BC Hydro
Power smart

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October 11, 2017

Mr. Patrick Wruck
Commission Secretary and Manager
Regulatory Support
British Columbia Utilities Commission
Suite 410, 900 Howe Street
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Dear Mr. Wruck:

RE: Project No. 1598922
British Columbia Utilities Commission (BCUC or Commission)
British Columbia Hydro and Power Authority (BC Hydro)
BCUC Site C Inquiry Process

BC Hydro writes further to the Commission's Preliminary Report of September 20, 2017, which posed a number of information requests to BC Hydro and invited further submissions on the Preliminary Report. The attached is BC Hydro's final Reply Submission to the Site C Inquiry Process.

We have already provided, in our filings over the past two weeks, responses to the Commission's direct requests. In this Reply Submission, we have provided additional information relevant to the Commission's preliminary report. We have also highlighted some of the most significant points from our responses to information requests.

We focus on broader themes in this Reply Submission, rather than replying to each element of the Preliminary Report or other filed materials line-by-line. As such, our silence on particular points should not be interpreted as agreement.

We would be pleased to provide any further explanation on any matter, whether covered in this submission or otherwise. We will have experts present at the technical session on October 14, 2017 to answer the Commission Panel's questions.

For further information, please contact Fred James at 604-623-4317 or by email at bchydroregulatorygroup@bchydro.com.

Yours sincerely,

Fred James
Chief Regulatory Officer

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Enclosure

BC Hydro Submission on the British Columbia Utilities Commission Preliminary Report

October 11, 2017

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1 Introduction and Executive Summary

1.1 Introduction

The Terms of Reference to the Site C Inquiry require that the Commission address the relative implications for ratepayers of three scenarios: continue with Site C as planned, terminate and remediate, or suspend and maintain with the option to proceed. The Terms of Reference identify considerations including cost, system benefits and greenhouse gas emissions. BC Hydro has already filed a significant amount of information in response to information requests in the Commission's Preliminary Report (Preliminary Report). This submission (Reply Submission) provides further information and commentary on the issues raised in the Preliminary Report.

The information we have filed confirms that completing the remaining work on Site C:

- remains – by far – the most cost effective and lowest risk option for ratepayers to obtain needed energy, capacity and other system and reliability benefits; and
- best supports the fight against climate change by providing electricity with lower greenhouse gas emissions per unit energy of any alternative, and enabling the integration of other intermittent clean and renewable resources as energy supplies to be used by BC Hydro.

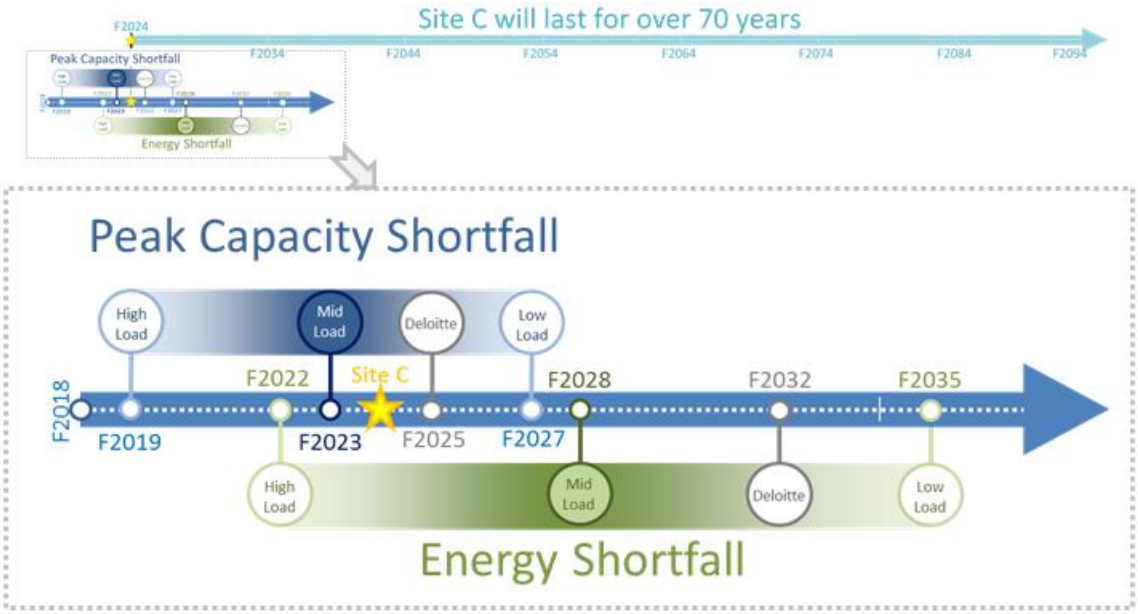
In this Reply Submission we have also addressed the input received from Aboriginal groups at the Commission's hearing sessions (Appendix A). Multiple courts have concluded that the adverse effects of the Project have been meaningfully and reasonably balanced, including with respect to Aboriginal groups. BC Hydro's efforts to consult and accommodate have led to comprehensive benefits agreements with six of the ten impacted First Nations. Those benefits would be lost if the Project were terminated.

1.2 Executive Summary

This Reply Submission highlights a number of factors that speak to why completing Site C as planned remains in the best interest of ratepayers. These factors tie back to the relative cost and cost risk among the three options in the Terms of Reference, and Site C's role in the fight against climate change.

- ***First, we need new resources to serve our customers (Section 2)***
  - BC Hydro's best assessment of when we will require new capacity and energy to meet shortfalls flows from our "mid" load forecast (refer to "Mid-Load" points in the figure below).
  - Supporting electrification initiatives to combat climate change would be a "game changer," resulting in our requirements for energy and capacity to be well above our high load scenario.
  - Site C is still cost effective in our low load growth scenario (refer to "Low-Load" points in the figure below), which assumes even lower growth than the "alternative scenario" identified by Deloitte.

Figure 1-1 Timing of Energy and Peak Capacity Shortfall (Without Site C and Without Electrification)



- ***Second, Site C will provide a long-term, cost-effective and flexible supply of clean energy and capacity with the lowest greenhouse gas emissions of any resource alternative.***

- The Joint Review Panel, as part of the three-and-a-half year environmental assessment process,[1] found:

  > The benefits are clear. Despite high initial costs, and some uncertainty about when the power would be needed, the Project would provide a large and long-term increment of firm energy and capacity at a price that would benefit future generations. It would do this in a way that would produce a vastly smaller burden of greenhouse gases than any alternative save nuclear power, which B.C. has prohibited. The Project would improve the foundation for the integration of other renewable, low-carbon energy sources as the need arises. The Project would also entail a number of local and regional economic benefits, though many of these would be transfers from other parts of the province or country. Among them would be opportunities for jobs and small businesses of all kinds, including those accruing to Aboriginal people.[2]

- ***Third, while there are residual risks to be managed on Site C, the significant progress made to date has reduced delivery and cost risks relative to other resource options.***

  - Planning for Site C began 13 years ago. Extensive site investigations allow us to understand the site and geotechnical conditions.[3]
  - Consultation with Aboriginal groups has been ongoing for a decade, and agreements have been reached with the majority of impacted First Nations.[4]
  - The environmental assessment, which spanned three-and-a-half years, is complete. The Federal and Provincial approvals have been upheld in court.
  - BC Hydro has obtained the majority of its required permits including *Fisheries Act* authorizations and Water Licences.[5]

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[1] Site C was the subject of a three and a half year federal-provincial Environmental Assessment that included a Joint Review Panel, which considered the environmental, social and economic effects of the Project, and potential impacts on Aboriginal groups. At the end of the process, two provincial Ministers and the federal Cabinet decided that the Project was in the public interest and that the likely adverse effects of the Project were justified in the circumstances. Refer to August 30 Filing, Appendix B.

[2] Joint Review Panel Report, p. iv.

[3] Significant assessment of the geotechnical and Site Conditions had already been done in prior decades August 30 Filing, Appendix B.

[4] August 30 Filing, Appendix B.

- Major contracts are in place and construction has been ongoing for more than two years. Work under some contracts has already been completed.[6]

- Fourth, upon termination, ratepayers would pay 36 per cent of the updated cost of the Project, without anything to show for it. (Section 3)
  - Deloitte and BC Hydro agree that, if the Project were to be terminated, ratepayers would incur approximately $3.2 billion to recover spent costs, terminate construction and remediate the site.
  - This termination and remediation cost estimate (which is only to return the site to a safe and environmentally sound state and not to return the site to its original state) is also subject to significant cost risk.

- ***Fifth, suspension results in either a more expensive and riskier project (if the Project subsequently proceeds) or a more expensive and riskier termination (if the Project is subsequently cancelled). (Section 4)***
  - The direct costs arising from suspension and maintenance ($1.1 billion) are approximately the same as the costs of termination.
  - Suspension could compromise BC Hydro's ability to deliver Site C. A complex infrastructure project cannot simply be "paused" for a number of years and then taken up again without substantial challenges to execution.
  - At a minimum, the project would be estimated to cost $13.6 billion if suspended for seven years and could be higher.

- ***Sixth, accounting for all costs, Site C is by far the most cost-effective option for ratepayers, even in low-probability scenarios that give rise to high cost risk for ratepayers. (Section 5)***
  - The Project is the most cost-effective in each of, <u>and all combinations of</u>, scenarios with: (i) cost overruns on Site C; (ii) low load growth; and (iii) highly optimistic cost assumptions regarding alternatives.[7]
  - Even with a 10 per cent increase in the cost of Site C, a portfolio of alternatives is still $7.0 billion more costly on a present value basis than completing Site C.[8]

[5] August 30 Filing, Appendix B.
[6] August 30 Filing, section 4.
[7] Response to the BCUC IRs 2.42.0, 2.44.0 and 2.46.0.

- In all of the scenarios the Commission asked us to run, Site C remains the best option for ratepayers. In the worst scenario combining (i) +50 per cent cost overrun scenario, (ii) low load growth, and (iii) highly optimistic assumptions of the future cost of alternative resource options, a portfolio of alternatives is still $1.9 billion more costly on a present value basis than completing Site C.[9]
- Low probability assumptions about alternative resource costs, or using an assessment period that ignores the longer term declining resource costs of Site C, entail very significant cost risk for ratepayers.

- ***Seventh, the fight against climate change means load growth from electrification is only going to increase and Site C is the best option in support of that fight. (Sections 2 and 6)***
  - A world in which there is significant switching to low carbon electricity sources would mean that we would need much more clean energy and capacity than could be provided by Site C alone.
  - The Joint Review Panel found that Site C:
    - produces the least amount of greenhouse gas emissions per unit energy of any generation option; and
    - facilitates the integration of other renewable resources, such as wind and solar.[10]
  - Site C is unmatched by any other resource in terms of the firming, shaping and storage benefits the Project provides that are key to integrating other intermittent renewable energy sources like solar and wind into BC Hydro's resource options.

- ***Eighth, the adverse effects of the Project have been meaningfully and reasonably balanced, including with respect to Aboriginal groups. (Appendix A)***
  - The Courts have characterized the Site C environmental assessment process as "one which assesses the project in the context of its broad

[8] Response to the BCUC IR 2.46.0.
[9] Response to the BCUC IRs 2.42.0, 2.44.0 and 2.46.0.
[10] Refer to August 30 Filing, section 2 and Appendix B.

impacts on society, weighs the efficacy of mitigative measures, and authorizes a project to proceed if it is in the public interest to do so."[11]

- The majority of First Nations in closest proximity to and most impacted by the Project do not oppose the Project.[12] They have entered agreements with BC Hydro that provide significant and ongoing benefits from the Project that would be lost if the Project were terminated.

- McLeod Lake Indian Band, one of the First Nations impacted by the Project who has signed a series of benefit agreements, has characterized the prospect of termination or suspension as an "economic catastrophe for the community" that would "unravel [the] process of reconciliation" and the "renewed relationship" between McLeod Lake and BC Hydro, and by extension, the provincial Crown.[13]

Two First Nations (West Moberly and Prophet River First Nations) unsuccessfully challenged the Project approvals in court. The BC Court of Appeal and Federal Court of Appeal, in affirming decisions of courts below, concluded that the Project impact on those First Nations has been meaningfully and reasonably balanced.[14]

[11] Peace Valley Landowner Association v British Columbia (Environment), 2015 BCSC 1129, para. 94, upheld on appeal 2016 BCCA 377, para. 29; Prophet River First Nation v British Columbia (Environment), 2015 BCSC 1682, upheld on appeal 2017 BCCA 58.

[12] BC Hydro has reached agreements with six of the ten Treaty 8 First Nations identified as potentially impacted by the Project, namely Doig River, Halfway River, Saulteau, McLeod Lake, Dene Tha', Duncan's First Nations.

[13] First Nation Input Session, Prince George, September 29, 2017, Transcript, pages 414, 427, 428. Refer to Appendix A for further information on McLeod Lake and other First Nations' input provided at the First Nation Input Sessions.

[14] *Prophet River First Nation v British Columbia (Environment)*, 2015 BCSC 1682, upheld on appeal 2017 FCA 58, leave to appeal to SCC refused 2017 CanLII 40513 (SCC); *Prophet River First Nation v Canada (Attorney General)*, 2015 FC 1030, upheld on appeal 2017 FCA 15, leave to appeal to SCC refused 2017 CanLII 40511 (SCC).

2 We Need New Energy and Capacity

2.1 Introduction

The Commission's Preliminary Report posed a number of questions to BC Hydro with regard to its load forecast, and cited Deloitte's "alternative" load scenario. We have provided responses to all of the information requests and this Reply Submission contains additional information supporting our load forecast methodology and the load forecast. We have assessed Deloitte's "alternative" scenario, identifying the methodological shortcomings with its analysis. We also conducted scenario analysis to demonstrate that the selection of a load forecast scenario does not change the conclusion that Site C is the most cost-effective option for our ratepayers.

In this section, we elaborate on the following points:

- New capacity and energy resources will be needed. BC Hydro and Deloitte agree on this;
- Combatting climate change will require increased electrification across B.C. BC Hydro did not reflect the additional load from electrification in its load forecast as it represents a paradigm shift rather than a typical economic factor that drives load up or down;
- BC Hydro's forecasting in the residential, commercial and light industrial sectors has been more accurate than industry benchmarks. Forecasting for the large industrial sector is inherently uncertain, and past forecast variances have been generally attributable to unforeseen events;
- Deloitte's "alternative" load scenario is based on flawed assumptions and methodology. Planning the province's energy and capacity resources using only Deloitte's forecast would introduce considerable risk of supply for ratepayers; and
- Our sensitivity analyses demonstrate that the Project is the best option for ratepayers even in our low load growth scenario and Deloitte's "alternative" load scenario.

2.2 Deloitte and BC Hydro Agree that New Resources Are Required

Both BC Hydro and Deloitte's load scenarios demonstrate a future need for capacity and energy. The question is not whether we need the electricity, but simply a question of timing. As the Joint Review Panel observed, "[t]he timing of need is necessarily uncertain".[15]

BC Hydro forecasts a need for new capacity by fiscal 2023 and for new energy in fiscal 2028. Under our low load scenario, capacity is still needed by fiscal 2027, and under our high load scenario, capacity is needed by fiscal 2019. These dates are depicted in Figure 2-2 below. The figure also shows that under Deloitte's "alternative" load scenario excluding their inclusion of DSM option 3, capacity is needed by fiscal 2025 and energy is needed by fiscal 2032.

Figure 2-2 Timing of Energy and Peak Capacity Shortfall (Without Site C and Without Electrification)

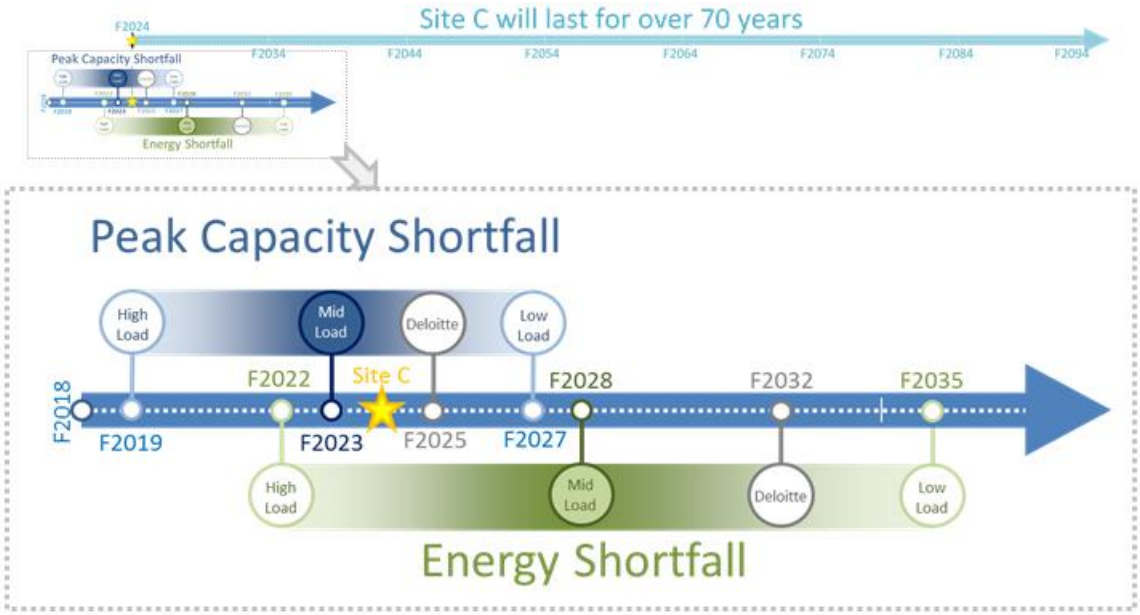


Figure 2-2 above does not reflect low carbon electrification initiatives, which are not yet reflected in BC Hydro's Current Load Forecast. These initiatives would advance each of low, mid and high load scenario dates for new supply.

[15] Joint Review Panel Report, page 305.

2.3 The Need to Combat Climate Change Means Load Growth from Electrification is Only Going to Increase

In a world in which decarbonisation is becoming more and more important, and the expectation is that policies limiting greenhouse gas emissions will only become more stringent, the need for clean, firm resources is only going to increase.

