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PG&E Comments on the Joint Bulk Energy Storage Workshop (11/20)

Additional submitted attachment is included below.

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California Energy Commission
Dockets Office, MS-4
Docket No. 15-MISC-05
1516 Ninth Street
Sacramento, CA 95814-5512

Re: Docket 15-MISC-05: Pacific Gas and Electric Company Comments on the Joint Commission Long-Term Procurement Plan Workshop on Bulk Energy Storage

I. Introduction

Pacific Gas and Electric Company (PG&E) was pleased to participate in the Joint California Energy Commission (CEC) and California Public Utilities Commission (CPUC) Long-Term Procurement Plan (LTPP) Workshop on Bulk Energy Storage held on November 20, 2015. At the workshop, PG&E provided the Commissioners with information regarding the operations of the Helms Pumped Storage Facility (Helms), which has played a vital role in California's energy system for over 30 years.

The following comments respond to a number of questions posed by CEC and CPUC Commissioners during the workshop regarding PG&E's bulk energy storage and hydroelectric generation assets. Namely, these comments will discuss:

- The composition and potential for increased flexibility of PG&E's existing hydroelectric generation assets.
- Trends in Helms utilization.
- Challenges to retrofitting Helms with variable speed pumps.

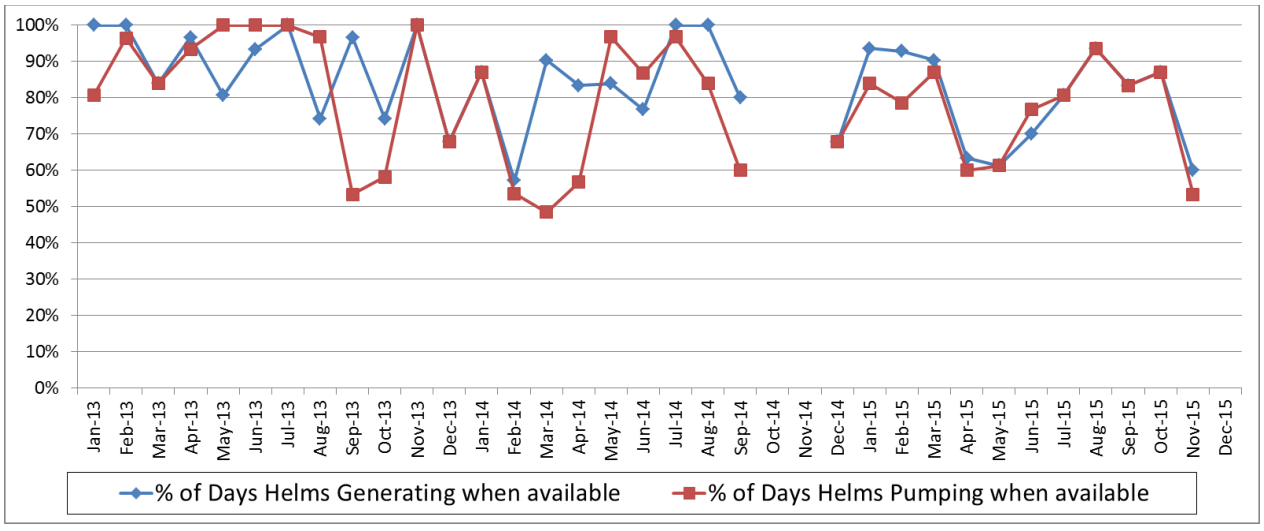
II. PG&E Works Continuously to Improve Hydroelectric Generating Capabilities

PG&E's hydroelectric system is the largest privately-owned system of its type in the nation, with nearly 4,000 megawatts of generation. Approximately ten percent of the nameplate capacity of PG&E's hydroelectric system is considered "run-of-river" with little to no water storage capability and, consequently, no controllable flexible capacity. The remaining ninety percent of PG&E's hydroelectric capacity, which includes Helms, is capable of daily, weekly, and/or or seasonal storage. These "ponded" assets, a large majority of PG&E's hydroelectric system, provide significant flexible capacity.

