A Southern Hemisphere comparison with Cragside

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1. Introduction

Cragside is generally claimed to be the first house in the world to have been lit by hydroelectric power (in 1878). Soon after (August 1886), a house was lit by hydroelectric power at Reefton (once Reef Town), New Zealand, claimed as the first in the Southern Hemisphere.

Reefton is in a remote location, 80 km inland from Greymouth in the Southern island (Fig.1), and was the place of a New Zealand 'Gold Rush' in the late 1860s. It is on the Inangahua river, and in 1886 a young British engineer named Walter Prince arrived in the town with a small 1kW electric generator, held public demonstrations and used it to light a local hotel (Dawson's Hotel) on 24th November 1886.

This astonished the local public who formed a company to build the Reefton Power Station, which used the steady supply of water from the Inangahua River (Fig.2).

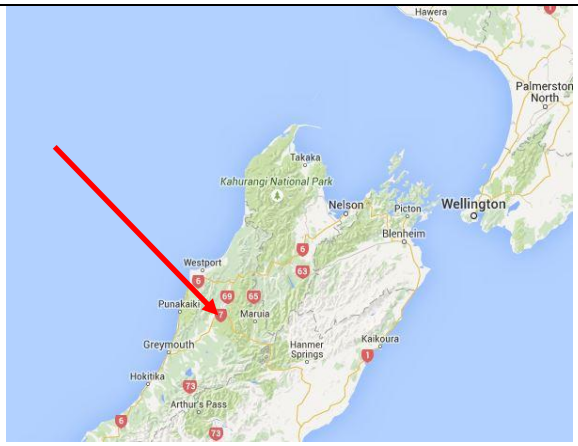


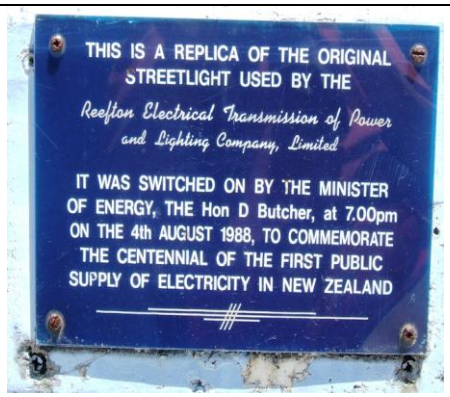
Fig.1 Reefton location

Fig.2 Inangahua River (as it is now)

Reefton Power Station became the source of the first municipal power supply in the Southern Hemisphere and supplied electricity to Reefton for over 60 years, until 1949 when the town was connected to the national grid.

Unfortunately, almost nothing of the original power system has been preserved (Fig.3), but the centennial was recognised by switching on a replica of the original street lamps on 4th August 1988 (Fig.4). Reefton has preserved some past memories, having the "Electric Light Cafe and Bistro" in the town centre (Fig.5).

Fig. 3 Remains of Reefton Powerhouse



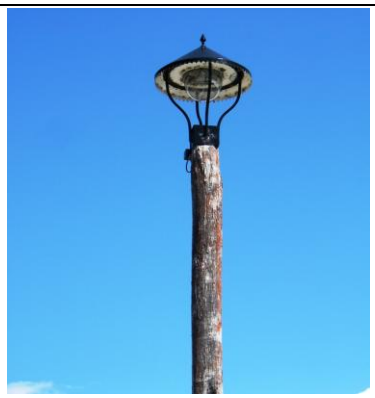


Fig. 4 Centennial recognition in 1988

Fig. 5 Reefton remembrances of the past

2. Details of the Reefton Powerhouse history [1, 2, 3, 4, 5]

The station (fig.6) had a head of 8.3 metres. A 70 horse-power (hp) Rafel turbine drove by a belt a 20 kW 30/110 volt DC Crompton bipolar dynamo (fig.7). It was intended to be sufficient for 500 lamps in the town. The turbine was made in Dunedin by Scott Bros. The dynamo was ordered through a Wellington firm, E.A. Ashcroft and Co. Water was taken from Blacks Point, about 1500m upstream from the Powerhouse, requiring some tunnelling, before travelling along a flume to the headrace.

As the load grew changes were made (Fig.8):
In 1901, the generator was replaced by a 220 V, 46 kW Fynn generator, supplemented by a steam engine.
In 1908, a new turbine (110 hp Boving horizontal) was fitted and the output increased to 80 kW. The Boving company was founded only just before that, in London in 1907.
In 1911, a new powerhouse was constructed and a 230 volt DC Lawrence Scott 100 kW generator installed
In 1920, there were additional steam driven generators added.
In 1935, a new Boving turbine and a Thomson-Houston generator were fitted.

The turbine and generator were linked by a large flywheel, to maintain a steady rotation speed. The flywheel rotated quickly, making its spokes invisible. It is reported that this led to a misfortunate end to the station cat, which jumped through the flywheel, thinking it was an open hole.

