KARĀPIRO HYDRO STATION REFURBISHMENT PROJECT

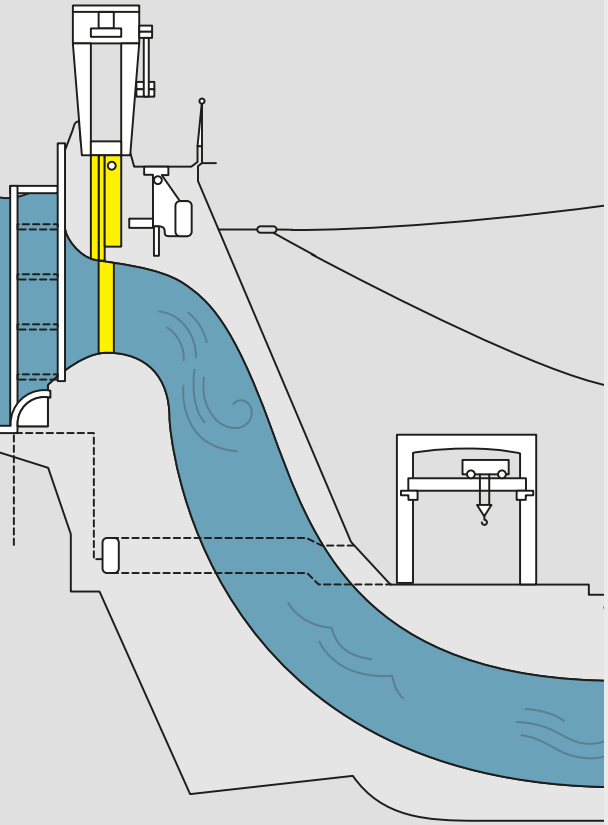
Water intake gates.

Photos: AEC.

The priming valve of the gate being assembled in the AEC workshop.

Fabrication of gate carcass at the AEC workshop.

The gate is lifted into a cradle on a trailor and then reversed onto the hydro dam.



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The water intake gates at a hydro station are essential for stopping water from the reservoir from flowing into the penstock, the large pipes that carry water to the turbines.

It enables the operators to isolate the system if the hydro station's normal flow controls, like the governor or wicket gates, fail, or when an emergency shutdown is needed.

Closing the water intake is also critical when we want to work on turbine maintenance, for example.

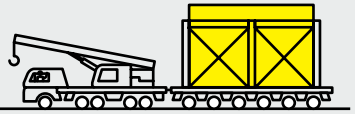
The three original water intake gates at Karāpiro were built in the 1940s, and we needed to replace them with modern equivalents as part of our refurbishment project.

The new gates were designed in New Zealand by engineering firm Norconsult to meet New Zealand Society of Large Dams, safety compliance standards and modern seismic requirements.

We contracted AEC (Ashhurst Engineering and Construction) to manufacture and install three new intake gates.

It took about 120,000 hours to build the three 40-tonne gates. One gate was installed each year, from 2023 to 2025.

How were the gates constructed and installed?



- The girder, wheel boxes and skin plates were constructed to support the load, weight distribution, and stability of the gate.
- Key components like the wheels, sealing surfaces, and embedded frame components were fabricated and machined to very close tolerances.
- A 50-tonne crane was used to manoeuvre the gate components for manufacturing and for machining. AEC designed a custom milling machine to work on the gates.
- The gate was painted offsite and returned for final assembly and checks before beginning the 356km journey from Ashhurst to Karāpiro.
- At Karāpiro, the AEC team removed the original gate components and reinstated the gate framework ready for the new gate installation. It took six months of work to get the dam ready for the new gate installation.
- It took about two hours for each gate to be lifted into place on the hydro dam, using three cranes and a special cradle designed by AEC.
- Once installed, the gate was tested and then commissioned for operation.

The gate being lowered into the hydro dam.

