

Electricite Du Laos (EDL) PM Control Successfully Retrofits Excitation and Turbine Control Systems at Xeset 1 Hydroelectric Power Plant



Background

Savankham Electrical Equipments & Machineries Supplier (SEMS) is an engineering company located in Laos. The company's core business is to handle the maintenance program of Electricite Du Laos (EDL) hydro power plants. 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 Xeset 1 hydropower plant, located in Senvang Village in Lao's Salavanh district, has been supplying electricity to the provinces of Saravan and Champasak, and surplus power has been exported to Thailand. Xeset 1 is a run-of-the-river hydro plant utilizing about 1.5 km of the river with a drop of 157 m. As this type of scheme has limited storage capacity, the energy production generally varies with the river discharge from day to day. A 10 m high gravity dam creates the intake pond and from here the water is conveyed through underground tunnels, which are partly steel lined to withstand the high water pressure. The powerhouse is built in the open air with five generating units, three with 13 MW capacity each, and two units with 3 MW capacity each.

Solutions

- UNITROL 1020 Automatic Voltage Regulator (AVR)
- UNITROL 6080 D5 Single Channel Static Excitation System (SES)
- Woodward Atlas-II turbine control
- Woodward SPC Servo Position Control
- Woodward SPM-D synchronizer
- Human Machine Interface

Results

- New hardware reduces obsolescence risk
- Easier unit operation through turbine HMI and generator ECT



Challenge

The Xeset 1 hydro power plant was experiencing system failure and obsolescence issues with both the generator excitation systems and the turbine control systems of all the five turbines. In the initial retrofit project two of the five turbines were retrofitted.

The generator excitation for Unit 1, which provides 3MW of power, was provided by a redundant ABB Automatic Voltage Regulator. An ABB single channel static excitation system provided the excitation for unit 5, providing 13 MW of power. Both turbines were equipped with an early digital ABB hydro turbine control system.

To provide the turbine and generator control retrofits EDL-Gen consulted its engineering and maintenance partner SEMS to advise on the maintenance and upgrade strategy for the power plant. Because of PM Control's proven track record and excellent references in providing governor and generator control retrofits in Asian utility and industrial power plants, SEMS consulted PM Control. Moreover, PM Control is ABB's Regional Technical Centre (RTC) for ABB excitation systems and since the existing systems were by ABB, a retrofit to newer ABB equipment was a logical step.

Solution

PM Control conducted a detailed site survey and proposed the following solutions:

- UNITROL 1020 Automatic Voltage Regulator (AVR)
- UNITROL 6080 D5 Single Channel Static Excitation System (SES)
 - 3-phase (6-pulse) or single-phase (full wave) thyristor converter
 - Combined Input Output (CIO) Device
 - Power Interface (PII) Board
 - Excitation Control Terminal (ECT)
- Woodward Atlas hydro turbine control
- Woodward SPC (Servo Position Controller)
- Woodward SPM-D synchronizer
- Human Machine Interface

UNITROL 1020 Automatic Voltage Regulator (AVR)

A UNITROL 1020 AVR was used to retrofit the existing ABB GX300P Voltage Regulator in Unit 1. Two Unitrol 1020's were supplied to provide the requested unit redundancy, allowing maintenance or failure of one AVR while the turbine remains online. The UNITROL systems are distinguished by their customer-specific system solutions and high quality. Headquartered in Switzerland, ABB has almost 90 years of experience in the field of excitation systems.



New Turbine Control Panel



3 MW Turbine



Actuation of 13 MW Turbine

UNITROL 6080 D5 Single Channel Static Excitation System (SES)

A UNITROL 6080 D5 SES was proposed to retrofit the existing ABB SES in Unit 5. The UNITROL 6080 is a solution specifically designed for small to medium power applications. The Static Excitation System generates and controls a current that establishes a magnetic field in the generator between the rotor and stator. This magnetic field in the generator allows the transfer of mechanical energy received from the torque of the hydro turbine shaft into electrical energy in the generator stator. The SES controls the characteristics of the magnetic field between the generator stator and rotor and thereby directly controls the quality and stability of the generated power.

A 3-phase (6-pulse) or single-phase (full wave) thyristor converter with the required interface board to the controller, providing input, output voltage measurement USYN, UE and current measurement from CTs.

Furthermore, a power interface (PIN) board was proposed, which forms the main interface between the CCM6080 board and the power stage of the system and provides a potential barrier inside the power converter. The PIN board is a fully passive board, implementing measurements of converter current, voltage and temperature as well as the output drivers for thyristor firing pulses.

A combined input output (CIO) device was also proposed. This device is used as a general-purpose interface to provide internal and external digital and analogue I/O signals to the superimposed control system. The device is based on the PEC80 control platform.

Moreover, the Unitrol 6080 for Unit 5 was supplied with a local Excitation Control Terminal, a service control panel that provides easy operation and maintenance of the ABB excitation system by the plant engineers.

Woodward Atlas II

The Atlas-II is a dedicated turbine control platform with a large variety of onboard I/O channels. It provides the control, sequencing and protection of the hydro turbine. The software for this application was designed and tested by PM Control.

Woodward SPC

The flow of water through the hydro turbine is dependent on the position of the turbine's wicket gates. A Woodward Servo Position Controller operates a hydraulic servo valve, which in turn positions the actuator of the wicket gates. An LVDT sensor is installed on the wicket gate actuator so that the SPC can precisely control the gate position to the requirement of the Atlas-II turbine control.



Actuation System



UNITROL 1000 Series AVR



UNITROL 6080 Series SES

Woodward SPM-D

When the turbine is synchronized to the grid, it is important that the frequency of the turbine is slightly higher than the grid frequency to avoid reverse power conditions. The Woodward SPM-D synchronizer ensures that the breaker is only closed when the turbine frequency is higher than the grid frequency.

Human Machine Interface

A Woodward Toolkit HMI system is provided for easy operation of the turbine. The HMI allows easy startup, operation and service of the turbine. The HMI also provides trending and alarm and trip indication.

Installation & Commissioning

The excitation and turbine control systems for unit 1 were replaced in March 2014. SEMS provided the removal of the old system and installation of the new system under PM Control's supervision. The systems were successfully commissioned on time and to full satisfaction of the end user. A post commissioning training was provided onsite. The commissioning of unit 5 is scheduled for early spring 2015.

Results

- New hardware reduces obsolescence risk
- Easier unit operation through turbine HMI and generator ECT

About PM Control

PM Control delivers energy optimisation solutions that increase efficiency while lowering emissions. Serving the energy, process and transportation markets, PM Control is the appointed distributor and recognized retrofit partner for Woodward Inc., Regional Technical Center for ABB Switzerland and Value Added Reseller for L&S Electric. Through our activities PM Control is having a positive impact on the lives of people across SE Asia, Australasia, India and beyond.

As a Regional Technical Center (RTC) for ABB, PM Control is authorized to:

- UNITROL 1000 series - Product sales and retrofit solutions
- UNITROL 6080 (D1, D3, D4 & D5) - Retrofit solutions
- Engineering support for ABB UNITROL 1000 series & UNITROL 6080
- Aftermarket field service and commissioning services

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