Modeling and Analysis of Value of Advanced Pumped Storage Hydropower in the U.S.

Project Summary

Objectives

The main objectives of the project are: (1) to improve the modeling representation of advanced pumped storage hydropower (PSH) and conventional hydro (CH) plants in power system and energy market simulation models; (2) quantify their ability to provide various grid services; (3) quantify the value of these services under different market structures and renewable energy (wind and solar) penetration scenarios; and (4) provide information for developing a business case for new investments in PSH and CH plants. Existing models have capabilities to represent CH and PSH plants, but typically do not provide levels of granularity required for detailed simulations necessary to capture the full range of technical capabilities, including dynamic response capabilities of new technologies, such as adjustable speed and ternary PSH plants. This project aims at developing capabilities to simulate and address the full value of services provided by advanced CH and PSH plants, including ancillary services, and quantify the benefits and revenues from these services.

Methodological Approach

The technical approach for the study has two main components:

(1) **Advanced Technology Modeling**: Develop and test vendor-neutral dynamic simulation models of advanced PSH plants, including adjustable speed and ternary technologies.

(2) **Production Cost and Revenue Modeling**: Simulate Western Interconnection and different balancing authorities within the region to assess potential revenues of PSH plants and the economic value of various contributions and services that they provide to the power system.

Figure 1: Technology Modeling Reports

Under the Advanced Technology Modeling task, the project team has developed vendor-neutral models for advanced PSH technologies (adjustable speed and ternary units) for which no models were available in the U.S. This work is documented in three reports (Figure 1) scheduled for publishing in June 2013.

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The analysis that is being performed under the Production Cost and Revenue Modeling task will address a wide range of power system control issues and timeframes. The study aims to capture PSH dynamic responses and operational characteristics across different timescales, from a fraction of a second to annual simulations. The project team uses a suite of four different computer models to simulate system operation and analyze various control issues occurring at different timescales. This is illustrated in Figure 2, which also shows an approximate zone of wind/solar variability impacts and the system control issues that are mostly affected by the variability of these renewable energy resources.

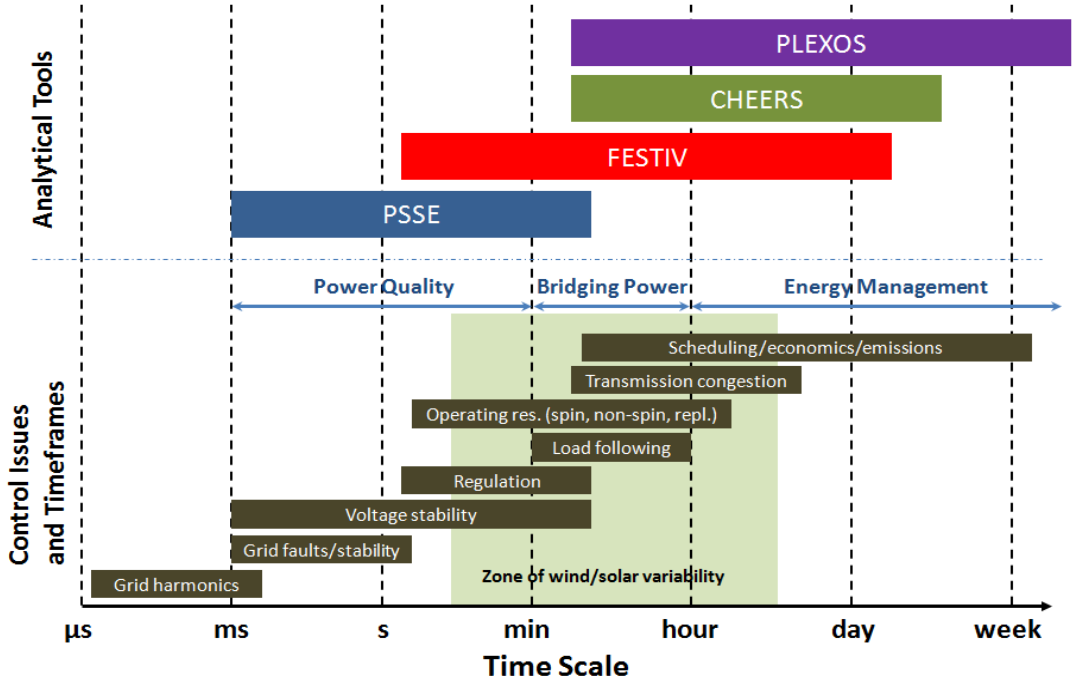

Figure 2: Power Grid Control Issues, Energy Management Timeframes, and Applicable Software Tools

Project Team

The project lead is Argonne National Laboratory and key core team members include Siemens PTI, MWH, Energy Exemplar, and the National Renewable Energy Laboratory (NREL). The composition of the team includes organizations with expertise in all aspects of project development, engineering design, equipment manufacturing, construction, and operation of PSH and CH plants, as well as with expertise in power system modeling, operations, markets, ancillary services, and reliability analysis. The team is guided by an Advisory Working Group composed of prominent experts in the field.

Project Funding

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