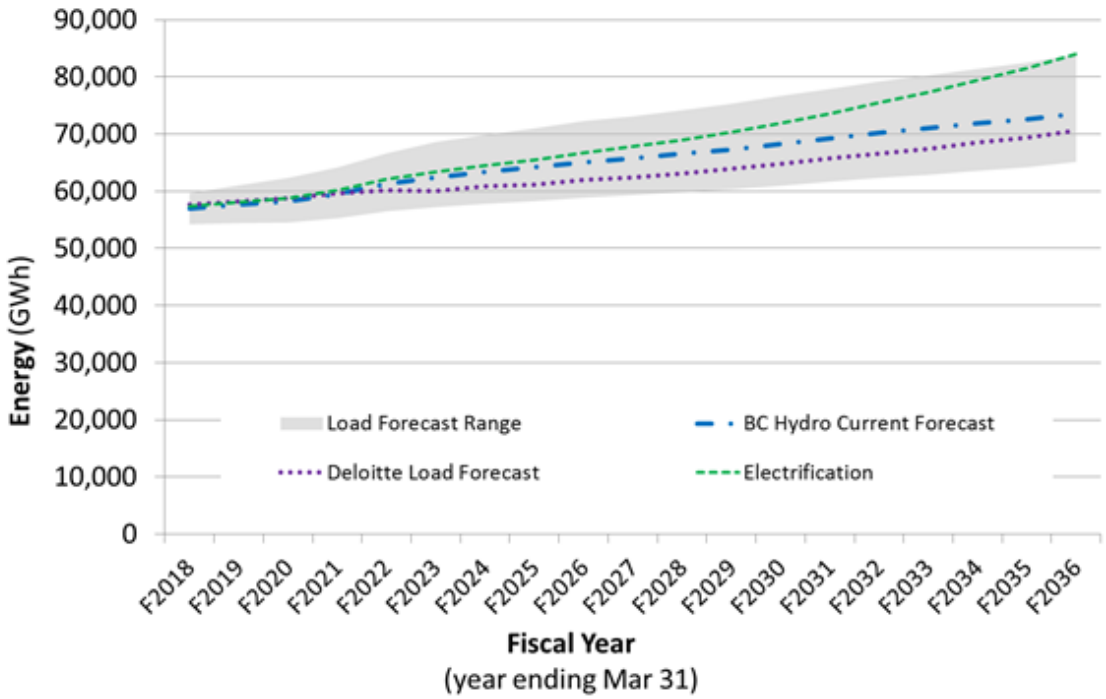
Deloitte is of the view that BC Hydro's projected increase in load from efforts to electrify end uses reliant on fossil fuels (referred to as "low carbon electrification") is conservative. Our August 30 Filing described how the Current Load Forecast does not incorporate material load from low carbon electrification efforts.[16] Electrification is not just another economic driven load scenario. The potential for electrification is large, and the realization of that potential would represent a paradigm shift in how the world uses energy and would be a major shift in expectations on our system.

The following figure depicts the result of the electrification study that BC Hydro undertook for its 2013 Integrated Resource Plan[17]. The figure illustrates that by 2036 the mid-load forecast with electrification is equivalent to the high-load scenario and will continue to grow thereafter. The figure also shows where Deloitte's "alternative' load scenario falls in relation to BC Hydro's forecast as discussed further below.

[16] August 30 Filing, page 101.

[17] BC Hydro's August 30 Filing at pages 53 and 54. This study was produced by MK Jaccard and Associates Inc. and is available at https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/integrated-resource-plans/current-plan/0600c-nov-2013-irp-appx-6c.pdf.

Figure 2-3 BC Hydro's Load Forecast Range, Impact of Electricification, and Deloitte's "Alternative" Load Scenario



BC Hydro has recently completed a joint study with the City of Vancouver which is found in our Site C Inquiry website.[18] The City of Vancouver is pursuing a 100 per cent Renewable City Strategy by 2050. Vancouver is like many other cities in the world that are leading the drive to addressing climate change and reducing their GHG emissions. The joint study looked at different pathways that could result in 100 per cent renewable energy. It demonstrates that along with energy efficiency and clean biofuels, electricity consumption in the City could double. As Dr. Jaccard describes, on behalf of BCSEA (Filing F29-6), if the federal and provincial government's deliver on their GHG reduction commitments, the increase in electricity consumption will be substantial.

Site C will produce the lowest greenhouse gas emissions per unit of energy of any resource, maximizing the greenhouse gas reductions associated with low carbon electrification. Moreover, a world in which there is significant switching to low carbon electricity sources would mean that we would need much more clean energy and capacity than could be provided by Site C alone. Site C is unmatched by any other

[18] https://www.sitecproject.com/submissions.

resource in terms of the firming, shaping and storage benefits the Project provides that are key to integrating other intermittent renewable energy sources like solar and wind into BC Hydro's resource options.

2.4 BC Hydro is Using a Sound Methodology But Uncertainty Can Lead to Variances

BC Hydro's load forecast is industry standard, independently-endorsed, and appropriately accounts for inherent uncertainties by developing a low, mid and high forecast. It has been reviewed in multiple forums, including through the Integrated Resource Planning process, a multi-year undertaking that engages stakeholders across the province. BC Hydro's variances in the residential, commercial and light industrial, which make up about two-thirds of the load, are lower than industry benchmarks.

2.4.1 BC Hydro Uses an Industry Standard Forecasting Methodology that Has Been Independently Endorsed

BC Hydro's methodology is described in our August 30 Filing,[19] and responses to the Commission's information requests.[20] Deloitte, the Joint Review Panel, and BC Hydro's independent auditor (GDS Associates Inc.) have each observed that BC Hydro's load forecasting methodology is consistent with other large North American utilities. It is also consistent with the Commission's resource planning guidelines. Deloitte made two main critiques of our load forecast methodology, which are addressed below. Deloitte's critique of our inputs is addressed in a subsequent section.

The evaluation performed by GDS Associates Inc. (**GDS**) as part of BC Hydro's audit process provides an independent expert assessment of BC Hydro's load forecasting.[21] GDS concluded that:

- BC Hydro's load forecasting is comprehensive and compares favourably to other large utilities in North America; and
- BC Hydro employs best practice methodologies.

[19] Appendix H – load forecast methodology and load forecast history; Appendix I – independent expert audit of our load forecast methods; Appendix J – developments since the load forecast was prepared and other factors that will and could impact future demand.

[20] Response to the BCUC IRs 2.16.0, 2.17.0 and 2.18.3.

[21] GDS's report was provided as part of our August 30 Filing, at Appendix I. GDS has experience both evaluating load forecasts and preparing load forecasts for a number of utilities.

GDS identifies some areas where BC Hydro can make improvements, but it recommends no fundamental changes to the methodology for any sectors (including industrial).[22]

Deloitte's first critique relates to BC Hydro's elasticity assumptions, which Deloitte describes as an oversimplification. GDS also recommended that BC Hydro review its elasticity value used to develop its load forecast. We are undertaking the review recommended by GDS, and it is at a very preliminary stage. However, BC Hydro has elasticity studies supporting the values used for the residential and commercial sectors. For the industrial sector, we account for elasticity in two ways. First, there is the -0.05 factor applied to all industrial load. Second, there is an elasticity factor implicit in the customer-specific probability weightings. As explained in the response to BCUC IR 2.19.0, our load forecast is supported by our data.

Deloitte's second critique relates to the potential for correlation across various independent components used in BC Hydro's Statistically Adjusted End Use (**SAE**) models.[23] Deloitte did not appear to do any of its own statistical analysis to determine whether, in fact, a correlation exists. We recognize this issue and routinely test for a correlation in our modelling. Our assessment of the statistical properties of each model demonstrates there is no statistical bias and very limited correlation.[24] Correlation across independent components is not an issue with our Current Load Forecast.

In light of BC Hydro's experience in load forecasting, our consistency with best practices across North America, and the independent third party endorsement of our methodology, the Commission should prefer BC Hydro's load forecast to others submitted in this Inquiry, and submit that our forecast should be used as the basis for the Commission's Final Report.

2.4.2 BC Hydro's Residential, Commercial and Light Industrial Forecasting Has Been More Accurate than Industry Benchmarks

GDS reports that our overall variances from forecast for the residential, commercial and light industrial sector, which accounts for about two-thirds of the load, are lower than industry benchmarks. Deloitte states that forecasts of residential, commercial

[22] GDS concluded: "There are no critical weaknesses with the load forecasting function at BC Hydro. GDS proposes a number of recommendations for process improvements, none of which call for major changes to the existing system."

[23] Deloitte Report, p 60.

[24] BC Hydro filed its statistical models in Appendix J of our August 30 Filing.

and light industrial sales are close to actuals in both the short and long run.[25] The load forecast history from fiscal 2008 to fiscal 2017 and other information on record in the Fiscal 2017 to Fiscal 2019 Revenue Requirements Application (**RRA**) confirms that this is the case, with the forecast tracking close to actuals.

The load forecast variances that BC Hydro has experienced are largely associated with one sector (the large industrial sector). All parties also agree that the industrial sector load forecast is the most volatile and subject to inherent uncertainties.

BC Hydro provided an assessment of past industrial load forecast variances in Appendix H in our August 30 Filing, and additional detail in our response to BCUC IR 2.17.1. Our load history over the last decade shows that most of the larger variances are primarily driven by unexpected developments such as the closure of a pulp and paper facility. For example, 54 per cent of our decline from fiscal 2006 to fiscal 2010 in the large industrial sector was the result of the closure of a single pulp and paper facility, which cannot be forecasted with any precision.

Our response to BCUC IR 2.16.1 shows the following subsectors are responsible for most of BC Hydro's load forecast variances since 2007: pulp and paper, mining, natural gas and LNG. The response also explains each of the probability changes and describes the risks that may prevent identified loads from materializing. The information demonstrates the aggregate impact of industrial sector developments will result in additional load over and above the Current Load Forecast.

Our assessment also concludes that the Current Load Forecast for each of these subsectors has significantly less uncertainty relative to prior load forecast vintages. For example, approximately 80 percent of the forecasted natural gas load by 2030 is practically already realized due to project advancements identified in our response to BCUC IR 2.16.0 above.

BC Hydro does not reflect projections of recessions or booms in its load forecast drivers. As stated in the response to BCUC IR 2.17.0, we rely on credible third-party expert sources for our long term economic forecasts (BC Ministry of Finance, Robert Fairholm Economic Consultant). The Ministry of Finance is predicting Gross Domestic Product (**GDP**) growth over the next five years, not a recession. With respect to longer term economic forecasts, BC Hydro is not aware of any credible economic forecasting entity with the ability to predict the timing or magnitude of future economic cycles (both recessions and boom cycles) over the long term. Alternative sources that develop global country specific GDP forecasts such as the

[25] Deloitte Report No. 2, page 58.

World Bank or the Conference Board of Canadian which does U.S and Canadian National forecasts and provincial B.C. 20-year GDP forecast, do not project recessions and periods of extended boom.

The SAE models, which are used to develop the load forecasts for these sectors, are calibrated over a 10-year period. As such, the estimation process, which is linear regression, produces the models coefficients that reflect various historical load impacts including recessions and recoveries over the estimation period. The model's coefficients along with the various economic, temperature and efficiency drivers are used to develop the forecasts hence to some extent the impacts of past recessions are reflected in the forecasts.

We develop both high and low forecast uncertainty bands, which reflect the uncertainty associated with future economic growth, commodity supply and demand, and related electricity demand over the long term. The portfolio analysis conducted by BC Hydro includes sensitivity analysis that incorporates this load forecast uncertainty.

2.4.3 BC Hydro Accounts for Inherent Uncertainty in Load Forecasting by Using A Range with Low, Mid and High Bands

BC Hydro bases the need for new resources on its mid load forecast. The mid-load forecast includes verifiable information that reflects possible (i.e., probability weighted) load increases or reductions for current large industrial customers. In addition, multiple reliable sources including customer information are used to establish probability weighted forecasts for new large industrial customers.

To account for uncertainties, we also identify a high load and low load forecast band using a Monte Carlo model. In this manner, BC Hydro accounts for the upward or downward pressures, including those identified by Deloitte (e.g., economic activity represented by GDP growth, weather, high and low range for large industrial loads, electricity rates and elasticities).[26]

The high (P90) and low (P10) forecast bands indicate the magnitude of load uncertainty in a given year and are used for planning contingency resources. Given that there is a 90 per cent probability that the load will be higher than the low load (P10) forecast, planning to the low load forecast is likely to result in BC Hydro not being able to meet its service obligation. Similarly, planning to the high load forecast is expected to result in oversupply and adverse rate impacts. For this reason, the

[26] For more information, refer to the response to BCUC IR 2.20.

appropriate and cost-effective approach, and the approach BC Hydro employs, is to plan resources based on the mid load forecast, and to regularly monitor and update this forecast and adjust as required.

Further detail on BC Hydro's methodology is set out in our Integrated Resource Plan, the Fiscal 2017 to Fiscal 2019 RRA, and our response to BCUC IR 2.17.0.

2.5 Deloitte's "Alternative" Load Forecast Has Methodological Flaws

In section 5.5 of Deloitte Report No. 2, Deloitte describes the "combined impact of several, alternative input assumptions on the fiscal 2016 load-and-capacity forecast" to produce an "alternative" load scenario. Deloitte notes that "These projections should be considered as indicative only".[27] Deloitte's load scenario has a number of methodological flaws that make it unreliable.

The main flaws are:

- About half of the load reduction in Deloitte's "alternative" scenario is attributable to assuming higher levels of DSM akin to DSM Option 3 from the 2013 Integrated Resource Plan. Deloitte did not assess whether pursuing DSM would be cost-effective for ratepayers, what rate impacts would be, and whether it would have an acceptable level of deliverability risk. This is a fundamental flaw in its analysis. DSM should be evaluated as a resource option and not treated as an assumed reduction to the load forecast;
- Deloitte's reductions for the residential, commercial and light industrial sectors rely on an overly simplistic and flawed methodology for calculating impacts associated with an alternative GDP forecast. As a result, Deloitte overestimates the reduction in load associated with a lower GDP by six times, as explained in the response to BCUC IR 2.18.3;
- The remaining reductions relate to a difference of views on whether or not to include the LNG Canada project and any related upstream gas production load in the load forecast. LNG Canada continues to request service from BC Hydro, and some upstream load is already in production and will continue regardless of whether LNG Canada, or the other LNG export facilities proceed. At a minimum, load that already exists in the absence of LNG Canada's LNG facility should not be arbitrarily deducted from BC Hydro's load forecast (refer to BC Hydro's response to BCUC IR 2.16.0); and

[27] Deloitte Report No. 2, pages 6, 79.

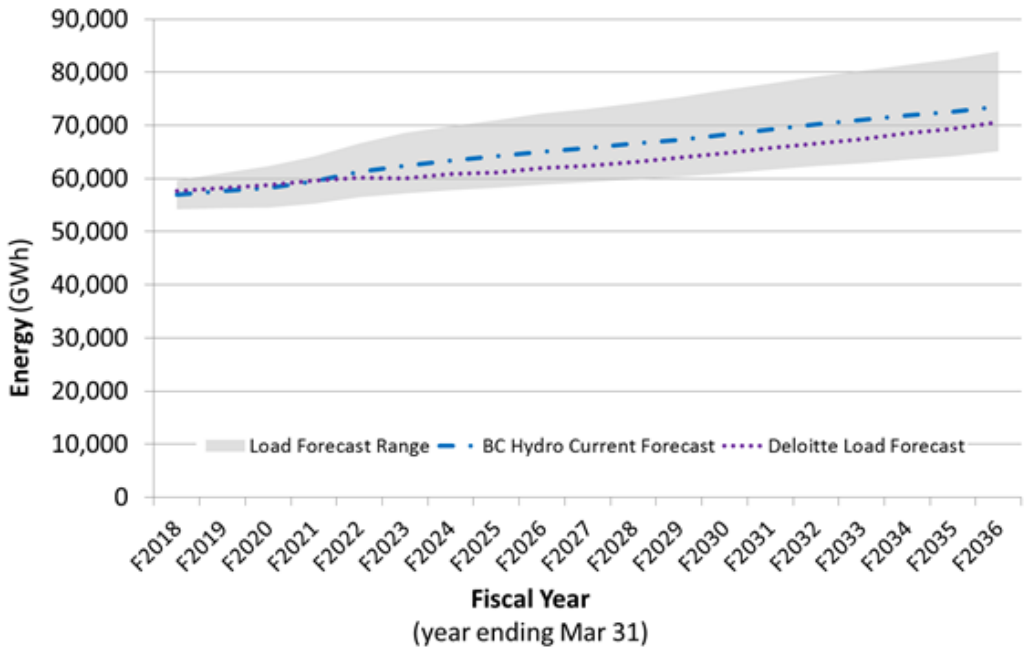
- More broadly, BC Hydro disagrees with Deloitte's conclusion that BC Hydro's LNG assumptions are above market consensus and, in particular, including LNG Canada in the Current Load Forecast is overly optimistic. BC Hydro provides ample evidence in its response to BCUC IR 2.16.0 that its LNG assumptions are consistent with expert third party market expectations and it is reasonable to continue to include LNG Canada load in its Current Load Forecast.

The cumulative effect of these issues represents the majority of Deloitte's deductions from BC Hydro's load forecast. BC Hydro submits that our load forecast should be preferred to that of Deloitte when making important resource planning decisions.

2.6 Site C is Cost-Effective Even Under the Low Load Scenario

BC Hydro's low load forecast projects even lower growth than Deloitte's "alternative" load scenario, even if we take Deloitte's flawed analysis at face value. Figure 2-4 below shows the Deloitte scenario relative to BC Hydro's high, mid and low forecasts for fiscal 2026 and the low load scenario.

Figure 2-4 BC Hydro's Load Forecast Range and Deloitte's "Alternative" Load Scenario



BC Hydro's sensitivity analyses (described further in section 6 and the response to BCUC IR 2.46.0) demonstrate that even under BC Hydro's low load scenario, new energy and capacity resources are needed, and the most cost-effective option is to proceed with Site C.

