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Divers install eccentric plug valve in reservoir tunnel

A team of specialist divers – working in a cramped, water-filled tunnel 20 metres beneath the surface of a reservoir – has just completed installation of an eccentric plug valve to control water flow.

The valve and associated equipment has been supplied to United Utilities by Viking Johnson, part of Crane Building Services & Utilities, and a world leader in the supply of pipe joints and repair and flow control products. The valve has been installed at the end of a tunnel which runs beneath the dam holding back 332,000 cubic metres of water in the Grizedale Reservoir.



The diving pontoon in position on the lake

The reservoir was built in 1866 by forming a 22 metre high, 120 metre long earth embankment across the valley of Grizedale Brook to act as the wall of the dam. A tunnel – 1.8 metres wide and 1.7 metres high – beneath the dam takes water from the reservoir to a pump house from where it is pumped up to the nearby Barnacre North Reservoir before it flows under gravity to the treatment works at Franklaw.

A gate valve sited near the outlet has for many years controlled water flow through the tunnel. However, recent inspections showed that the valve was no longer adequate. In order to improve operational control of the water flow without reducing the water level in the reservoir or potentially polluting the downstream watercourse it was decided to install a secondary valve.

Viking Johnson was selected to supply this replacement valve which, rather than being of a gate design, is of the 'eccentric plug' type. This will provide United Utilities with the ability to not only isolate but also control the flow when transferring water to Barnacre. The eccentric plug valve requires only a one-quarter turn of the shaft between its fully open and fully closed positions, therefore making it relatively easy to automate its operation for submerged duty.

In addition to the valve Viking Johnson has provided a total solution including the bespoke actuation system: a specially-designed hydraulic power pack and an emergency hand pump facility for the hydraulic system which permits the valve to be operated in the event of electrical supply failure. The system also includes almost 400 metres of high

specification stainless steel braided hydraulic hose lines running between the valve and the pump house:

A team of ten divers winched the valve and actuator, weighing almost three quarters of a tonne, along the tunnel on a specially designed trolley. Viking Johnson provided the diving company with a 'dummy' valve ahead of the installation to permit the divers to practice manoeuvring it in controlled conditions within a training facility.

On site at Grizedale the divers used a decompression chamber housed on a floating pontoon above the submerged tunnel entrance, 20 metres beneath the surface, to permit them to work for up to 70 minutes at a time.



The Viking Johnson valve and trolley being lowered into the lake

The 450 mm bore Viking Johnson eccentric plug valve is designed to give reliable service for many years in this almost inaccessible location. Manufactured in cast iron using high pressure moulding techniques the valve incorporates a nickel welded seat for corrosion resistance, specially profiled for low torque and extended valve life.

The valve is trunnion-supported and fully encapsulated in elastomeric polymer with a valve body fully internally and externally lined with epoxy. The eccentric plug design ensures that the ductile iron plug – fitted on permanently lubricated austenitic stainless steel bearings – rotates away from the seat as soon as movement begins, avoiding scuffing and therefore extending the operational life of the valve.



Graham Biggs, business development manager for Viking Johnson, said:

"This unique and complex project has required close co-ordination with a number of specialist companies and personnel including Eric Wright Civil Engineering, Shakespeare Engineering Supplies, Rotork Fluid Systems, Consortium Underwater Engineers Ltd, Red 7 Marine diving contractors and MWH project consultants working alongside United Utilities capital maintenance, site operations and project management teams.

"The custom-built design and the engineering quality of the new eccentric plug valve and its automation and power system means that it will be very many years before such an operation is required again to replace it."

James Tresnan, United Utilities project manager, said:

"Grizedale was a particularly challenging project. Installing a 450 mm diameter valve 50 metres along a 1.7 metre high brick arch tunnel should never be classed as straightforward. But when the tunnel is submerged 20 metres below water and the silt in it results in zero visibility for the divers, then the degree of difficulty is amplified tenfold.

"This was the situation at Grizedale. Consequently it was key that we worked with our contractors and suppliers from an early stage in the development of the scheme to ensure that we simplified the construction activities whilst at the same time achieving the required functionality. Viking Johnson was part of the strong team that was developed on this project and worked with us to assist in the successful delivery of the scheme."