



REGOVERNING FOR EXISTING HYDRO INSTALLATIONS

RE-GOVERNING FOR EXISTING HYDRO INSTALLATIONS

Hydro turbine machinery is well known to be hard wearing and will usually have a long life. However, the control systems and governing mechanisms associated with hydro turbines often start to be a cause of trouble after 20 or 30 years. The operational problems that this causes coupled with the difficulty in obtaining spare parts for old equipment often forces plant owners to consider renewal of the control and governing equipment.

However, control technology has developed very fast in recent years, and therefore it is not just a case that systems need to be renewed, but advantage needs to be taken of the latest methods of control in order to improve the performance and ease-of-use of hydro plant.

Speed governors in particular have undergone a revolution over the last decade or so. The mechanical-hydraulic governor used to be the mainstay for speed control of small to medium size hydro turbines. Modern practice for turbines that require speed governing is now to use electronic governors. As a result, it is becoming more and more difficult to service and repair the older mechanical governors.

The Gilkes Digital Electronic Governor

Gilkes has also developed its own electronic governing system for its new turbine installations. However, with a history as long as Gilkes has, with so many turbines in the field, we have had to address the needs of our customers with existing equipment who wish to upgrade their governors from mechanical to modern electronic units.

The Gilkes governing system comprises the following items:

- A shaft mounted toothed wheel with magnetic speed pickups
- A control panel containing the digital governor unit, complete with power supplies, controls, displays and alarm annunciator.
- A hydraulic module, complete with electric pump, accumulators, and proportional valve driven from the governor
- A hydraulic actuator with position feedback transducer, connected to the proportional valve of the hydraulic module

The system can be applied to Pelton and Turgo turbines, with governor control of the deflectors, or to Francis turbines with governor control of the guide vanes.

Advantages of the system:

- The digital electronic system gives extremely accurate control of speed
- Each module of the equipment is well proven and highly reliable
- The governor can easily be interfaced with autosynchronizing relays or other control devices.
- The system can control additional actuators in order to control the complete startup, load control and shutdown sequencing functions.
- Load sharing across multiple generators can easily be implemented
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APPLICATION TO ANY EXISTING TURBINE

The Gilkes Electronic Governor system can be applied to any make of turbine, not just our own. Gilkes would welcome enquiries from any owners of hydro plant who wish to upgrade to electronic governing. We can provide a tailor-made solution based upon our proven components that will give good results and high reliability in the field.

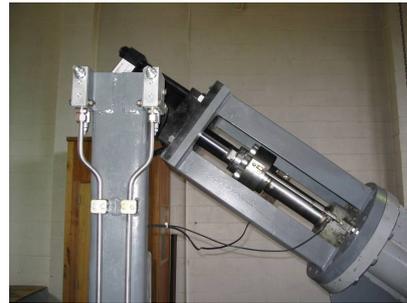


A view of the governing equipment in relation to the existing plant. The hydraulic module stands close to the turbine, and the governor panel is located at the end of the existing line of panels & switchgear

CASE STUDY: Cuajone Copper Mine in Peru

In 1976 Gilkes supplied two 4MW Pelton turbines with generators to the Southern Peru Copper Corporation (SPCC) at their Cuajone mine. Each machine is housed in a separate powerhouse in different locations. The mechanical governors had given good service for 28 years but were starting to show signs of wear. SPCC approached Gilkes about this problem and it was agreed that a new electronic governing system would be the best way forward.

The Cuajone Pelton turbines had electric actuators controlling the spear valves, as well as the mechanical governor controlling the deflectors. The electric actuators were also quite worn, and there was an operational problem in that they did not close the spear valves during “loss of grid” trips. It was decided that the electric actuators would be replaced by hydraulic cylinders which could easily be controlled by the hydraulic module associated with the governor.



Spear valve conversion to hydraulic actuation

Governor control panel showing speed display (rpm), load control display (%), and proportional valve control cards for turbine top & bottom spear valves and deflectors.

There are also switches to select parallel/islanded running mode, and to select droop/ isochronous governor response.

New controls

- Startup of the turbine is now initiated by pressing the “Start” button on the governor control panel.
- The pump on the Hydraulic Module then starts, and when pressure has stabilised, the deflector opens and the spear valves move to a “start position”.
- As the spear valves open, the turbine begins to rotate and accelerate to synchronous speed (600rpm in this case).
- As soon as synchronous speed is attained, the deflector will modulate under governor control to hold the speed constant.

For parallel running with the grid:

- The generator excitation is switched on, and the generator is synchronized to the grid using speed “Raise/Lower” push buttons connected to the governor panel, and the main breaker is then closed.
- Once the breaker is closed, and the speed of the generator is locked to the grid, the governor opens the deflector and the load on the turbine is controlled by a “Load Control” potentiometer on the governor panel.

For islanded running:

- The generator excitation is switched on, and then the spear valves opened by the “Load Control” potentiometer to pre-load the turbine, so that it is capable of picking up the electrical load when the breaker is closed.
- After closure of the breaker, the governor remains engaged to control the speed and therefore frequency of the electrical supply.

Present status & future plans at Cuajone

The system has functioned very well since installation, the customer being particularly impressed by the accuracy of the speed control that is now possible. Manual synchronising of the generator used to be a highly skilled job with the old governor, but now it is so easy to control the speed that less skilled staff can now be safely allowed to do this.

During “loss of grid” shutdowns, the stored pressure in the accumulators now closes the spear valves so that water is no longer wasted and the customers operational problem in this regard is solved.

Future plans for these stations is to develop the control systems for increased automation – particularly head level control, auto-synchronizing and modern AVR's. The new electronic governor is already designed to interface with these new functions.



GILKES

Hydro

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