Moreover, to further account for uncertainties, BC Hydro's sensitivity analysis includes a scenario removing the three LNG export projects included in our Current Load Forecast, along with a reduction of 2,000 GWh of related upstream gas production. Site C remains cost-effective even in this unlikely "no LNG (and no associated upstream gas)" scenario.

The results of the sensitivity analysis avoid any need for the Commission to make determinative findings regarding the methodology that should be used in forecasting load growth. These considerations are better addressed in other forums.

3 Site C Cost and Schedule

3.1 Introduction

On October 4, 2017 BC Hydro provided an update on the Project's schedule and cost. This section highlights the following points:

- Site C is well underway. The considerable work completed to date lowers the risks associated with the Project;
- We have postponed river diversion by one year to September 2020, but the Project is still on schedule to be fully in-service by November 2024;
- The change in the river diversion schedule is estimated to increase project costs by $610 million, which is a 7.3 per cent increase over the original budget of $8.335 billion. Additional cost risk remains, but as set out in section 6, Site C is the least risky and the most cost-effective of alternatives; and
- We have the resources and processes in place to continue to manage the project's risks, schedule and costs.

3.2 Site C is Well Underway and Considerable Work Completed to Date Lowers Risk

Site C is well underway with over two years of construction completed. Cumulative project expenditures to June 30, 2017 are $1.8 billion and are expected to reach $2.1 billion by December 31, 2017.[28]

Work on the Project began in 2004, and included extensive field and technical studies, acquiring the necessary land rights, obtaining environmental assessment approvals and other permits, entering into major contracts, consultation with Aboriginal groups, and advancing the design and construction of the Project. To date, major contracts with a combined scope of work of approximately $2.7 billion have been awarded and are ongoing, the majority of required permits have been obtained, over 1,500 hectares of land have been cleared, and more than 10 million cubic metres of rock have been excavated. Over 2,000 people are working on the Project.

[28] The Commission agreed with this finding in its Preliminary Report, Executive Summary, page iv.

We described the completed work on the project in section 4.1.2.2 of our August 30 Filing, and this is shown in our video included at Appendix E of that Filing. Since that filing, work has continued. There have been some changes to the schedule and cost, which are explained further below.

3.3 BC Hydro Still Expects to Complete Site C on Schedule But at Additional Costs

As we described in our August 30 Filing, BC Hydro and the Main Civil Works contractor were engaging in a constructability review regarding work on the left bank. On September 27, 2017, executives from BC Hydro and the contractor met and determined that we would not be able to meet the September 2019 milestone for river diversion set out in the Main Civil Works contract.

The Project remains on schedule to have all generating units in-service by November 2024. This will be achieved by postponing river diversion to September 2020, and using the one-year schedule contingency (or float) built into our schedule to complete the necessary construction activities prior to river diversion.

Postponing the 2019 river diversion milestone is estimated to increase project costs by $610 million. This is a 7.3 per cent increase in project costs from $8.335 billion to $8.945 billion.

We provided more information on the postponement of river diversion and associated costs in our response to BCUC IRs 2.3.0 and 2.15.0, respectively.

3.4 Additional Risks Remain but BC Hydro has the Resources and Processes in Place to Manage Them

Given the project complexity and the lengthy construction period, BC Hydro recognizes it will continue to face risks. As Deloitte notes, opportunities exist to mitigate existing and future challenges.[29]

3.4.1 Risks on a Project of this Size are Expected

All Projects experience risks. In the case of Site C, through our 13 years of study and work on the Project and our knowledge of the Peace River, project risks are largely identified.[30] Through the construction, permitting and design work to date, a

[29] Deloitte Report No. 1, page 3.
[30] Refer to the response to BCUC IRs 2.5.0 and 2.13.0.

number of these risks have been greatly reduced. The main remaining risks relate to the following:

- There are inherent geotechnical risks associated with building a dam on the Peace River. These risks are well known and have been significantly reduced as the majority of the work zones at the dam site have been developed and largely excavated. Deloitte reviewed these risks and stated:

  > "It appears that the geotechnical risks for the Project have been investigated and that the design and construction methods have been adapted to the conditions. Issues would mainly occur if conditions deviated from the assumptions made as a result of the design investigations. It appears that BC Hydro has made provisions in the Project estimate for the assumed conditions, by establishing appropriate quantities of work, material sources, and design features, and providing advice to contractors about constructability";[31]

- Given the complexity of tunnelling and diversion work, there are remaining construction execution risks with the Main Civil Works. However, BC Hydro has an advanced design for the Main Civil Works, and is working with the contractor to work through the challenges; and

- Several large procurements are pending, including for the Generating Station and Spillway civil construction, transmission line and the highway realignment. Risks associated with this work is described in our August 30 Filing and in more detail in our response to BCUC IRs 2.10.0 and 2.14.0.

3.4.2 BC Hydro Has the Experience, Resources, and Processes in Place to Manage Risks

Before the decision to proceed, BC Hydro commissioned independent reviews of:

(i) our risk management approach and framework,

(ii) our project cost assumptions, and

(iii) our estimate of direct construction costs.[32]

[31] Deloitte Report No. 1, page 40.
[32] August 30 Filing, section 4, pages 25 and 26.

After construction commenced, BC Hydro sought a further independent review of our project risk and cost management processes by Ernst & Young LLP and BTY Consultancy Group Inc. That review, completed in September 2016 – more than a year into construction – concluded:

> "Overall, the Site C project is both clearly defined and well-planned. BC Hydro employs an industry leading approach to project management via the Project & Portfolio Management system, with practices scaled to both the complexity and size of Site C. While project execution risks do exist, we consider those risks to be well-understood and managed by the project team. A robust process was followed in order to establish the project budget, and extensive due diligence was conducted. Site C also benefits from best-in-class software that BC Hydro has implemented and integrated over the past 5 years, including SAP, P6 (Primavera), HeavyBid, Unifier, and others. Finally, we were strongly encouraged by the level to which Site C has leveraged the depth of knowledge within the broader BC Hydro organization around key areas such as project, contract, and interface management." [33]

As these independent reviews confirmed, we have a number of measures in place to manage risks. Those measures include, among others:

- ***Contingency:*** At the time of the Final Investment Decision, the Project capital cost estimate of $8.335 billion included $794 million allocated to contingency. Since that time, due to lower forecasted interest rates, additional project contingency of $401 million has been identified. While some of this has been spent, as of June 2017, $839 million remained;
- ***Risk Management Plan:*** BC Hydro had developed a Risk Management Plan and a risk register to identify and monitor potential risks associated with project construction and mitigation strategies should those risks occur. We also regularly review and update our expected use of contingency for each element of the scope of work; and

[33] Ernst & Young and BTY Consultancy Group Inc., "BC Hydro Site C Clean Energy Project – Infrastructure Risk and Cost Management", September 13, 2016, page 1. The report, is available at https://www.bchydro.com/news/press_centre/news_releases/2016/site-c-ey-bty-review.html.

- ***Experienced Project Team:*** BC Hydro has a fully staffed Project team with experience in designing, building, and permitting hydroelectric and transmission projects, and extensive knowledge of the Peace River.

Given all these measures, while costs have increased and there is a possibility of further cost increases, there is a very low likelihood of a cost overrun or schedule delay that is in the High Range identified by Deloitte.[34]

In our response to BCUC IR 2.50.1, further expanded on in Appendix B, we outline the relative risks of Site C in comparison to risks of alternative portfolios. Even though risks on Site C remain, the analysis indicates that Site C is the lowest risk of the portfolios.

[34] Refer to response to BCUC IR 2.15.0.

4 Suspension Results in Either a More Expensive and Riskier Project or a More Expensive and Riskier Termination

4.1 Introduction

As outlined in our August 30 Filing and as supplemented in additional analysis provided below, suspension would be significantly more costly and risky for ratepayers than continuing with Site C as planned and results in significant risk of not being able to restart and complete the Project.

This section is organized around the following points:

- First, the evidence of Deloitte and BC Hydro is that suspension and maintenance costs alone would be approximately $1.1 billion, or over $1.4 billion including the cost of recommencing the Project;
- Second, the estimating accuracy range around the Deloitte and BC Hydro estimates for suspension and maintenance costs (-35 per cent/+100 per cent) means that refined estimates could yield costs of over $2.8 billion including the cost to recommence the Project, which only improves the case for continuing with Site C;
- Third, there is considerable risk that, once suspended, the Project could not be restarted. Termination after suspension is the most expensive of all scenarios; and
- Fourth, if it were possible to restart the Project in 2024, we estimate that the total Project cost would increase to $13.6 billion, an increase of approximately 54 per cent over the updated Project cost estimate. This would also come with greater risk to ratepayers.

In the suspension scenario, alternative resources would be required. BC Hydro expects to require capacity resources by fiscal 2023 and energy resources by fiscal 2028. Even in the low load growth and Deloitte “alternative” load scenarios, capacity resources are required by fiscal 2027 and energy resources by fiscal 2035. Suspending the Project would necessitate acceleration of new resources on an aggressive timeline, which increases the cost and risk to ratepayers. The cost and risks regarding alternatives is discussed in section 6 and in Appendix B.

4.2 Deloitte and BC Hydro Agree that Suspension and Maintenance Work Would Cost at Least $1.4 Billion

The evidence of Deloitte and BC Hydro is that suspension, maintenance, and recommencement costs alone would exceed $1.4 billion. This does not include additional costs for inflation amounts and risk adjustments for completing Site C construction. In light of the fact that Deloitte has not included inflation and risk related costs in its analysis of the cost of restarting of the project in 2024, the most reasonable estimate is much higher than $1.4 billion. Either way, the suspension and maintenance scenario with a restart in 2024 is significantly more costly than termination, and substantially increases the Project costs and resulting impact on ratepayers.

4.2.1 BC Hydro and Deloitte's Estimates of Suspension and Maintenance Costs Are Largely Consistent

The estimates of BC Hydro and Deloitte regarding the cost of suspending the Project and maintaining the site are generally consistent, although Deloitte does not estimate amounts for inflation or risk adjustments to the restarted project.

In order to facilitate comparison, BC Hydro has reallocated the amounts we estimated in Appendix O to be consistent with the breakdown used by the Commission and Deloitte. We have used this reallocation to compare the BC Hydro and Deloitte estimates as shown in Table 4-1 below.[35]

[35] For further explanation of BC Hydro's Project suspension cost estimate and associated risks, refer to our response to BCUC IR 2.81.

Table 4-1 Comparison of Suspension Cost Estimates

Cost Component[1]	Deloitte Estimate[2] ($ million)	BC Hydro Estimate[3] ($ million)
Cost to suspend	381	532
Cost to maintain in a state of suspension	510	316
Cost to remobilize to begin construction in 2025	200	407
Contingency	327	410
Total cost of suspension and maintenance, including contingency	1,418	1,665
Additional inflation on remaining Site C costs	Not estimated by Deloitte	585
Special provision for suspension risks		500
Total cost of suspension and restart of Site C (nominal)		2,750

1. BC Hydro has made best efforts to align the components of the BC Hydro estimate with the listed components of the Deloitte estimate. However, there is the potential for costs to be misallocated between categories.
2. Deloitte estimate sourced from Table 21 of Deloitte Report No. 1.
3. Amounts shown are for real dollar impacts excluding financing. BC Hydro's estimate discussed in section 7 of our August 30 Filing included a) inflation to time of spending; b) incremental financing costs, and c) increases in the costs to complete the Project due to additional risk factors.

As shown above, BC Hydro's estimate of the cost of suspension, maintenance and remobilization is approximately 17 per cent higher than Deloitte's estimate. The total cost to suspend and the cost to maintain the site are similar. Our estimated cost of site remobilization is **som**ewhat higher than Deloitte's, but is well within the -35/+100 per cent estimating range used by both BC Hydro and Deloitte. The remaining difference is due to additional costs estimated by BC Hydro and not estimated by Deloitte.

The additional costs not estimated by Deloitte are real and should be accounted for:

- Expected increases in costs from inflationary effects due to shifting the remaining spending on Site C to seven years later. We use a 2 per cent per annum inflation rate to estimate the impact of construction occurring seven years later than currently forecast; and
- A special provision to account for the risk of material changes to drivers of project costs over the seven-year suspension period. The contingency amount estimated by BC Hydro is only for the costs of suspension, maintenance and remobilization, and not for any risks associated with the completion of the Project. The later construction date would result in increased risk from changes

to the market or regulatory conditions, and is expected to increase project costs.

As set out in Appendix O of our August 30 Filing, with inflation BC Hydro's suspension and maintenance cost estimate is approximately $2.3 billion excluding the special provision for project risk.[36] With the special provision, the cost to suspend and restart the Project is $2.8 billion (nominal dollars).

4.2.2 Cost of Suspension Must Also Consider Financing and the Cost of Alternative Resources

Deloitte has only estimated the direct costs associated with suspension and maintenance, and does not include inflation or adequate risk adjustments. [37] In addition to direct costs and the associated inflation and risk-related costs outlined above, ratepayers would incur three other significant costs that are omitted by Deloitte:

- Financing costs between the date of expenditure and the date of recovery from ratepayers;
- Impacts on BC Hydro's import and/or export position for the period of suspension; and
- Additional costs due to the higher cost of alternative energy and capacity resources to replace Site C.

These costs are significant and should be accounted for in the analysis.

When costs of acquiring additional resources over the analysis period are taken into account, BC Hydro estimates the additional cost to ratepayers of suspending and restarting would be $1.1 billion on a present value basis even with a 10 per cent increase in Site C project costs.

4.3 BC Hydro and Deloitte Provide the Only Reliable Evidence on Suspension and Maintenance Costs

BC Hydro has reviewed the submissions of other parties and has not identified any submission, other than Deloitte Report No.1, that provides a reliable estimate of the costs of suspension and maintenance.

[36] August 30 Filing, Appendix O, page 34.
[37] Deloitte Report No. 1, page 65.

Very few other submissions provide any opinion on suspension costs, but those that do, rely on information from other non-representative projects. BC Hydro submits that the Commission's determinations on the cost to suspend and maintain should be based on the estimates of Deloitte and BC Hydro. These parties have the required expertise and have retained expert consultants. BC Hydro's estimates, in particular, are based on a detailed knowledge of the Project.

4.4 Significant Cost Risk Exists (-35 per cent/+100 per cent) on Suspension and Maintenance Costs

Both Deloitte and BC Hydro's estimates are AACE Class 5 estimates with a range of -35 per cent/+100 per cent. BC Hydro's sensitivity analyses in its August 30 Filing demonstrate that continuing the Project is cost-effective even when the costs of suspension are at the lower end of the estimating range. However, the assumptions built into the cost estimate make it very conservative, and the risk of a Class 5 estimate is asymmetrical. In other words, there is considerable risk the costs would be higher than estimated, and the risk that refined estimates will be higher is greater than the potential for a revised estimate to be lower. At the upper end of the estimate (+100 per cent), the costs would be over $2.8 billion based on a doubling of Deloitte's estimate of $1.4 billion to suspend and maintain the project for restart in 2024.

4.5 There is Considerable Risk that Once Suspended, the Project Could Not Be Restarted

We identified in section 7 of our August 30 Filing that there is considerable risk that, if suspended, the Project could not be restarted. The Commission asked a follow-up question on this point in its Preliminary Report. BC Hydro's response to BCUC IR 2.81.2, explains that in order to attempt to restart the Project, Project team members and major contracts would need to be replaced, key permits would need to be re-obtained or amended, and studies would be required to identify any changes to environmental conditions.

A scenario where the Project is suspended and then terminated would mean that ratepayers would be paying (based on BC Hydro's estimate) roughly $3.5 billion (in sunk costs, suspension and maintenance and then termination costs) and with no resources to show for it. That represents roughly 39 per cent of the total updated Project cost.

Altogether, we expect the suspension option to cost ratepayers $7.3 billion more on a present value basis than if the Project were completed as planned.

4.6 Continuing Work After Suspension Would Mean Higher Completion Costs and Significant Deliverability Risk

If the Project could be restarted in 2024, we estimate that the total Project cost would rise significantly.

Overcoming all of the risks noted above, and those identified in our response to BCUC IR 2.81.2, would add to the costs of Site C. This includes re-acquiring or amending permits (most of which have already been obtained and will expire), including the possibility of requiring an amendment to the environmental assessment approvals[38], re-procuring contracts, and re-establishing a project team.

The cost of completion following suspension would also be affected by the recent updates in the Project cost. We estimate the total cost to be $13.6 billion.[39]

The fact that the cost will be higher after suspension is consistent with the BC Supreme Court's observations with respect to this Project: "It stands to reason that if the Project is delayed, the construction costs would increase substantially. This is an enormous project … I do not need expert evidence to prove that bringing the Project to a halt would dramatically increase costs."[40]

[38] In Deloitte Report No. 1, page 54, Deloitte notes this is a possibility.

[39] August 30 Filing, section 7, page 90 indicated a figure of $12.9 billion. We revised it based on updated project cost information discussed in the response to BCUC IR 2.3.0.

[40] British Columbia Hydro and Power Authority v Boon, 2016 BCSC 355, paragraph 36.

5 Termination and Remediation Would Cost $3.2 Billion With No Resources to Show For It

5.1 Introduction

The cost of termination is a matter on which there is significant alignment between Deloitte, BC Hydro and the Commission's Preliminary Report. The Commission's preliminary findings regarding the costs incurred to date and termination and remediation costs demonstrates that ratepayers would face costs in the neighbourhood of $3.2 billion in the event of termination, even before considering the cost of acquiring alternative resources. In other words, ratepayers would be responsible for approximately 36 per cent of the updated cost to complete Site C, with nothing to show for it.

This section is organized around the following points:

- First, consistent with the Commission's preliminary finding, $2.1 billion in sunk costs would need to be recovered from ratepayers in the event of termination;
- Second, consistent with the Commission's preliminary finding, termination and remediation work would cost ratepayers more than $1 billion (estimated by the Commission to be $1.1 billion); and
- Third, there is considerable risk the termination and remediation costs could be much higher. The estimating accuracy range for the cost estimate of -35/+100 per cent has an upper end of $2.2 billion. Including sunk costs, termination costs at this upper end would be over $4 billion, which further reinforces the ratepayer benefits of continuing with Site C.

