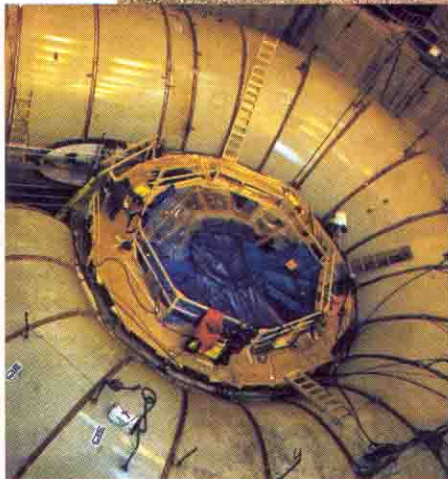


Dam gets new Life

BY TONIA JURBIN

The largest capacity post-tensioned strand anchors ever to be used in North America are being installed at BC Hydro's Seven Mile Dam near Trail, BC as part of the ongoing upgrades that reflect new seismic and dam safety criteria. For the last 20 years BC Hydro has been working to seismically upgrade their generation and transmission assets throughout the province. This 81 m-high, 357 m-long concrete gravity dam was completed in 1980 and generates about 600 MW of power. When the 4th generation unit comes on line in March 2003 the power will increase to 800 MW making it the 6th largest generator in the system producing about 8% of BC Hydro's power.

Fifty-one anchors are being installed for the dam safety upgrade. The anchors are about 100 m in length and have 90 individually sheathed steel cables. The current four-month contract awarded to Peter Kiewit Sons out of Richmond, BC is for a test program to install three anchors. Worth about \$800,000 the contract covers assembly and installation of the anchors including the drilling, grouting and post tensioning. The anchor materials are being supplied by Dywidag Systems International Canada Ltd. of Surrey, BC and are worth about \$300,000 or, about \$1000/m.



Massive anchors are being installed as part of a seismic upgrade program to protect BC's Seven Mile Dam and its components.

Over the course of the test program several material and installation options are being evaluated. One important decision that will result from the test program will be the corrosion protection method that will be used for the remaining anchors. Two of the test anchors are 'stuffed', that is the sheathing is filled with wax and the strands are stuffed into it. The third anchor is 'extruded'; that is, the sheathing is melted onto the wax-coated strands of cable. The durability of the sheathing and the friction between the sheathing and the strand will be assessed by the designers during the installation process. The results will be evaluated before the final decision is made on which of the two products will be specified in the next phase of the work.

When the anchor material arrives on site they are on pallets with two or three spools of 100 m-long sheathed strands per pallet. Each strand weighs about 117 kg; the cable when fully assembled weighs about 11250 kg plus another 1350 kg



for the bearing and wedge plates. It is up to the contractor to assemble and label each of the 90 individual strands and the grout tubes without damaging the sheathing.

That was only one of the challenges facing Dario Gnoato, Superintendent for Peter Kiewit Sons.

"The fabrication of anchors of this size and length has never been done in North America. We're the first to do this work and because we're not fabrication contractors, we've had to learn by trial and error. The assembly is going really well now, but we have modified it about a dozen times," says Gnoato. It takes up to two weeks to assemble each anchor. The installation of the anchors was accomplished by using a long conveyor with a large diameter installation wheel (or dinosaur) at the end to lead the anchor into the vertical holes.

"Drilling the holes in the dam was also difficult, in fact we had a tough time finding a sub-contractor that would take on the work," explains Gnoato. Drillwell Enterprises out of Duncan, BC won the contract. "It took a while for them to get the tooling right, and the work is slow due to the precision called for in the spec (a 1/300 verticality requirement). If the hole wanders we have to grout it up and start again, there was no room for error."

Paul Slade of Drillwell Enterprises elaborates on the challenges of preparing the anchor holes. "We were kind of worried about meeting the spec, so we used a 10 foot long guidance system that follows right behind the bit to keep the drill rods straight". They drilled an 8" pilot hole that was reamed out to 15-3/4" in one pass. "There were a few changes made to the guidance system in the field as we progressed. We also encountered more steel than was indicated on the drawings so it took about a week before we saw any production." The steel re-bar encountered when drilling through 62 m of concrete and 31 m of rock can chew up the tungsten bits quickly too, each hole took about 7 to 10 days to complete. "We were also limited in that we couldn't use any drilling additives or foams because of environmental concerns, and concerns over how the additives might effect the subsequent grout bond between the anchor and the rock." After the holes are complete the walls of the holes are washed

and all of the cuttings are airlifted out. Airlifting the cuttings out of a 100 m hole can present its own challenges, especially if the air hose develops a kink in the bottom 6 m.

Once the pilot hole is drilled, reamed open to 15-3/4" and cleaned out, the outer sheath of the cable is dropped into place. Fabricating the sheath with a demonstrated water tight joint between the bottom 50 feet of 12" diameter, 1/8 inch thick corrugated H.D.PE. and the top 250 feet of 10" diameter-thick smooth walled pipe, was also difficult. "That was tricky too because that had never been done before either so I couldn't just pick up the phone to ask somebody how to do it."

Once the crew started lowering the first test anchor into the sheath, at about 25 m the weight of the anchor in the hole started to flatten the cable at the installation wheel so it had to be pulled out, the wheels removed, the process modified and the cables reinstalled.

Once the anchor assembly was carefully lowered into place the spaces between the individual strands, and the annulus between the outer sheathing and the concrete and rock were grouted. It took about 4 hours plus set up and clean up to grout each hole.

On a job that's never been done before in an environment and locality with strong union issues, Gnoato faces political challenges too. "It's a challenge to keep efficient on a small job like this in a heavy union environment. We might need an experienced operator for just a couple of hours a day, but we still have to pay his minimum four hours, and he can't do anything else for us while he is here." Before the contract was awarded there was a lot of negotiation between BC Hydro and Peter Kiewit Sons to develop the final specifications for the installation contract. Gnoato continues, "We knew when we bid on this job that it was a test program. While we are working very closely



Fourth generation unit under construction.

with the BC Hydro designers, there are still some outstanding issues as to compensation for some of the changes." He does expect these issues to be sorted out quickly at the conclusion of the testing contract. Since Gnoato figures they are the only contractors who have experience with this kind of installation he is looking forward to bidding on the next phase of the work which will be worth about \$15,000,000. ♦