

First Farmer Holding Corporation PM Control Successfully Upgrades Turbine and Power Management Control for a GE Double Extraction Turbine



Background

First Farmer Holding Corporation (FFHC) is a cooperative-based, Filipino agro-industrial business enterprise, primarily focusing on sugar milling and refining, sugarcane production, poultry and feed mill operations and other agricultural nurseries, as well as private socio-economic development undertakings. The company was founded in June 1963 out of the desire of a number of major sugar plantation owners to manage their own sugar mills. To date, the corporation is managed by a group of plantation owners.

In 2007, FFHC collaborated with the Philippine government to upgrade their power plant. The objective was to upkeep their environmental friendly status by replacing all boilers and turbine generators with a co-generation station. This transformation of co-generation would be powered by bio-fuel in the form of sugar cane bagasse. Bagasse is a leftover product of the sugar refining process that can be burned in a boiler to produce steam. The FFHC power plant has sufficient bagasse to fuel the steam boilers for 8 months. To ensure full year power availability, FFHC purchases excess bagasse from neighboring sugar mills and plantations.

As a first step in the upgrade, FFHC purchased a secondhand 21MW General Electric double extraction steam turbine generator from Hawaii, which came with an outdated GE Mark II Speedtronics Control System. This double extraction steam would be able to provide the company with electricity through the attached generator as well as steam of low pressure and low temperature for heating purposes in the sugar refining process.

Being able to supply its own electricity and heat demand through the excess bagasse, FFHC no longer needed to import electricity from the state utility grid and could even sell its surplus electricity to the state utility.

By constructing a ten kilometer long 69KV overhead transmission line from the project site to an existing electrical substation of Negros Occidental Electric Cooperative (NOSECO), approximately 210 GWh of power could be exported annually.

Solutions

- Woodward 505DE Digital Control System
- Woodward 505DE Opview Human Interface Machine (HMI)
- Servo Position Controller (SPC)
- Linear Variable Differential Transformers (LVDT)
- EasYgen 3200

Results

- The possibility for FFHC to power-up its plant with a secondhand turbine.
- The ability to handle the fluctuating voltage of grid while exporting power to grid thanks to the EasYgen 3200.
- Improvement of FFHC's image as it now supplies power to utility.



Challenge

Due to the complexity of retrofitting control systems on double extraction steam turbines, FFHC contacted PM Control, the region's Woodward Recognized Turbine Retrofitter.

FFHC purchased its steam turbine from a Hawaiian sugar mill that had not serviced or maintained the system since its shutdown five years earlier. Most technical information relating to the steam turbine generator was not well maintained. PM Control was responsible for finding the missing information and designing the controller to work as per FFHC's technical requirements.

The fact that FFHC had signed an agreement with Luzon Visayas Grid to provide eight months of power supply created a buzz in the Philippines, as FFHC would become the first sugar mill to export power to utility. Moreover, FFHC's prime mover was the sole double extraction steam turbine in the country's sugar industry.

Solution

Requirements for the new control system included the following features:

Turbine Control:

- Start/stop and speed control of the entire turbine/generator train
- Double extraction control
- Human Machine Interface (HMI) for easy operation of the system

Power Management Control:

- Export power control
- Synchronizing generator breaker, synchronizing utility breaker
- Power factor control
- Generator protection function
- Mains protection function

PM Control cooperated with Integrated Power Inc. (iPower), its authorized Woodward partner in the Philippines, for this retrofit. The following products were proposed:

- Woodward 505DE Digital Control System
- Woodward 505DE Opview Human Interface Machine (HMI)
- Servo Position Controller (SPC)
- Linear Variable Differential Transformers (LVDT)
- EasYgen 3200

Woodward 505DE Digital Control System

PM Control replaced the plant's double extraction steam turbine governor with a Woodward 505DE digital control system. The Woodward 505DE is a 32-bit microprocessor-based control system designed to control single valve, single extraction, single admission, or double extraction steam turbines. The Woodward 505DE is field-programmable, which allows a single design to be used in many different control applications to reduce costs and delivery times. It uses menu-driven software to instruct site engineers on programming the control to a specific generator or mechanical drive application. The Woodward 505DE can be configured to operate as a stand-alone unit or in conjunction with the plant's Distributed Control System (DCS).

Woodward 505DE Opview Human Interface Machine (HMI)

The Woodward 505DE is operable via its PC interface program. This can either run on laptops or as a plug-and-play touchscreen. The Opview HMI



Sugar Cane



First Farmers Holding Corporation
Sugar Mill

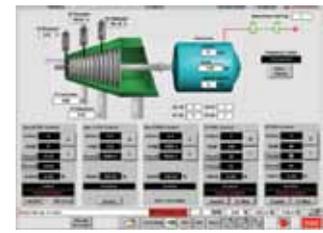


Woodward 505DE
Digital Control System

functions as a system overview for FFHC's electric double extraction steam turbine.

EasYgen 3200

An EasYgen 3200 was used for power management control. The EasYgen 3200 is a microprocessor-based power management control. Its modular software structure allows the EasYgen to be used in a wide range of applications, such as import and export power with a selector switch and protection of the prime movers.



