SITE C | CLEAN ENERGY PROJECT

RESPONSE TO WORKING GROUP AND PUBLIC COMMENTS ON THE SITE C CLEAN ENERGY PROJECT ENVIRONMENTAL IMPACT STATEMENT

Technical Memo

HYDRO-ELECTRIC STORAGE AND DISPATCHABLE CAPACITY

MAY 8, 2013

Subject: Hydro-Electric Storage and Dispatchable Capacity

Purpose

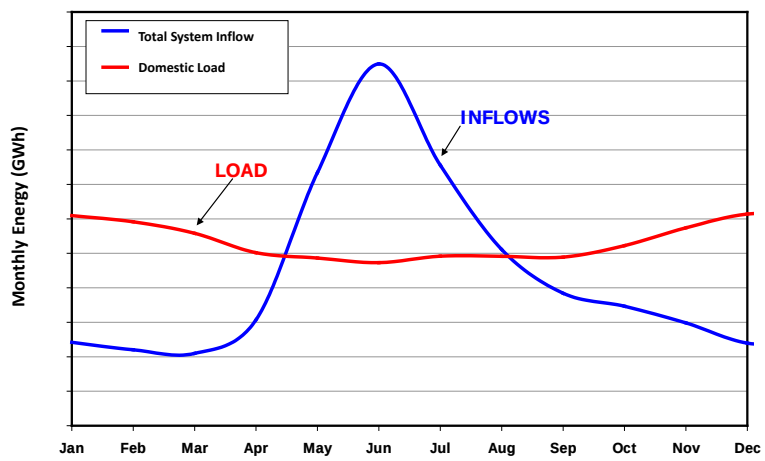
The purpose of this Technical Memo is to summarize, for convenience, the information provided in the EIS on hydro-electric storage and dependable capacity.

Hydroelectric Storage

The water stored in BC Hydro's major storage reservoirs – Williston reservoir and Kinbasket reservoir – enable BC Hydro to meet peak demand in the winter despite peak inflows occurring in the spring, by storing water in the spring and using it in the winter. The Project would add to the value of the water storage in Williston reservoir by enabling it to be used an additional time to generate electricity. As stated in Section 7.4.1 of the EIS:

> Electricity demand in British Columbia varies, with the highest seasonal demand in the winter, the highest weekly demand during the work week, and the highest daily demand during the daytime. As shown in Figure 7.3, water inflows to the BC Hydro reservoirs also vary, peaking in the spring with annual snowmelt and reaching a minimum in late winter. As part of normal operation of Williston Reservoir, water is stored during the high runoff and relatively low electricity price period from late April/May to early July, making water available to supplement the low runoff during the high demand and/or high price electricity period in summer and winter.

BC Hydro System Load and Inflows[1]



The Williston Reservoir can store three years of water inflow and enables BC Hydro to use water for generation when required for domestic demand. Flow from Williston Reservoir is regulated by the G.M. Shrum generating station. The regulated flow from G.M. Shrum and the natural flow enter Peace Canyon Dam's Dinosaur Reservoir. Outflow from Peace Canyon Dam is regulated by the Peace Canyon generating station. The flow into the Project's proposed reservoir would thus be regulated by the G.M. Shrum generating station and, to a lesser extent, the Peace Canyon generating station, to provide year-to-year shaping as well as seasonal and weekly shaping. In effect, this optimizes the value

[1] Volume 1 Section 7 Project Benefits, Figure 7-3.

of the water stored behind W.A.C. Bennett Dam, as that water would be used for generation a third time after being run through turbines at the G.M. Shrum generating station and the Peace Canyon generating station.

The Project reservoir, with a maximum normal operating range of 1.8m and an active storage volume of 0.4% of the active storage volume of Williston Reservoir, does not have sufficient storage volumes to provide seasonal shaping of generation. However, the Project takes advantage of the storage in the Williston reservoir to allow for seasonal shaping of generation to match BC Hydro customer demand. As stated in Section 7.4.3 of the EIS:

> This upstream regulation allows the Project to generate electricity to match the timing of BC Hydro customer demand without the need to establish another large multi-year storage reservoir similar to Williston Reservoir. As a result, the Project is able to produce approximately 35% of the energy produced by the G.M. Shrum generating station with 5% of the reservoir area.

