway required construction of the largest plant of its kind in the World.

Fine Screening Plant under construction with Abbey Mills F Pumping Station in background Photo: *Courtesy Thames Water*

The works are situated on the site of the Abbey Mills Pumping Station in Stratford, East London, originally designed by Sir Joseph Bazalgette, whose original 1860's building is still in use. The network of pumping stations lift combined sewage flows from the low level sewers, which drain London on the north bank of the Thames, into the Northern Outfall Sewer (NOS). Flows then gravitate to Beckton Sewage Treatment Works about 6.5 kilometres to the east. During storm conditions, when flows can exceed 40 cubic metres per second, there are consented discharges to the tidal Channelsea River. To put these flows into perspective; the normal maintained flow of the whole of the River Thames over Teddington Weir is only 10 cubic metres per second. This scheme is designed to alleviate the impact of these storm discharges by screening out any waste material greater than 6mm in diameter.

From experience gained within Thames Water in dealing with fine screening on large sewage works inlets it was proposed to avoid sophisticated screening machinery which has complex operational and maintenance requirements. Abbey Mills site is unmanned so a simpler fail-safe screening system was needed with minimal mechanical equipment aimed at high levels of reliability.

Following extensive investigations and site visits, it was decided that drum screens would be best placed to provide the high flow screening capability with the reliability and efficiency required. Although this type of drum screening is being used more often in inlet works screening to large sewage treatment works, it is still more commonly known in power stations for raw water intakes. Consequently, this would be the first application for storm discharges thus making it the largest installation of its kind anywhere in the world.

Delivery strategy

Due to the uniqueness of this application only one drum screen has been initially installed to be used as a large scale pilot. This initial phase of a £20m project has been successfully delivered, with the construction of a single 10 metre diameter drum screen, capable of screening 14m^3/s of the total 40+m^3/s flow from the site. The plant is being tested and further developed for the optimum solution to be completed in the next phase. Operational staff have already learnt a great deal about the maintenance issues and are advising the team on improvements that can be made for the next stage.

The project is being delivered by the Network North Alliance, one of the AMP3 Network Alliances set up by Thames Water in the Summer of 2000. Following modified IChemE 'Green Book' conditions of contract, the contractor, in this case *Barhale Construction plc,* becomes responsible for the delivery of the project for an agreed target cost. This target cost includes ALL the project costs such as design resources and compensation, which may have traditionally sat outside the contractor's construction costs. This procurement route enabled the fast track approach required to complete the first phase and allow a significant trial period before completing the works before April 2005.

Project delivery
A Thames Water lead design engineer heads the design team which is made up of civil, mechanical, electrical and control and instrumentation engineers from *Faber Maunsell Ltd* and supplemented by *Hyder Consulting Ltd.*

Main elements of the first phase are:

* construction of a structure to house the single drum screen including inlet & outlet channels. This was designed and constructed to be extended in the final phase;
* connection to the existing outfall culverts from 'F' pumping station.
* installation of a single 10m diameter drum screen with associated washwater, electrical and control systems;
* installation of a 4.75m x 5.0m modulating penstock and associated electrical & control systems to control flows through the drum screen;
* construction of the screenings conditioning & handling area including stone trap, conditioning plant, liquid separators and skip loaders,plus ancillaries such as the liquor pumping station, potable water pumping station & MCC building;
* installation of a SCADA system to control plant and collect data from the trial.

In a project of this size many suppliers and sub-contractors were used. *Brackett Green Ltd* were selected to provide and install the all important drum screen and associated washwater system. *Haigh Engineering, Huber Technology* and *Arnolds Engineering* have been involved extensively with the screenings handling and conditioning plant. *Engenica* installed the site wide electrics and control panels and *Aston Dane* have been involved with the instrumentation and control systems.

Early engagement with the supply chain was essential to ensure our tight timescales were met. Creation of a teamwork atmosphere with a 'no blame' culture appeared difficult at first, particularly with so many companies coming together as partners. Unfortunately, co-location of the whole team was not possible so efficient communications were identified as a potential weakness. Although information was communicated, team members lacked an understanding of exactly what was required of them. This issue was overcome by establishing Service Level Agreements (SLA's), which defined relevant responsibilities and outputs – essentially what kind of information, in what format, when and from whom. An SLA was drawn up for all of the major disciplines such as design, commercial, procurement and construction, and a functional champion was nominated for each. These SLA's then formed a useful tool for driving the programme and measuring performance. Thus continuous improvement was achieved and measured.

Significant challenges
With such a unique project a number of significant challenges were met and overcome along the way. These included:

Washwater challenge
The amount of washwater required to clean the completed plant during operation was estimated to be over 300 litres per second. The use of potable water at these rates was not acceptable so other sources were sought. Borehole and river water were ruled out due to cost and practical reasons. So, screened flow was the only cost effective alternative. However, Thames Water Operations had reservations on this method based on past experience. Their experience was brought together with the expertise of *Brackett Green* to develop a simple system for the filtering of screened flows to effectively clean the screens using spray water jets.

Interfaces with existing structure
A critical element of phase 1 was the construction of interfaces between the new screening plant at the existing outfall structure from 'F' pumping station. This involved two break-ins into the existing outfall culverts and the construction of a new weir wall. All this had to be done with storm and tidal restrictions. Innovative techniques were used to implement the work. Hydro-demolition was used to undertake the initial breakthroughs. This method was safe, efficient and allowed more control and accuracy of the concrete wall demolition. Once the apertures were completed a temporary bulkhead door was installed to minimise disruption to the adjacent works. The door, some 2.5m by 3.0m in size, was designed to withstand storm and tidal flows, so when shut work could continue without the threat of flooding and the rework this would entail.

Commissioning
To avoid the discharge of dry weather flows to the river, recirculation pipework was laid so that storm flows could be replicated for commissioning purposes. This was achieved by continually recirculating dry weather flows through the pumping station. building up the flows through the screen. Using this method, the screen was tested with flows up to 12m³/s under controlled circumstances and without reliance on storm conditions.

Lessons
First phase of the work has been working since June 2003, collecting valuable data for optimisation of the final plant. Lessons which have already been learnt and incorporated into the design of phase 2 include:

* accurate flow measurement has allowed the team to cut the number of screens from 4, as originally envisaged, to 3;
* due to the accurate 'real-time' measurement of the screenings loading rationalisation of the screenings handling and conditioning plant has been possible;
* physical modelling of the outfall structures has enabled the design team to devise a unique compound weir arrangement to control water levels through the screens. This innovative idea has eliminated the need for mechanical systems with complicated control logics, which are prone to failure;
* because this is a new application for the drum screen the project team has identified necessary modifications to make maintenance and operations safer and easier. Working with the manufacturer, all new screens will have locking and inching mechanisms installed. Also, a new screening panel removal system has been devised to minimise the amount of time the screen will be unavailable due to maintenance.■

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Note: *The author of this article James Smith is Project Manager, Thames Water.*