

Littlehempston, Devon WTW

hydro power station at works inlet offsets 30% energy needs

by Paul Mitchell

South West Water Asset Management & Development project team have recently completed building of the Company's eighth hydro power station into its portfolio of green energy production units. This hydro power station is somewhat different from its predecessors as it is positioned at the inlet to one of its strategic water treatment works. An environmental methodology was used throughout the life cycle of the scheme utilising industry best practices.



Littlehempston: Francis Turbine

courtesy: S.W.Water

Littlehempston

Littlehempston water treatment works is situated near the town of Totnes in the County of Devon. The works has a number of sources for raw water one of them being via what is called the South Hams raw water spine main, which is capable of delivering flows in excess of 100 MLD. The spine main carries this most precious resource from South West Water's Burrator reservoir, situated in the well-known area of the Dartmoor National Park famous for its 365 square miles of natural beauty and rugged grandeur.

The Littlehempston site was recognised as having generating potential because of the residual head of water available at the end of the pipe. The decision not to introduce additional water treatment in the area meant that this residual head could now be utilised for generating purposes.

Turbine building

The turbine building contains the turbine, motor control centre, supervisory control and data acquisition (SCADA) node interfacing the plant with the works control centre and automatic changeover valve that reverts the flow of water through existing pressure reducing valves in the event of a site mains power failure or equipment malfunction as the system operates in "fail safe" mode of operation.

Water flows through a control valve into a scroll case housing a turbine that turns with the pressure of flowing water. A fixed blade Francis turbine manufactured by Gilbert Gilkes of Kendal is installed. The rate of water flow into the turbine is controlled by the demand selected by works operators and is set at a constant flow through long periods of the day, this daily volume is itself determined by the water needed in the distribution system. Water flowing through the control valve causes the control system to open and close the turbine vanes situated inside the casing of the turbine, similar to the opening and closing of a Venetian blind. The water drops into the draft tube, a chamber that discharges the water to the tail race and into a sealed pipe that delivers the water to the inlet chamber of the water treatment works.

The turbine drives an alternating current synchronous generator to produce electricity. The rotation of the turbine causes an electromagnet in the generator to rotate past three independent and stationary stator windings, which generate power at 400v which is then transformed up to 11kV for connection into the site's electricity distribution system. Power created by the turbine is classed as "green" renewable energy and is subsequently more valuable than electricity generated by the burning of fossilised fuels such as coal or gas. The electricity produced reduces the Littlehempston site's energy and Climate Change Levy (CCL) costs and provides an income from Renewable Obligation Certificates (ROCs). The UK Government introduced the Renewables Obligation where electricity suppliers have to provide a percentage of their energy from renewable energy sources.

Environmental benefits

Littlehempston turbine is rated at over 500kW and should generate 2400 MWh of electricity each year. This is sufficient to supply some 500 homes. The energy is consumed on site and offsets around 20% of the total energy required from the electricity supply company. The production of this energy not only means that South West Water is reducing the depletion of the earth's fossil reserves that are used in the generation of power in the conventional way. It also means that when operating at maximum flow, 1786.4 tons of carbon dioxide, 17.6 tons of sulphur dioxides and 5.72 tons of nitrogen oxides are no longer released annually into our atmosphere.

This facility allows us to make a worthwhile contribution towards the Government's target for green energy generation, which is 15% of all energy supplied by 2015. South West Water currently produces 7% of its energy requirement from green energy and remains ahead of the Government's own programme.

The decision to build the turbine and associated plant is ecologically sound and is one of the strands in South West Water's strategy for sustainable development. The Company promotes the development of renewable energy sources within its Environmental and Energy Policies.