Integration of Clean or Renewable Resources

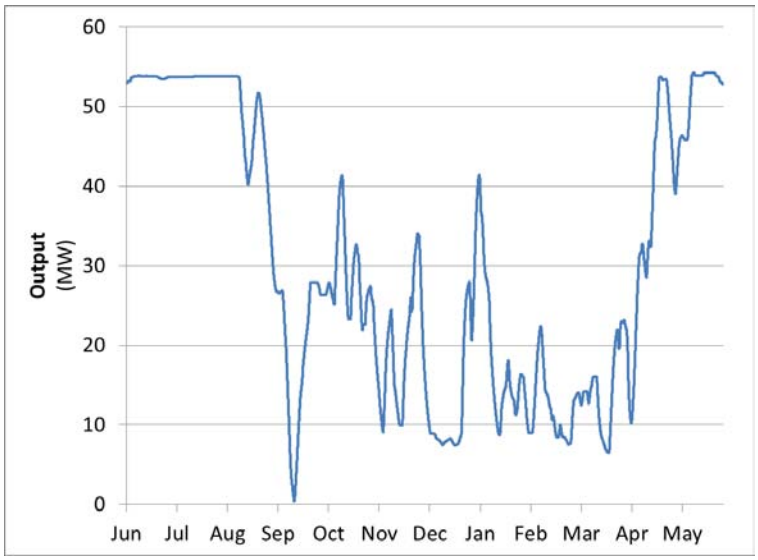
An additional benefit of hydro-electric storage is the ability to integrate energy projects with low dependable capacity such as wind and run-of-river hydro. As stated in Section 7.4.1 of the EIS:

> Many clean or renewable energy resources – such as wind or run-of-river hydro – are intermittent, as their generation varies with natural factors. In order to integrate these clean or renewable resources into the BC Hydro system and meet electricity demand, this variability must be backed up by dispatchable capacity. The Project provides additional clean and renewable dispatchable capacity to the BC Hydro system and increases the system's capability to integrate renewable resources such as run-of-river hydro and wind.

With respect to the variability of run-of-river hydroelectric projects, the EIS states:

> As described in Section Volume 1 Section 5.2, run-of-river hydroelectric projects do not have any material amounts of storage, meaning that their output varies with the natural flow in the river. Typically, run-of-river projects generate at full output during the spring and early summer when river flows are high as well as during periods of heavy rain. Generation drops during low flow periods. Refer to Figure 5.5 in Volume 1 Section 5.5.2.1, which shows the annual power output of a typical run-of-river project in the coastal region of B.C. […] The output from run-of-river projects is less predictable outside of the spring freshet, which makes it difficult to operate to match demand.

Typical Annual Output from a Run-of-River IPP[2]



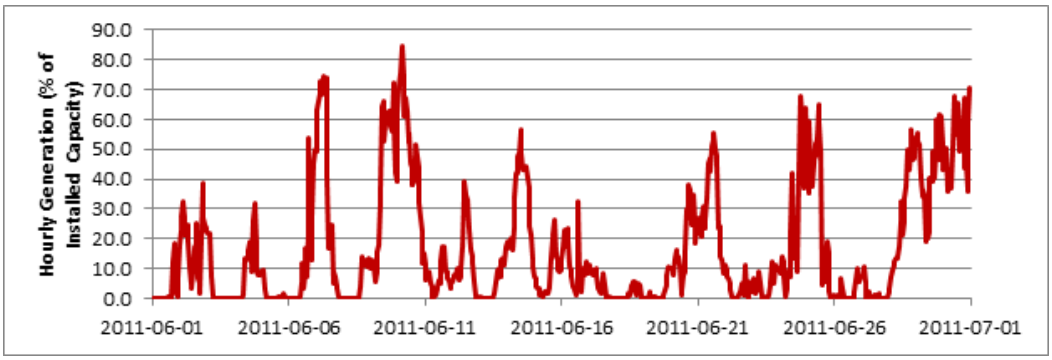
The seasonal variability demonstrated in Figure 5.5 illustrates the potential benefits of hydro-electric storage in integration of run-of-river resources. Generation at run-of-river resources generally peaks in the spring and early summer when customer demand is lowest. Facilities, such as the Project which are downstream of large hydroelectric storage reservoirs, can be operated to have lower generation during the spring and early summer allowing the run-of-river generation to be used to serve load as much as possible and then have higher generation in the fall/winter when customer demand is highest (and run-of-river generation is low).