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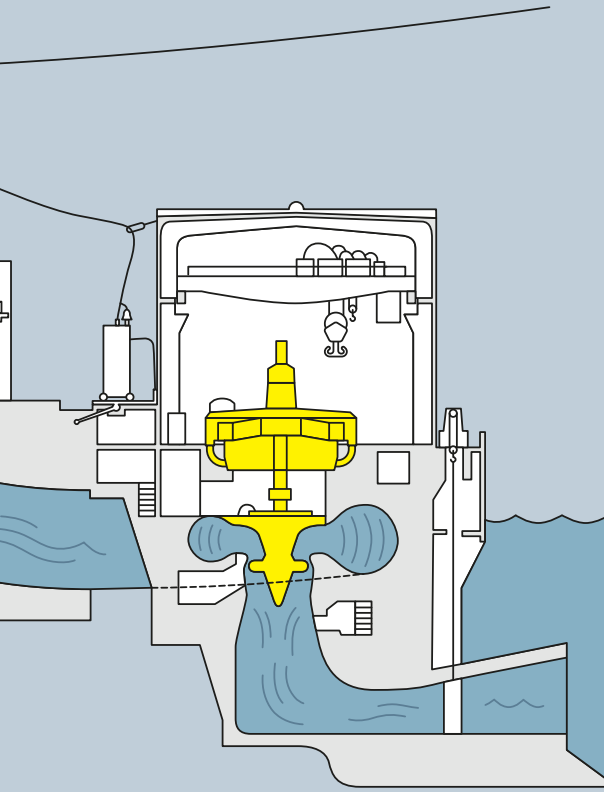
Generation unit replacement.

Photos: AEC and ANDRITZ.

Generator Two was the first to be refurbished in 2023. The powerhouse cranes were upgraded with new lifting bogies on the existing rails, to lift the new rotors and turbines into place.

The crane delivering the rotor for Generator Two to its new stator windings.

Precision work to install the rotor for Generator Two.



The three original generation units at Karāpiro worked hard to help keep the country powered for about 75 years.

They had reached the end of their life, and it was time to replace the units with modern versions to ensure Karāpiro could continue to generate electricity for many more years to come.

Mercury engaged hydro specialist ANDRITZ to complete detailed turbine and generator designs in 2019 and to install the three new generation units from 2023 to 2025.

Components were manufactured by companies across Europe, China, and Mexico and shipped to New Zealand for transport to Karāpiro.

Key components included three identical modern Kaplan turbines, which replaced the original Kaplan turbines installed in the 1940s.

The Kaplan turbine is widely used in hydroelectric power stations around the world.

The new turbines at Karāpiro have six adjustable blades and wicket gates, an upgrade from the old turbines which had five. These features help maximise performance ensuring we can use the water flowing through the turbines as efficiently as possible.

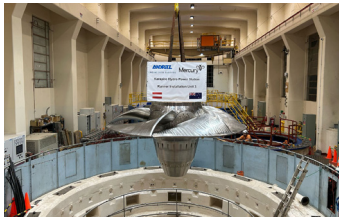
Water-lubricated turbine hubs and turbine shaft bearings replaced the old oil-lubricated components, to eliminate the risk of oil leakage into the river.

The generators were completely replaced with modern stator, rotor, shaft, bearings, brackets, and covers manufactured.

The original mechanical governors were replaced with digital versions and modern high-pressure hydraulics.

One of the original turbines removed from its chamber after decades of service.

The final of the three new turbines ready for install inside the powerhouse in April 2025.



Lowering the turbine into the chamber.

How were the turbine and generator units installed?

- The three 1940s-installed turbines were removed, and replaced with their modern equivalents, one each year from 2023 to 2025.
- Specialised equipment and methods were designed to surgically remove the old turbines and the chambers they were housed in. It was the first time this type of work was completed in New Zealand.
- The old turbines were recycled for scrap metal.
- New chambers were installed to house the new turbines.
- Each turbine and rotor unit were assembled on site at the powerhouse and took just under a year to install and commission.
- Working on one unit at a time meant we were able to keep generating electricity from the station during the rehabilitation project.
- Each turbine was tested during the commissioning process before entering service.
- The turbines will be removed for a service after 25 years. In total, the turbines are expected to operate for 50 years.

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