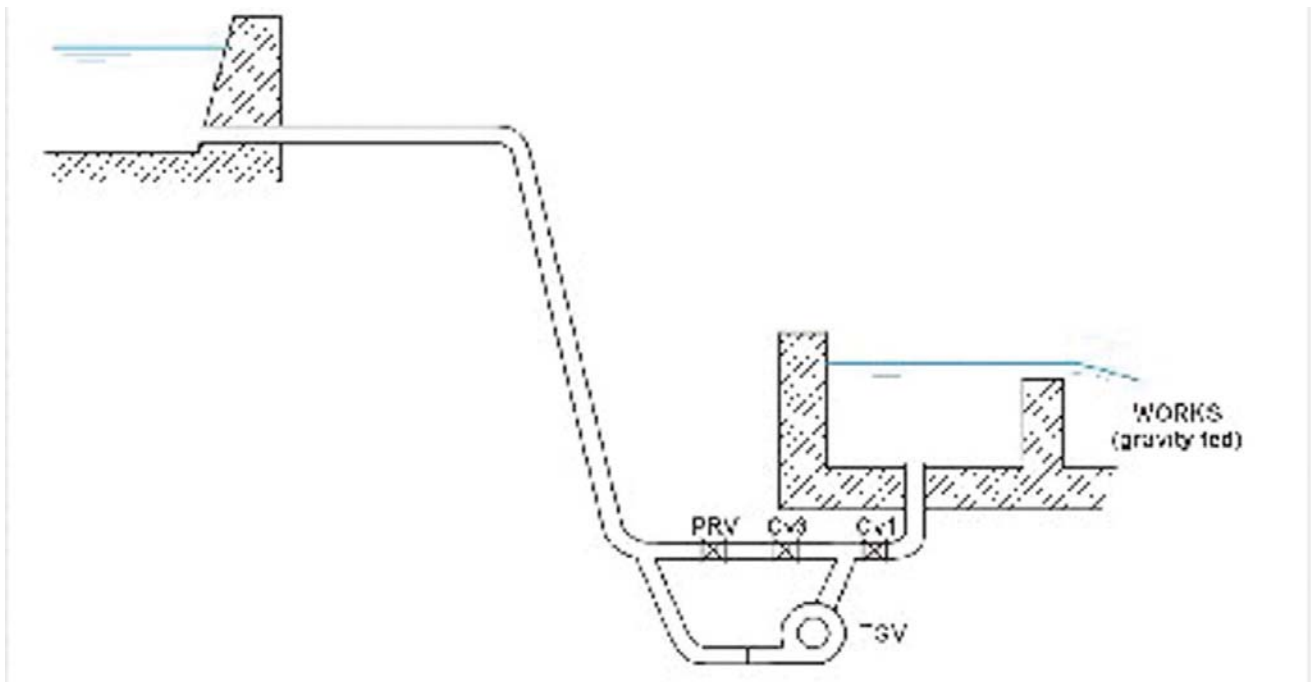


Fig 1 (above) Simplified control philosophy diagram indicating “bump less” transfer capability when bypassing the turbine -essential to ensure WTW is not affected during changeover.

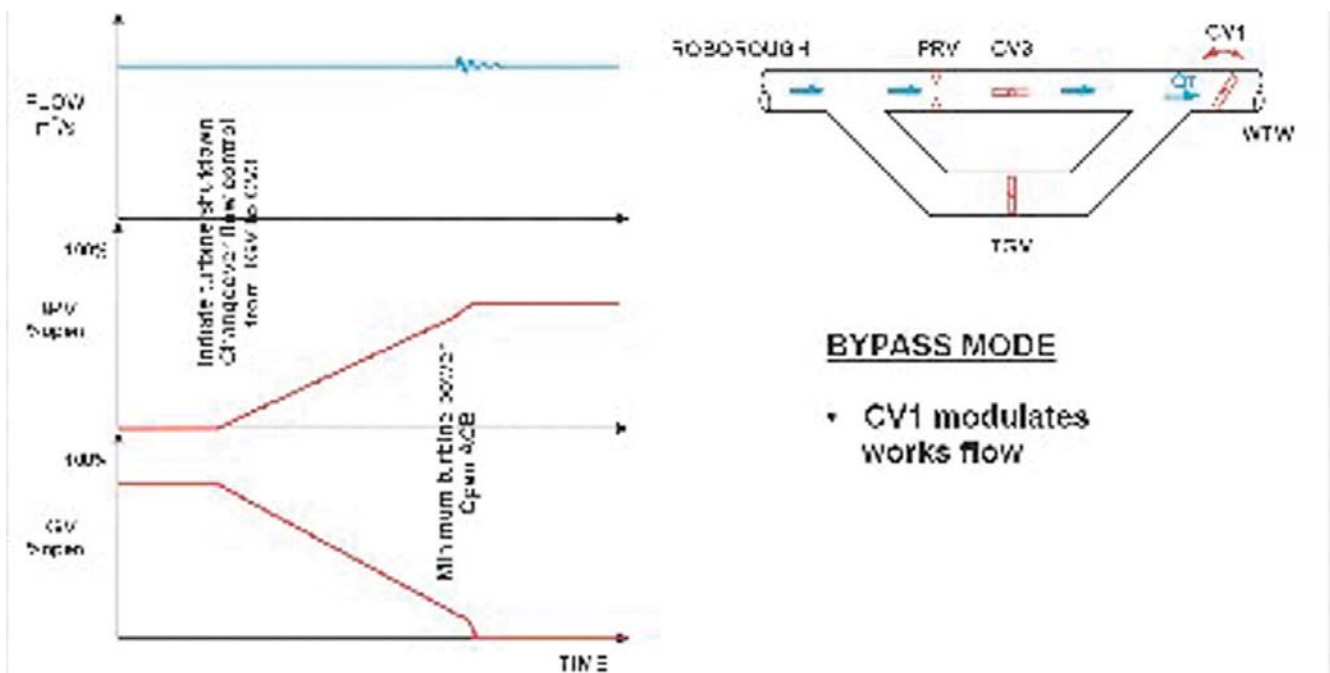


Fig 2. Basic control philosophy “bump less” transfer during turbine bypass.

Drawings courtesy: South West Water

The turbine building was built on a piece of redundant land at the water treatment works. Some 400 tons of soil and sub-soil was required to be displaced for the facility. Movement of such volumes would have required thirtysix six wheel vehicle movements through the small village, such movements would have an impact on the narrow roads, causing annoyance to the neighbours, used up land tip space unnecessarily and created pollution caused by vehicle movements. Instead, the design incorporated a landscaping feature which used the 400 tonnes of spoil to create a wild life habitat for animals, an area for wild flowers to grow, provide a screen for the turbine building from neighbouring farm cottages, screen the cottages from possible noises emitting from the water treatment works and provide an area at the works where the operational staff can get away from the industrial environment and enjoy a short walk whilst having a lunch break - thus improving the quality of life whilst at work.

South West Water has a number of future hydro generation projects ‘in the pipeline’ and intends to continue to build on the experience gained to improve on its green energy production, thus improving the environment which it has a duty to preserve.

The team involved in the scheme were predominantly from the West Country including SW Water’s Asset Management & Development team, Energy Manager, Water Treatment team, SW Water Hydro Group, Hydro Plan turbine consultant, Dean and Dyball Civil Construction Partner, Tecker Electrical contractor partner and turbine manufacturer Gilbert Gilkes. ■

Note: The author, Paul Mitchell, is Project Manager, Asset Management & Development Department, South West Water.