With respect to the variability of wind projects, the EIS states:

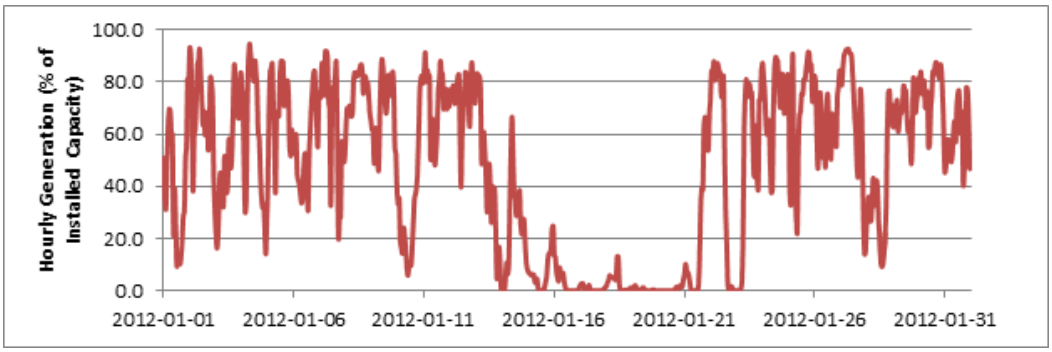
> As described in Volume 1 Section 5.2, due to natural variations in wind speed, wind power generation is highly variable in the short-term timescales of seconds to minutes, resulting in the need for additional highly responsive generation capacity reserves on the electric system to maintain system reliability and security. The natural variability in wind power generation also makes it difficult to forecast wind in the hour- to day-ahead time frame, resulting in the need to set aside system flexibility to address the potential for wind generation to either under- or over-generate in this time frame. Figures 5.6 and Figure 5.7 in Volume 1 Section 5 of this EIS show sample BC Hydro load and wind generation variability from a sample eight-day period in June 2011 and January 2012, respectively.

[2] Volume 1 Section 5 Need for, Purpose of, and Alternatives to the Project, Figure 5-5.

Sample Wind Generation during Freshet Period (June 2011)[3]



Sample Wind Generation during Wintertime (January 2012)[4]



In order to evaluate the potential benefits of the storage provided by the Project to integrating intermittent resources, BC Hydro conducted analysis as described in Section 7.4.1:

> BC Hydro has reviewed many wind integration studies, utility practices, and regulatory agency proposals in the area of wind integration to inform the analysis of the effect of wind integration on the BC Hydro system. BC Hydro expects that the understanding of the issues surrounding the integration of wind resources will continue to evolve as BC Hydro gains more experience with the operation of wind resources in B.C.
>
> A preliminary analysis has been completed to determine the amount that the Project would increase the maximum amount of wind power that can be integrated into the BC Hydro system without affecting the reliability and security of the system. The results of the analysis show that the wind integration limit could increase by up to 900 MW with the addition of the Project.

[3] Volume 1 Section 5 Need for, Purpose of, and Alternatives to the Project, Figure 5-6.

[4] Volume 1 Section 5 Need for, Purpose of, and Alternatives to the Project, Figure 5-5.

Value of Economic Dispatch

As discussed, generation from intermittent resources such as wind and run-of-river hydro is determined by environmental conditions such as river flows or wind speeds. As a result, intermittent resources cannot be economically dispatched in response to changes in market prices.

In contrast, the EIS considers three sets of resources that are economically dispatchable – Pumped Storage, Natural Gas generation, and the Project. These projects can generate power when market pricing is high and stop generation when pricing is low, providing additional value to BC Hydro's ratepayers.

The difference in the capability of resources to dispatch based on market prices is largely captured in the portfolio analysis results shown in Table 5.41. However, the economic dispatch benefits are not addressed in the levelized unit energy cost and accompanying comparison shown in Table 5.42.

Related Comments / Information Requests:

This technical memo provides information related to the following Information Requests:

pub_0191-001	pub_0525-001	pub_0591-001	pub_0604-001	pub_0605-013
pub_0605-019	pub_0989-002	ab_0001-167		