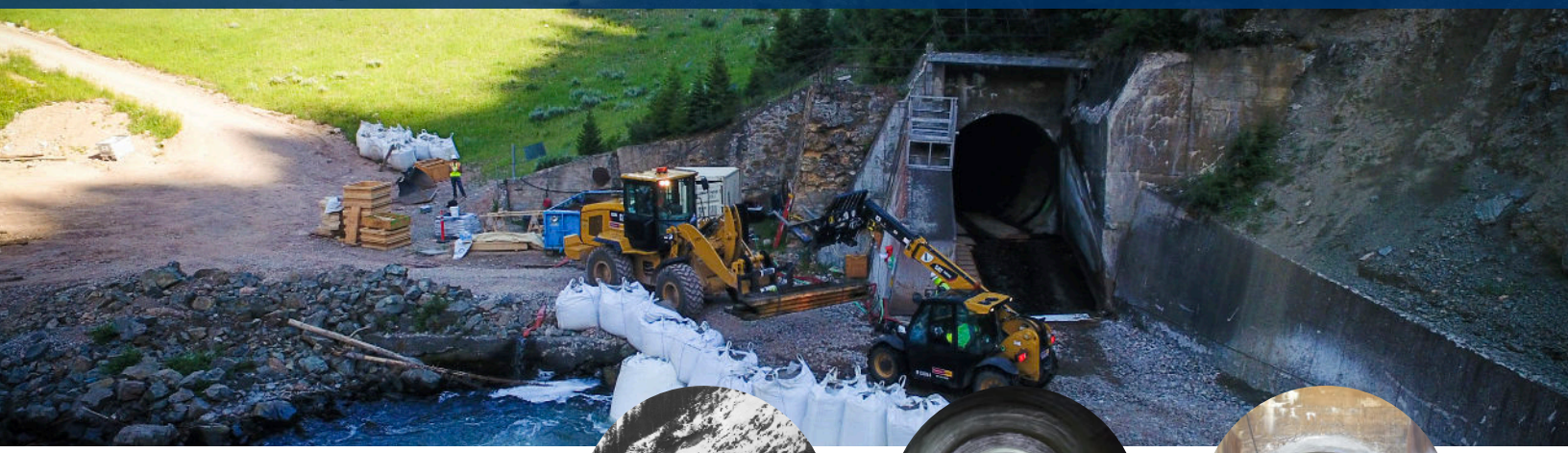
DOME TECHNOLOGY®

# Outlet-Pipe Rehabilitation

NorthWestern Energy | Hebgen Dam, Montana, USA



The original outlet pipe was completed in 1911 to operate as the reservoir's low-level outlet.

After the bottom half of the tunnel was set, crews built a platform through the tunnel before spraying concrete on the upper portion.

Dome Technology's team added a one-foot (0.3m) layer of concrete to the entire circumference of the tunnel.

## Shotcrete Benefits

- Eliminated need for formwork
- Enabled access to restricted space and difficult-to-reach areas

## Dimensions & Features

- 1 tunnel 475 feet long and 10 feet, 8 inches (3.3m) in diameter
- Relining with one foot (0.3m) steel-reinforced concrete
- Chemical grout injections to stop leaks
- Concrete was placed in the bottom of the tunnel and was installed to the upper curve using the shotcrete method


## Overview

In the world of dams and hydro energy, things work well until they don't. Such was the case with the outlet pipe at Hebgen Dam in Montana. Completed in 1911, the unreinforced concrete pipe lined with 16-foot-long (4.88m) wood-timber staves functioned as the reservoir's low-level outlet for more than 100 years.

After a 1959 earthquake rocked the region, gates were added to the intake structure at the upstream end of the pipe as an additional control measure; until that point, logs controlling the flow were removed or added as needed to achieve optimal flow, said BJ Cope, senior engineer of hydro engineering at NorthWestern Energy. The dam was operated without issue for many years with many of the original stoplogs in place until four of them broke spontaneously on Labor Day 2008, allowing for unregulated flow. The stoplog failure accelerated the planned and Federal Energy Regulatory Commission-required rehabilitation of the Hebgen Dam intake, spillway, and outlet pipeline.

Dome Technology, in collaboration with Hydro-Arch, was contracted to rehabilitate the 475-foot (145m) tunnel for another century of function by installing a concrete liner inside the pipe. The team started by removing the wood staves, then used chemical grout injections to stop leaks in the existing pipe. Next, the team lined the bottom of the tunnel with prebuilt rebar cages. Concrete was then placed and finished on the lower portion of the tunnel. Crews did the same for the top portion of the tunnel, applying concrete to the upper curve using the shotcrete method. In fact, "it was our ability to position the rebar and spray the concrete that made us valuable on this project," said Dome Technology project manager Jason Craig.

The result is a one-foot-thick (0.3m) layer of steel-reinforced concrete lining the entire outlet pipe, which is now nearly 11 feet (3.4m) in diameter. The project was completed in less than four months, and the tunnel rehab is "essentially an incremental reduction of risk to this structure and the facility as a whole," Cope said.

*"For nearly four decades we've relied on a collaborative approach with companies—they're in the driver seat, and we help navigate. In every project Dome Technology incorporates innovative technology to maximize system performance with an economical solution," Bradley Bateman, CEO, Dome Technology.*

Read more about this project at link.dometechnology.com/12315 and watch our video at https://www.youtube.com/watch?v=pqjt0ZIqnok