

Electricite du Laos Generation Company Limited PM Control Retrofit of Hitachi Hydro Turbine Increases Efficiency and Reduces Risk of Downtime

Application Bulletin
PMCS-SG-0009



Background

Electricite du Laos (EDL) is the state corporation of Laos that owns and operates the country's electricity generation and distribution. In 2010 EDL incorporated EDL-Generation Company Limited (EDL-Gen), making the company the only net exporter of power in the region by selling power to Thailand, Vietnam, Cambodia and China. EDL-Gen plans to double its hydropower generation capacity by 2016, and currently operates seven plants with a total capacity of 387MW.

The Num Ngum 1 hydropower plant, situated 60 kilometers north of Lao's capital Vientiane, is one of these seven plants. It has a capacity of 155MW and was constructed in 1971 with two 15MW turbine generators. Two 40MW turbine generators were added in 1978 and an additional 40MW unit in 1984.

One of the 40 MW units is a Francis type hydro turbine manufactured by Hitachi. A mechanical Hitachi governor controls the turbine.

Challenge

Considered to be the core element of the turbine system, the Hitachi governor suffered from long-term wear and tear and was reaching the end of its technical life cycle. Therefore, EDL-Gen decided to upgrade it to present day technology.

Previously, EDL-Gen had completed the upgrade of two smaller turbine

Solutions

Turbine Control System:

- L&S Digital Hydro Controller (Multi Runner Type, MRT)
- L&S Distributing Valve
- Speed Signal Generator
- Operator Interface Terminal (OIT)

Results

- Increased efficiency as hydro turbine is able to run at full load again and can now achieve more turbine power.
- Reduced risk of downtime, thanks to the replacement of all wear-and-tear components.



controls to Hitachi digital control systems. This time they preferred working with another governor specialist and consulted PM Control.

Prior to being awarded the contract, PM Control performed detailed site surveys with EDL-Gen and the main contractor, Vientiane Automation Solutions Engineering (VASE). The Electricity Generating Authority of Thailand (EGAT) acted as a consultant for this project, supporting EDL-Gen.

During the site visits it quickly became clear that incomplete technical documentation would make this a challenging project. In addition, the turbine was in operation during the site visits, which limited the possibility to take detailed site measurements. These site measurements could only be taken when the turbine was shut down, days before the commencement of the installation. On-site engineering and machining and a flexible, proactive attitude enabled PM Control to successfully overcome these challenges.

Solution

PM Control proposed the following products for the Nam Ngum 1 power plant:

- L&S Digital Hydro Controller (Multi Runner Type, MRT)
- L&S Distributing Valve
- Speed Signal Generator
- Operator Interface Terminal (OIT)

L&S Digital Hydro Controller, Multi Runner Type (MRT)

As PM Control was still in the development phase of its proprietary Hydro508 and Woodward turbine controls, it decided to use the L&S MRT hydro controller for the control of this Hitachi hydro turbine. The L&S controller is a cost-effective PLC-based digital control system with standard software for Francis, Kaplan and Pelton type hydro turbines. The L&S MRT uses a Modicon PLC with off-the-shelf components, ensuring long-term support and widely available low-cost replacement parts.

EDL-Gen preferred not to have the new L&S MRT cabinet mounted in the existing governor cabinet. Instead, they requested it to be wall-mounted on a wall nearby. Cable trays were installed to connect cables running across the ceiling from the MRT cabinet to the top of the existing governor cabinet. The interface field wirings were connected to a row of terminal blocks in the aforementioned cabinet and then extended to the new control system. A Balluf sensor was installed to provide an analog (4~20mA) signal for position feedback of the wicket gates to the MRT.

L&S-7500 Distributing Valve

An L&S-7500 distributing valve replaced the Hitachi mechanical governor in the cabinet. Numerous mechanical components were removed for this replacement, which freed-up a lot of space in the cabinet. The L&S-7500 is a distributing valve with high flow capacity that is designed specifically to work with hydroelectric turbine controllers of low to medium operating pressure.



Nam Ngum 1



Hydropower Plant



Mechanical Over-speed Device on top of PMG, to be replaced by L&S SSG

Speed Signal Generator (SSG)

The old mechanical governor sensed the turbine rotational speed mechanically. To measure speed for the new digital controller, a Speed Signal Generator (SSG) was mounted on top of the generator shaft. Two proximity sensors, providing an electrical frequency-based signal, measured the turbine speed for speed control and creep detection.

Operator Interface Terminal (OIT)

The L&S MRT control was provided with an Operator Interface Terminal (OIT) to allow site engineers easy access. This Human Machine Interface was panel mounted on the governor cabinet and also used for the system configuration and tuning.

Installation & Commissioning

The removal of the old components turned out to be challenging. Due to the space constraints in the governor cabinet, hoisting equipment could not be used and removing these heavy mechanisms without any lifting gear proved almost impossible. PM Control therefore enlisted the assistance of local EDL-Gen and VASE technicians, who provided support with the hoisting and installation of the new governor system.

During the mechanical modifications of the old system specialized metal works were required. Due to the absence of a properly equipped mechanical workshop, the milling of some components was done at the EGAT workshop in Thailand, a four-hour drive away.

Before the turbine start-up all relevant subsystems were calibrated and tested. This included the calibration of the wicket gate position feedback and setting the correct gate opening and closing rates through the timing nuts. Using the Hitachi specified opening and closing time settings ensured that no rapid opening/closing of the wicket gates occurred, preventing water hammering in the penstock and subsequent equipment damage.

As requested by EDL-Gen, the turbine's dynamic response was tested through a series of load rejections at varying loads. Prior to the handover PM Control made final dynamic adjustments for the generator off-loading after which EDL-Gen approved the system and the turbine was put back into operation in June 2009.

Results

- Increased efficiency as hydro turbine is able to run at full load again and can now achieve more turbine power.
- Reduced risk of downtime, thanks to the replacement of all wear-and-tear components.

The commissioning at the Nam Ngum 1 plant was a success story. The L&S MRT with the new distributing valve illustrated that PM Control's solution could meet all operational and technical requirements of the hydro turbine application.



Before Retrofit - Hitachi Mechanical Cabinet Actuator



After retrofit - L&S Manifold & Distributing Valve mounted in the existing governor cabinet



A Happy Client

