# Evaluation of Hydro-PV-Battery Microgrid Systems as a Non-Wires Alternatives Solution to increase Renewable Integration and System Reliability

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## ABSTRACT

Hybrid energy systems and technologies have been studied and implemented across the world in off-grid and grid-connected applications. In the past, research has primarily been focused on combinations of solar and batteries or solar and wind systems. However, as per the International Energy Agency (IEA), hydropower currently generates more electricity than all other renewable technologies combined and is expected to remain the world's largest source of renewable electricity generation into the 2030s. While hydro is expected to be eventually overtaken by wind and solar, it will continue to play a critical role as a dispatchable power source to back up variable renewable generation.

Moreover, as demand load increases, power generation is increasingly being co-located or closely installed to load centers, which enables high reliability, while lowering costs as a Non-Wires Alternative (NWA). These Microgrid Systems can operate in grid-connected or islanded mode, depending on real-time operational and financial considerations.

To promote the adoption of hybrid solar PV and Hydropower Systems (PHHS) and Microgrids as a cost-effective NWA, Eagle Creek Renewable Energy (ECRE) in collaboration with GE Vernova (GEV) and Hanwha Q CELLS (Q CELLS), is developing a novel science-based approach and a multi-objective Microgrid Controller, that will quantify and demonstrate the grid-enabling advantages of these systems.

The hybrid PHHS system is composed of three hydro generators of 13MW each, one photovoltaic generator (PV) and one energy storage battery (BESS, optional). Advanced dispatch & control strategies are used to maximize plant revenue, achieve water conservation and shifting, Improve and optimize operations and maintenance strategies, manage uncertainties in integration with PV and energy storage system (BESS) and improve operational flexibility.

The control system is composed of the microgrid central controller and the field control units and intelligent electronic devices (IEDs). The control architecture of PHHS system has two levels of control – plant level and generation level. GEV's GridNode Microgrid Solution is used for the PHHS plant control and is comprised of two parts - the real-time Microgrid controller, and the optimizer. The real-time controller is responsible for the

reliability of the system through high-speed communication, control, and automation. The GridNode Microgrid Energy Management System (MEMS) platform provides the functionality of optimal dispatch based on the plant's desired outcome or mode of operation such as economics, conserving water, maximizing time of life, maximizing renewables, or peak shaving. Additionally, MEMS is responsible for scheduling, event management, dispatch case comparisons and KPI indications and tracking. This functionality is based of configurations, pricing schedules, load forecasts, PV forecast, and real time system and asset statuses. These two systems work in tandem to provide the PHHS plant an optimal solution to manage the system in grid connected mode, maintaining reliability, and resiliency while serving nearby demand load with high flexibility.

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