Cryptosporidium Barrier Membrane Project

improving water quality at groundwater sources

by

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Following a risk assessment by Severn Trent Water (STW), a number of their shallow groundwater sources have been identified as being at potential risk of cryptosporidium ingress. As a result of the Water Supply *Cryptosporidium* Regulations 1999, it was decided to install ultrafiltration barrier membranes to meet the DWI requirements. Membrane plants are currently being installed at four sites with capacities ranging from 3 Ml/d to 24 Ml/d capacity. At Llandinam, the largest site, it was decided to increase the abstraction capacity from 18 to 24 Ml/d and build a completely new works on an adjacent greenfield site. On the other three sites the ultrafiltration stage is being incorporated into the existing works.

Norit primary membrane unit before leaving factory in Holland *(courtesy Black & Veatch)*

Severn Trent Water's strategy for reducing costs and increasing value under AMP3 includes the following:

* batching similar work to achieve increased efficiency;
* use of a small number of framework contractors/suppliers for increased standardisation and formation of long term working relationships;
* challenging traditional ways of doing things and applying the test of "just good enough";
* fostering a teamworking approach between all parties in the supply chain.

As part of this strategy these four schemes, together with a fifth smaller scheme not involving an ultrafiltration plant, were combined into a single design and build contract worth £7.3 million, which was awarded to *Black & Veatch (UK)* in April 2001. The contract is based on a team working approach between all parties against a Target Price, on the basis of cost-plus reimbursement moderated by a pain/gain share arrangement. The client's Engineer and Planning Supervisor is the *Carl Bro Group.*

STW had entered into a framework contract for the supply of ultrafiltration plant with *Norit Membrane Technology BV (NMT)* of Holland, so NMT were sub-contracted the design/supply of the membrane units and writing of the control software. Other major sub-contractors/suppliers are *Alpha Construction Ltd* for civil design/construction and *CEMA Ltd* for supply of MCCs (Motor

Control Cabinets), for which they are framework suppliers to STW, and for electrical installation (non-framework).

Description of schemes
There are four separate membrane schemes as follows:

	Name	Capacity	Water source	Location
*	Llandinam WTW	24.0ml/d	boreholes (new works)	Powys, Wales
*	Chalford Springs	13.6 ml/d	spring source	Stroud, Glocs.
*	Lydbrook Springs	3.0 ml/d	spring source	Lydbrook, Glocs.
*	Haseley Springs	3.0 ml/d	spring source	Hatton, Warwick

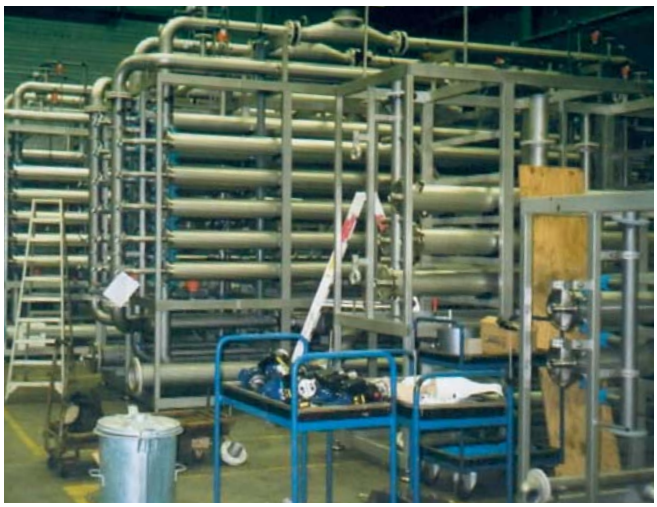
The membrane process is similar at all sites, but since the scope at Llandinam also includes replacement works it is described here. Significant differences for other sites are discussed below.

Llandinam WTW is located near Llandiloes in the upper Severn valley and is currently supplied by three shallow boreholes. It is the sole source of water serving a population of about 40,000 via a relatively small service reservoir so it is continuously in service at maximum capacity in the summer. STW have commissioned a fourth borehole in order to increase the capacity to 24 ml/d and, as it is considered impracticable to uprate the existing works, a completely new works is being constructed on a greenfield site adjacent to the existing works.

Borehole water is fed to a new raw water collection/balancing chamber with three variable speed low lift submersibles, which pump water through manual backwash strainers the primary membranes and then on to the contact tank via a chlorination dosing point. Part of the permeate flow from the six UF primary membranes is fed to a washwater tank. Backwashes of each membrane unit occurs at 20 minute intervals with water discharged to a wastewater tank for washwater recovery. All the wastewater is fed through a single secondary membrane unit with the permeate from this being returned to the raw water sump. Backwash/waste water from the secondary membrane is discharged to an adjacent stream through an existing settlement lagoon to meet the requirements of the current discharge consent.

To prevent the build up of fouling on the membranes, there are also more infrequent (every two or three days) chemically enhanced backwashes (CEB). These are performed by dosing with either hydrochloric acid or sodium hypochlorite. The waste from these CEBs is discharged to a separate neutralisation tank, where it is neutralised by sodium hydroxide or sodium bisulphite respectively before being discharged to a foul water pumping station (FWPS). Due to the batch nature of the CEBs (ie the need to keep the neutralisation tank ready for the next CEB) and the limited discharge capacity of the sewer leaving the site, the FWPS also acts as a balancing tank to smooth the pumped discharges to sewer.

Treated water leaving the contact tank via an overflow weir is dosed with lime for pH correction and discharges into the high lift pumping station feed sump/balancing tank. Four high lift pumps transfer water to the off-site service reservoir, pumping against a static head of about 100m. Orthophosphoricc acid (for prevention of plumbosolvency) and sulphur dioxide (for residual chlorine) is dosed just downstream of the high lift pumps.



Norit primary membrane units (secondary in foreground) before leaving factory in Holland *(courtesy Black & Veatch)*

Chalford, Lydbrook and Hatton
At these sites the membrane process is almost identical, there being minor differences in exactly where in the existing process the ultrafiltration stage has been inserted and also in the waste discharge arrangements. Due to limited space available on the existing sites, the location and layout of the new plant has been a challenging exercise. At Chelford the membrane plant has been inserted down stream of the existing chlorination point so super-chlorinated water is passed through the membranes. For this reason, all waste discharges are made to the foul sewer rather than the local water course. At Lydrook and Hatton, restrictions on possible discharge consent to watercourse also means that all waste is discharged to local sewers.

Control system
As there is no redundancy in the primary membrane unit capacity, flow through the works will vary as each membrane unit is taken out of supply for normal or CEB backwashing. The control system and size of the feed/balancing tanks have been optimised to cope with these fluctuating flows through the works. At all the sites the plant is designed for unattended operation, with visits at two weekly intervals. Alarms generated locally are transferred to STW Plant Monitoring and Control System (PMCS) which relays key alarms to a central control centre. It is also possible for operations staff to access the control system remotely through a laptop to see plant status and diagnose faults if necessary.

Completion
Commissioning of the new plant at Chalford, Lydbrook and Hatton is due this summer. The start on site at Llandinam was delayed due to access restrictions resulting from the foot and mouth outbreak and completion is due in early 2003. ■

Note: *The author of this article, Graeme de Lande Long, is Project Manager with Black & Veatch (UK) Ltd.*