The system was purchased by the Grey Electric Power Board in 1946 and ceased to operate three years later when Reefton became part of the NZ national grid. The powerhouse was demolished in 1961.

Fig. 6 Powerhouse with tail race in front

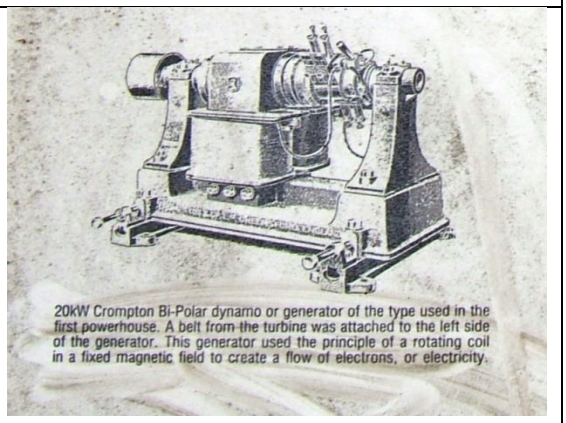


Fig. 7 Dynamo

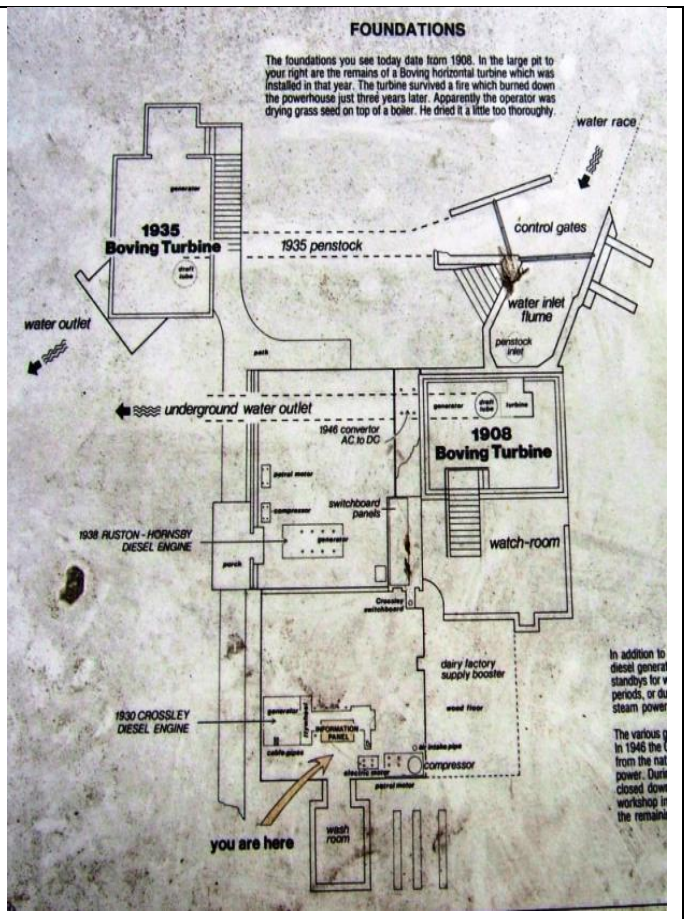


Fig.8 Plan showing layout and later additions

It is interesting to compare these details with Cragside.

3. Details of the Cragside Powerhouse history

In 1878, in the Cragside Power House building, Lord William Armstrong installed a 6hp turbine driving a dynamo to generate electricity for carbon rod arc lamps lighting the Picture Gallery in the house. The dynamo was a Siemens series wound, bipolar horizontal pattern with a drum armature and single magnetic circuit.

Because of increased demand for electricity, the Burnfoot Power House was constructed in 1886 to house a Gilkes turbine and Crompton generator.

Forty-five new incandescent lamps had been installed in the house, of the Joseph Swan design type. Swan was a friend of Lord Armstrong.

The turbine was powered from lakes approx 104 m above the Power House, creating a pressure of 150 psi at the turbine. The electricity supply was taken from the generator via ceramic conductors and then routed up to the house by a cable housed in a buried wooden conduit supported on trestles.

4. Other New Zealand Hydroelectric systems

Although almost nothing has been preserved at Reefton, there is another later plant which has been preserved. The Six Mile Hydro Power Station, in Upper Buller River Valley, Murchison, NZ, opened January 1922. It is the oldest still-existing Hydro Power Plant in New Zealand, closed November 1975. Although closed, equipment has been maintained in good condition (Fig.9) in the original Powerhouse (Fig.10), and includes a Francis type Turbine from Switzerland (Escher Wyass and Co) which cost £1250, and a generator (alternator) from USA, which cost £664, giving 80 kW output at 3.3kV. It was originally installed to enable local dairy farmers to replace steam engines by electric motors.

