Trickle-fed Tur

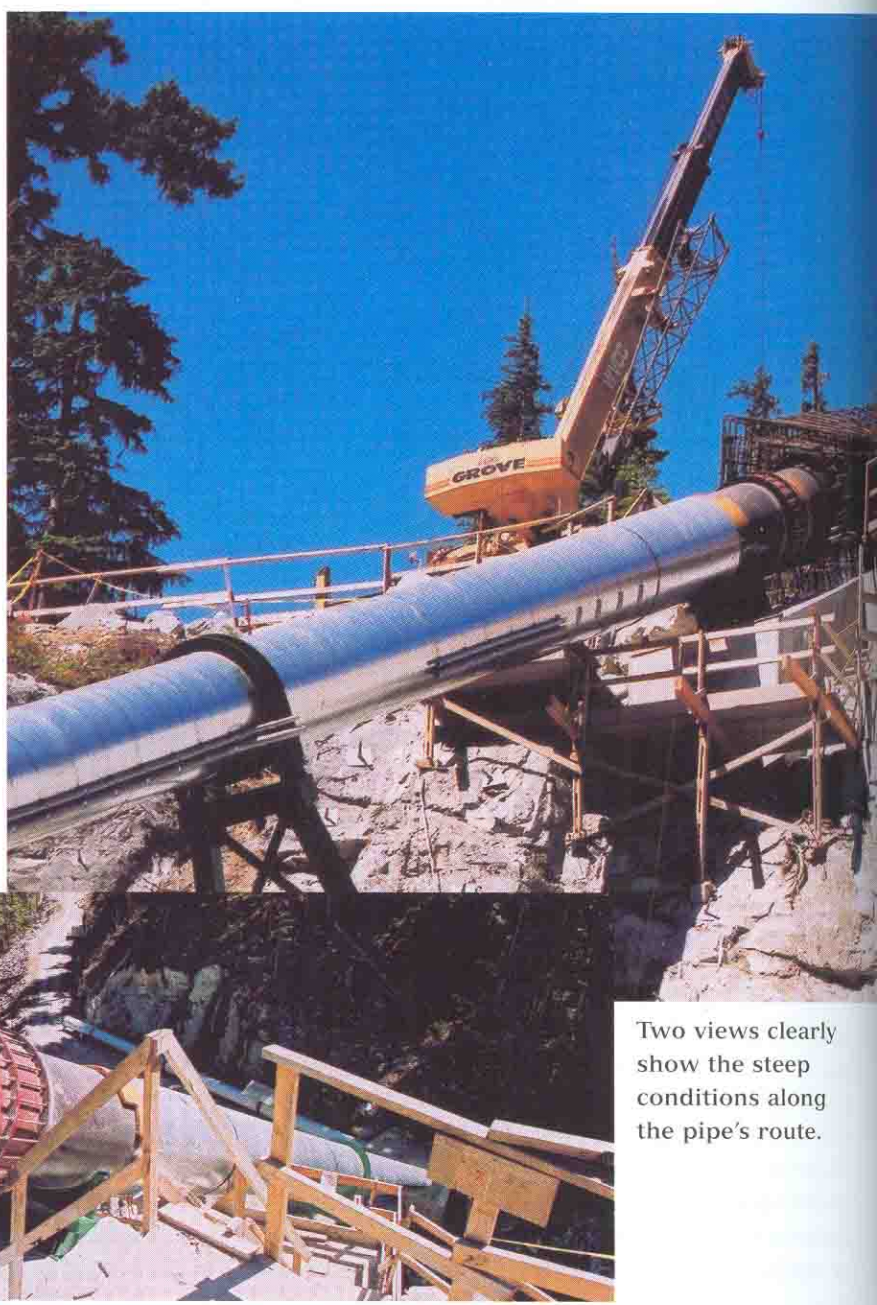
By Correspondent Tonia Jurbin

With the big push on for more renewable or 'green' energy, Epcor Power Development Corporation based in Edmonton, is currently developing its second hydroelectric run-of-the-river project in British Columbia.

Run-of-the-river projects generate electricity by harnessing the power of water through penstocks on portions of rivers or creeks that are too steep for fish to spawn in.

The power generated varies seasonally, typically peaking during the spring runoff. After the water passes through the turbines it is returned to the river. Only a small reservoir is required at the penstock intake, and, only a portion of water is drawn in so as to retain as much as possible the original character of the river.

Miller Creek is fish bearing several hundred metres in elevation below the new powerhouse. At peak flows, the $35 million dollar development at Miller Creek near Pemberton, BC, about two hours drive north of Vancouver on the 'Sea-to-Sky' highway, will generate about 26 mW, or enough energy to power 26,000 homes. When completed it will feed into the BC Hydro power grid.



Two views clearly show the steep conditions along the pipe's route.

The highlights of this contract include 14 km of access roads pushed through extremely rugged terrain, a 4.5 km penstock, and a hard rock tunnel over one km long to divert water from North Miller Creek to South Miller Creek where the penstock intake is located. The general civil contractor, Western Versatile Construction Corp. of Langley, BC, is working with a few specialized sub-contractors mostly from

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Construction manager Art Penner (left) and a crew member shown at the top of pipe bridge.