Section 6 discusses the additional cost of acquiring resources, which would far exceed the costs remaining to complete Site C and which would come with higher cost and availability risks.

5.2 $2.1 Billion in Sunk Costs Would Need to Be Recovered From Ratepayers

The Commission accepted BC Hydro's analysis that by the end of December 2017, BC Hydro will have spent $2.1 billion on the Project.[41] This finding is supported by BC Hydro's evidence and should be affirmed.

5.3 Termination and Remediation would Impose Significant Costs on Ratepayers

The Commission made a preliminary finding that termination and remediation work would cost approximately $1.1 billion, based on the mid-point between the estimates provided by BC Hydro and Deloitte.[42] BC Hydro and Deloitte's estimate of the cost of termination and remediation site work are within approximately 12 per cent of each other, but Deloitte has not estimated the cost of financing, import/export impacts, and alternative resources to replace Site C.

5.3.1 There is Considerable Alignment Between Deloitte and BC Hydro on the Cost of Termination and Remediation Work

There is considerable alignment between Deloitte and BC Hydro regarding the cost of terminating the project and remediating the site. We have undertaken a comparison of the BC Hydro and Deloitte estimates in the table below.

Table 5-2 Comparison of Termination Cost Estimates

Cost Component[1]	Deloitte Estimate[2] (F2018$, million)	BC Hydro Estimate[3] (F2018$, million)
Cost to terminate	370	182
Cost impact of site remediation	555	650
Contingency	278	249
Total including Contingency	1,203	1,081

1. BC Hydro has made best efforts to align the components of the BC Hydro estimate with the listed components of the Deloitte estimate. However, there is the potential for costs to be misallocated between categories.
2. Deloitte estimate sourced from Table 22 of Deloitte Report #1.
3. Amounts own are for real dollar impacts excluding financing. BC Hydro's estimate in section 6 of our August 30 Filing also included (a) inflation to time of spending and (b) incremental financing costs.

[41] Commission Preliminary Report, pages iv, 43.
[42] Commission's Preliminary Report, page 44.

As shown above, Deloitte's estimate of the costs of termination and remediation is approximately 12 per cent higher than BC Hydro's estimate. The two estimates are well within the respective estimating accuracy range of -35/+100 per cent for these Class 5 cost estimates.

5.3.2 The Cost of Termination Must Consider Financing and Alternative Resource Costs

The Commission's preliminary finding was based on the mid-point between the cost estimates of BC Hydro and Deloitte. However, this termination cost estimate reflected only the direct costs of terminating Site C and remediating the site. In reality, there are several additional cost categories that are directly related to termination. Deloitte expressly acknowledges that its analysis excludes:

- Inflation on costs between the date of estimate and the actual date of expenditure; and
- Financing costs between the date of expenditure and the date of recovery from ratepayers.[43]

These costs are significant and would need to be incurred if Site C were to be terminated, and should therefore be accounted for in the analysis.

In addition, consideration of terminating Site C must also reflect the higher costs of alternative resources. As described further in section 6 and in our August 30 Filing, BC Hydro estimates that when the above costs are included, the total cost to ratepayers of terminating Site C would be $7.3 billion on a present value basis.

5.3.3 BC Hydro and Deloitte Provide the Only Reliable Evidence on the Cost of Termination and Remediation Work

BC Hydro has reviewed submissions of other parties and other than Deloitte Report No. 1 has not identified any that provide a reliable estimate of the costs of termination and remediation work.

Some submissions propose alternative estimates, but they are:

- largely based on comparisons to other non-representative projects; and
- are provided by persons without expertise in civil construction, environmental remediation, and/or cost estimating.

[43] Deloitte Report #1, page 83.

BC Hydro submits that the Commission's determinations on the direct costs on termination and remediation work should be based on the estimates of BC Hydro and Deloitte. BC Hydro and Deloitte have the required expertise and have retained expert consultants on capital infrastructure projects and cost estimating. BC Hydro's estimates, in particular, are based on detailed knowledge of the Project.

5.4 Significant Cost Risk Exists On Termination and Remediation Work Costs

Both Deloitte and BC Hydro's estimates are AACE Class 5 estimates with a range of -35/+100 per cent. BC Hydro's sensitivity analyses in its August 30 Filing demonstrate that even if termination costs are at the low end of the estimating range, the Project is cost-effective. However, the assumptions built into the cost estimate make it very conservative, and the risk of a Class 5 estimate is asymmetrical. In other words, there is considerable risk the costs would be higher than estimated, and that risk is greater than the potential for a revised estimate to be lower. At the upper end of the estimate (+100 per cent), the costs would be $2.2 billion, making the total of sunk costs and termination/remediation costs over $4 billion.

As shown in BC Hydro's Monte Carlo analysis (page 47 of Appendix O), the 90th percentile (P90) cost of termination is approximately $1.8 billion, an increase of $0.7 billion. That is, there is a 10 per cent chance of a $700 million or more increase in the costs of termination.

Some of the circumstances that would result in higher termination and remediation costs are described below.

5.4.1 Termination Would Likely Trigger Claims by Our Existing Contractors which Could Result in Prolonged Litigation

The cost estimate does not take into account prolonged litigation that could result from termination activities. Winding up contracts before completion will likely result in additional contractor claims. These claims could lead to costly litigation.

5.4.2 Termination Could Require a New Environmental Assessment

BC Hydro's cost estimate for termination and remediation does not include the costs of obtaining a new environmental assessment approval, should one be required.[44] Decommissioning was not included in the environmental assessment conducted for

[44] BC Hydro August 30 Filing, Appendix O.

the Project, and therefore a new assessment to address decommissioning could be required before termination in the event of that scenario. Deloitte is of the view that an environmental assessment would likely be required.[45] An environmental assessment, whether provincial or federal, would considerably increase the length of time required for termination and remediation and could substantially increase the scope of remediation (refer to section 5.4.3 below). This would drive up costs beyond those currently estimated by BC Hydro.

5.4.3 Cost Exposure Is Much Greater if a Higher Level of Remediation is Needed

BC Hydro's estimate is based on returning the site to a safe and environmentally sound condition. That does not mean returning the site back to its original state. As stated in Appendix O of our August 30 Filing, additional remediation activity beyond returning the Project site to a safe and environmentally sound condition would add significant costs.[46] Given the extent of excavation that has occurred to date (visible on the video provided as part of the August 30 Filing),[47] this may not be possible. Additional remediation activity beyond what is contemplated in the August 30 Filing would take decades, resulting in an impact on ratepayers that would be considerably more than what is currently estimated.

5.4.4 Termination and Remediation Introduces Considerable Environmental Risk Leading to Additional Costs

In assessing the termination and remediation scenario, it is important to recognize that termination introduces considerable environmental risks, which in turn, could greatly increase costs. These are described in section 6 and Appendices O and P of our August 30 Filing.

One of the major concerns would be large volume of cubic metres of potentially acid-generating (**PAG**) waste rock that has been excavated. This rock has been deposited in areas that will eventually be inundated and therefore permanently stored in a saturated state, which, as described by Hemmera Envirochem Inc., effectively reduces the very serious risk of acid rock drainage and metal leachate to zero.[48]

[45] Deloitte Report #1, page 74.
[46] BC Hydro August 30 Filing, Appendix O, page 42.
[47] BC Hydro August 30 Filing, Appendix E.
[48] BC Hydro August 30 Filing, Appendix P, page 22.

In contrast, if the Project were terminated, this material would create a serious environmental risk that would have to be managed. Final placement of PAG material in a non-saturated state is contrary to a number of environmental guidelines and policies and without further mitigation introduces unacceptable environmental risk.[49] The PAG waste rock is in a location that drains into the Peace River, and would at minimum need to be encapsulated and monitored for many years. It might also need to be moved. The considerable cost of moving the PAG waste rock is not taken into account in BC Hydro's current remediation cost estimate.

[49] These are cited in BC Hydro's Acid Rock and Drainage and Metal Leachate Management Plan for the Project, found at Appendix E of the Construction Environmental Management Plan, available at https://www.sitecproject.com/sites/default/files/construction-environmental-management-plan-aug-2.pdf.

6 Continuing With Site C is More Cost-Effective and Less Risky Than Pursuing Alternatives

6.1 Introduction

In our August 30 Filing, we provided information demonstrating that no other project has the firming, shaping, and storage capabilities with the same low greenhouse gas emissions as Site C.[50] We also provided information showing that continuing with Site C is cost-effective when compared to alternative portfolios.[51] At the request of the Commission, BC Hydro has undertaken further analysis using sensitivities proposed by the Commission and Deloitte. This section sets out the conclusions of that analysis and provides further discussion.

We have organized this section around the following points:

- First, Site C's ability to deliver clean, reliable energy and capacity, as well as provide other system benefits (firming, shaping, storage), is beyond dispute;
- Second, the Project is the most cost-effective in each of, and all combinations of: (i) cost-overruns on Site C; (ii) low load growth; (iii) very optimistic (i.e., high risk) cost assumptions regarding alternatives;
- Third, portfolios that include Site C are also much lower risk for ratepayers than the low probability scenarios reflected in the Deloitte Report and Commission information requests; and
- Fourth, given the cost risk for ratepayers associated with low probability scenario assumptions, the Commission's Final Report should be explicit regarding any assumptions that it makes and explain the practical significance of those assumptions.

6.2 Site C Will Deliver the Necessary Energy, Capacity and System Benefits

While some comments filed by participants in this Inquiry debate the attributes of Site C, the attributes are clear and have been the subject of prior reviews. Site C meets the needs of our customers.

[50] August 30 Filing, section 5.4.
[51] August 30 Filing, sections 6, 7 and 8.

One of the most pressing concerns for B.C. for years to come is meeting the need for dependable capacity in a manner that contributes to the reduction of greenhouse gas emissions. There are very few clean alternative resources that offer dependable capacity benefits. Resources like batteries, pumped storage and capacity focused DSM offer within-the-day shifting of loads from peak hours to off-peak hours. However, our ability to meet capacity needs by shifting loads is limited because those resources need a recovery period. The recovery period has the effect of flattening the load, eliminating any further opportunities to shift. Once the load is flat, it is necessary to provide resources that can run 24 hours a day.

Winter loads, when combined with BC Hydro's existing hydro system (which includes smaller reservoirs with limited storage), really require future capacity resources to be able to serve peak hours as well as into the shoulder hours as well (e.g., 16 hours/ day) capacity.

The other pressing concern is the ongoing ability for BC Hydro to integrate clean intermittent energy resources. Any significant acquisitions of solar energy will be produced largely in the summer months when BC Hydro's load is low. In order for solar to benefit the system, most of its energy will need to be shifted to the winter period when our loads are high and we will receive much less solar. This is especially true for the winter peak dinner time loads when there will be no solar.

Site C is unmatched in these respects. It has firming, shaping and storage capabilities, while producing less greenhouse gas emissions per unit of energy than any other resource.[52] It allows for the integration of intermittent resources, like wind and solar, which must be backstopped by resources that provide dependable capacity. Resources with the attributes of Site C are an essential component of supporting climate change policies. Refer to Appendix F for a discussion of BC Hydro's interpretation of greenhouse gas emission requirements.

The attributes of Site C have also been acknowledged by the Joint Review Panel, as quoted in the Executive Summary of this Reply Submission.

6.3 Site C is the Most Cost Effective Option in All Scenarios

Site C is also the superior option when viewed from an economic perspective. As discussed below, Site C is least costly by a wide margin in BC Hydro's expected scenarios. Deloitte's alternative portfolio does not deliver the same amount of capacity as Site C, and its alternative portfolio cost was understated due to a

[52] These are all attributes noted in the Order in Council (Terms of Reference), paragraph 3(b)(iv).

significant calculation error. With respect to the scenarios outlined in the Commission's information requests, Site C is still the most cost-effective in each of, and all combinations of: (i) cost-overruns on Site C; (ii) low load growth; (iii) overly optimistic and high risk cost assumptions regarding alternatives.

6.3.1 Site C is Least Costly By a Wide Margin in BC Hydro's Expected Scenarios

BC Hydro's expected alternative resource portfolio is a combination of wind, backed by pumped storage. The August 30 Filing outlines how continuing with Site C is more cost effective than pursuing this alternative portfolio.[53] Even with more optimistic assumptions regarding the cost of this portfolio, Site C is considerably more cost-effective (refer to the response to BCUC IR 2.46.0).

6.3.2 Deloitte Errors Led to Understating Alternative Resource Cost by About 25 Per Cent and Includes Less Capacity than Site C

Deloitte proposed an alternative resource portfolio consisting primarily of geothermal, upgrades to BC Hydro facilities, wind and biomass. They made a number of assumptions about resource costs and availability that were largely reflected in the Commission's information requests, and we have addressed them in that context. However, before turning to the Commission's scenarios and the risks implicit in the assumptions, it should be noted that Deloitte's analysis contained several major errors that would preclude a direct comparison of their portfolio to the Site C-based portfolios.

On October 2, 2017 (Filing A-17), Deloitte provided answers to questions posed by BC Hydro (Filing F1-3) with updated portfolio costs that show it underestimated the cost of alternatives resources by roughly 25 per cent and included insufficient capacity resources. This results from the following:

- Deloitte calculated the costs of Site C using Canadian dollars, but calculated the cost of all alternative resources except storage hydro in U.S. dollars. This error led to an understatement of the cost of the alternative portfolio by roughly 25 per cent; and
- Deloitte assumed a number of capacity resources from upgrades to existing BC Hydro facilities that engineering studies have dismissed as not feasible. These infeasible resources represented approximately 10 per cent of Deloitte's portfolio and were among the lowest cost resources.

[53] August 30 Filing, sections 6, 7, and 8.

The overall result of these revisions is a roughly 25 per cent increase in cost for a portfolio that only delivers around 90 per cent of the expected capacity. This portfolio would require additional unidentified capacity options to meet domestic demand, further increasing the portfolio cost.

Deloitte provided updated calculations. We have calculated that the present value impact on ratepayers associated with these corrections is an additional $1.4 billion incremental cost for Deloitte's "alternative" portfolio over their 19-year evaluation period. To put the magnitude of Deloitte's revision in perspective, this increase exceeds the ratepayer impact associated with the updated construction costs on Site C. The supporting calculations are included as Appendix E.

6.3.3 Site C Portfolios are the Most Cost-Effective Option Even in Very Low Probability Scenarios

In addition to our base portfolio analyses from our August 30 Filling, BC Hydro has performed two additional sets of sensitivities (found in our response to BCUC IRs 2.44.0 and 2.46.0):

- A portfolio analysis using the assumptions provided in the Commission's information requests (referred to as the "Commission Portfolio Sensitivities"); and
- A portfolio analysis that we believe would be a reasonable test of Site C's cost-effectiveness under more optimistic (but still plausible) assumptions (referred to as "BC Hydro Optimistic Portfolio Sensitivities").

BC Hydro ran both of these sensitivities under low, mid and high load growth scenarios, compounded with cost overruns of 10 per cent, 20 per cent and 50 per cent above $8.335 billion.

The results of the analysis demonstrate:

- Using our August 30, 2017 portfolio analysis with mid (expected) load growth, an alternative portfolio with primarily wind and pumped storage resources would be $5.5 billion to $7.3 billion more expensive on a present value basis, where Site C costs range from $8.335 billion to 50 per cent over budget;

Table 6-3 Project Overrun Cost Sensitivities (August 30 Filing Assumptions)

August 30 Filing Cost Overrun Sensitivities	Benefit Site C Portfolio vs. Alt. Resources Portfolio (PV - $ billion)	Site C Portfolio Unit Energy Cost ($/MWh)	Alternative Resources Portfolio UEC ($/MWh)
BC Hydro August 30 Filing Mid Gap	7.3	76	110
+10% Site C Project Cost	7.0	78	110
+20% Site C Project Cost	6.6	79	110
+50% Site C Project Cost	5.5	84	110

- The BC Hydro Optimistic Portfolio Sensitivities use more optimistic (but still plausible) assumptions for resource cost, availability and financing than the Commission Portfolio Sensitivities. However, some of the assumptions built into both sets of BC Hydro and Commission sensitivities are unlikely to materialize; and

Table 6-4 BC Hydro Optimistic Portfolio Sensitivities

BC Hydro Optimistic Portfolio Sensitivities	Benefit Site C Portfolio vs. Alt. Resources Portfolio (PV - $ billion)	Site C Portfolio Unit Energy Cost ($/MWh)	Alternative Resources Portfolio UEC ($/MWh)
Mid-Gap w/ BCH UEC Assumptions	6.5	69	90
Mid-Gap w/ BCH UEC Assumptions + Low Market Prices	6.4	68	97
Mid-Gap w/ BCH UEC Assumptions + Low Market Prices + BCH Financing of Alternatives	4.7	59	80
Mid-Gap w/ BCH UEC Assumptions + Low Market Prices + BCH Financing of Alternatives + Low Cost Wind Renewal Assumptions	4.6	58	79
+10% Site C Project Cost	4.2	60	79
+20% Site C Project Cost	3.8	61	79
+50% Site C Project Cost	2.7	66	79

- The Commission Portfolio Sensitivities use the same low probability assumptions used in the BC Hydro Optimistic Portfolio Sensitivities along with even more optimistic assumptions about the availability and cost of resources and assume BC Hydro would be the developer and financier of all projects.

