APSENSING.

Dam Leakage Detection and Monitoring

Knezevo Dam/Macedonia

Project Overview

A rockfill dam with an asphalt core in Macedonia required leakage detection and seepage monitoring. AP Sensing provided a monitoring solution using our partner GTC Kappelmeyer's fiber optic leakage detection method alongside an AP Sensing Distributed Temperature Sensing (DTS) device.

In order to solve water-supply problems in six municipalities in eastern Macedonia, a major dam project was commissioned: the Knezevo dam. The rockfill dam is 75 m high and 300 m wide at the base. Its storage facility is 4 km long and it has a maximum accumulation of 23.5 million m3 of water. A dam of this size and importance needs to be monitored for leakage.

Solution

The cable was installed on the downstream side of the interior asphalt core, inside the filter zone. Approximately 1,200 m of sensor cable was required. The type of cable selected was a hybrid sensor cable which utilizes multimode sensor fibers together with copper wires in the tube to facilitate controlled heating and cooling. In this case, the copper wires have about 11 W/M heat output and four heating cycles are carried out daily.

Both the monitoring and alarm-generating operations use the measured values for achieving an absolute temperature, effective thermal conductivity, and temperature change using the Heat-Pulse Method developed by AP Sensing's partner, GTC Kappelmeyer (now Solexperts GmbH)*.

An AP Sensing DTS device with a 2 km range and two channels was securely installed in the control center. With the DT Sdevice, the operators have a permanent, real-time overview of all seepage and leakage conditions via a web browser. This overview can be viewed anywhere with the login details.

Background

- Knezevo Dam (75 m) supplies water to six Macedonian municipalities
- Leakage monitoring was crucial for safety
- AP Sensing partnered with GTC Kappelmeyer for a fiber optic solution

Solution & Benefits

- Hybrid sensor cable enables precise leakage detection
- DTS device provides real-time, remote monitoring
- Heat-pulse method ensures sensitive seepage detection

Figure 1: Cable installation

Both the DTS device and the heat-pulse control unit make use of the Modbus protocol and are connected to the local network via TCP/IP. The AP Sensing DTS Configurator and the customer-specific evaluation software are installed on a local PC.

Conclusion

Following a successful installation, the system was brought online and has been monitoring the dam successfully ever since. The technicians and operators are satisfied with the results. An important infrastructure that ensures the water supply for six Macedonian municipalities is securely and efficiently monitored.

*The GTC Kappelmeyer Fiber Optic Leakage method was developed as a highly effective and sensitive tool to monitor seepage. Employing fiber optic sensing technology, absolute temperature changes within the body of the dam caused by seepage water are detected.

In addition, a heat-pulse method can be used to detect temperature differences. The copper wires in the hybrid cable are used to heat the sensor fiber, making it possible to identify zones within creased heat transport (an indication of seepage).

Temperature differences between the start and the peak of the heat-pulse cycles can visibly reveal seepage.

It is also possible to monitor the effective thermal conductivity along the cable itself. Like the heat-pulse method, the monitored information reveals zones within creased heat transport.

When used in combination, these methods reveal seepages and changes in ground saturation levels with great sensitivity.

Figure 2: Knezevo Dam overview

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