Woodward 505DE Opview HMI

Servo Position Controller (SPC)

A Servo Position Controller (SPC) links the 505DE and the hydraulic servo for the actuation of the steam admission and extraction valves. The SPC can position a hydraulic or pneumatic actuator based on a position demand signal received from a control as well as a single-coil actuator using single or dual position feedback devices.

Linear Variable Differential Transformers (LVDT)

The SPC is part of an integrating actuation system. Linear Variable Differential Transformers (LVDT) sensors were installed on the steam valve actuators to provide a position feedback to the SPC.

Installation & Commissioning

Gathering information on the system proved to be challenging, which posed some difficulty when designing the system. Luckily, PM Control had previously executed a number of similar projects, which proved to be very helpful and resulted in the successful production of a double extraction turbine control integrated with the power management system.

FFHC was responsible for cable laying and the termination of wirings, while PM Control and iPower took care of the installation and ensured that terminations were done correctly. Inputs/Outputs (I/O) checking and calibration of the system were also carried out by PM Control.

During commissioning, several tests were done and faults were simulated to ensure the proposed solution suited the site requirements. After this intensive testing period, a scheduled duration test was performed on the entire system. During this test, the Woodward 505DE functioned correctly and according to FFHC's expectations.

The EasYgen 3200 generator and mains protective functions were also activated and tested. With the EasYgen 3200 as the power management control, the generator could supply power for the plant's operational needs and export surplus power to Grid, whereby the EasYgen controls the power factor. The EasYgen 3200 also fulfilled its tasks on breakers logic such as synchronizing the generator and mains breakers.

The new system was officially handed over to FFHC after a duration test. FFHC's engineers and operators were taught how to operate and maintain the control system with iPower and PM Control rendering local and technical support.

Results

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- The ability to handle the fluctuating voltage of grid while exporting power to grid thanks to the EasYgen 3200.
- The Improvement of FFHC's image as it now supplies power to utility.



EasYgen 3200



Servo Position Controller

The commissioning of FFHC was a success; the operation of the Woodward 505DE and the EasYgen 3200 illustrated the adaptability of Woodward controls to any applications.

The EasYgen 3200 was able to bias the Woodward 505DE as well as the third-party automatic voltage regulator to perform all required power management functionality. The synchronizing generator breaker, synchronizing mains breaker, export power, power factor control and protective functions were verified. All this allowed FFHC to power-up its plant while using a secondhand turbine.

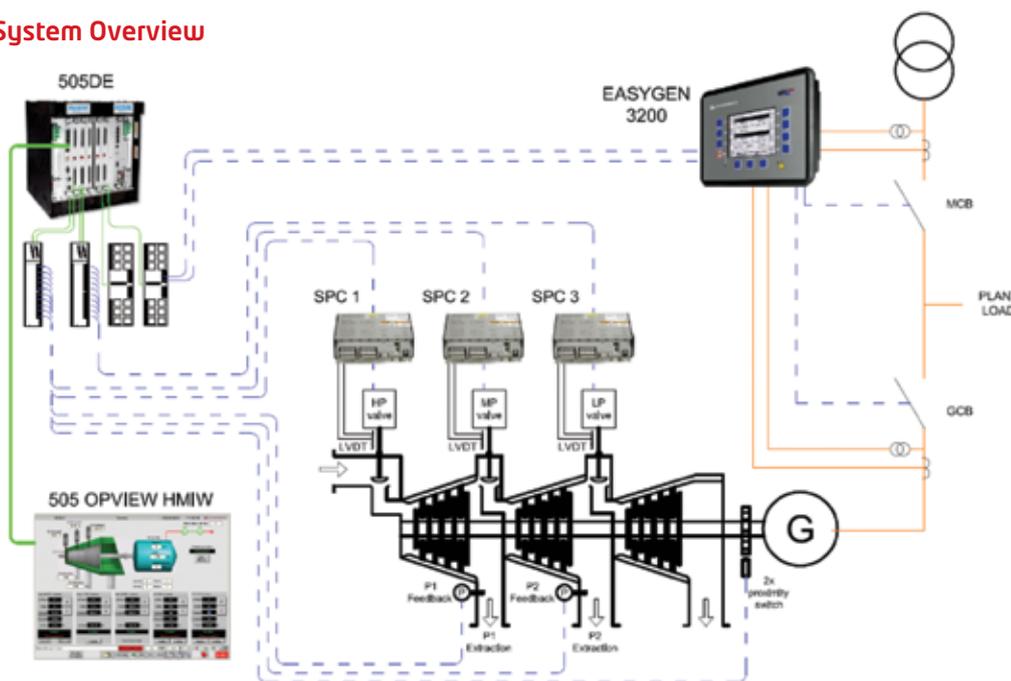
Thanks to the EasYgen 3200, FFHC can now handle the fluctuating voltage of grid while exporting power to grid. The fact that FFHC supplied power to utility improved the company's image and took the Philippines sugar industry to the next level.

Thanks to the success of the FFHC site, PM Control was awarded another project to retrofit a double extraction steam turbine system integrated with a power management system.

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.

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