Table 6-5 Commission Portfolio Sensitivities

Commission Portfolio Sensitivities	Benefit Site C Portfolio vs. Alt. Resources Portfolio (PV - $ billion)	Site C Portfolio Unit Energy Cost ($/MWh)	Alternative Resources Portfolio UEC ($/MWh)
Mid Gap - UEC Sensitivities	6.2	73	96
+10% Site C Project Cost	5.8	75	96
+20% Site C Project Cost	5.4	76	96
+50% Site C Project Cost	4.3	81	96
Mid Gap - UEC Sensitivities + Low Market Prices	6.0	75	99
Mid Gap - UEC Sensitivities + BCH Financing of Alternates	4.7	62	79
Mid Gap - UEC Sensitivities + BCH Financing of Alternates + Low Cost Wind Renewals	4.6	61	78
Mid Gap - UEC Sensitivities + BCH Financing of Alternates + Low Cost Wind Renewals + Low Market Prices	4.1	65	81
Small Gap – UEC Sensitivities	6.1	35	73
Small Gap – UEC Sensitivities + Low Market Prices	4.7	38	70
Small Gap – UEC Sensitivities + Low Market Prices + BCH Financing of Alternates + Low Cost Wind Renewals	3.8	34	59
+10% Site C Project Cost	3.4	35	59
+20% Site C Project Cost	3.0	37	59
+50% Site C Project Cost	1.9	43	59
Large Gap – UEC Sensitivities	9.7	128	154

Combining low probability assumptions has a compounding effect and creates a very low probability scenario. Even under a combination of these unlikely assumptions that are adverse for the Project – for example, a scenario with low load growth and in which Site C's costs increase by 50 per cent – completing Site C remains a lower cost option than alternatives using both the BC Hydro Optimistic Portfolio Sensitivities and the Commission Portfolio Sensitivities.

Resource planning is not a theoretical exercise and is in place to make decisions on which assets will be a reliable and cost-effective source of supply for our customers. While we have included portfolios combining low likelihood assumptions for the purposes of this Inquiry, these portfolios would not be a sound basis on which to make resource planning decisions. It would not be a sound investment decision to

cancel a high-value, flexible clean resource that is cost-effective in hopes that low probability assumptions around the costs of other resources will come to pass. The next section provides further discussion of the cost risks for ratepayers associated with making low probability assumptions.

6.4 Portfolios With Site C are the Least Risk Option

Risk assessment is a critical component of the consideration of alternate portfolios, and relative price should not be considered in isolation. In response to a request from the Commission (BCUC IR 2.50.1), BC Hydro has extended our risk assessment from our August 30 Filing to consider the Deloitte alternative scenario and provide additional information on the relative risks of the resource alternatives. This considers the following portfolios: (i) BC Hydro's portfolios with Site C; (ii) BC Hydro's portfolios without Site C; and (iii) Deloitte's alternative portfolio. The risk assessment demonstrates that:

- There are risks associated with the development of any resource project. Site C has residual construction risk (although this has been reduced given the progress to date) but once completed the costs to ratepayers are predictable and will decline over the 100-plus year life of the assets;
- While Site C may have the potential to create a comparatively larger surplus than a portfolio of IPP contracts, the capacity and flexibility-rich nature of Site C generation makes it a more valuable market asset;
- An alternative portfolio with BC Hydro's expected alternatives (wind and pumped storage) has a higher overall risk portfolio than Site C, but that risk is still tolerable; and
- The alternative portfolio proposed by Deloitte (consisting primarily of geothermal, upgrades to BC Hydro facilities, wind and biomass) relies on a combination of low probability assumptions. These assumptions make the risk to ratepayers associated with this portfolio very high.

BC Hydro's response to BCUC IR 2.50.1 (filed on October 4, 2017) included a summary risk matrix and some additional explanation. Appendix B to this Reply Submission provides additional supporting information for the risk analysis.

6.4.1 Work Done on Site C Mitigates Development Cost Risk Relative to Other Options

This point is addressed in section 3 of this Reply Submission. Section 3 describes the substantial work on Site C to date that reduces both delivery and cost risks associated with the Project. Once the project is completed, the costs to ratepayers will be predictable and will decline over time[54].

Alternative resources would still have procurement, regulatory, engineering and design, and consultation risks that have largely been mitigated with respect to Site C. There would also be a much higher degree of long-term cost uncertainty for ratepayers due to unknown technology evolution, market conditions, and renewal risks for shorter life assets.

6.4.2 Site C's Capacity and Flexibility-Rich Resources Can be Sold in the Market at a Premium

Our costing analysis in the August 30 Filing, and the portfolio sensitivities analysis conducted since the Commission's Preliminary Report, accounts for the trade value that surplus energy has in our system. It does not account for any premium associated with capacity value. This is a conservative assumption, as capacity is likely to generate a premium that will further reduce the unit energy cost of Site C for ratepayers.

Our response to the BCUC IR 2.22 series addresses the opportunity in considerable detail. In essence, given the anticipated growth of intermittent resources such as wind and solar across North America, there is a large market for electricity that has both capacity and flexibility attributes, like the generation from Site C. Capacity and flexibility attributes are integral for backstopping intermittent renewables with variable output. As a result, capacity and flexibility-rich resources like Site C are considerably more valuable in the market than electricity produced by intermittent resources.

Site C, on its current schedule, will begin providing power approximately when neighbouring jurisdictions are planning to transition off of coal-fired resources (mid-2020s). The amount of intermittent energy resources in neighbouring jurisdictions is anticipated to grow to facilitate this transition. These factors will only increase the demand for capacity and flexibility in the market. BC Hydro and its

[54] August 30 Filing, section 2.1.1, page 9-10.

subsidiary Powerex are confident in our ability to sell any surplus power from Site C at a premium, given its capacity and flexibility characteristics.[55]

6.4.3 Deloitte's Portfolio Would Impose Unacceptable Risk on Ratepayers

The portfolio proposed by Deloitte relies on a number of unlikely or unrealistic assumptions, some of which are implausible. Many of those assumptions were the subject of information requests by the Commission. Low probability assumptions such as those used in Deloitte's alternative portfolio translate into cost risk for ratepayers.

Deloitte's portfolio includes:

- ***Geothermal:*** The amount of geothermal resources proposed by Deloitte is more than the total geothermal generation in Iceland (which has much more favorable conditions for this type of generation than in B.C.), and would need to be developed over an implausible timeframe. Deloitte's model assumes in-service geothermal resources by 2027.

  In our response to BCUC IR 2.61, we found that expecting material amounts of geothermal electricity generation in B.C. by 2025 is unrealistic. To address the Commission's request to include geothermal in a portfolio, as part of our sensitivity analysis we reviewed portfolios that assumed 200 MW of geothermal was available;

- ***Wind:*** Both BC Hydro and Deloitte agree that alternative portfolios would include wind resources and that the cost of wind is expected to decline. BC Hydro's pricing estimates are already forward-looking. Nonetheless, at the request of the Commission, BC Hydro modelled scenarios including larger capital cost declines of wind resources of 30 per cent by 2030 and 45 per cent by 2045. We explained in our response to BCUC IRs 2.44.0, 2.62.0, and 2.63.0 why this assumption is very aggressive and unlikely to be achieved. Planning on the assumption that costs would come down by these values would be very high risk for ratepayers, who would be burdened with the costs in the event the declines do not materialize;

- ***Biomass:*** Deloitte includes biomass within its portfolio. BC Hydro identified greenfield biomass as an eligible resource for its portfolios, but it was not selected because there are other lower cost alternatives. There is considerable

[55] August 30 Filing, Appendix S; response to the BCUC IR 2.22.

uncertainty in fibre supply availability and biomass costs are expected to escalate over time as fuel availability decreases (refer to the response to BCUC IRs 2.40.0, 2.44.0 and 2.67.0);

- ***Upgrades to BC Hydro facilities:*** BC Hydro agrees that upgrades to our existing facilities should be considered a future capacity resource. However, to be cost-effective, these upgrades should be timed when other upgrades to the facility are required (refer to the response to BCUC IRs 2.44.0 and 2.59.0). Moreover, as described in our letter (F1-3) and acknowledged by Deloitte (A-17), Deloitte's portfolio overstated the capacity available from these upgrades and understated the cost;
- ***Batteries:*** The Commission requested that a portfolio be run assuming a 50 per cent cost decline in battery storage by 2040. As described in the response to BCUC IR 2.72,0, this decline is highly speculative, and even if it materializes, would still be much higher than the cost of pumped storage (refer to the response to BCUC IRs 2.44.0, 2.48.0 and 2.72.0);
- ***Solar:*** BC Hydro's pricing estimates for solar resources are already forward-looking, and there are both upward and downward pressures on the cost of solar resources. Nonetheless, at the request of the Commission, BC Hydro included a capital cost decline of solar resources of 60 per cent by 2040. This decline is at the highest end of National Renewable Energy Laboratory's forecasts and is unlikely to be achieved (refer to the response to BCUC IRs 2.44.0, 2.47.0 and 2.68-series). Again, planning on the assumption that costs would come down by this value would be very high risk for the ratepayers who end up paying for the resource; and
- ***Financing assumptions:*** Deloitte proposes a financing structure that presumes BC Hydro would be developing and financing all future resource projects at its lower cost of capital. Deloitte's assumption is reflected in the Commission's requests for portfolio sensitivity analysis. Building and financing all future resource projects is not BC Hydro's mandate, nor would it be in the interests of ratepayers given the risks and costs associated with exploration and development activities for the many smaller resources. These resources are most effectively delivered by the IPP industry. Financing assumptions that presume otherwise are not realistic and would not accurately reflect ratepayer impacts. This assumption means ratepayers would be exposed to significant costs when this fails to materialize (refer to the response to BCUC IR 2.42.0).

An alternative portfolio with unrealistic assumptions around resource availability, financing, and future costs, such as the one proposed by Deloitte, imposes an intolerable level of risk on ratepayers that would effectively be hoping for a combination of very low probability outcomes while subjecting ratepayers to a high risk of substantially greater costs. Nonetheless, as already described, even with these unrealistic assumptions, Site C remains the most cost-effective option for ratepayers.

6.5 Final Report Should Be Explicit Regarding the Risks Associated With Assumptions

The discussion in this section has highlighted the very real and substantial cost risk for ratepayers associated with using hypothetical, low probability assumptions in comparing Site C to an alternative portfolio. This risk speaks to the need for the Commission's Final Report to be explicit regarding any assumptions that it makes when comparing Site C to an alternative portfolio. We respectfully submit that this type of discussion is necessary so the Government understands the assumptions and material risks when assessing whether to proceed with Site C.

It would take a very remote probability scenario – much more remote than those tested – to reach the point where finishing Site C no longer makes sense. None of the scenarios tested came close to that point. There has been considerable analysis of Site C project risks in this inquiry. We respectfully submit that the same level of risk analysis should be applied to the alternatives as well.

The only other way for it to make sense for ratepayers to incur $3.2 billion to terminate Site C is if one was to measure Site C's benefits over a very short period of time, and ignore the long-term benefits that justified the decision to build the Project in the first place. It has been known since the outset that the greatest benefits associated with Site C are the long-term benefits – declining costs over a long asset life for clean and renewable energy and capacity. These benefits will flow to future generations and are the same benefits we currently enjoy from our Heritage generation facilities, allowing B.C. to be one of the lowest cost and cleanest electricity jurisdictions in North America.

BC Hydro
Power smart

BC Hydro Submission on the British Columbia Utilities Commission Preliminary Report

Appendix A

Comments on First Nation Submissions

Comments on First Nation Submissions

The Commission held sessions dedicated to hearing directly from First Nations, and heard from the following groups:

- McLeod Lake Indian Band;
- West Moberly and Prophet River First Nations;
- Sekw'el'was Cayoose and N'Quatqua (two St'at'imc First Nations);
- Tsilhqot'in First Nation; and
- Mikisew Creek First Nation (scheduled for October 11, 2017)[1]

Of these groups, only McLeod Lake, West Moberly, and Prophet River First Nations exercise rights in the Project area that are being affected by the Site C Project. BC Hydro's response will focus on their submissions.

In total, ten First Nations have been identified as potentially impacted by the Project, all of whom are signatories to Treaty 8.[2] Of these ten First Nations, six have stated they do not oppose the Project, and have entered impact and benefit agreements with BC Hydro. If the Project is terminated, future benefits flowing under those agreements will be lost.

[1] BC Hydro prepared these Reply Submissions before Mikisew Cree First Nation's presentation to the Panel but has responded to their written submission (F84-1) in its response to BCUC IR 2.30.0 (F1-5).

[2] Saulteau First Nations, Doig River First Nation, Halfway River First Nation, Blueberry River First Nation, McLeod Lake Indian Band, West Moberly First Nations, Prophet River First Nation, Duncan's First Nation, Horse Lake First Nation, Dene Tha' First Nation. The Environmental Assessment Certificate also lists Fort Nelson First Nation although they were not found to be impacted, and the federal Decision Statement names two Métis groups.

McLeod Lake Indian Band – Supports Continuing with Site C and Has Benefit Agreements

McLeod Lake Indian Band supports the continuation of Site C. As they stated to the Commission, "Site C provided the opportunity to move forward and do things better. And it provided compensation in a way for McLeod Lake to be involved in economic development and move the community forward, and it did so in respect of McLeod Lake Indian Band's treaty rights, aboriginal title, and aboriginal rights."[3]

In contrast to the benefits McLeod Lake will receive if the Project continues, McLeod Lake is of the view that a decision to suspend or terminate the Project would be "an economic catastrophe for the community"[4] and would "unravel" their renewed relationship with BC Hydro, setting back reconciliation.

Mr. Jones, speaking for McLeod Lake, summarized the Band's position as follows:

> McLeod Lake is here to confirm that it supports the continuation of Site C based on the agreements that have been put in place between McLeod Lake, BC Hydro and the provincial Crown. And perhaps, the most important aspect of those agreements is that those agreements acknowledge the impacts that were created by the Williston Reservoir and past BC Hydro infrastructure development.
>
> In that respect, Site C provided a turning point in the relationship between McLeod Lake, BC Hydro and the provincial Crown. And that <u>terminating or suspending Site C at this point in time would unravel not just those agreements that I know that you have access to, the IBA, the contracting agreement and the tripartite land agreement, but would also unravel that renewed relationship between McLeod Lake and BC Hydro</u>. And in that respect, <u>would set back reconciliation</u> between the McLeod Lake community and McLeod Lake Nation and BC Hydro.
>
> That's McLeod Lake's first reason for supporting the continuation of the Site C project. The second reasons is that

[3] First Nation Input Session, Prince George, September 29, 2017, Transcript, pages 427, 431.
[4] First Nation Input Session, Prince George, September 29, 2017, Transcript, pages 427, 445-446.

> discontinuing it or suspending it at this point in time would be an economic catastrophe for the community. We have a community that's building capacity, that has been displaced from its traditional ways and it is finding ways to move forward, both by reviving and retaining its traditional ways, but moving forward with new economic opportunities. Site C provides that opportunity and McLeod Lake has entered into agreements with that respect to the Site C Project.
>
> So continuing -- McLeod Lake comes out in support of continuing the project and wants to note that suspending it or discontinuing it, terminating it, would unravel that process of reconciliation.5 [Emphasis added.]

BC Hydro can also offer further information in response to a question posed by one of the Commissioner's regarding whether the Tripartite Land Agreement was entered into to replace land owned by McLeod Lake that would be affected by the Project. As Mr. Jones speaking for McLeod Lake noted, this is not the case.[6] The fee simple land transfers that McLeod Lake (and three other First Nations) are receiving under these agreements is one of the benefits they are receiving in respect of the Project (in addition to lump sum payments, payment streams over 70 years, Crown land protection measures, and contracting opportunities). No reserve land or land owned by First Nations is being impacted.[7]

BC Hydro's agreements with McLeod Lake and with five other First Nations reflect the efforts BC Hydro has invested in consultation. The agreements provide ongoing and valuable benefits, which will end if the Project is terminated. McLeod Lake is of the view that suspension or termination would be “an economic catastrophe for the community” at a time when they are recovering from long-term impacts.

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5 First Nation Input Session, Prince George, September 29, 2017, Transcript, pages 426, 427, 428.

6 First Nation Input Session, Prince George, September 29, 2017, Transcript, pages 453, 454.

7 Specifically, approximately 64 km^2 of land will be affected by Project components, and approximately 56 km^2 is land that will be inundated. Of the total land affected, at FID, approximately 80 per cent belongs to the Crown, 11 per cent was owned by BC Hydro, and 8 per cent was privately held (since that time BC Hydro has acquired some of the private land). None of the land affected is reserve land or held by First Nations.

West Moberly and Prophet River First Nations – Courts Have Found Deep and Meaningful Consultation

West Moberly and Prophet River have opposed the Project from the outset and continue to oppose the Project.[8] In this Inquiry, they have provided submissions on a number of issues, essentially all of which were issues they raised before the Joint Review Panel and the Courts in their litigation challenging the environmental assessment approvals and various permits. Given that the Terms of Reference provide that this Inquiry is not a reconsideration of those decisions, we will not provide a response to each concern raised by West Moberly and Prophet River, but below provide some information on the key concerns they raise and how they have been addressed.

Appendix B to our August 30 Filing provides more information on the environmental assessment and the Courts' various decisions, each of which found consultation with West Moberly and Prophet River to be deep and meaningful.

Methylmercury (pages 357-361, 370, 380-384)

Chief Willson (West Moberly) raised concerns that fish in the Williston reservoir and connecting rivers may be "contaminated" with methylmercury and therefore unsafe to eat. He further stated this would also be the case with fish in the future Site C reservoir.[9]

There are a number of inaccuracies and misconceptions in the information provided by Chief Willson that we would like to clarify:

- As a matter of background, mercury is naturally found in low concentrations in all environmental media including in air, water, soil, plants and in all animals. The majority of mercury in the environment that can be transformed by bacteria

[8] This is noted by the Federal Court (2015 FC 1030, paragraph 62), in which the Court referred to the First Nations' "vow to use all lawful means to stop the Site C Dam from proceeding".

