



TIP 284: EPRI Flexible Operation of Hydropower Assets

Context

With continued deployment of variable solar and wind generation, hydropower will play an increasingly important role in system load balancing and regulation. Hydropower can provide excellent response to variable demand requirements, as evidenced by pumped-storage projects. Wear and tear costs associated with more frequent flexible deployment of aging hydropower assets, however, will increase. Accelerated aging of generators, cavitation of runner blades, hydraulic actuator reliability, and transformer failures are examples of damage that can be linked to increased unit starts and more frequent load changes. These effects on low-temperature, low-speed hydro components differ from the thermal and mechanical fatigue related to operational flexibility of thermal plants.

Asset owners and operators must understand the impact that increased flexible operation will have on conventional and pumped-storage hydropower equipment for more accurate dispatch cost modeling and industry wear-and-tear cost data. This research will create new learning by documenting the impacts and costs associated with increased flexible operation and hydro asset cycling damage mechanisms, along with minimizing cost impact through more proactive maintenance strategies. The project will focus strictly on the needs of generating equipment used in conventional and pumped-storage hydropower.

Description

Information on accelerated wear and tear of hydropower generating equipment will be assembled from published hydropower equipment reliability data, interviews with hydropower asset operators, and input from equipment experts. Data on plant electrical equipment common to both hydropower and fossil plants will be assembled from existing equipment data tables maintained by EPRI's Generation Maintenance Application Center. Both domestic and international hydropower experience will be included, all compiled into a reference report that includes details of equipment failure modes and effects.

Equipment data tables are used extensively in non-hydro generating facilities as a basis for optimizing a preventive maintenance program to the unique operating demands on the asset, such as transition to increased flexible operation. These tables contain estimates of equipment reliability corresponding to specific preventive maintenance

strategies, failure mode effects, and fault diagnostics. Hydropower asset equipment tables will be assembled using a range of subject matter experts, as elicited by EPRI to create the more than 150 equipment data tables currently used by the fossil industry today.

A framework for assessing true generating costs of hydropower assets will need to take into account the additional preventive and future corrective maintenance activity that results from increased wear and tear due to flexible operation. The wear and tear impacts will be the basis for a new cost database on hydropower flexible operation. An interactive spreadsheet tool will be developed that contains an overall cost analysis framework integrated with the ranges of cost data corresponding to specific plant equipment and operational characteristics.

Why It Matters

Owners and operators of hydropower assets will benefit from an improved technical basis for maintenance strategy and dispatch cost modeling. Realistic valuation of the wear-and-tear costs to reflect increased component degradation rates is critical to providing the necessary plant maintenance resources. Reliability of conventional and pumped-storage hydro must remain high for their strategic role in the bulk electric system.

Goals and Objectives

- Improve understanding of flexible operation impacts on plant equipment
- Develop dispatch cost modeling framework
- Create technical basis for proactive maintenance strategy

Deliverables

- A technical report documenting hydropower equipment failure modes associated specifically with increased flexible operation.
- A database of hydropower equipment data tables that support a structured approach to preventive maintenance and fault diagnostics for flexible hydropower assets.
- A hydropower generation cost analysis framework and supporting database specifically for addressing increased flexible operation.

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Project Start Date: October 1, 2012

Project End Date: March 30, 2014

Funding

Total Project Cost: \$400,000

BPA Share: \$50,000

External Share: \$350,000

BPA FY2013 Budget: \$50,000

Reports & References (Optional)

Links (Optional)

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Participating Organizations

EPRI

