AWARD OF EXCELLENCE

Kokish River Hydroelectric Project

Knight Piésold

Left: vertical slotted fish ladder. Right: diversion weir with fish ladder entrance nearside.

Knight Piésold

"This 45 MW run-of-river project in Port McNeill, B.C. has innovative features to provide safe passage for both adult and juvenile steelhead trout and salmon. We also liked the fact that the local First Nation was part of the development team and were able to contribute their in-depth traditional knowledge of the site."
–Jury

The Kokish River Hydroelectric Project is a 45 MW run-of-river facility 15 km east of Port McNeill, on the north of Vancouver Island, B.C.

Every step during the development process took into consideration the diversity of fish habitats in Kokish River. The project has unique and innovative details throughout the diversion reach designed to cater to this sensitive environment, and in particular the presence of steelhead trout and salmon. It has one of the largest capacity Coanda screen intakes in the world, together with one of the smallest Obermeyer crest gates in the world, a wrap-around vertical slot fish ladder, and a tailrace fish screen.

As the lead design engineer, Knight Piésold worked closely with the owner, Kwagis Power Limited Partnership, and the EPC Contractor, Peter Kiewit Infrastructure, to develop innovative and cost-effective solutions that more than met the stringent fisheries permitting requirements. The Knight Piésold team was involved throughout the project's development.

"Fish first" design

The intake and diversion weir were designed to:

— Divert a portion of the natural stream flow to the water conveyance system, while excluding large sediment and debris to limit damage to the pipe and turbine generating equipment.

— Provide safe passage — for both adult and juvenile salmon and steelhead trout — past the intake and diversion weir, for upstream and downstream migration.

— Allow for precise control and real-time flow monitoring of the in-stream flow release downstream of the intake to maintain the natural aquatic ecology. The required in-stream flow releases varied by season and month from 3.4 m^3/s to 12 m^3/s.

— Allow passage of flood flows without damage to the structure.

The 9.3 km-long water conveyance system is unusually long for a high-head, run-of-river project in B.C. Its design had to be cost-effective, yet robust, because the penstock is exposed to hydraulic transient

continued on page 66

Giant Mine continued from page 65

different applications: some for filling voids in bulk, some for filling remote barricades, and others for plugging leaks.

The team drilled investigative boreholes into openings as narrow as 2 metres wide and 140 metres deep. Using laser scanning, they were able to gather information about the inaccessible cavities and create 3D models and 2D plans in order to plot positions for delivering the backfill and building the containment barricades.

Backfilling in extreme cold

Backfilling began in October and ceased in mid-December 2014, with crews workin in the extreme cold (temperatures ranged from -25 to -52 C). Producing paste backfill with an outdoor mobile system using highly variable frozen arsenic and silica laden tailings at extremely cold temperatures had never been done before. The mine's utilities were limited, so the team adapted by using portable artificial lighting, by heating water and equipment, erecting tents for monitoring and testing, and building indoor tailing storage facilities.

With limited underground access and incomplete mine plans, the underground geometry was uncertain. The team had to adjust the paste recipes and delivery locations on the fly. This meant sequencing plans had to be developed for multiple options and "if-then-else" scenarios. The hazards to underground workers posed by leaked paste also had to be constantly assessed.

Teamwork, Aboriginal training, taxpayer benefits

The technical team and contractors worked closely in a multi-disciplinary approach and counted on teamwork to overcome hurdles such as paste freezing in the pipeline in mid-pump stroke.

Golder committed to providing a monetary award for work done by Aboriginal people in an educational setting and to support local communities through Aboriginal training and apprenticeships.

Proving that local tailings material present at the site can be used to stabilize underground openings represented a large cost saving. The project was delivered on time and on budget, and it helped reduce the $903 million liability that the overall Giant Mine Remediation project is estimated to be by the federal government. **CCE**

Project name: Giant Mine Remediation Project – Mine Support Services, Phase 1, Yellowknife, N.W.T.

Award-winning firm (prime consultant): Golder Associates (Darren Kennard, P.Eng., Sue Longo, P.Eng., Hugh Carter, PMP, John Hull, P.Eng., Steve Otto, P.E., Ashley Pakula, P.Eng., Dave Caughill, P.Eng., Andres Quintero, P.Eng., Kevin Hachmeister, Theresa Bahry-Abbott)

Owner: Aboriginal Affairs and Northern Development Canada (AANDC)

Client: Public Works and Government Services Canada (PWGSC)

Other key players: Clark Builders (contract management), RTL Construction (tailings excavation, processing and delivery and tailings site management); LPR Concrete (paste production and distribution), McCaw's Drilling and Blasting (drilling of investigation and paste delivery boreholes).

NATURAL RESOURCES, INDUSTRY, MINING & ENERGY

Kokish River continued from page 63

pressures internally, and logging road traffic and natural forces externally. Over its entire length, its thin-walled pipe sections were designed to be buried in the natural ground. Engineered fills were used to restrain pipe movement, eliminating the need for concrete anchor blocks.

A unique feature of the powerhouse — a fish fence across the tailrace outlet — prevents the adult fish from entering the tailrace, and generates flow patterns that would encourage the fish to continue on their upstream migration.

Diversion weir and intake Coanda screen

The diversion weir and intake structures are designed to ensure that during operations the natural rates of sediment movement are maintained over the life of the project. A purpose-built 1:12 scale hydraulic model of the intake and diversion weir was tested in Northwest Hydraulic Consultants' laboratory to verify various aspects of the design..

The diversion weir incorporates Coanda shear effect screens that prevent debris, coarse sediment, and fish from entering the penstock. Knight Piésold conducted extensive research and model testing to optimize the Coanda screen configuration, resulting in a spillway screen through-put capacity that is one of the highest in the world for a hydropower project.

Possibly the world's smallest multi-segmented Obermeyer crest gate was added immediately upstream of the Coanda screen to allow the concentration of low flows over the weir and prevent fish from being stranded on a seasonally dry screen surface.

Local contributions and benefits

The 28-month project brought direct and indirect socio-economic benefits to the north Vancouver island area, creating work and nearly $30 million in goods and services. Designed and constructed on time and on budget, the run-of-river facility will generate clean renewable energy to power 13,000 homes annually.

The 'Namgis First Nation was part of the owner's development team, and provided significant benefits by sharing their in-depth knowledge of the site, the surrounding environment, and traditional use of the area. **CCE**

Project name: Kokish River Hydroelectric Project, Vancouver Island, B.C.

Award-winning firm (prime consultant/lead design engineer): Knight Piésold, Vancouver (Sam Mottram, P.Eng., Egbert Scherman, P.Eng., Travis Brown, P.Eng., Katrina Wechselberger, P.Eng., Benoit Otis, P.Eng., David Levi, P.Eng., Rob Adams, P.Eng., Jamie Cathcart, P.Eng., Daniel Friedman, P.Eng., Oscar Gustafson)

Owner: Kwagis Power Limited Partnership (Brookfield Renewable Energy Group and 'Namgis First Nation)

Client: Peter Kiewit Infrastructure

Other key players: Peter Kiewit Infrastructure (engineering-procurement-construction contractor), Northwest Hydraulic Consultants (intake scale model testing), Rockwell Automation (design of electrical components and control system)