Lessons Learned

The Washed-Out Dam: $1 Million in Damages from a $100 Problem

The consulting engineer's daughter came running into the room, shouting excitedly, "Dad, that dam you visited last month has washed out! It's on TV!"

The next morning, the consultant stands on what remains of the dam, wondering what happened. During his recent visit to the site, everything had appeared normal, and yesterday's storm had not been exceedingly large.

Examining the features, operations at the dam site

In addition to the dam, there is a hydropower plant at the site. The plant contains four Francis turbines. A spillway is attached to the powerhouse. This spillway has eight openings that are closed using stoplogs, which are operated by an electric-powered hoist. Two additional openings are closed with motorized gates. The spillway-powerhouse concrete structure spans the entire width of the river, and connects to a short earth dam. There is small headpond at the site, and upstream, other hydro plants provide additional storage.

The site was developed in the mid-1920s to power a cotton mill in a nearby village. Initially, the plant was operated as a run-of-river facility with a full complement of shift operators. After about 50 years of uneventful operation, the plant was automated and staff reduced to one visiting operator, with another on call to assist with stoplog operation. A flood warning system was instituted, with upstream power plant operators telephoning downstream plant staff to advise of changes in flow.

Over the years, the nearby village evolved into a small town, and residences were built on both banks of the river around the power plant. Pedestrians and cyclists began crossing over the river via the unattended spillway-powerhouse structure, to avoid a 5-kilometer trek to use the nearest bridge. Vandals soon appeared. Several attempts were made to halt trespassers by building fences topped with barbed wire and steel gates, all to no avail.

Circumstances causing the washout

On the day before the washout, the operator had just completed his twice-daily inspection during a thunderstorm. Due to the rain, he expected to be out again to lift some stoplogs. Later that evening, he received a call from the upstream power plant, advising that they were about to open their gates to increase flow. It was time to lift those stoplogs.

When the operator arrived at the dam, water was starting to flow over the top logs. On opening the stoplog hoist's power cable box, he was startled to find that the 550-volt connector at the end of the cable had been chopped off. No power, no hoist, no opening of stoplogs!

The headpond continued to rise. With about half a meter of water spilling over the dam crest, the earth embankment at the left abutment washed out. (Eventually, it was determined that the flood had been equivalent to only 15 percent of total spill capacity.) The washout caused more than US$1 million in damage — all because of a damaged US$100 cable connector!

Owing to the fact that the volume of water stored in the headpond was small and the river downstream was wide, there was no flooding or loss of life. Damage to the facility, though, was extensive.

The lesson learned

Hydro facilities that are not staffed fulltime or are subjected to vandalism should have simple weir spillways, or, alternatively, an emergency means of passing flood waters that does not require the use of power.

At the facility described here, one of the stoplog openings was converted to a "fuse-log" gate. The stoplogs were cut in half and supported in the middle with a steel flange section. This section rests on the top of the concrete ogee and is supported by an angle anchored to the concrete. At the top, an inverted U-bolt slides into holes in an angle welded to the flange section. A simple 5-ton hydraulic car jack can be used to lift the U-bolt, releasing the top of the wide flange, which, in turn, falls downstream, releasing the logs. In an emergency, the fuse-logs can be opened within a few minutes.

— By James L. Gordon, B.Sc., Hydropower Consultant.