Fibre optic leakage monitor system for an underground water reservoir made of precast wall units: Hanchurch Service Reservoir

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ABSTRACT: Service reservoirs retain food grade water for human consumption. Novel construction solutions such as the use of pre-cast concrete walls incorporating proportionately significantly more wall joints arguably introduces a higher risk of bacteriological failure longer term, particularly when backfill is placed against reservoir walls.

A leakage monitoring system based on distributed fibre optic temperate sensing (DTS) with a spatial resolution of 0.7m has been installed at the newly constructed 45Ml Hanchurch Service Reservoir. The leakage detection is based on two methods: the Gradient Method and the Heat-Pulse-Method. The Gradient Method provides information regarding possible seepage by monitoring the absolute temperatures over time, meanwhile the Heat-Pulse-Method consists in measuring the temperature changes over time using the DTS during heating the hybrid cable with a known electrical power obtaining two measured variables; the temperature difference and the thermal conductivity. Both variables provide information regarding the thermal properties of the material in the near field around the cable.

The paper will also expand on the results of a leakage simulation test on site by injecting water with a flow rate of 0.3-0.4 l/s in the filter at the top of the walls.

The monitoring system is fully automatic and has a web based visualization. When trigger levels are reached automatic alarms are generated.

Balgray Reservoir: Outlet Pipework Condition Assessment and Rehabilitation

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Balgray Reservoir was constructed in 1853-54 and the original cast iron drawdown and scour pipes through the embankment are still used for reservoir drawdown. The pipes are now substantially encrusted, and concerns and recommendations were raised in the statutory inspection carried out in 2017 regarding their structural adequacy, and reduced discharge capacity. A pipe condition assessment was undertaken to determine the make-up of the encrustation, the condition of the pipe, and the risk they pose to the embankment.

The paper will detail the investigatory studies undertaken including cutting a section of pipe to take thickness readings and hardness testing of the cleaned cast iron pipe and testing of the encrustation to determine the materials present.

The findings will be presented along with the postulated corrosion conditions and implications for the condition of the pipe. The elements leading to the encrustation build up and the such as the conditions during original dam construction, and the chemical properties of the ground and water at the site will be discussed. The resulting impact on the pipe in terms of its strength and thickness will be presented and the assessment of the risks posed to the dam.

Finally the paper will outline the options considered for encrustation removal, and the risks and benefits associated with these.

The paper compliments the CIRIA Guide “Pipework, Valves and Associated Equipment – A Guide to operation, maintenance, condition assessment and rehabilitation” due for issue in early 2020.

Synopsis Paper Title: Large leakage incident in a Norwegian Concrete Faced Rockfill Dam due to ice build up within the dam body

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SYNOPSIS: Aursjøen dam is a Concrete Faced Rockfill Dam (CFRD) in central Norway built between 1950-58 and is owned by Statkraft. The dam was originally constructed with an upstream face consisting of wooden planks which acted as the impermeable element of the dam. The dam underwent a large rehabilitation between 2005-06, where the wooden planks were replaced with a reinforced concrete slab. In 2017 a large leakage event occurred at the dam and at its peak was estimated to be up to 600 l/s. This paper covers the incident itself including the emergency response, the investigation into the cause of the high leakage, the potential effect on dam safety, and finally the recommended measures implemented at the dam.

During the detailed investigation the cause of the leakage was identified as the release of water after an ice dam within the dam body burst. Ice build-up and subsequent rapid release of water is not an unusual occurrence at rockfill dams in Norway and there are examples where the same phenomena has occurred at other dams. However due to the amount of water released, the uncertainty regarding the source of the water, and the high consequence of a dam failure, it was critically important to identify and confirm the exact cause of the leakage. Measures were subsequently recommended that will help quickly identify the source of leakage water if a similar event occurs again and measures were also recommended that will potentially reduce the likelihood of ice build-up within the dam body.

Non-invasive detection and monitoring of a leak within a Victorian peat core dam

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Dams have played a critical role in the industrial and social development of the UK for centuries, providing water for consumption, sanitation, agriculture and manufacturing. Ageing dams and reservoirs are being repurposed to provide hydroelectric power and are critical components of flood defence schemes, which is of particular relevance as the effects of climate change become increasingly frequent. Damage and wear are inevitable over the lifetime of any dam, and whilst some deterioration may be observed at the surface, there is significant potential for unidentified defects to be present within the structure itself. Leakage and water ingress can lead to internal erosion and in turn, can cause voiding, fractures and ultimately catastrophic failure.

TerraDat has been at the forefront of non-invasive surveying of engineered structures for over 25 years. We have now developed an innovative, real-time monitoring system for the detection of leaks through dam structures using the Self Potential (SP) method. This paper presents the findings of the SP system in combination with other geophysical methods, including Electrical Resistivity Tomography (ERT), through a cycle of refilling Llyn Barlwydd reservoir, Blaenau Ffestiniog. This peat-core, masonry dam was constructed circa 1880 and has had a long history of leakages. The dam is to be repurposed for a hydroelectric scheme, and it is therefore of importance that any current leakages are detected prior to remediation.