History

The earliest record of a mill in Guildford is 1214. It was owned by Stephen de Turnham and is thought to have been located at the current boathouse site

A 2nd mill was recorded in 1250. It was owned by Richard Testard and is thought to have been located on the island opposite the Turnham mill.

Henry III later built 3 additional mills somewhere between the Town Bridge and Bridge House. In order for them to operate he had the river penned at that point to raise the upstream water level. This damming of the river negated the head required to drive the existing mills and also flooded and destroyed them. The Abbess of Wherwell, Geoffrey de Braeboeuf and Richard Testard were all part owners. They took legal action against the King and were compensated for their losses. The King then leased his own mills to Braeboeuf & Testard on condition that they were dismantled and re-erected upstream where flow conditions proved to be more suitable.

- 1649 – 3 mills of timber construction were known to be on the current site.

- 1770 – The two buildings at the eastern end were reconstructed in brick and known as the New Mills. The easternmost building contained an extra water wheel and external pumphouse to pump water for the town reservoir at Pewley Down. The outline of the old pumphouse can still be seen on the end wall. The route of the pipework from the pumps was along Rosemary Alley.

  The remaining timber building was known as the hogsmeat mill because it was used to grind animal feed.

- 1852 – The hogsmeat mill was rebuilt as an extension to the New Mills. It was powered by a single external breastshot water wheel.

- 1896 – The pumping station was demolished at the east end. The Toll House was built at the west end to house twin turbines to drive the water pumps which were transferred to the New Mills extension building. This is the event commemorated by the date plaque on the front wall of the Mill building.

- 1930 – The twin turbines were decommissioned and replaced by a single turbine.

- 1952 – Electric pumps were installed at a new pumping station (now the Thames Water site). The turbine then became redundant and fell into disuse.

- 1961 – Construction of the road Millbrook.

- 1990 – The turbine was decommissioned. It is now on display at the National Trust building at Dapdune Wharf.

- 2006 – A replacement identical turbine was restored and installed in the Toll House to generate electricity.

Specification

THE TURBINE – 42" Francis open flume turbine by Gilkes of Kendall. 42" is the diameter of the impeller. It is housed inside a circular frame of louvres which control the quantity of water passing through the impeller. The diameter of the housing is 2.300m.

- the turbine is rated at 68 HP at a 6 ft head of water. (the difference between the upstream and downstream water levels).
- it rotates at 75 rpm

THE GENERATOR. – is rated at 55 kW and spins at 1500 rpm. The speed difference is obtained through a gearbox providing a 20 : 1 speed increase.

The power generated is Alternating Current in 3 phases at 415 volts and is fed directly into the local electricity network via an export meter. This is similar to the import meter in a domestic house but measures what is being fed into the network as opposed to what is being taken out. The power required to operate the turbine control systems is taken off before the export meter.

THE POWER - Under optimum conditions the generator will provide 45 kW. Over 1 hour that equates to 45 kWh or units. The target to be generated over a year is 260,000 kWh. That approximates to the total annual usage of about 50 houses.

General / Technical.

The turbine spins in a vertical plane over what is effectively a plughole in the bottom of the upstream river leading to the lower level. The louvres around the outside of the impeller are operated through linkages by a hydraulic ram. They accurately contol the flow of water passing through the impeller.

The entire system is controlled by an electronic unit which constantly monitors the upstream water level. It is connected to a sensor which is set to a specific working water level. If the sensor detects a high level it knows that the flow entering the river upstream is greater than what is passing through the turbine and it will instruct the hydraulics to open the louvres by a small amount. This allows more water to pass through the turbine. This procedure continues until the two flows match each other and the level then remains constant.

Similarly if the flow upstream decreases (e.g. after a storm surge or opening of another sluice gate to the lower level) the sensor will detect a low level and will gradually close the louvres until the flows match.

The system is therefore constantly hunting for the maximum it can generate from the available flow.

The control unit has a built in soft starter. In order for the generator to work it has to spin at a precise speed. Any faster or slower will affect the voltage or frequency of the electricity and may be outside the safety limits for the connection to the local network. This poses a problem when starting up.

The procedure is that the turbine vanes gradually open until the generator spins up to 1500 rpm. As it is not generating at that stage, there is no load on it and consequently no braking effect. This is similar to the alternator on a car. When you turn on the lights the alternator is energised to produce power and it has a braking effect on the engine causing it to slow slightly. Car alternators are not speed dependent but the braking effect of energising the windings is the same.

The problem with energising the generator is that a sudden heavy braking effect could slow the system beyond the lower limit and would also create very high shock loads on the gearbox. The soft starter operates in a similar way to a dimmer switch gradually increasing the energising over a few seconds to a level where generation is above the minimum required and the connection to the grid can be made. This is usually at about 1kW. It is similar to using the clutch in a car to start the motion. After the connection is made the amount of power can then be increased.

As the louvres open, the turbine tries to increase in speed. The control unit has a tachometer, which monitors this and requires the generator to produce more power. The result of this is that as the turbine produces more torque the generator produces more braking effect. The two are always balanced and the speed therefore remains constant.

Safety Features.

There are many safety trips and shutdown systems to protect the generator, the grid and personnel. These include:-

- Mains failure trip - If the power in the grid is switched off all lines beyond the grid switchgear must be dead. The generator also needs to shut down to prevent feeding power into the system from the other end.

- Voltage trip - shuts down if the voltage generated is outside defined limits.

- Frequency trip - shuts down if the current frequency is outside defined limits

- Reverse power trip. - If the generator is still connected to the grid but has closed down to a level where it is not actually generating, the power will begin to flow backwards from the grid to the generator. This will effectively turn the generator into a motor driving the turbine rather than the other way round. This could be catastrophic. The reverse power trip detects this condition and immediately breaks the connection to the grid.

  The reverse power trip has to be manually reset. All the other trips reset themselves and the system restarts automatically.