



LANARK HYDROS TECHNICAL FACTSHEET



OVERVIEW

The Lanark Hydros, on the banks of the River Clyde, dates back to 1926 and is believed to be the oldest hydro-electric plant in the

UK electricity industry.

The stations, Bonnington (11 MW) and Stonebyres (6 MW), were developed by the Clyde Valley Electrical

Power Company to meet demand for electricity in Lanarkshire after the First World War. They are powered by three waterfalls,

known collectively as the Falls of Clyde. Weirs divert an agreed amount of water from the river to power the turbines at the two stations.

INTRODUCTION TO LANARK HYDRO-ELECTRIC SCHEME

The Lanark hydro-electric scheme harnesses the power of three spectacular waterfalls on the River Clyde, near Lanark.

The scheme has two power stations, Bonnington and Stonebyres, which are believed to be the oldest hydro-electric stations in the UK electricity industry.

Bonnington Power Station has the capacity to generate 11 megawatts (MW) while the capacity of the smaller Stonebyres Power Station is 6 MW.

Together, the stations can generate 17 MW – enough electricity to supply approximately 17,000 homes.

A tunnel and pipeline diverts water from the waterfalls Bonnington Linn and Corra Linn, to Bonnington Power Station 58 metres below.

There is no dam – instead, an ingenious tilting weir above the falls regulates the flow of the river to maintain, within specified limits, a constant “head” of water at the tunnel intake.

The weir comprises three large gates that pivot on the river bed and are supported against the thrust of the water by counter balance weights.



■ Bonnington Power Station (above) and the penstock pipes that feed water from Bonnington’s tilting weir (right)

When the river rises, the extra thrust tilts the weir gates, allowing the river to overspill, until the water level behind the weir falls sufficiently for the balance weights to pull the weir back into its normal position.

At Stonebyres Power Station, which is powered by the “head” of water created by Stonebyres Linn, there is a similar arrangement of weir, pipeline and tunnel some 30 metres above the power station.

The rush of river water from the weirs and pipelines passes through the turbine runners, giving up its energy, before the water is returned to the river.

The water at each station powers two turbine-generators – vertical shaft Francis turbines, which rotate at 375 revolutions per minute, connected to 50 Hertz, three phase generators.

There are two 5.5 MW units at Bonnington and two 3 MW units at Stonebyres.



A PROUD HISTORY

The Lanark Hydros was developed by the Clyde Valley Electrical Power Co. to satisfy a growing demand for electricity in Lanarkshire after the First World War.

A key player in the scheme’s development was engineer Sir Edward McColl, who later became world-renowned for his brilliant engineering in the development of hydro-electric power in the north of Scotland.

A development company, the Lanarkshire Hydro-Electric Power Company, was formed to advance the project. The engineering specification was drawn up by Buchan 7 Partners of Edinburgh and the proposals were approved by Parliament in 1924.

Civil engineering was undertaken by Sir Wm Arrol & Co. and the English Electric Co. Ltd was contracted to supply the hydro-electric plant.

Until the Lanark scheme was built the potential of hydro power had not been realised, except for private estates and a few aluminium producers, on the basis that it did not provide security of supply.

But with a large new thermal station at Clydesmill connected to the electricity network, Lanark could operate at full load when water was plentiful, conserving coal, while in times of restricted river flow the steam plant could make up any shortfall from the hydro stations.

Subsequent hydro projects, such as ScottishPower’s Galloway Scheme, solved the problem of intermittent output through the construction of storage reservoirs.

Name of station	Bonnington	Stonebyres
Capacity of machines (MW)	2 x 5.5	2 x 3
Date commissioned	1926/27	1926/27
Generator voltage (kV)	11	11
Speed (rev/min)	375	375
Station generator capacity (MW)	11	6
Catchment area (km ²)	857	997
Working head (m)	57.6	29.7
Tunnel diameter (m)	3	3.4
Pipeline diameter (m)	1.98	1.98

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HOW OUR HYDRO STATIONS WORK

The two power stations that form the Lanark hydro-electric scheme work in similar ways to convert the energy of stored water into electricity.

① The amount of electrical power that can be generated is related to the water flow rate and the vertical distance – the head – through which the water has fallen.

② Turbines extract the kinetic energy of flowing water diverted from the weirs and convert it to mechanical energy, through the turbines rotating at high speed.

③ The turbines drive a generator that converts the mechanical energy into electrical energy.

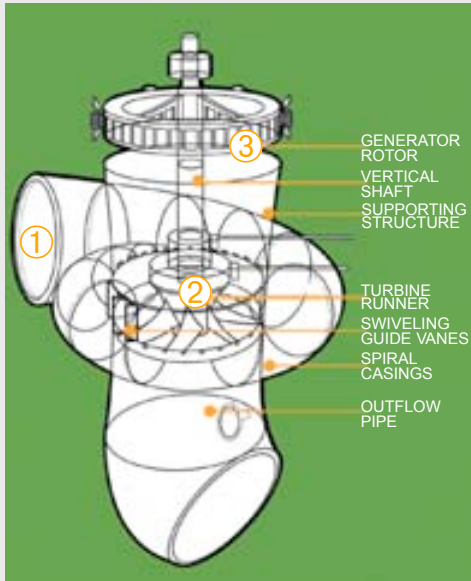
The generators at the Lanark stations are induction generators, producing an 11,200 volt, three-phase supply of electricity at a frequency of 50 Hertz.

The 11 kilovolt (kV) electricity output from the turbogenerators is distributed through the local transmission system to a remote substation where it is stepped up to a grid voltage of 132kV.

The generators at each station are controlled remotely from Stonebryes Power Station.

As there are no storage reservoirs, the Lanark Hydros are dependent on “run of river” water. Flows in the River Clyde are usually sufficient for the two stations to operate almost continuously, all year round.

For further information about environmental aspects of the scheme, see our information sheet on **Lanark Hydros and the Environment**.



■ A cut-away diagram of a turbogenerator



■ One of Bonnington's turbogenerators



A number of major upgrades to maximise the efficiency and output of the stations have taken place at Bonnington and Stonebryes Power Stations over the years.

The stations were automated in 1970 and, at the same time, the original synchronous generators were replaced with induction models, to simplify the synchronisation of the machines with the electricity network.

In the late 1990s, custom-built stainless steel turbine runners were installed to replace the original ones, improving efficiency by 10% and generation output by 14%.

The control systems at both stations were also upgraded, enabling both stations to be controlled and monitored from Stonebryes Power Station.

If debris, such as branches, obstructs the flow of water into the stations, the “intelligent” control system will recognise this and cut off



■ The turbine hall at Bonnington Power Station and, inset, an exterior shot of the station

INVESTING IN THE FUTURE OF LANARK HYDROS

the supply of water to the turbines, creating a backwash of water to dislodge the obstruction, up to three times, before ceasing generation.

Before this equipment was installed the generators would have shut down automatically – and not started up again until any debris had been cleared away manually.

Between 2002 and 2004, significant refurbishment was carried out to enable the

stations to qualify for Renewable Obligation Certificates (ROCs).

Work included the replacement of guide vanes and turbine runners.

More recently, penstocks – the large pipelines that carry water from the weir to the station – were refurbished at both Lanark stations.

The tilting weir gate at Stonebryes was replaced and a new intake screen and screen cleaners were fitted.

ScottishPower continues to

invest significant sums in the Lanark hydro-electric scheme annually to ensure the scheme can continue to generate green energy efficiently and safely for many years to come.

Among the future projects currently in planning is the replacement of the road bridges at the weirs.

For further information about future developments, please see our information sheet on **Planned Projects at the Lanark Hydros**.