Wolf Creek Dam Repair

Monitoring seepage in an earthen dam.

By William Walker and Jim Hummert, Jr.

The National Inventory of Dams shows that in the U. S. alone there are more than 82,600 dams. The Association of State Dam Safety Officials (ASDSO) reports that over 3,300 of these dams are classified as deficient (meaning they are susceptible to failure). Close to 17 percent of the dams in the U. S. are classified as having high-hazard potential—meaning failure could result in loss of life. And over 40,000 dams are 50 years old or older.

Fortunately, as dams have increased in number and age, tools for facilitating their maintenance have also increased in capability. Automated monitoring systems have become an important part of many dam maintenance programs. These systems usually consist of sensors, dataloggers, and telemetry equipment that work together to measure critical parameters and provide data logging, reporting, control, and alarms. Data can be logged over time to provide information regarding the effects of aging, earthquakes, erosion, storm events, and other variables on the overall health of the dam. Alarms and callouts can be programmed to warn engineers of potential failures. Most important of all, these systems provide 24/7 monitoring and allow detection of many changes that could otherwise go unnoticed.

Common causes of dam failure include overtopping, foundation problems, structural problems, and piping (internal erosion due to seepage). With an effective monitoring program, these causes can be detected early and repaired or mitigated. Due to the number of factors involved (hydrological, geotechnical, structural, and power related), a variety of measurements are required for dams. These cover everything from the structure of the dam, to the dam's foundation, to the water in the reservoir.

Structure of the dam. Cracks and joints, tilt, inclination,

The Wolf Creek Dam near Jamestown, KY, is monitored with an automated data acquisition system (ADAS). The ADAS monitors the large number of piezometers measuring water level (seepage from the reservoir) in the embankment.

stress, strain, deformation, and seepage flow.

Foundations holding the dam in place. Pore pressure, slope stability, subsurface water table, regional versus local tilt measurements, and subsurface rock mass deformation.

Water in (and upstream of) the reservoir. Water level and flow, rainfall.

Wolf Creek Dam

The Wolf Creek Dam near Jamestown, KY, was constructed partially as a regular concrete hydroelectric dam, but mostly as an earth-fill embankment structure. Finished in 1950, within 20 years it developed serious reservoir seepage problems. Several repair projects had a degree of success at stemming the flow, but in recent years managers decided that resurging seepage at the dam constituted an emergency situation.

To seal off further damaging seepage, remedial construction began in 2006. The project includes a major grouting program to be followed by construction of a nearly one million-sq ft concrete diaphragm wall. As part of the monitoring and analysis portion of the project, the Army Corps of Engineers (USACE) retained URS Corporation to design, install, and operate an automated data-acquisition system (ADAS).

The ADAS monitors the large number of piezometers measuring water level (seepage from the reservoir) in the embankment. System installation began during the summer 2008. All instrument readings are collected by a host PC located in the dam's powerhouse. A local FTP server provides remote transfer of daily data files to both the Corps' Nashville district office and the URS St. Louis office, where data are being managed in the USACE WinIDP program. In addition, URS is hosting a project web server that displays graphs and instrument readings every hour.

The ADAS consists of 81 vibrating-wire pressure transducers being read by Campbell Scientific (www.campbellsci.com) CR1000 dataloggers and 25 AVW206 wireless interface units. The AVW206 uses Campbell's spectral-analysis method to eliminate almost all noise from the vibrating-wire signals.

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All data is transmitted over a spread-spectrum IP radio network. As part of the project, URS installed an 800-ft fiberoptic cable to carry the radioed data from atop the dam structure down to the communication room in the dam's power house. URS performs operation and maintenance of the ADAS to keep track of seepage levels as dam repair progresses through 2014. GE

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Lane Separation System Keeps Traffic Moving

A lane separation system is guiding more than 6,000 vehicles each day through changing traffic patterns along Tyburn Road in Falls Township, Bucks County, PA. About 12,000 ft of FG 300 Interstate Grade Curb System (Pexco, www.pexco.com) delineates the detour along two critical half- and mile-long sections of the five-bridge reconstruction job. Designed for use wherever pavement markings are not sufficient to provide safe channelization, the system includes 4,000 modular raised curb sections and channelizer posts that enable PennDOT to establish a visual barrier that detours and maintains efficient traffic flow. The unique anchor bolts will facilitate rapid modification to the traffic pattern throughout the duration of the project, slated for completion in September 2011.

The installation is part of a $12.4-million PennDOT project that began in July 2010 to rehabilitate five bridges in Bucks County along Tyburn Road. The project was expanded when a hole developed on the shoulder of the concrete bridge deck above an Amtrak line in February 2010. The construction includes replacing the decks and beams on each structure and rehabilitating the abutments and piers.

Pexco supplies traffic control products for roads and bridges across the country. The posts were manufactured in its Tacoma, WA, factory and pre-assembled for installation less than two miles away from the project at the company's Philadelphia facility. The plant also served as a materials staging location for Protection Services (PSI), a Harrisburg, PA-based work site controls specialist. Pexco's location and expertise helped PSI effectively control its labor costs and provide just-in-time materials to the jobsite.