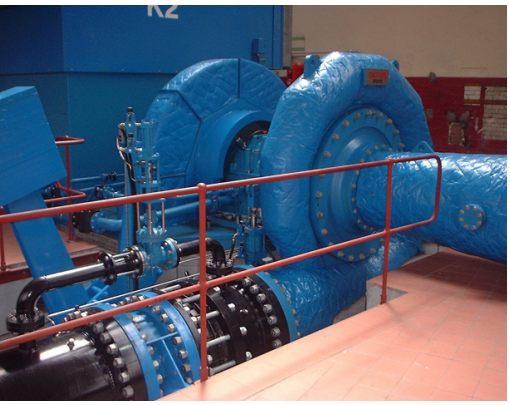
CASE STUDY
KINLOCHLEVEN - Scotland, UK



KEY STATISTICS

Head: 278m
Flow: 4.15 m^3/s
Turbine type: 3 x Francis Turbines
Speed:1000rpm
Output power: 30MW

The Kinlochleven scheme first produced aluminium in 1907, with completion of plant construction in 1909. Originally Eleven Pelton turbines each drove two 250V DC generators to provide power for the smelting process. In 1996 a rehabilitation programme was started to install a series of Francis turbines. The first of these turbines was installed from a head of 278m at 1000rpm generating 10MW of electrical power and replacing motor generator sets. 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.

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 was 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.

Following the installation of this first machine, known as K1, two further Francis machines were installed in 1999 (K2) and 2000 (K3). The Kinlochleven site has a total combined power output of 30MW and the machines are still serviced annually by the Gilkes maintenance team.

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