ROCK ISLAND Modernization

First dam on the Columbia River gets a makeover

By Kimberlee Craig

Rock Island Dam, the first hydroelectric facility to span the Columbia River, is getting a modern, multi-million dollar makeover by the Chelan County Public Utility District.

Chelan PUD is in the process of replacing six generating units – turbines, shafts and generators – installed in the 1950s.

Reflecting more than a half-century of improvements in design, materials and technology, the new turbines – costing $22.5 million each – will improve conditions for migrating salmon and steelhead as they head past the dam to the ocean. In addition, the new and refurbished components of the generating units are expected to increase Rock Island's power production by 8 percent to 12 percent.

"We looked at what was cost-effective: replacing in kind; or achieving improvements by installing new, more fish-friendly and more efficient units that are also more environmentally responsible in generating with equipment that uses less lubricating oil and grease," explained Brett Bickford, PUD project manager.

The first of the new turbines, cast in Austria, arrived in December 2006. Crews from VA Tech Hydro USA of Charlotte, N.C., began dismantling the old B10 unit early last year and should have the new turbine installed by mid-March. If all goes

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well during a year of testing, the other five turbine-generators will be installed by 2013.

The new turbine blades are made from stainless steel manufactured to resist pitting from water pressure. The blades are designed with greater curve than the original runners, which improves efficiency. The operating mechanism and guide bearings are self-lubricating, thanks to a new polymer material, which reduces the chance that grease will find its way into the river.

Replacing the generating units, however, is only part of the PUD's $200 million modernization project.

The PUD has already replaced nine of the original transformers on the deck of Powerhouse 1 with four larger ones. The PUD also plans to refurbish the generators on the four original units installed in the 1930s, work that will run through 2014. In addition, the PUD has installed four new transformers at Powerhouse 2, which was completed in 1979.

Rock Island Dam was built in the early 1930s by the Stone and Webster Engineering Corporation, a Boston-based holding company that then managed Puget Sound Power & Light. The dam sits about 15 miles south of Wenatchee near the geographic center of the state, at a point where the eastern foothills of the Cascades give way to the basalt cliffs and sagebrush of the Columbia Basin.

The dam, with its four original turbine-generators, began producing power in 1933. But when Alcoa decided to build an aluminum smelter in Wenatchee during the Korean War, Puget Sound Power & Light (now Puget Sound Energy) agreed to lease space in the unfinished powerhouse to Chelan PUD to provide power to the plant. Between 1951 and 1953, the PUD installed six 22.5-megawatt generating units at the dam.

A few years later, when it looked like the city of Seattle might try to acquire Rock Island Dam through condemnation, Chelan PUD began condemnation proceedings of its own. The PUD eventually purchased Rock island Dam in 1956 for $31.8 million, and now operates the hydroelectric facility under a 40-year federal license that runs through 2028.

In the 1970s, Chelan PUD added a second powerhouse with eight horizontal bulb turbines – the first of their design in the United States – at a cost of $330 million. The dam now has a generating capacity of 624 megawatts, enough to power about 312,000 Northwest homes.

The modernization work at Powerhouse 1 requires the new 25-ton turbines to be lowered three stories through a hatch just 18 feet square. Reversing that process, removing the first of the old turbines – after 50 years in service – attracted a film crew from The Discovery Channel's "Modern Marvels."

The new units also include a "splitter vane" to better channel water back into the river after flowing past the turbine blades. Shaped like an upside-down airplane wing, the stainless steel splitters are designed to reduce water turbulence, known as "disorganized flow, resulting in increased efficiency.

Installing the first 58-foot wide vane, however, also proved to be a challenge since it had to be lowered about 70 feet from the powerhouse floor in five pieces and then assembled in the draft tube.

The vane sits on three steel pedestals, which required drilling 18 feet into bedrock to install anchor bolts. Crews had to continually pump water out of the draft tube during construction, and even then, workers faced water spurting at 80 pounds per square inch as they drilled.

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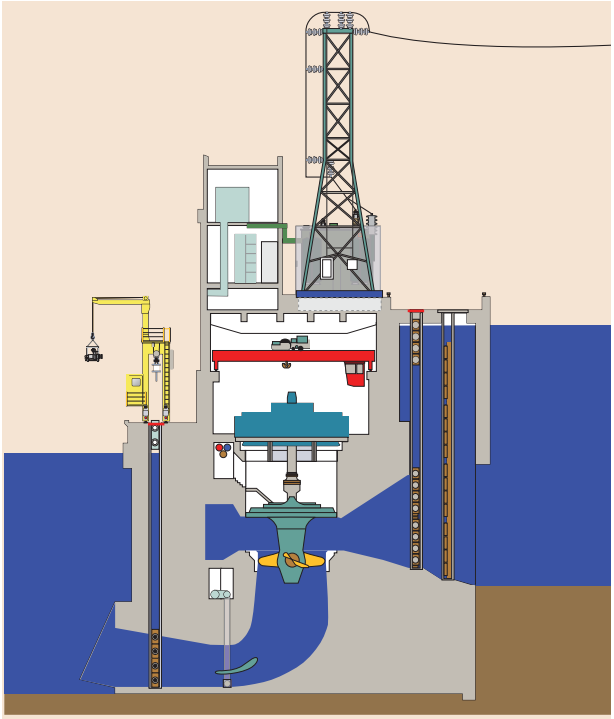
A camera crew for the Discovery Channel's "Modern Marvels" videotapes a rotor being lifted out of the unit to be refurbished at Rock Island Dam. On the previous page, a section of the refurbished rotor is positioned over a hatch to be lowered three stories into the powerhouse.



Harnessing the river's energy

Hydroelectric dams harness the river's energy and use simple mechanics to convert that energy into electricity. When gates on the dam are opened, water flows through the penstock, a pipeline that leads to the turbine. As the water strikes the turbine, the blades begin to turn. The turbine is attached to a generator, and as the turbine blades turn, so do a series of huge magnets inside the generator. These magnets rotate past copper coils, producing alternating electric current. A transformer inside the powerhouse takes the alternating current and converts it to higher-voltage direct current. After the water passes the turbine, it is carried through pipelines, called tailraces, and re-enters the river downstream. The graphic above shows how the turbines originally installed in the 1950s are situated at Rock Island Dam. The "vane" in the tailrace is part of the current modernization. Shaped like an upside-down airplane, the stainless steel vane is designed to reduce turbulence, thus increasing the dam's efficiency.