Fig.9 Preserved equipment in Hydro Powerhouse at Six Mile, Murchison, NZ

Fig. 10 The preserved Six Mile Hydro Powerhouse

5. Some other Southern Hemisphere power plants

Of course, there were other hydroelectric power plants elsewhere before the ones in Cragside and New Zealand. In Tasmania (Australia), the South Esk River was used to generate electricity and in 1885, it is claimed that Launceston became the first town in the world with public street lighting supplied from hydroelectricity. When the scheme was expanded soon after, households in Launceston became the first in

Australia to be supplied with electricity from a hydroelectric plant. A Boving Turbine example has been preserved at Waddamana Power Station, Tasmania where hydroelectricity was first produced in 1916. Good photos of this turbine can be seen in Reference [6].

6. Elsewhere in the world: USA

In USA, in 1880, Michigan's Grand Rapids Electric Light and Power Co. generated electricity by dynamo, belted to a water turbine at the Wolverine Chair Factory, and lit 16 brush-arc lamps [7, 8].

In 1853, the Niagara Falls Hydraulic Power and Manufacturing Company was established and in 1861, it completed an 11 m wide and 2.4 m deep canal. The powerhouse finally opened in 1874, but produced little electricity even by the standards of the day.

In 1877, Jacob Schoellkopf purchased the canal, along with the water and power rights, for $71,000. He improved the canal and put the powerhouse into commercial use. In 1881, his company completed Schoellkopf Power Station No. 1 near Niagara Falls in the U.S. side; This "old Schoellkopf Power Station No. 1" began to produce electricity in 1881, enabling city street lamps in Niagara Falls to be powered by hydroelectricity, and so this was one of the first hydro-electric generating stations in the world. It operated until 1904. In 1891, Schoellkopf Power Station No. 2 opened directly in front of the original, in the gorge below the falls, with a higher 64 m drop. In 1904, the company built Schoellkopf Stations No. 3A and 3B.

In 1886, the competing Niagara Falls Power Company, owned by the Cataract Construction Company, built the Edward Dean Adams Power Plant in 1895. This was a two-phase, 25Hz system, and is often called "the most famous historical power station in the world". Between 1900 and 1904, the company built its Powerhouse No. 2, making its total of generators to 11.

On 30th September, 1882, what is often claimed as the world's first hydroelectric power plant began operation on the Fox River in Appleton, Wisconsin. This plant, in Vulcan Street, had a direct current generator capable of lighting 250 sixteen-candle-power lamps each equivalent to 50 W. The generator operated at 110 volts and was driven through gears and belts by a water wheel operating under a 3m fall of water.

7. Krka-Šibenik Electric Power System, 1895 [9]

On 28 August 1895 electricity generated at this location, using the Krka river, was transmitted to the city of Šibenik, where six power transformers supplied a large number of street lamps. This early system of power generation, transmission and distribution was one of the first complete multiphase alternating current systems in the world and it remained in operation until World War I.

Krka-Šibenik was the first alternating current electric power system in Croatia. Two generators (42 Hz, 550 kW each) and the transformers were produced by the Hungarian company Ganz. The transmission line from the power plant to the city of Šibenik was 11.5 km and the municipal distribution grid 3000V/110V included six transforming stations. 340 street lights and some houses in the town were supplied. Three years later after the first Jaruga power plant, the construction of the second Jaruga hydro plant began. Two three phase, 50 Hz, 5.5 MW generators were installed. Only ruins of the first power plant (Jaruga I) exist today, but the power plant built in 1903 (Jaruga II) is still in operation.

8. Rheinfelden Hydroelectric Power Plant, 1898-2010 [10]

The 1898 Rheinfelden plant, on the German/Swiss border, was an outstanding achievement in Europe's early large-scale generation of hydroelectric power. It was important for its 17,000 hp (12,500 kW) output, for pioneering the use of three-phase alternating current which was later adopted around the world, and for using 50 Hz which afterwards became standard in many countries.

9. Conclusions and Comments

This paper is an extended version of a short presentation made at the IET History of Technology Weekend Conference at the Discovery Museum, Newcastle-upon-Tyne, on 6th June 2015. The photos of Figs 2 to 10 were all taken by the author in February 2006, Figs. 6,7,8 being from a display board at the location of the Reefton powerhouse. A higher resolution copy of Fig.6 can be found in [1] together with a plan of the complete system and town.

One may wonder how this British engineer William Prince had a 1kW generator amongst his luggage when he arrived in Reefton. The explanation seems to be that he had been brought to New Zealand by a Dunedin firm and prior to this visit to Reefton, he had supervised the construction of a hydro-electric plant for a mining claim on the Shotover River (which might be one of the world's first) [11, 12].

A very thorough and illustrated description of the developments in the New York state area by Craig .A. Woodworth, can be found in [13].

References

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