

Egham Water Treatment Works

forward flow to waste & filter refurbishment

by John Ellis BSc, BEng

Three Valleys Water (TVW) own and operate Egham WTW which serves a population equivalent of 500,000 in a geographical area covering south west London and north Surrey, drawing its water directly from the Thames. Forward Flow to Waste (FFTW) has been recommended in the Badenoch/Bouchier reports as being advantageous in reducing the risk of viruses and bacteria entering supply following the washing of Rapid Gravity Filters (RGFs) such as those at Egham and consists of an immediate start of filtration to waste in place of slow starting into supply. As part of its AMP3 quality objectives, (TVW) agreed and undertook with the Drinking Water Inspectorate to implement FFTW at Egham with a Statement of Intent date of December 2002. A concurrent programme of filter refurbishment was undertaken to improve the efficiency, reliability and performance of the RGFs on site.

Scope of work

The works undertaken to implement FFTW included:

- * modification of RGFs to install FFTW connections and pipework;
- * refurbishment of RGFs;
- * construction of a 300m³ capacity reinforced concrete underground balancing tank for FFTW flows;
- * installation of external pipework of pipe diameters ranging from 250mm to 500mm;
- * electrical instrumentation, control and automation (EICA) works;
- * software modifications to incorporate FFTW.

Vivendi Water Partnership (VWP), acting as managing consultants on behalf of TVW, managed the project from feasibility stage through to project completion.

Modifications to filters

There are twenty RGFs at Egham, arranged in five filter houses with four filters in each house.

FFTW connections were made in 300mm diameter pipework to the underfloor filtered water collection channel of each filter in Filter Houses 2 and 3 and at filtered water drop pocket manway entry flanges of each of the newer filters in Filter Houses 4 & 5.

In Filter House 1 access to the underfloor central collection channel was impossible, so FFTW connection has been achieved by extending the filter house backwash main to connect it to external FFTW pipework, installing a segregation valve to isolate the main from backwash pumps and a FFTW valve to control flow to waste.

Rapid Gravity Filter refurbishment

Refurbishment of the filters included replacement of existing filter media and nozzles, cleaning and flushing of underfloor laterals, minor structural repairs, installation of FFTW connections and replacement of penstocks and valves.

The five filter houses at Egham each contained four, dual sand/anthracite media RGFs. Filtration rates at maximum works throughput range from 10.1m/hr in the newest filter houses (4 & 5) through 8m/hr in Filter Houses 2 and 3 to 4.8m/hr in the oldest filter house (1).

Prior to refurbishment the filters operated separate air and water backwashing regimes. Air rise rates were typically 6.7 – 7.5mm/s and upwash water rise rates varied between 5.7 and 7.4mm/s.

Filter Houses 1, 2 and 3 had previously been converted from single media to dual media. Conversion necessitated an increase in upwash flow rates but resulted in excessive velocities (up to 5.55m/s) in underfloor channels causing uneven distribution of backwash water. In addition, washwater collection troughs had insufficient capacity to cater for the increased flow rates causing dirty washwater to remain on the filter after washing, reducing filter run times and leading to mudballing of the filter media.

Paterson Candy Refurbishments (PCR) was commissioned to undertake a partnering study in association with (TVW) and *VWP* to review refurbishment options for the filters.

Based upon their findings, (TVW) took the decision to revert Filter Houses 1,2 and 3 back to single media and adopt a combined water/air media washing regime. This uses a lower upwash flowrate (5 mm/s) in conjunction with a higher air scour rate (16.7 mm/s) to provide a vigorous cleaning of the filter media, even upwash flow distribution through underfloor channels and free discharge of upwash water into the central washwater collection trough.

Balancing tank & external pipework

The balancing tank is situated entirely below ground level and functions to even out large (up to 200 litres/second) but intermittent, FFTW flows of water. Inlet and outlet pipework is sized at 500mm and 250mm diameter respectively. Smoothed flows are directed back to the head of the works at a maximum flow designed not to exceed 5% of the total intake volume even at minimum works throughput rates.

EICA & software installation

EICA works included supply and installation of actuators for FFTW valves, installation of power and control/indication cabling to FFTW actuators and flow meters and modification of the RGFs' PLC control panels to incorporate additional remote input/output signals.

Software works included modifications to the RGFs' Programmable Logic Controller (PLC), Man Machine Interface (MMI) and Supervisory Control and Data Acquisition (SCADA) control software to include FFTW into the existing filter backwash cycle.

During FFTW the FFTW valve is controlled by the associated filter's level control software to maintain the level in the filter at the appropriate set point. On completion of FFTW, the filter is put back into service by transferring filter flow to the filter outlet such

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that as FFTW decreases, filter outlet flow increases by an equal amount. In this way a seamless changeover between FFTW and filtration to supply is achieved.

Procurement

VWP was appointed by (TVW) to manage implementation of the project from feasibility stage, design the balancing tank and external pipework, supervise work on site and act as Planning Supervisor under the Construction (Design and Management) Regulations..

Refurbishment contracts were let using Model Form of General Conditions of Contract MF/1 with the contractor specifying and designing filter media to meet stated performance criteria.

Refurbishment of Filter House 4 was completed by PCR in February 2001. PCR also carried out refurbishment contracts for Filter Houses 2,3 and 5. External pipeline works and construction

of the balancing tank was completed by *JBS Construction* under ICE Minor Works conditions of contract. *Eastern Contracting* was awarded an MF/1 contract to install power and signal cabling, tray work and lighting.

Changes to filter operating software to incorporate FFTW into the normal filter backwashing cycle was designed in house by *VWP* software engineers.

Refurbishment of four of the five filter houses by June 2002 has allowed Three Valleys Water to undertake a full review of supply/demand balance and resource requirements for the geographic area served by Egham WTW prior to affirming the requirement to refurbish the oldest and most costly filter house, Filter House 1. ■

Note: *The author of this article, John Ellis, is Project Manager with Vivendi Water Partnership.*
