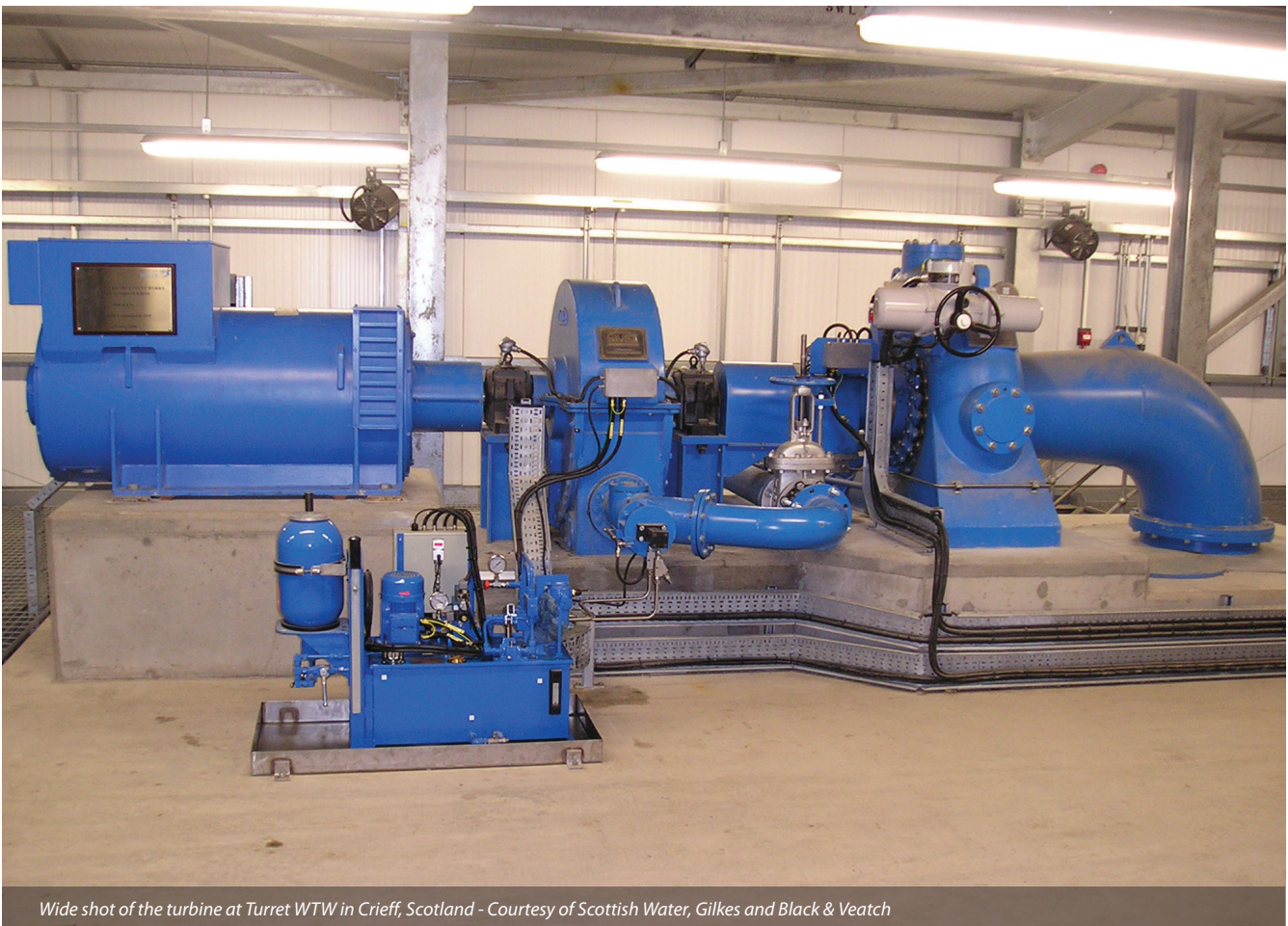


Hydropower Generating Scheme

hydro project will provide Scottish Water with self-generated power for their assets

by William Ancell BA (Hons)

The topography of Scotland means a large amount of Scottish Water's energy use is in pumping water around the country. Additionally, a lot of energy is required to treat water to meet regulatory standards, despite the generally high raw water quality in Scotland. In order to reduce power costs for water supply and treatment by 10%, and in doing so help keep down Scottish Water's operating expenditure, the company is progressing with a £20 million+ hydropower generating scheme that will use the existing water supply pipes to generate electricity for the utility's own assets.



Wide shot of the turbine at Turret WTW in Crieff, Scotland - Courtesy of Scottish Water, Gilkes and Black & Veatch

Project background

The project involves installation of hydro turbines at raw water and treated potable water locations. More than 30 sites have been identified that could, using techniques most commonly seen in hydroelectric schemes, power the water treatment process in areas such as rural Lanarkshire, the Borders, Stirlingshire, Angus and Fife.

The schemes will make good use of existing Scottish Water buildings and also see the construction of some small buildings and electricity infrastructure to transfer the power from the point of generation back to the water treatment works where it is required. Some of the electricity infrastructure will be 'off the grid', so any major power loss caused by the power companies would not affect the supply of water to customers. This is a key part of Scottish Water's Climate Change Strategy and will substantially reduce its carbon footprint. The technology offers the dual benefits of improved service and reduced operating costs.

This is nothing new; Scottish Water's asset base is already generating 5% of the company's power requirements across Scotland and this investment will double that output. The project team have identified a number of potential sites and these will be whittled down to the best 20 or so small hydro schemes.