[9] First Nation Input Session, Prince George, September 29, 2017, Transcript, page 370.

into the organic or methylmercury form is found in the humic layer of soils and lake sediments. When land is flooded by water to create a reservoir, methylmercury is generated by bacteria as a by-product of organic soil decomposition. This causes a pulse of methylmercury that is cascaded upwards through the food web over a period of years, ultimately reaching highest concentrations in fish. This phenomenon is well understood with peak fish mercury concentrations occurring between 5 and 10 years after reservoir creation, returning to background 10 to 15 years after this peak. The mercury available for methylation is almost entirely found in humic soils; it is not in or released from trees or living vegetation. There are no 'deposits' of mercury in the ground, nor does it move or be influenced by the weight of water in a reservoir;

- The Fish and Wildlife Compensation Board, a partnership between BC Hydro, B.C., Fisheries and Oceans Canada, and First Nation communities, is undertaking a three-year investigation of mercury in fish in the Williston reservoir watershed. Eight First Nations are involved in the study, including West Moberly and Prophet River. Considerable information on the program and on methylmercury in general can be found here: http://fwcp.ca/mercury-in-fish-investigation-in-williston-dinosaur-basins/;
- Initial results of the three-year FWCP study have shown that fish mercury concentrations in Williston reservoir and tributary streams, including the Crooked River are currently similar to mercury concentrations in nearby lakes for all species tested and are safe to eat. The preliminary report is available here: http://fwcp.ca/app/uploads/2017/06/2016-Data-Analysis-Report-Mercury-Sampling-Program-May-2017.pdf;
- With respect to Site C, potential changes to methylmercury concentrations in fish were assessed during the Environmental Assessment and reviewed by the Joint Review Panel. According to baseline investigations, fish mercury

concentrations in the Peace River are extremely low, and even at forecast peak concentrations in the reservoir, it would be safe to consume several meals of fish per week of any species without exceeding Health Canada guidelines. After the peak period, mercury levels would return to baseline. For more information, see BC Hydro's Environmental Impact Statement, Sections 11.9, 33, Volume 2, Appendix J, and Technical Memo: Methylmercury, all available at http://www.ceaa.gc.ca/050/document-eng.cfm?document=92870; and

- In accordance with condition 60 of our Environmental Assessment Certificate and condition 13 of our federal Decision Statement, during Project operations, BC Hydro will implement a monitoring program of methylmercury concentrations in fish and the aquatic food web in the Peace River and Site C reservoir in collaboration with Aboriginal groups, as well as a communication strategy.

West Moberly and Prophet River initially filed a challenge to BC Hydro's water licences on, among other grounds, an allegation that effects from methylmercury were not properly considered. They have since withdrawn that challenge.

Caribou (pages 364-367)

Chief Willson referred to the impact of the Williston reservoir on caribou and referred to previous litigation relating to a coal project. While Chief Willson did not specifically refer to impacts arising from Site C, for the Commission's information, BC Hydro reviewed the potential for the Project to affect caribou and found there would be no effects. The Project does not intersect with caribou habitat, except for one off-site pre-existing quarry.[10]

[10] Technical Memo: Caribou, available at http://www.ceaa.gc.ca/050/document-eng.cfm?document=92870.

Potential Gravesites at Bear Flats / Cache Creek (page 371)

Chief Willson stated that in the Cache Creek area, BC Hydro "decided to put the road right through the middle of the gravesites" referring to the realignment of Highway 29.

For clarity, there are no confirmed burial sites within the Project area, including at Cache Creek.

In March 2017, the First Nations identified the location of what they believe is a burial on the west side of Cache Creek within the highway realignment. This information was communicated to BC Hydro after we selecting the current highway realignment in Cache Creek following consultation and geotechnical investigations. At the request of the First Nations, BC Hydro has not conducted testing to confirm whether or not the site is in fact a burial. After learning about the potential burial site, BC Hydro re-designed the bridge over Cache Creek so that the site would not be disturbed (refer to BCUC IR 2.14.0).

Consultation on Alternatives, including Alternative Projects on the Peace River (pages 373, 385-386, 396-397)

Chief Willson stated on a number of occasions that "they were never allowed" to discuss alternatives to Site C, and that "there was no consultation".[11]

This is not true, and it was one of the subjects of West Moberly and Prophet River's challenges in the Federal Court,[12] BC Supreme Court,[13] and BC Court of Appeal[14]. Each Court concluded there had been meaningful consultation, including on alternatives. The BC Court of Appeal reviewed this issue at some length and concluded the consultation process was very much one of quantity <u>and</u> quality:

[11] First Nation Input Session, Prince George, September 29, 2017, Transcript, pages 373, 402.
[12] *Prophet River First Nation v Canada (Attorney General)*, 2015 FC 1030, paragraph 67.
[13] *Prophet River First Nation v. British Columbia (Environment),* 2015 BCSC 1682, paragraphs 167-169.
[14] *Prophet River First Nation v. British Columbia (Environment)*, 2017 BCCA 58, paragraphs 54-67.

[60] Certainly, as the judge found, a consideration of alternatives to the project was undertaken by the Joint Review Panel. Its analysis led to the conclusion that the project was the least expensive and that its cost advantages would increase in the future. The consideration of alternatives was mandated by the Panel's Terms of Reference. The terms were expanded to address the appellants' concerns with respect to the consideration of alternatives which then formed part of the Environmental Impact Statement Guidelines, the Environmental Impact Statement, and ultimately the Joint Review Panel Report. BC Hydro devoted an entire section of its Environmental Impact Statement and a technical appendix to the need for and alternatives to the project. Three of the 26 days of the Joint Review Panel hearings were devoted to that subject. Further, the Consultation and Accommodation Report prepared in the Post-Panel Stage specifically addressed the alternatives proposed by First Nations and set out the responses of BC Hydro and the Joint Review Panel to those alternatives.

[61] Beyond that, during the course of the process, there was direct consultation between the appellants and BC Hydro that included the subject of alternatives to the project. T8TA provided BC Hydro with comments on the Environmental Impact Statement on a range of topics, including the need for the project, project alternatives, and cumulative effects. There were 730 comments in total, occupying 470 pages. BC Hydro responded to each comment received and submitted 29 technical memorandums on common themes that arose including treaty rights, consultation, the need for the project, alternatives, and cumulative effects. The Joint Review Panel hearings were followed by BC Hydro's further communications with T8TA, explanations of how T8TA's comments were considered, and consideration of reports written by T8TA.

[62] The consideration given to specific alternatives at one point in the process is found in BC Hydro's assessment of three alternate locations for a hydroelectric dam, including the First Nations' requested consideration of Site 7b (a proposed alternative for a dam at another site on the Peace River). BC Hydro produced a table containing its responses to comments on the Environmental Impact Statement submitted by First Nations. It prepared a report headed "Review of Alternate Sites on the Peace River". With respect to Site 7b in particular, it

was considered that it would not meet the need described in the Environmental Impact Statement, as it would produce only about one-fourth of the energy that could be produced by the project. In short, BC Hydro concluded that situating the project at Site 7b would be uneconomical. Following the issuance of this report, BC Hydro met with T8TA to review it and seek the First Nations' input. BC Hydro also provided funding to T8TA to engage consultants with engineering expertise to support a review of the report. It is evident that a meaningful dialogue took place with respect to this report and with respect to alternative sites.

[63] Ultimately, following the Joint Review Panel report, T8TA advised BC Hydro that it was only interested in discussing alternatives to the project. BC Hydro agreed to discuss alternatives and to arrange for its experts on this issue to participate. Between September and December 2014, BC Hydro and T8TA engaged in further consultation on the need for and alternatives to the project. BC Hydro provided T8TA with $58,250 to participate in this consultation alone. It appears evident BC Hydro did identify and consult on at least seven potentially viable alternatives referred to as: demand-side management, run-of-river hydro, wind, biomass, geothermal resources, natural gas, and pumped-storage hydroelectricity. In the end, BC Hydro determined that the project offered the best combination of attributes and was the preferred option.

…

[67] Viewed from the perspective of a reviewing judge at first instance, <u>there is no sound basis on which to conclude the process of consultation in which the appellants were engaged was other than adequate in the sense of being reasonable in all the circumstances</u>. Reconciliation, as indeed the judge concluded, was not achieved because of an honest disagreement over whether the project should proceed, but that does not mean the process was flawed. The fact that the appellants' position was not accepted does not mean the process of consultation in which they were fully engaged was inadequate. <u>Although the appellants maintain the record is one only of quantity, it is apparent it is very much one of quality as well. It demonstrates the thorough consultation and efforts to accommodate apart from abandoning the project that were</u>

> made before, during, and after the environmental assessment, including meaningful consideration of, and consultation on, alternatives. [Emphasis added.]

It is unfortunate that to date no common ground has been found between BC Hydro and these First Nations, but as the BC Supreme Court observed:

> "In the end the parties were unable to reconcile their differences over the Project. However, I conclude that they failed to achieve reconciliation because of an honest but fundamental disagreement over whether the Project should be permitted to proceed at all. I am satisfied that the government made a good faith effort to understand the petitioners' position on this issue and made reasonable efforts to understand and address the petitioners' concerns."[15]

BC Hydro continues to welcome opportunities to discuss how to move forward with West Moberly and Prophet River.

Geothermal Projects in Valemont and Pemberton (page 373)

Chief Willson stated there are two approved geothermal projects, one in Valemont and one in Pemberton. This is not the case. While applications for two projects have been submitted to BC Hydro's Standing Offer Program, those applications have not been accepted. Their status is described in our August 30 Filing: "BC Hydro has received two applications for low-medium temperature geothermal projects (for less than 15 MW) in BC Hydro's Standing Offer Program; however, neither site has proven the viability of the underlying resource through confirmation drilling."[16]

To date, there has not been any confirmed viable geothermal reservoir in B.C.

Further information can be found in Appendix L of our August 30 Filing (pages 32 to 36) and our response to BCUC IR 2.61.0.

[15] *Prophet River First Nation v. British Columbia (Environment),* 2015 BCSC 1682, paragraph 159, cited at paragraph 67 of 2017 BCCA 58.

[16] August 30 Filing, Appendix L, page 35.

Infringement Lawsuits (page 396-401, 408-413)

Mr. Gailus noted that the First Nations challenged the environmental assessment decisions alleging the decisions infringed their treaty rights. He then stated “the Minister has never *considered* whether or by issuing this approval they’d be breaching their treaty promises” (page 396) and that “the Crown does not need to look at infringement” (page 397). This is not accurate. Both the provincial Crown and federal Crown acknowledged that they considered the issue of treaty infringement. What they did not do, because the Ministers had no jurisdiction to do so, was make a legal determination of whether or not the decisions unjustifiably infringed their treaty rights.[17]

Despite it being open for West Moberly and Prophet River to commence a lawsuit alleging that the Project infringes their Treaty rights (just as it is open for them to do so with respect to any project), they have to date elected not to do so. Contrary to Chief Willson's submission, there is nothing preventing West Moberly and Prophet River from filing a lawsuit before completion of the Project, and seeking the suite of remedies available (including injunctions). This was observed by the Federal Court (paragraph 50) and confirmed by both the BC Court of Appeal (paragraph 37) and Federal Court of Appeal (paragraphs 77, 81).

With respect to the lawsuit brought by Blueberry River, Mr. Gailus stated it "includes Site C" (page 398). What the lawsuit brought by Blueberry River in March 2015 in fact alleges is that accumulated activities that have already occurred over a very broad area (38,000 km^2) have resulted in an infringement of their Treaty rights. While that broad area includes the area where the Project is being constructed, they

[17] *Prophet River First Nation v. Canada (Attorney General)*, 2015 FC 1030, paragraphs 53, 58; affirmed 2017 FCA 15, paragraph 74; *Prophet River First Nation v. British Columbia (Environment),* 2015 BCSC 1682, paragraphs 131 to 134, affirmed 2017 BCCA 58, paragraph 33.

identify "critical areas" considerably north of the Project area. The lawsuit does not name BC Hydro or make any claim for damages.[18]

Note also that the injunction applications in the Blueberry River action referred to by Mr. Gailus would not have affected Site C. There have, however, been two injunction applications related to Site C construction and in both, the Court allowed work on Site C to continue. One of the applications was brought by West Moberly and Prophet River, in which the Court found:

> "I am simply not satisfied that the petitioners [West Moberly and Prophet River] have shown that any serious long-term harm will be caused to their interests if the work contemplated over the next three months proceeds pending the hearing of the petition in this case. In the course of argument, I was struck by the lack of specificity in the evidence about harm to the petitioners' interest. I was presented with no evidence of any actual activities of actual members of either petitioner whose ability to earn a livelihood or pursue traditional hunting, fishing, or trapping would be seriously impacted in the three months between this hearing and the date set for the hearing of the petition."[19]

For more information on these decisions and the others related to Site C, see Appendix B of our August 30 Filing.

In summary, there are no existing lawsuits alleging Site C is an infringement of Treaty or other Aboriginal rights. Any costs in this regard are purely speculative.

Sekw'el'was Cayoose and N'Quatqua (St'at'imc First Nations) and Tsilq'otin First Nation

These two groups each presented information regarding other energy resources that it would like BC Hydro to refurbish or develop in place of Site C. BC Hydro notes that

[18] Refer to *Yahey v British Columbia*, 2017 BCSC 899, paragraphs 21-23.

[19] *Prophet River First Nation v British Columbia (Forest, Lands and Natural Resource Operations)*, 2015 BCSC 2662, paragraph 18. The other injunction was sought by BC Hydro to allow work to proceed: *British Columbia Hydro and Power Authority v. Boon*, 2016 BCSC 355.

its portfolio analysis comparing Site C to alternatives incorporates types of alternative resources, and not specific projects. While it does not make the direct comparisons sought by the First Nations, it leaves open exactly what projects could be developed in those scenarios. BC Hydro welcomes discussions with these First Nations on those projects, but also notes they do not replace Site C.

This Inquiry is Not a Reconsideration of Decisions Made in the Environmental Assessment Process or By Statutory Decision-Makers or the Courts

A number of the issues raised in submissions by First Nations, particularly West Moberly, Prophet River and Mikisew Cree, have been canvassed at length in the consultation to date and the environmental assessment. The issues were further raised in each of these group's judicial review proceedings challenging those processes. Mikisew Cree discontinued their proceeding by agreement with BC Hydro and Canada, and West Moberly and Prophet River's challenges have all been dismissed or discontinued.

The Terms of Reference specifically direct that the Commission not reconsider prior decisions. The Commission should avoid doing so, particularly on issues that have been the subject of years of consultation and review by statutory decision-makers or the courts.

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BC Hydro Submission on the British Columbia Utilities Commission Preliminary Report

Appendix B

Supporting Detail on Risk Assessment Methodology

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List of Figures

List of Tables

BC Hydro's response to BCUC IR 2.50.1 included a risk analysis. The response included a summary table and some discussion of the process and outcomes. However, time did not permit the inclusion of all of the supporting detail. This Appendix provides additional details regarding the portfolios considered in our risk analysis (section 1), the nature of the risk assessment we performed (section 2), and a discussion of each risk factors relevant to the portfolios (section 3). Table 1 at the end of this appendix reproduces the comparative risk assessment table from the response to BCUC IR 2.50.1.

A relative risk assessment, such as that provided in our response to BCUC IR 2.50.1, is a key component of the review required by the Terms of Reference. Assessing cost in the absence of assessment of risk can lead to an unrealistic picture of the potential costs associated with each option. BC Hydro's assessment is that the risks associated with terminating Site C and looking elsewhere for the required resources is a higher risk option for ratepayers than completing a project (Site C) that is already well underway and will provide relatively predictable resource costs for decades.

1 Resource Portfolios Considered in BC Hydro's Risk Assessment

The resource portfolios considered are:

- Site C portfolios:
  - Resource Assumptions:
    - Continue with Site C on current schedule; and
    - Acquisition of incremental IPP wind (energy) and IPP pumped storage (capacity) once Site C is complete;
  - Financing Assumptions:
    - Site C and BC Hydro upgrades constructed and financed by BC Hydro; and

    - Alternative resources constructed and financed by IPPs;

- BC Hydro alternative portfolios:
  - Resource Assumptions:
    - Termination of Site C;
    - Acceleration of certain projects (DSM 2);
    - Acquisition of incremental IPP wind resources (energy); and
    - Acquisition of incremental IPP pumped storage resources (capacity).
  - Financing Assumptions:
    - BC Hydro upgrades constructed and financed by BC Hydro; and
    - Alternative resources constructed and financed by IPPs;
- Deloitte alternative portfolio:
  - Resource Assumptions:
    - Termination of Site C;
    - Acceleration of BC Hydro facility upgrades;
    - Acquisition of incremental IPP geothermal resources (energy and capacity); and
    - Acquisition of incremental IPP wind and biomass resources;
  - Financing Assumptions:
    - BC Hydro upgrades constructed and financed by BC Hydro; and
    - Alternative resources constructed and financed by BC Hydro.

BC Hydro has not done a comparative analysis of the risks of a scenario in which Site C is suspended for up to seven years as the uncertainty in the Project restarting following the period of suspension makes comparisons difficult. In short, a suspension scenario

would include either the risks of the Site C or BC Hydro alternative portfolios (depending on whether the Project is restarted), along with incremental risks associated with the suspension period (refer to the response to BCUC IR 2.81.2 for discussion).

2 The Nature of BC Hydro's Risk Assessment

BC Hydro has reviewed the portfolios under consideration in our portfolio analysis with respect to the risks identified below and has developed a comparative risk assessment of portfolios. This risk assessment is:

- **Relative**, in that risks are assessed as compared to the other portfolios, rather than an absolute and individual risk assessment. We have performed the risk assessment on a relative basis because that is the essence of the Commission's examination under the Terms of Reference - to compare the ratepayer implications of continuing with Site C as planned, terminating or suspending;
- **Qualitative,** in that while quantitative analysis underlies the assessment the assessment here is not numerical. The qualitative analysis is based on assessments of quantitative factors, such as the required capital expenditures associated with portfolios or the results of sensitivity analysis; and
- **Inclusive of mitigation activities,** in that the relative risk assessment includes our assessment of the potential mitigation opportunities and the likelihood of the success of this mitigation. For example, assessment of the risk impact of Load Resource Balance variance includes BC Hydro's assessment of the ability to mitigate these impacts through market exports.

3 Risks Associated with Site C and Portfolios of Alternative Resources

All resource options have risk associated with them. In this section, we identify the risks associated with the resources that make up the portfolios with and without Site C. The analysis demonstrates that portfolios without Site C pose a higher risk for ratepayers.

