

CASE STUDY

KINLOCHLEVEN - Scotland, UK



KEY STATISTICS

Head: 278m

Flow: 4.15 m³/s

Turbine type: Francis Turbine

Speed: 1000rpm

Output power: 10.2MW

Gilkes scope of supply included the design, manufacture, supply, installation, commissioning and performance testing of the Gilkes Francis turbine, GEC Alsthom generator, main inlet valve, hydraulic controls, turbine controller, lube oil system and special inlet pipework.

The Kinlochleven scheme first produced aluminium in 1907, with completion of plant construction in 1909. Eleven Pelton turbines each drove two 250V DC generators to provide power for the smelting process. The new plant was installed in place of motor generator sets and generates 10MW of electrical power from a head of 278m at 100rpm.

A full hydraulic analysis of the existing penstock system was undertaken to ensure penstock pressure rises, under all operational conditions, remained below the permissible design limitations. As a result, a substantial flywheel was incorporated to limit rate of speed rise and corresponding flow reduction in the penstock system. Tests carried out during the commissioning of the plant confirmed the accuracy of the design data.

Careful design of the new inlet pipework was necessary to minimise the forces transmitted to the existing penstocks. Flow from two existing penstocks combines in a fully constrained Y piece, and a lateral compensator fitted downstream allows inlet pipework movement without subjecting the turbine to transmitted pipework forces. Installation of this special inlet pipework system went to programme a result of the care and detail in planning and design phases. The reduction in site times associated with such detailed planning bring projects on line more rapidly and economically.

The turbine is a low specific speed Francis machine with stainless steel runner mounted directly onto the extended generator shaft. This direct mounting arrangement gives a compact plant layout. All the turbine shaft loadings are taken by the generator bearings and detailed liaison with the generator manufacturer were required. A Gilkes supplied PLC system controls turbine speed up to synchronisation. The synchronous generator can supply power factor correction when required.

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