Dam Leakage Detection and Monitoring

Macedonia

A rockfill dam with an asphalt core required leakage detection and seepage monitoring using GTC Kappelmeyer's Fiber Optic Leakage Detection method with an AP Sensing DTS (Distributed Temperature Sensing) device.

Knezovo Dam: late construction phase

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 with an asphalt core is 75 meters high and 300 meters wide at the base. Its storage facility is 4 km long and it has a maximum accumulation of 23.5 million cubic meters of water.

A dam of this size and importance needs to be monitored for leakage. The following diagram shows the most efficient pattern to use for the sensor cable layout. The cable was installed on the downstream side of the interior asphalt core, inside the filter zone.

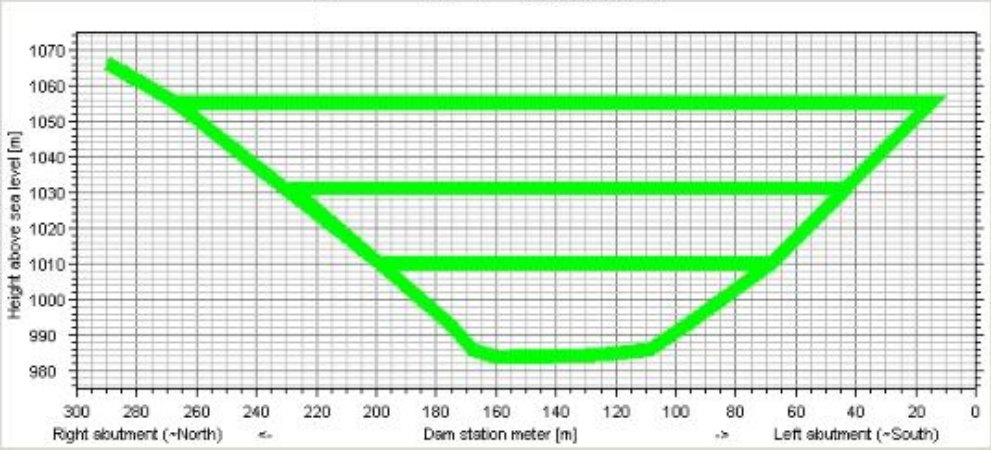

Diagram of the fiber optic sensor cable layout

Approximately 1200 m of sensor cable was required. The type of cable selected was the hybrid sensor cable, which makes use of 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 4 heating cycles are carried out daily.

Both the monitoring and the alarm-generating operations use the parameters for absolute temperature, effective thermal conductivity, and temperature change using the Heat-Pulse Method developed by AP Sensing's partner, GTC Kappelmeyer(*). An AP Sensing DTS device with a 2 km range and 2 channels was securely installed in the control center. Here the operators have the permanent, real-time overview of all seepage and leakage conditions via a web browser. With the login details this can be viewed anywhere.

Cable installation

Interior DTS 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.

Following a successful installation the system was brought online and has been monitoring 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 with increased 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. Similar to the heat-pulse method, the monitored information reveals zones with increased heat transport.

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

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