3.1 Site C Portfolio Risk Assessment

3.1.1 Site C Construction Risks

BC Hydro's response to BCUC IRs 2.5.0, 2.13.0, and 2.15.0 set out our assessment of the risks associated with the Site C project. Key risks include:

- ***Procurement of remaining contracts***: While approximately half of the Project direct costs have been procured (thereby reducing risk) there remain several major contracts to procure including the generating station and spillways, roads, and transmission contracts. There is a risk of poor market response or other factors leading to a cost increase during procurement;
- ***Contractor performance:*** While BC Hydro transfers substantial risk to contractors under construction contracts, BC Hydro holds some residual risk associated with poor contractor performance due to interfaces between contractors and indirect effects of poor contractor performance (such as delays);
- ***Regulatory and permitting:*** BC Hydro has acquired major permits for construction work including environmental assessment approvals. There will be ongoing permit and regulatory approval requirements for the balance of project construction. Delays to receiving permits may impact project schedule and/or costs;
- ***Litigation:*** BC Hydro has been successful in all litigation to date. There remains some risk that litigation could be initiated with respect to construction matters, but this risk has declined significantly;

- ***Cost escalation:*** BC Hydro has transferred some risk associated with escalation in labour, equipment and commodity costs to contractors under its construction contracts. We retain some of these risks under procured contracts, and are subject to cost escalation for un-procured contracts until the contract is established; and
- ***Interest rate increases:*** Fluctuations in interest rates will affect the Site C project costs. BC Hydro has reduced its exposure to variable rate debt and increased its exposure to fixed rate debt. In March 2016, the Commission approved a Debt Hedging Regulatory Account for BC Hydro to capture the gains and losses related to the hedging of future debt issuance.

3.1.2 Impact of Load Resource Balance Variance

In general, while Site C may have the potential to create a comparatively larger short-term surplus to a portfolio of IPP contracts, there are more options to help mitigate the impact of this surplus through market activities and/or customer incentives due to the capacity-rich and flexible nature of Site C generation. Please refer to the discussion of the impact of low load growth scenarios and potential mitigation provided in the response to BCUC IR 2.20.0.

3.2 BC Hydro's Alternative IPP Resource Portfolio

This portfolio refers to the alternative portfolio that BC Hydro developed and assessed in the August 30 Filing.

BC Hydro does not have a mandate or the internal capability to conduct site investigations and develop alternative energy resources. As a result, resources other than Site C and upgrades to BC Hydro facilities are expected to be procured through contracts with IPPs, consistent with Government policy and BC Hydro's strategic focus. Contracts with IPPs transfer some, but not all risk associated with the resource to the IPPs and BC Hydro pays a risk-adjusted (i.e., directionally higher) cost for those resources. This section discusses the risks transferred and retained.

3.2.1 Site C Termination Risk

The direct costs a program to cancel existing Site C agreements and remediate the site are estimated to be $1.1 billion (2018 real dollars). The estimate provided is a Class 5 estimate with an estimating range of +100/-35%. There are substantial risks to the costs and schedule of this program. As shown in BC Hydro's Monte Carlo analysis (page 47 of Appendix O), the P90 cost of termination is approximately $1.8 billion, an increase of $0.7 billion. That is, there is a 10% chance of a $700M or more increase in the costs of termination.

Further, the assessment of risk above is based on the key assumptions listed in conceptual cost estimate being correct. Several of these assumptions can have material impacts on the cost and timeline of termination, including:

- An environmental assessment is not required for termination (note that Deloitte is of the view one would likely be required);
- Market conditions in the Peace River area do not change from the current somewhat depressed state;
- That the scope of the remediation work does not substantially change, such as through a requirement to fully remediate to a pre-project condition on one or more major aspects of the project footprint;
- There are no changes to major design parameters which would require substantial re-engineering of temporary and/or permanent works; and
- BC Hydro is able to attract commercially competitive bids for procurement of contracts to conduct the remediation work.

3.2.2 IPP Resource Risks

3.2.2.1 IPP Availability Risks

Availability Risk for IPP Projects

Availability Risk represents the uncertainty that sites can be found to produce as much energy as assumed at commercial rates. The availability risk varies significantly by resource.

- For technologies with existing implementations and site investigations (such as wind resources) availability risk is relatively low;
- For technologies that are unproven in B.C. and without successful site investigations (such as geothermal) this risk is very high. See the response to BCUC IR 2.61; and
- While the technology of pumped storage is similar to existing technology used in hydroelectric generation in some respects, the application is not exactly the same given the need for reservoirs and pumping equipment. This resource has seen limited use in North America and has not been implemented in B.C.[1]. While this dimension of availability risk is not high, neither is it low given the lack of B.C. experience and importance of meeting system capacity requirements:
  - **Mitigation:** BC Hydro has ensured that natural gas fired capacity options remain open to it should needs arise that are either unable to be met by clean resources or cannot be met by clean resources in a timely fashion. BC Hydro notes that use of natural gas fired capacity would not enable it to maintain or reduce GHG emission levels as required by the Site C Review Terms of Reference and would not contribute to the clean energy objective of reducing GHG emissions in B.C. and Canada.

[1] FERC indicates a total of 24 pumped storage projects that are constructed and in operation, with a total installed capacity of approximately 16,500 megawatts. Most of these projects were authorized more than 30 years ago. https://www.ferc.gov/industries/hydropower/gen-info/licensing/pump-storage.asp

3.2.2.2 IPP Cost, Volume and Timing Risk

BC Hydro has conducted several calls for IPP power over the years. Each stage of the call and delivery process has different risks to BC Hydro. The table below shows the key process steps.

Table B-3-1 Power Acquisitions Process

Call design: BC Hydro conducts planning and consultation discussions with IPPs and other stakeholders and First Nations
Procurement: BC Hydro conducts energy procurement process (e.g. Call for Power)
Design/Permitting/Construction: IPP conducts design work, obtains permits, and constructs project
Operations: IPP operates project
Expiry: BC Hydro allows contract to expire or negotiates contract renewal

Overall Scheduling Risk

The duration of the first three stages of acquiring electricity from IPPs creates significant uncertainty regarding the ability to meet BC Hydro's system needs. Not having adequate energy delivered as planned is a violation of the *Clean Energy Act*'s self-sufficiency requirements. Not having adequate system capacity represents a far greater risk as this undermines system reliability and BC Hydro's ability to "keep the lights on".

BC Hydro's portfolio modelling for a mid-load forecast, including the IRP DSM plan, but without Site C shows that 1,000 MW of pumped storage is needed by 2024. In the Clean Power Call, it took roughly 8 years, from the start of the call design to the point where projects representing half of the total volume contracted in the call had reached their Commercial Operation Date (COD). There was a high level of attrition in the 2006 Call for Tenders, and only projects representing 33 per cent of the total volume contracted in the call reached their Commercial Operation Date (46 per cent of total volume contracted if the two terminated coal projects are excluded). BC Hydro has limited experience in calls for capacity and thus a call for pumped storage may take additional time and/or come with additional risks.

Regardless of future load growth, based on today's projections, procurement would need to begin in a short period of time to meet BC Hydro's capacity requirements, even in a low load scenario as discussed in the response to BCUC IR 2.20. Given the short timelines, the size of this need, the asymmetric risk of under-delivery, and the unproven nature of pumped storage in this jurisdiction, this risk is considered moderate.

- **Mitigation** – BC Hydro would need to start an accelerated procurement process for pumped storage, starting in the near term. Running a process that achieved 100 per cent of the projects reaching commercial operation on a significantly faster timeline than the two previous calls would require radically shortening the call design, consultation and planning process. Reducing these timelines from historic experience could be challenging given the uniqueness of a capacity call and the necessity for meaningful consultation with First Nations. Moreover, fast tracking these call elements only addresses the first half of the scheduling risk. Proponents' timing from award to COD in the F2006 Call for Tenders and the Clean Power Call ranged from 2 years to over 10 years. BC Hydro could build financial penalties into its contracts in order to incent faster, more timely delivery of the energy and/or capacity. This would likely push up bid prices since it transfers risk on to the developer. It may lead to faster delivery of the final project. However, this does nothing to mitigate the consequences of not having adequate capacity when the system requires it. A final element of this delivery risk on the proponent side is whether or not a proponent can deliver on an awarded contract at all. This subject is addressed below under Attrition Risk.

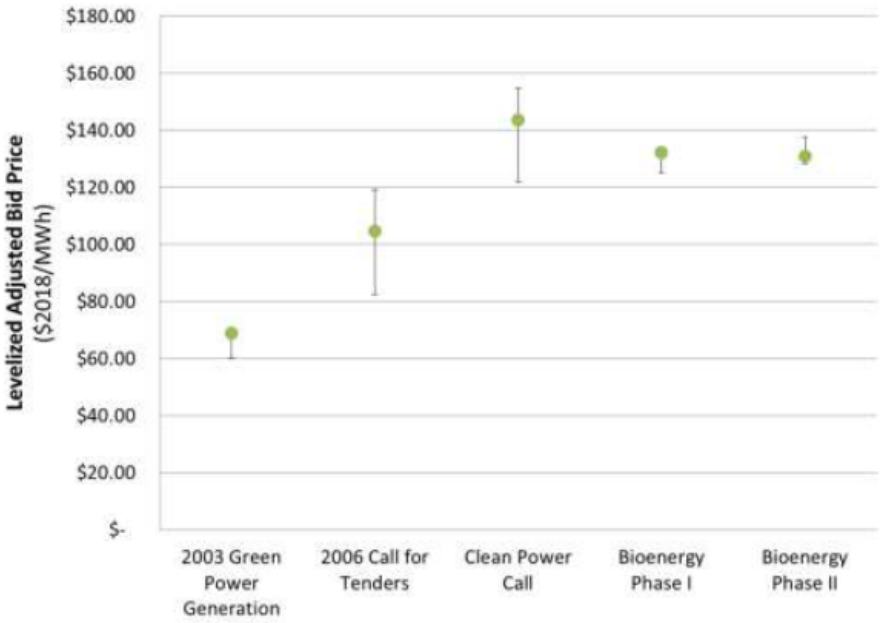
Procurement Risks

BC Hydro has full exposure to cost risks during the procurement process. Up until the call is completed and EPAs awarded, prices for IPP resources may vary due to several factors beyond BC Hydro control. These key risks and available mitigation are described below.

- **Market Conditions:** BC Hydro is exposed to risks of changes in market conditions during the procurement process. This includes changes in factors such as equipment, materials, labour, finance costs, and contractor risk tolerance. Costs in BC Hydro's energy studies are based on available information regarding the cost of equipment and construction. These costs can vary based on both overall construction market trends and risk drivers specific to wind resources.

  For example, Figure 1 shows BC Hydro's history of energy procurement prices since 2003. As shown, over the period from 2003 to the Clean Power Call (with EPAs awarded in 2010) prices increased substantially primarily due to market factors.[2]

Figure B-3-1 Average Energy Procurement Prices Since 2003



[2] Note that the product delivered is not identical between calls, and may explain a portion of the price variance.

- **Mitigation:** BC Hydro works to understand this risk through gathering best-available information regarding these resources as part of its integrated resource planning process. However, while this information allows BC Hydro to better define and understand this risk, there is no direct mitigation available and this is a retained risk to BC Hydro.
- **Lack of Competitive Pressure:** If BC Hydro is not able to maintain competitive pressure between suppliers, the suppliers would be expected to seek a higher profit in their bids increasing the price paid for alternative resources.
  - **Mitigation:** BC Hydro sizes its energy procurement processes to obtain competitive pressure (a call that is too small may exclude large, cost-effective projects and will have disproportionate transaction costs for BC Hydro; a call that is too large may have insufficient incentive to provide competitive pricing). Optimal procurement size is also partially driven by whether the call is limited to a single technology (as with the previous bioenergy calls) or is open to all potential resources.

    Note that call sizing is a trade-off between maintenance of competitive pressure and the ability to bring resources on-line to match load growth.

Permitting, Design and Construction Risks

Following award of an Electricity Purchase Agreement, the IPP is responsible for finalization of design and obtaining all required permits. The IPP is then responsible for construction of the project. During this period BC Hydro is not directly exposed to the cost risks associated with these processes. However, when IPPs encounter financial difficulties, which may involve restructuring negotiations around the EPA, BC Hydro is exposed to the following factors that affect the product delivered by IPPs:

- **Attrition Risk:** If the IPP is unable to obtain the permits required for the resource or if design changes or market conditions for labour, equipment or financing make

the pre-agreed price commercially unsustainable, it will likely cease activity under the Electricity Purchase Agreement. While BC Hydro is not exposed to the sunk costs of this permitting / project development process, we will still fail to obtain the energy and/or capacity we have contracted for and will likely have to enter into a supplementary procurement process to replace this generation source. This supplementary procurement process will have costs associated with it, and will "reset" the process such that BC Hydro is once again exposed to procurement risks.

BC Hydro's experience with attrition risk is that it is:

a) **Counter-cyclical:** attrition is higher during periods of rapid load growth (potentially due to higher competition for capital, labour and equipment) and lower during periods of low load growth (potentially due to lower competition). If this trend continues in the future it exacerbates the impact of attrition risk.

b) **Primarily applies to the permitting and design period:** BC Hydro has not yet had a case where an IPP project failed to enter into commercial operations following significant construction, although commercial challenges on a small number of IPP projects resulted in changes in ownership and project restructuring.

- **Mitigation:** Prudent mitigation strategies will likely vary between energy and capacity procurement processes.
  - There is asymmetrical risk associated with acquiring adequate capacity resources. As a result, it might be prudent for BC Hydro to over-purchase its capacity target and also split up its project size to diversify away individual project risk. Both of these mitigation measures could add to cost.
  - For energy, the risk of under delivery is lower but must still be considered.

- **Volume Risk:** As design progresses, more definition is received on the energy and/or capacity to be available from the IPP resource. Volume risk is driven by delivery (i.e., will the project reach its Commercial Operation Date and deliver what was promised) and timing (i.e. when will it reach its Commercial Operation Date). BC Hydro's EPAs have typically under-delivered energy compared to expected amounts. In addition, EPAs have in some cases delivered a different energy profile than expected (which can be of lower value) and have in some cases not met the expected level of reliability.
  - **Mitigation:** Again, prudent mitigation strategies will vary by product.
    - In all cases, BC Hydro is improving its energy procurement processes through an increase in pre-screening activity to validate IPP claims, as well as planning to increase project data requirements and due diligence during the permitting and design phase.
    - Since capacity procurement is relatively new to BC Hydro, extreme care will need to be taken during the design phase of a capacity call.
- **Restructuring Risk:** While IPPs retain construction risk under contracts, when they encounter financial difficulties they often approach BC Hydro in order to explore the potential to restructure their EPA. BC Hydro works with its vendors to determine if there is a mutually agreeable solution to the IPP's difficulties.

Operations Risks

IPPs take on cost-related risk during operations, although BC Hydro retains risk for this period with respect to delivery volumes and system integration issues. As during construction, BC Hydro's vendors also sometimes encounter financial difficulties, which may involve restructuring negotiations around the EPA. These risks are discussed below:

- **Volume Risks:** There is the risk that IPP projects do not deliver the expected volumes of energy during operations, either due to operational issues or fuel availability. BC Hydro tends to see under-delivery problems in early years of operations due to operational "growing pains". However, for some resources these under-deliveries persist for the period of operations. For example, some of BC Hydro's biomass EPAs have under-delivered on firm energy commitments, and these under-delivery problems may continue through the term of the EPA.
- **Project Life Risk:** Some technologies have uncertainty regarding the term that the resource will be available over. This is low for resources with no reliance on fuel supply, such as wind or solar. By comparison:
  - Geothermal projects can have significant uncertainty in the project life due to loss of water from the geological formation.
  - Wood-based biomass projects can have significant uncertainty due to fuel supply considerations.
- **Restructuring Risk:** While IPPs retain operations risk under contracts, when they encounter financial difficulties they often approach BC Hydro in order to explore the potential to restructure their EPA. BC Hydro works with its vendors to determine if there is a mutually agreeable solution to the IPP's difficulties.

Expiry / Extension Risks

In general, BC Hydro EPAs have a set term that is based on the date at which the project reaches commercial operations. Typically, contracts expire 10 to 40 years following the Commercial Operation Date, depending on the resource type. When approaching the contract expiry date, BC Hydro will generally enter into discussions with the IPP to determine if renewal of the contract will be cost-effective for BC Hydro. Refer to the response to BCUC IR 2.40.0 for a discussion on EPA renewal risks.

- **Market Risk:** Market conditions at the time of expiry will have a substantial impact on pricing. BC Hydro's current energy surplus situation presents a limited opportunity for IPPs and has resulted in lower renewal prices than the cost of greenfield resources. Renewal prices may be different in a situation where BC Hydro is in an energy deficit.

3.2.3 Impact of Load Resource Balance Variance

Refer to the discussion of the impact of low load growth scenarios and potential mitigation provided in the response to BCUC IR 2.20.0.

In general, while an IPP portfolio may have the potential to create a comparatively smaller surplus to a portfolio with Site C, there are fewer options to mitigate the impact of this surplus through market activities and/or customer incentives due to the capacity-poor nature of the IPP projects in the Alternatives portfolio.

3.3 Deloitte Alternative Portfolio

The alternative portfolio proposed by Deloitte provides a different risk profile than BC Hydro's Alternative Portfolio. The key differences are as follows:

- The Deloitte portfolio relies heavily on geothermal resources, with 764 MW constructed by 2034. Geothermal provides 84 per cent of the energy and 68 per cent of the 2034 incremental capacity in Deloitte's alternative portfolio. This substantially increases the availability and other risks of this portfolio. Given the lack of proven geothermal resources in B.C. it is highly unlikely these geothermal resources will be available on the schedule proposed, and there is substantial cost uncertainty with the projects if they are available;
- The Deloitte portfolio relies on more capacity from BC Hydro facility upgrades than is available. As a result, this capacity must be replaced by other sources. The risk impact of replacing this missing capacity will depend on the resources selected. If pumped storage is selected, as in BC Hydro's portfolio, the risk impact will be low

to moderate. If a more speculative technology such as batteries is selected the risk impact will be higher. Relying on uncertain assumptions about future cost declines for batteries substantially increases the cost risk of alternative portfolios;

- The Deloitte portfolio assumes that BC Hydro would be responsible for financing and constructing alternative resources. This substantially increases the risk associated with the Deloitte portfolio, as BC Hydro would retain the risk for development and construction of $7.1 billion in capital projects (2018 real dollars) for which we have no in-house expertise; and
- BC Hydro has been unable to determine the impact of Deloitte's alternative assumptions on expiry and project life risks. While BC Hydro's role in constructing these projects would remove the risk of market conditions affecting renewal costs, the addition of geothermal projects with uncertain project life may increase this risk. BC Hydro has been unable to reach a conclusion on the net effect of these offsetting risk impacts.