The project team is working closely with the national park authorities, community councils, power companies and planning officials to make sure these small hydro turbines have minimal effect on the landscape. Some of them will be situated in areas that are very remote so constructing them will require very diligent planning work.

Investment

£20m is a large investment, but it will soon pay itself back by allowing Scottish Water to generate its own power. The power derived from the project can be used by Scottish Water to offset

required energy at water treatment facilities across Scotland, or to directly feed into the power grid system via a power purchase agreement with NPower; and in some instances, both.

During the project feasibility phase, a number of various scheme types/location have been identified, for example: run of river; dam compensation flows/spills; inlet to water treatment works; and inlet to break pressure tanks and network pipelines.

The turbines

Scottish Water has set up new supplier frameworks for the hydroelectric equipment, and the required turbines will be sourced where possible from Gilkes, Ross-shire Engineering and SSE.

The proposed turbines for installation range from TJ Turgos to Francis and Peltons; however detailed design will clearly identify the "best fit" for each location to match head and available flow.

Civil engineering works

Additional civil structures will be required for the chosen sites/locations. The main civil work will be undertaken at the run of river locations. These are essentially installed on greenfield sites, so in order to install the hydropower solutions new intakes, penstocks, pipelines, access roads etc will be required.

Civil works will also be required at other locations. However these are within existing Scottish Water operational assets and most have existing pipelines and some structures already in place.

Power generation using compensation flows from (raw water) dams/reservoirs

This is the traditional form of power recovery at reservoirs and to some extent at treatment plants, where water requires to be returned to a river/water course to maintain agreed minimum flow regulation.

For these schemes, there is generally a constant flow of water available. Installing a hydro turbine at these locations allows Scottish Water to tap into this existing resource and generate power via installation of a suitable hydro turbine unit. The generated power can be utilised to offset required energy for the water treatment works or be exported to the power grid system via a power purchase agreement, or both.

Inlet to water treatment works

Water entering a plant for treatment will pass through a suitable turbine. This also provides power for use (off-set) on-site or again export to the grid again via a power purchase agreement.

In general a Turgo impulse turbine is used at these locations because it allows inlet flow control to be independent of power generation.

Feasibility studies key to identifying sites

The project team carried out feasibility studies on 48 sites, this was reduced to 34 sites on completion of the feasibility phase. Identified sites range across all of Scotland, from Loch Katrine in the Trossachs, to Glendevon in Fife and to areas in the south, east and west of Scotland.

Under this programme of works, Scottish Water have in the region of 20+ sites that will progress forward to the construction phase. Within these sites the estimated annual energy output ranges between 318MWh-4,632MWh.

Sites being utilised fall into the following categories:

- **Raw water:** run of river schemes (greenfield site); dam flows to water treatment works; dam compensation flows & spills to rivers.



A Gilkes turbine installed at a WTW by Black & Veatch
Courtesy of Scottish Water, Gilkes and Black & Veatch



Detail of the external casing of the turbine at Turret WTW
Courtesy of Scottish Water, Gilkes and Black & Veatch

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- **Potable water locations:** Inlet to break pressure tanks, inlet to service reservoirs or by running water through pressure reducing valves (PRVs).

Scottish Water completed the project feasibility phase at the end of August 2011 and has now moved into the development phase with all 34 identified sites.

Regulatory outputs

The regulatory outputs were set by the Water Industry Commission for Scotland (WICS) and are as follows:

1. Increase generation of renewable energy on Scottish Water assets by 25GWh per annum by 31st March 2015.
2. During 2014/15, deliver (net) operational expenditure savings of £2m as a direct result of investment in hydro-renewable energy schemes on Scottish Water assets.

Undertakings

Scottish Water has undertaken a partnering approach with their framework Design and Build contractors. The 34 sites have been split into three groupings then allocated to each of three partners:

- Black & Veatch.
- Amalgamated Construction.
- Ross-shire Engineering.

The development phase is presently programmed for completion across all three groupings by August 2012. The project team are currently liaising with local planning departments, SEPA, National Parks Authority and DNOs (Distribution Network Operators: SSE and Scottish Power).

The design and build partners are developing each of the identified schemes. On completion of the development phase,

the project team will identify and take forward 20+ sites into the implementation phase (construction) to allow achievement of regulatory outputs for this programme of works. The identification of the best sites will be based on selection criteria ranging from simple payback to whole life cost analysis.

Progress

Scottish Water procurement has set up new frameworks to cover the requirements of the hydro programme of works:

- Design and Build contractors (now in place).
- Kit suppliers (turbines, now in place).
- Operation and maintenance (presently ongoing).

This work is all part of Scottish Water's wider renewable energy portfolio which also includes wind and biogas production from food waste.

The overall portfolio of green energy projects places Scottish Water at the forefront of innovation in the UK water industry and is in line with the aspirations of the Scottish Government's 'Building a Hydro Nation' Water Bill, which aims to harness Scotland's renewable energy potential from water and the wider Scottish Water estate and to capitalise on the industry expertise that has been built up over the ten years that Scottish Water has been in existence.

In addition to this project, Scottish Water Horizons, the commercial arm of Scottish Water, has recently installed a micro-turbine at the redundant Touch WTW in Stirling. This is creating power which is then sold back to the current power purchase agreement partner NPower. Horizons is driving forward the green agenda as part of Scottish Water's drive to be a low-carbon business.

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Detail of a Gilkes turbine - Courtesy of Scottish Water, Gilkes and Black & Veatch

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