Case Stories

Conjet Robot boosts up power plant capacity

3312 8003 26

Conjet Robot 361 in the process of increasing the chamber diameter in the turbine draft tube.

A Swedish Conjet Robot 361 hydrodemolition machine has played a major role in boosting the electricity generating capacity of three hydro-electric power plants on the Drava River in the Republic of Slovenia. Contractor Gradis is using its Conjet Robot for removing concrete from nine vertical turbine draft tubes. This operation will make way for new reshaped steel linings and larger diameter, more efficient, greater capacity turbine generator sets.

Gradis worked on its DM 2.9 million contract for client and power station owner Dravske Elektrarne Maribor as part of the approximate DM 200 million second phase of refurbishing and upgrading three of the Slovenia's chain of eight hydro-electric power plants. These power stations are strategically located along an approximate 100 km stretch of the Drava river, which falls about 120 m between the upper and lower power stations. The power plants, which operate on the run-of-river storage principle, were built during a 60 year period from 1918 to 1978 and provide about 23% of Slovenia's electricity. But the ageing power plants' electrical and mechanical equipment were worn out and were gradually replaced over a period of several years.

The hydro power plant at Fala, the first to be commissioned in 1918, was also the first to be upgraded. This plant's original seven turbine generators were replaced with two new more efficient ones in 1991. The second phase of refurbishment, which started in 1996, was centred on the three hydro-electric stations at Dravograd, Vuzenica and Mariborski otok, which were all built during the 1940s and early 1950s. Dravograd's renovation was complete with three new turbine generator sets which increased the power station's total installed output by 31% from 22.8 MW to 29.8 MW. One of Mariborski otok's three turbines was also replaced, but Gradis focused on removing concrete from the three turbine draft tubes at Vuzenica, before returning to complete its contract on the two remaining turbines at Mariborski otok.

One of Vuzenica's three turbine generator sets had already been replaced when Gradis was removing concrete to increase the diameter of the power station's second turbine draft tube. But before Gradis could put its Conjet Robot to work and make a start on hydrodemolition, the power station's overhead gantry crane had to lift out the old worn out generator and turbine. This operation was followed by another demolition contractor cutting out an approximate 5.25 m high section of the turbine's cylindrical to rectangular stainless steel draft tube casing liner, which was embedded in concrete.

65 m³ of concrete had to be removed from the draft tube by hydrodemolition

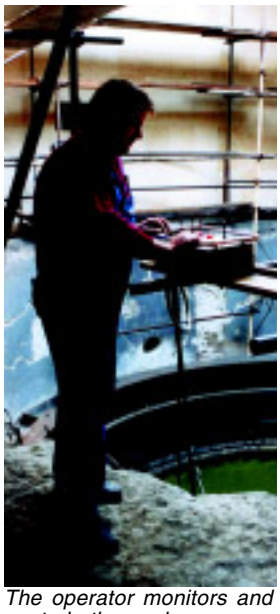
Gradis, which adopted the same hydrodemolition technique for all nine turbines, placed its Conjet Robot on a moveable platform inside

CONJET AB
P.O. Box 507
SE-136 25 HANINGE
SWEDEN
PHONE:
+46 (0)8 55 65 22 40
FAX:
+46 (0)8 55 65 22 60
E-MAIL:
conjet@conjet.com
WEBSITE:
www.conjet.com

the confined 4.65 m diameter vertical turbine housing. About a 840 mm thickness of concrete had to be cut out round the entire periphery to increase the diameter to 6.33 m. This was done using the Robot 361 making three separate circum-ferential cuts from the working platform set at two different levels. The first two passes removed about 780 mm followed by a third and final cleaning cut of about 60 mm. About 65 m^3 of concrete had to be removed from the draft tube by hydrodemolition, which the Robot 361 was able to achieve at about 1m^3/hour. The concrete spoil was allowed to fall into the draft tube sump were it was loaded by a mini excavator into a skip and lifted to the surface for disposal.

Conjet proved to be more efficient than expected

"Hydrodemolition was specified for this contract," said Gradis technical director Ivan Kosi. "We were aware of Conjet and knew their hydrodemolition equipment would work. Even so we've been very surprised with the Conjet Robot 361 as it has been more productive than we expected and also proved to be very robust and reliable working in a very confined and hostile environment."



3312 8003 27

The operator monitors and controls the work progress, from a position above the working area.

All the Robot 361's functions were remotely controlled by the Robot operator working with a bird's eye view high above the cutting area. High pressure water for the Conjet Robot was supplied by a Hammelmann power pack. This consisted of a heat and sound insulated ISO container housing a 750 hp (550 kW) Caterpillar diesel engine driving a pump operating at 1400 bar pressure and flow of 194 litres/minute.

Hydrodemolition, the only approved method

"We have been very pleased with Gradis and their Conjet Robot, which has performed to our expectations," said Dravske Elektrarne Maribor engineer Duvìan Rajh, who spent a long time evaluating hydrodemolition prior to starting on the refurbishment programme. "I read an article about Conjet and went to Stockholm to see their equipment working for myself and was very impressed," adds Mr Rajh. "Our consulting engineer IBE was also in favour of hydrodemolition so the technique was written into the contract specification as the only approved method which would be allowed to remove the concrete in the turbine housings. We would not allow pneumatic breakers to be used as they would have caused cracking and secondary damage to the concrete left behind."

Turbine up-grade boosts the power output by 43 per cent

Once Gradis had completed the concrete removal a new and larger 4.85 m diameter stainless steel liner casing, reshaped to improve hydraulic efficiency, was positioned in the void, which was backfilled with fresh concrete. This was followed by installing a new four bladed, variable pitch turbine, built by Litostroj in Slovenia, coupled to a Siemens generator. The new runner, just 200 mm larger than the old one and operating at 125 rev/min with the same maximum gross head of 13.65 m, is able to accommodate an approximate 15% increase in water flow to just over 183 m^3/second, raising rated power output of the replacement turbine generator set to 18.6 MW. This second turbine generator at the Vuzenica hydro-electric power station is scheduled to go on stream in May 1999. Completion of the identical third unit, about one year later, will boost the refurbished and uprated plant's total installed power output by nearly 43% to 64 MW.

After finishing the hydrodemolition work at Vuzenica, Gradis moved back to complete its outstanding work at Mariborski otok and used the Conjet Robot 361 in an identical manner to remove concrete from the station's two remaining draft tubes. Completion of the second phase of the renovation and upgrading of the upper Drava River hydro power plants provided not only further electricity generation in those plants but also additional power capacity of roughly 40 MW.

3312 8003 29

The new four blade, variable pitch, turbine.

Equipment used
1 Conjet Robot 361 MPA
1 Conjet Powerpack 535-550 kW

3312 8002 62 • 0304 • SCOP