



PENSTOCK REPLACEMENT AT KINLOCHLEVEN HYDROELECTRIC SCHEME

Glenfield Invicta supplied, installed and commissioned three new DN1000 replacement penstocks on the Kinlochleven hydroelectric scheme. The contract also included the electric actuators that enable the penstocks to be controlled remotely.

The location of the penstocks some 1,000 ft above sea level, the weather and tight manufacturing timescales combined to make Kinlochleven a challenging and exciting project to work on.



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The History

The Alvanche Aluminium smelting works based at Fort William is the last one in the UK. Aluminium smelting is energy intensive as the process requires alumina (aluminium oxide) to be dissolved in synthetic Cryolite at 1,000°C. The only commercial deposit of the mineral Cryolite was in Greenland, but this has now been exhausted. The Fort William smelting works draws the majority of its power from two hydroelectric schemes: the Lochaber hydroelectric scheme commissioned in 1929 and built specifically for the works, and the Kinlochleven hydroelectric scheme, originally built to supply power to a now-defunct smelting works in the town of the same name some fifteen kilometres from Fort William. Both schemes are now operated by Alvanche's sister company, SIMEC, and in their day were major civil engineering projects.

The Kinlochleven scheme is fed by the Black Water chain of lochs. The Blackwater dam, the longest dam in the Highlands at 948.5m, was constructed in the first decade of the 1900s to create a reservoir.

Water from the reservoir is transported via a 5.6km long concrete conduit and subsequently into steel pipes that feed the water into the power station turbines. The flow of water into the conduit and pipes is controlled by three DN1000 penstocks; these were originally manually operated.



Case Study

Hydropower



Challenging conditions

Access and potential exposure to extreme weather events were two of the key challenges facing the customer and Glenfield Invicta on the Kinlochleven project. The penstocks themselves are located almost **1,000 feet above sea level** and, during the original construction of the scheme almost **142mm (5.6 inches) of rain fell in one 24-hour period.**

Given the location and weather the customer was keen for the work to be undertaken in one visit. This in itself was a challenge with the penstocks in three separate locations and a short manufacturing time from drawing approval to start on site. Compounding all of these hurdles was the Covid-19 lockdown. The project was awarded, manufactured and installed during lockdown.

Peter Dodds, mechanical engineer at SIMEC, was in charge of managing the project.

Made by hand

The Blackwater dam is located in almost inaccessible terrain. Amazingly, the dam was constructed using hand tools by over 2,000 'navvies', without the benefit of mechanical earth moving machinery. Materials were transported to the site from the wharf at Loch Leven via a 10.5km cableway.

Almost a Century in Operation

Wilson McPhail and Jim McAllister from Glenfield Invicta visited the site and discussed the scope of the penstock upgrade project and the challenges that needed to be addressed. Glenfield Invicta had worked on the Kinlochleven in the past, and the current valves dating back to the 1930s were manufactured by Glenfield Invicta in Kilmarnock.

This pedigree, reinforced by a rapid response and a scheme of works that required only one visit to site, led to Glenfield Invicta being awarded the works. The general arrangement (GA) drawings quickly followed and customer approval enabled the manufacturing process to begin.

Manual to remote operation

The penstocks were manufactured from stainless steel and measured 1000mm x 1000mm. The penstocks were fitted with electric actuators to enable them to be operated remotely, a major benefit compared to the manual operation of the legacy penstocks.

The installation was undertaken by Glenfield Invicta's Engineering Site Solutions Team. Despite significant flooding during the week of the installation, the team managed to start and complete the works before another significant weather system arrived.

Peter Dodds, Maintenance Manager at SIMEC was delighted with the attitude of the team and their drive to get the job done without a need for a second visit:

'The works themselves were quite challenging as cofferdams had to be created and water pumps used, to divert the flow of water.

The installation team were great to deal with and helped overcome all problems such as the unexpected rainfall which tested the pumps and cofferdams.

The newly installed penstocks have been a great improvement in terms of operation, leakage, and improved safety for our operators.'

The final word

Wilson McPhail - Business Development Manager Water & Wastewater - was Glenfield Invicta's lead on the Kinlochleven penstock replacement project:

'Kinlochleven was a really interesting project to work on. The location, weather, logistics and time constraints ensured that we had to be on our toes to bring the project in on time.

I think the success of the project can be put down to three key factors. Firstly, the customer trusted our expertise and allowed us to get on with the job. Secondly, open communications and teamwork helped smooth project delivery. Finally, the positive attitude of the Glenfield Invicta workshop and installation teams meant we were able to absorb everything that the weather had to throw at us – and it was very, very wet! – and still complete the works within the narrow time window available to us.'



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