A small number of PG&E's hydroelectric assets have designated "no-run" zones which call for a unit to be ramped quickly through a range of power outputs that would be damaging the asset if it were operated within that range for extended periods of time. While utilizing rather than avoiding these rough operating zones would increase the flexible operating range of existing hydroelectric assets, doing so would also result in equipment damage and associated increased maintenance and replacement costs to compensate for wear. Modifying existing turbines to shift rough operating zones is also costly; it is rarely economical to replace a turbine prior to the end of its useful life in order to improve rough operating zone characteristics. Additionally, turbine modification carries a performance penalty, as a turbine only has a single point of best efficiency. Any modification to eliminate a low-power rough operating zone would come with reduced efficiency at full load and possibly reduced full load output. PG&E continuously evaluates opportunities to minimize or eliminate rough operating zones in its hydro fleet and implement cost effective improvements as part of its on-going evaluation of fleet performance.

III. Helms Is Frequently Utilized, With Mid-Day Pumping Increasing with More Renewables on the Grid

Helms is frequently called upon to generate electricity or store energy by operating in pump mode, as shown in the graph below. Over the past 3 years, Helms has on average generated approximately 80% of the days each month and pumped approximately 80% of the days each month it was available for operations.



(Note: In October and November 2014 Helms was on planned outage for maintenance; data are based on actual outputs and is not normalized to account for different hydro conditions from year to year.)

The table above utilizes the frequency of Helms generating or pumping to show how often the asset is used. This is a reasonable representation of Helms' utilization as Helms also often provides ancillary services (such as spinning reserve, non-spinning reserve and regulation) to support grid operations, making it difficult to provide utilization insights using a traditional capacity factor approach.

It should also be noted that, as Mike Jones presented at the November 20 workshop, the pumping capability at Helms is at times limited due to transmission constraints in the Fresno area. During the workshop, PG&E mentioned four projects that will reduce or eliminate these transmission limitations:

- The Warnerville-Wilson 230 kilovolt (kV) line series reactors
- Gates 500/230 kV transformer
- Kearney – Herndon 230 kV reconductoring
- Gates – Gregg 230 kV, a new line

In consultation with CAISO staff, CAISO President and CEO Steve Berberich confirmed during the workshop that these transmission upgrades will be "more than adequate to handle all configurations of Helms."[1]

The utilization of Helms pumps for mid-day energy storage has increased over the past three years as more renewables have connected to the grid. In July and August of 2013, for example, Helms performed minimal mid-day pumping. However, mid-day pumping increased to occur during thirty percent of the days in August 2014, while being confined to a subdued five percent of days in July of that year. In 2015 the increase in mid-day pumping continued, with approximately 30 percent of the days in both July and August having mid-day pumping occurrences.

IV. Retrofitting Helms Offers Limited Benefits with High Risks

In 2010, PG&E performed an initial screening of variable speed pumped storage technology capabilities for new installations. That screening effort was also used to investigate the opportunity for replacing the existing Helms generators with variable speed units.

The screening results showed that for a newly installed unit designed to provide the best range of variable speed operation in pumping mode (consuming energy from the grid), the total energy consumed in pumping would be approximately 325 MW, with a minimum pumping demand of 200 MW (determined by the hydraulics of the tunnel system). Consequently, the new unit would provide a useful range of approximately 125 MW that could be used for regulation. Helms has a pumping demand of 310 MW, so the analysis assumed a retrofit would yield no greater than 125 MW of regulation during pumping.

A retrofit of this nature at Helms would face many technical barriers, one of which is the inability of the existing cavern space to accommodate a modified variable speed generator and associated electronic equipment. The Helms power house is carved out of a mountain of granite, and while the cost of further excavation of the cavern is unknown, such work risks significant damage to the existing facility, thus prohibiting a retrofit.

If cavern size was not a limiting factor, additional technical evaluations would need to be conducted to determine retrofit feasibility, including evaluations of the hydraulic system, generator power density, and rotor dynamics. Conducting these evaluations would cost tens of millions of dollars, with the possibility that additional insurmountable technical hurdles would be identified.

In summary, the costs and risks of retrofitting Helms with variable speed technology are high, while the benefit would be only a narrow range of variable power consumption in pump mode. Consequently, PG&E currently has no plans to conduct a retrofit at Helms.

[1] Transcript of 11/20/15 Joint Workshop with the California Energy Commission and the California Public Utilities Commission, p. 66

V. Conclusion

We appreciate the opportunity to provide information about PG&E's hydroelectric and pumped storage facilities, and commend the Commissioners for their further consideration of bulk storage as an important tool in managing the modern grid.

Sincerely,

/s/

Nathan Bengtsson