

# Electrical/Computer Engineering Design Project Proposal

**Title:** Synchronous Condenser Operating Mode for Hydro Electric Generators

**Client:** Newfoundland Power Inc.

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## ***Description***

Newfoundland Power has recently upgraded control and protection systems for several hydro electric generators. The upgrades include conversion to a programmable logic controller based governor, replacement of the electro-mechanical protective relaying with a microprocessor based multifunction relay and replacement of the programmable logic controller based unit control system. A unit control system programmable logic controller is used to control the starting and stopping sequences for the generator as well as monitoring all the unit instrumentation during operation. Voltage regulation is also integrated with the unit control system programmable logic controller.

Newfoundland Power's hydro electric generators are normally connected to the island electrical grid for energy production. A number of our generators are in locations where it would be beneficial to operate them as synchronous condensers for system voltage regulation.

The project would be to develop the logic and protective relay settings necessary to introduce a synchronous condenser mode of operations to the unit control programmable logic controller. Project deliverables will be development of the control sequence and protection necessary to accomplish this while providing protection and control of all the plant's systems. One hydro plant will be identified for development of ladder logic and relay settings based on the hardware currently used by Newfoundland Power.

Before starting the project, it would be necessary to review the existing logic in the programmable logic controllers to understand how the generator is current operated and protected while producing energy. Settings for the multi-function relay will also need to be reviewed.

## ***Roles***

1. Investigate the impacts of operating hydro generators as a synchronous condenser for extended periods on mechanical system protection.
2. Develop control sequence to be integrated with existing programmable logic controller ladder logic to permit the generator to be changed from it normal energy production mode to synchronous condenser mode.

3. Modify existing monitoring and control logic to ensure the rotating equipment and mechanical system are adequately protected when operating in synchronous condenser mode.
4. Develop a group of settings for the protective relay to permit operation as a synchronous condenser. These setting must provide adequate protection for the generator in this mode and co-ordinate other system protection.
5. Develop voltage regulator setting for synchronous condenser mode to ensure the generator is operating within it's design limits.