Photo on right shows construction of thrust block.

British Columbia.

The project is being built in three phases over three construction seasons. Phase I comprised of an access road sub-contracted to Lizzie Bay Logging Ltd. of Pemberton that included blasting about 15 000 m of rock, rough grading of the penstock, the powerhouse excavation and the south Miller Creek channel diversion. WVCC's budget for the road was about 8% of their $25 million contract. Phase II includes the completion of the penstock, the powerhouse, the South Miller intake and the tunnel. Phase III will see the commissioning of the larger of the two turbines in the spring of 2003, the North Miller intake and the 650 m long, 762 mm HDPE low pressure pipeline from the tunnel to the South Miller head pond. The smaller, 3 mW generator will be commissioned late in 2002.

The job is roughly divided into seven areas of responsibility, each with its own superintendent for the entire site, all of who report to Art Penner, the Construction manager for Western Versatile. The areas include a foreman for the two batch plants which will produce about 4500 m of concrete, a powerhouse superintendent, a head of quality control, and a foreman responsible for the construction of the penstock thrust blocks and the pipe bridge.

There are also three full-time heavy-duty mechanics, two full-time survey crews, and a five-man iron worker crew for a total of about 65 full-time employees, about 20% of which are from the Pemberton area.

The penstock winds down the rugged terrain through 57 bends and a 763 m drop like a 4.5 km-long super waterslide. There are 13 distinct pipe sizes to accommodate the changes in pressure and head losses. Pipe sizes range from 48" OD 3/8" thick at the top, to 36" OD, 1" thick walls at the bottom. The 33 bends in the upper half of the penstock at lower pressure do not require thrust blocks. The 24 bends in the lower half of the pipe that operate at higher pressures have massive thrust blocks, the biggest up to about 150 m^3 of concrete at large horizontal bends. About 1500 m of concrete and about 170,000 kg of steel were used in the thrust blocks. 131 soil and rock anchors up to 15 m long were installed by Southwest Contracting Ltd. from Surrey, BC.

The summer temperatures in Pemberton can get HOT, up to about 40 deg. C. The spec did not allow backfilling if the pipe temperature was higher than 25 deg. C because of concerns over locking the heat related stresses into the pipe. Most of the backfilling was done early in

Compacting fill around the exposed pipe on a 67% grade posed many challenges.

the day. Other times, cool river water was drawn from Miller Creek to add moisture to the fill and cool things down a little.

It was tough work running a plate tamper over pipe backfill in 40 degrees on a pipe that has up to 75% grade!

The two exposed sections of the pipe including one 41 m-long pipe bridge at 67% grade, were insulated because of concerns over possible freezing during the winter when flows are typically low. There is only one expansion joint on the penstock, at the top of the pipe bridge.

Another major component of the project is the 1050 m-hard rock tunnel being done by Pacific Blasting & Demolition Ltd. out of Burnaby, BC and worth about 10% of WVCC's budget. The tunnel was sized to accommodate the smallest equipment available and therefore blast the smallest possible volume of rock. Specialized equipment is required because of strict controls over power, gas emissions and fire suppression systems. The tunnel was about twice as large as it needed to be for diverting the required flow volumes. The dimensions are roughly 3 m wide by 2.75 m high. The roof has some bolting and mesh, but it is not lined. At about 1% grade, particle transportation into the system is not an issue. About four re-muck bays will be built throughout the length of the tunnel to temporarily store the blasted material so that the drill can go back to work quickly after a blast. When things are going well the crew hopes to get about 8 m a day working around the clock.

About 300 m of the tunnel will be blasted from the north side.

"The portal at the north end hasn't been identified yet but right now, it looks ugly. We're bracing for the worst," says Phil Read, the project manager for Pacific Blasting. "The overburden is glacial till and is probably underlain by weathered rock. Soft tunneling techniques may have to be used to reach the rock interface. The tunnel needs to have two entrance ends not only to get two crews working, but also because ventilation requirements become complicated over longer tunnel distances. The tunnel is expected to take about seven months and remove about 8000 m of material. About 25 tonnes of explosive and about 3 km of line will be used.

A close look at the 3 m x 2.75 m tunnel.

"Access and communication is really difficult here. We are on the edge of a cellular area and right at the end of the access road too," says Read. Pacific's contract also includes some of the trenchwork blasting and about 2000 m for the powerhouse excavation.

"The biggest challenge on this job is the logistics of moving men and equipment safely and efficiently up and down these steep grades," says Penner. "Delivering materials is difficult and there is little room for laydown because of the terrain and the need to keep the penstock right-of-way narrow to minimize the environmental impact."

A delivery truck and crane can cause a site traffic jam. There have also been design challenges in keeping up with the construction due to the limited geotechnical investigations throughout the entire site. This project was not a traditional tender; with no road access into the pipe corridor or to the intakes, there was no detailed design to bid on. Western Versatile submitted the successful proposal document and continues to contribute by offering alignment recommendations as a part of an agreement to get the best design. Penner elaborates, "our input is based on trying to minimize the earthworks, and on constructibility issues." ◆