Table B-3-2 Summary of Risk Assessment

Risk Category	Site C Portfolio	BC Hydro Alternatives (Wind, Pumped Storage)	Deloitte Alternative Assumptions[3] (Geothermal, batteries, and upgrades)
Portfolio Composition			
Portfolio Composition	Site C 1,132 MW 5,286 GWh/year	Wind 6,119 GWh no dependable capacity Pumped Storage Net loss of 811 GWh 1,200 MW	Geothermal – 84% of energy, 68% of capacity BCH Facility Upgrades – 14% of energy, 28% of capacity Wind & Biogas – <5% of energy and capacity
Developer/Finance	BC Hydro builds and finances Site C	BC Hydro builds and finances any system upgrades. IPPs build and finance alternative resources	BC Hydro builds and finances any system upgrades. BC Hydro builds and finance alternative resources
Direct Capital Costs (F2018 real dollars)	$5.1B (Site C direct capital costs, excluding inflation, interest and sunk costs)	$8.1 billion total ($1.1B Site C termination costs, $7.0B for alternative resources)	$7.1 billion total ($1.1B Site C termination costs, $6.0B for alternative resources)
Annual Operating Costs (F2018 real dollars)	$47 million per year (Site C Operating Costs)	$150 million per year upon completion of full block (IPP operating costs, excluding taxes)	$169 million/year upon completion of full block
RISK ASSESSMENT			
Availability Risks	**Very Low**	**Low to Moderate**	**Very High**
	• Site C is a hydroelectric facility, utilizing a proven, mature technology. Generation levels have been confirmed through independent model testing of the vendor's turbine design.	• Wind is a proven resource in BC with a substantial level of site investigation. • Pumped storage has a slightly increased level of availability risk as there have been no commercial implementations in BC to-date and only limited implementations in Canada. This risk is partially mitigated by substantial site investigations in BC. Pumped storage is also similar in construction requirements to proven hydroelectric resources.	• There have been no viable geothermal sites identified in BC despite substantial investment by BC Hydro and the private sector over the past decades. The amount of geothermal proposed by Deloitte is implausible over the considered timeframe. • The Deloitte portfolio entirely relies on a capacity from BC Hydro facility upgrades up to 2026. Deloitte's assumptions of the available capacity and associated costs are based on outdated or inaccurate assumptions. As a result, this missing capacity must be replaced from a different source. • Replacing the missing capacity with pumped storage will have risks aligned with the BC Hydro alternative portfolio. Replacing the missing capacity with other resources such as batteries would have a substantially higher level of risk – such technologies are currently not commercially competitive with other resources and the likelihood of prices declining to the point where they are cost effective by the early 2020s (when capacity is required) is low

[3] BC Hydro has utilized the composition of the Deloitte portfolio from the Deloitte Report #2, including the amendments to the annual costs provided by Deloitte in their response to BC Hydro questions (Exhibit A-17). BC Hydro has utilized the composition and costs of the Deloitte portfolio as of 2034, which represents the timing where the Deloitte portfolio has replaced the energy and capacity of Site C.

Risk Category	Site C Portfolio	BC Hydro Alternatives (Wind, Pumped Storage)	Deloitte Alternative Assumptions[3] (Geothermal, batteries, and upgrades)
Procurement Risks	**Low**	**Moderate**	**High**
	• BC Hydro has procured the majority of the Site C direct costs. BC Hydro has several contracts remaining to procure, which will be subject to risk in cost escalation and competitive pressure. • BC Hydro's has contingency in place to address some variation in bid prices from BC Hydro estimates.	• BC Hydro will need to negotiate or procure an estimated $8.1B (F18 real $) of capital works and other contract costs. This procurement and negotiation activity has substantial risk: ○ The total cost to terminate Site C contracts and procure contractors to undertake the Site C and remediation work is $1.1B. There is substantial uncertainty with this amount due to risks including scope variance, bid price variance, schedule uncertainty, and the outcome of contract termination negotiations. ○ BC Hydro will need to procure alternative resources through IPPs. The estimated capital expenditure component of this procurement is $7.0B. There is substantial uncertainty in the cost of this procurement due to variance in market conditions and site availability. ○ The schedule for delivering 1000MW of pumped storage capacity by 2025 is very aggressive and contributes substantially to the procurement risk of this portfolio.	• BC Hydro will need to negotiate or procure an estimated $7.1B (F18 real $) of capital works and other contract costs. This procurement and negotiation activity has substantial risk: ○ The total cost to terminate Site C contracts and procure contractors to undertake the Site C and remediation work is $1.1B. There is substantial uncertainty with this amount due to risks including scope variance, bid price variance, schedule uncertainty, and the outcome of contract termination negotiations. ○ BC Hydro will need to investigate, develop and procure alternative resources, with an capital expenditure estimated by Deloitte of $6.0B. There is a high level of risk regarding the cost of unproven resources such as geothermal, and a high likelihood that BC Hydro would have to procure other resources at a higher price if geothermal fails to deliver. ○ It is uncertain what Deloitte would propose to replace the missing capacity resources. Pumped storage would have similar risks to the BC Hydro alternative portfolio, while other technologies such as batteries would have higher level of risk._
Design/Permitting/Construction	**Moderate**	**Low to Moderate**	**Very High**
	• Substantial design, permitting and construction work has been completed on Site C to date. • BC Hydro retains risk associated with the remaining design, permitting, and construction work on Site C.	• BC Hydro will retain substantial risk associated with the design, permitting, and construction work associated with Site C remediation activities. • BC Hydro will experience attrition / volume delivery risk during the design and permitting phase of IPP projects. This could result in too little or too much of the desired product being acquired. • IPPs generally take on construction cost risk, however when IPPs encounter financial difficulties they may approach BC Hydro to restructure the contract.	• BC Hydro would retain risk for design, permitting and construction work on the portfolio of alternative resources. • BC Hydro has negligible experience in the development of geothermal and other alternative resources. As a result, there will be a very high level of risk associated with the implementation of this portfolio.
Operations	**Very Low**	**Low**	**High**
	• BC Hydro has extensive experience in operating large hydro facilities, and has existing regional expertise in the Peace. • Large hydro is "fuel secure" in that it does not rely on a distant, or	• IPPs generally take on operations risk, however when IPPs encounter financial difficulties they may approach BC Hydro to restructure the contract.	• BC Hydro would have to decide whether to retain risk for the operations of the portfolio of alternative resources or to subcontract the operations activities to a third party.

Risk Category	Site C Portfolio	BC Hydro Alternatives (Wind, Pumped Storage)	Deloitte Alternative Assumptions[3] (Geothermal, batteries, and upgrades)
	remote fuel supply, nor a fuel supply that is subject to substantial variation in price.	• Pumped storage is an unknown entity on the BC Hydro system and it is not clear how a run/pump cycle could best fit into system operations. • Both wind and pumped storage are "fuel secure" in that it does not rely on a distant, or remote fuel supply, nor a fuel supply that is subject to substantial variation in price.	• There is no experience in BC or Canada with operations of geothermal facilities, resulting in a high level of operational risk • Geothermal facilities tend to have an uncertain project life, as water loss from the formation can result in a lack of available generation.
Expiry Risk	**Very Low**	**Moderate**	**Undetermined**
	• There is negligible risk associated with "expiry" of Site C. The project has a 70-year economic planning life and is expected to operate for well beyond 100 years.	• IPP contracts tend to have an EPA life of up to 30 years. There is risk associated with the electricity market conditions at the time of IPP contract expiry. Tight market conditions may increase contract renewal prices or require BC Hydro to build greenfield energy resources instead.	• BC Hydro has not completed an assessment of potential procurement methods for this alternative portfolio and cannot make a judgement on the potential impacts of any contract expiry.
Impact of Load Variance	**Moderate**	**Moderate**	**Moderate**
	• While Site C may have the potential to create a comparatively larger surplus to a portfolio of IPP contracts, there are more options to mitigate the impact of this surplus through market activities and/or customer incentives due to the capacity and flexibility-rich nature of Site C generation.	• While an IPP portfolio may have the potential to create a comparatively smaller surplus to a portfolio with Site C, there are fewer options to mitigate the impact of this surplus through market activities and/or customer incentives due to the capacity and flexibility-poor nature of the IPP Alternatives.	• While an IPP portfolio has the potential to create a comparatively smaller surplus to a portfolio with Site C, there are fewer options to mitigate the impact of this surplus through market activities and/or customer incentives due to the capacity and flexibility-poor nature of the IPP Alternatives.

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Appendix C

Response to Load Forecast Submissions of Robert McCullough

Response to Load Forecast Submissions of Robert McCullough

BC Hydro's August 30, 2017 Filing and responses to the Commission's information requests answer the majority of the load forecast-related issues raised in various submissions. This Appendix responds to the remaining submissions that have yet to be addressed, which were authored by Robert McCullough, on behalf of Peace Valley Landowner Association (**PVLA**) and Peace Valley Environment Association (**PVEA**).

PVLA and PVEA filed submissions prepared by Mr. McCullough regarding BC Hydro's industrial load forecast on August 30, 2017 (F35-2), September 21, 2017 (F35-6) and September 29, 2017 (F35-11). Mr. McCullough draws conclusions regarding the pulp and paper sector and the LNG sector. BC Hydro's response on each point is as follows:

- Mr. McCullough's assessment of the viability of the BC LNG sector is based on:
  - Selective use of corporate and market research reports, to the point where a report he cites reaches the opposite conclusion from what he suggests; and
  - An analysis using market forwards which does not produce meaningful results; and
- Mr. McCullough's analysis of the B.C. pulp and paper sector is cursory, and his call for further research is unwarranted given the sophistication and depth of BC Hydro's analysis.

1 Answer to Mr. McCullough's Comments on LNG Sector

Mr. McCullough maintains that most of the LNG terminals currently under consideration in British Columbia won't see the light of day, arguing that B.C. LNG is not competitive. Mr. McCullough's assessment is based on

- A selective use of corporate and market research reports; and
- A superficial analysis.

1.1 Mr. McCullough's Selective Use of Market Research Reports

The following are examples of Mr. McCullough's use of selective information:

- Analysis provided in the PVLA/PVEA September 29, 2017 Filing (F35-11) cites a TD Economics report[1] brief to conclude BC LNG is not economic because its capital intensity (capital cost per unit of LNG production) is several times higher than U.S. gulf coast brownfield LNG facilities. Mr. McCullough has omitted from his description the fact that the TD Economics report identifies capital intensity as being only one of a number of factors that determine the overall competitiveness of BC LNG projects against other LNG projects, including U.S. Gulf Coast Brownfield LNG projects (e.g., Cheniere Energy). In fact, the TD Economics report concludes, notwithstanding its higher capital intensity…"The breakeven price of Canadian LNG is competitive when compared to alternatives (see Chart 9)";[2]
- Furthermore, while the TD Economics report acknowledges there are challenges facing BC LNG projects, its overall assessment is the opposite of what Mr. McCullough implies:

[1] Footnote 3 of Mr. McCullough's analysis. Liquefied Natural Gas. The Next Leg of Canada's Energy Boom?, TD Economics, May 29, 2014

[2] The Next Leg of Canada's Energy Boom?, TD Economics, May 29, 2014. Page 5

> "The ample supply of natural gas unlocked by the shale revolution in North America, along with high prices in the Asia Pacific market have made potential Canadian liquefied natural gas exports an especially attractive opportunity. Canada's ample supply of gas, proximity to high priced markets, hospitable regulatory environment and political support for resource development make it an ideal candidate for developing LNG capacity. Resource producers are still weighing the benefits of developing this capacity against the significant capital costs and risks associated with future market uncertainty. While no final investment decisions have been made yet, two projects are expected to make a final decision by the end of this year. The ultimate shape of Canada's LNG future remains a question mark. While many issues factor into to these decisions, the real deal breakers to LNG development in Canada concern shifts in the exchange rate, cost recovery and uncertainty over future demand. Market conditions permitting, developing LNG capacity in Canada would generate a significant amount of economic benefits which would span multiple provinces and economic sectors of the country";[3]

- In the same analysis, Mr. McCullough cites a Cheniere Energy corporate LNG presentation showing the breakeven price of Cheniere Energy LNG export facilities to be one of the lowest compared to other proposed LNG projects.[4] What Mr. McCullough fails to disclose from this presentation is that future global LNG demand will require significantly more LNG production than can be supplied by Cheniere Energy alone. The Cheniere Energy presentation cited by Mr. McCullough shows global LNG demand expecting to double between 2015 and 2030. Specifically: "160 mtpa of new liquefaction capacity required by 2030. This requires around 33 new LNG trains to FID between 2016 and 2025." [5] Mr. McCullough also cites a more recent Cheniere Energy presentation[6] which appears to revise the global supply-demand gap from the previous estimate of

[3] Ibid. Page 8.

[4] Footnote 8 of Mr. McCullough's September 29, 2017 Filing (Exhibit F 35-11). Cheniere Energy, Inc. J.P. Morgan Inaugural Energy Equity June 2016, page 26.

[5] Cheniere Energy, Inc. J.P. Morgan Inaugural Energy Equity June 2016, page 24.

[6] Cheniere Energy, Inc. Barclays CEO Energy-Power Conference, September, 2017. Pages 17-18.

160 mtpa of new supply needed by 2030 to 127 mtpa of new supply needed; and an additional 90 mtpa of expected recontracted demand for a total of 214 mtpa of "uncommitted demand" by 2030;"[7]

- The same presentation shows that Cheniere Energy currently has two facilities with a total of seven trains either in operation or under construction, which will produce 31.5 mtpa (4.5 mtpa per train); and another 4 trains under development, but not yet committed, which would produce 18 mtpa.[8] Cheniere Energy's estimates of new global supply requirements are in addition to plants that are newly operational or under construction. Consequently, if Cheniere Energy's additional proposed trains proceed, they will supply just 18 mtpa (or 14 per cent) of the estimated 127 mtpa global LNG demand growth. In other words, while the Cheniere Energy facilities may be competitively well positioned, overall global LNG demand is expected to significantly outstrip what Cheniere Energy is proposing to develop. Mr. McCullough's conclusion that B.C. LNG will not proceed does not logically follow from the fact that they are not expected to be price competitive against the Cheniere facilities, given the overall global supply/demand context.

1.2 Mr. McCullough's use of Market Forwards Produces Results that are Not Meaningful

Mr. McCullough's own economic analysis, which compares price differentials between Japanese spot market LNG prices and North American (**AECO**) spot gas prices, provides limited insight into the overall LNG economics. In particular:

- The market forwards are drawn from a single day of trades (listed as August 27, 2017 in Mr. McCullough's report). There are several weaknesses with this approach. First, spot market values vary from day to day, and thus

[7] Footnote 2 of Mr. McCullough's September 29, 2017 Filing (Exhibit F 35-11). Chenier
[8] Cheniere Energy, Inc. J.P. Morgan Inaugural Energy Equity June 2016, page 4.

reflect the sentiment of the market on that day only. Second, the market becomes illiquid due to low trade volumes beyond several years from the current date. Therefore, spot market prices beyond 2019 are not reliable;

- LNG investment decisions would not generally be based on market forwards. While there has been an increase in short-term spot LNG trades, traditionally, LNG has been traded through long-term arrangements between buyers and sellers. This is because the long term forecasts account for changes in production and demand volumes, pipeline capacities and buildouts, underground storage, and changes in technology and production costs over time[9], while market forwards represent current market sentiment only. Even Cheniere Energy's LNG production is primarily tied to long term contracts;[10]
- Consequently, using spot market price differentials to conclude BC LNG projects are not economic does not produce meaningful results. By applying Mr. McCullough's logic, even Cheniere Energy's breakeven LNG price range of $7.50-$8.50/mmbtu[11] would be uneconomic compared to Mr. McCullough's estimated forward price differential of $6.03/mmbtu.

In summary Mr. McCullough's analysis on the future of BC's LNG potential and upstream gas supply is limited. In contrast, BC Hydro's expectations rely on market research undertaken by recognized expert organizations (i.e., Wood Makenzie, IHS, Bloomberg, ABB, PIRA), The technique used by the experts is based on planned terminal projects, cost estimates of the terminals and country demand to produce price forecasts. Iteratively, the technique is carried out until likely terminal projects are concluded. Effectively, this fundamental methodology is what supports BC Hydro's forecast (and entirely absent from Mr. McCullough's statistical

[9] IHS Energy. Regional Power, Gas, Coal and Renewables Methodology. 29 September 2016. Pages 4-5.

[10] Cheniere Energy, Inc. Barclays CEO Energy-Power Conference, September, 2017. Page 3. "20-year 'take-or-pay' style commercial agreements with investment grade off-takers for approximately 87 per cent of the expected aggregate nominal production capacity under construction or completed."

[11] Footnote 8 of Mr. McCullough's September 29, 2017 Filing (Exhibit F 35-11). Cheniere Energy, Inc. J.P. Morgan Inaugural Energy Equity June 2016, page 26.

approach). We provide a high level updated assessment from these market experts in Appendix J of our August 30th Filing and more detailed information in our response to BCUC IR 2.16.0. In fact, as reported in the response to BCUC IR 16.0, updated assessments from several market experts are forecasting likely BC terminal export volumes that exceed those being assumed in BC Hydro's Current Load forecast.

2 Answer to Mr. McCullough's Comments on Pulp and Paper Sector

Mr. McCullough concludes that B.C.'s pulp and paper sector will decline and requires further analysis based on a cursory review of pulp and paper mill closures in North America, historical newsprint production volumes and pricing and historical paper production volumes. BC Hydro makes the following points in response:

- BC Hydro's Current Load Forecast already reflects a continued decline in B.C forestry sector, which includes pulp and paper, wood products and chemical sub sectors; and
- Our forecast for this sector is based on a comprehensive and detailed mill-by-mill and product line-by-product line assessment undertaken by consultants that are recognized industry experts.

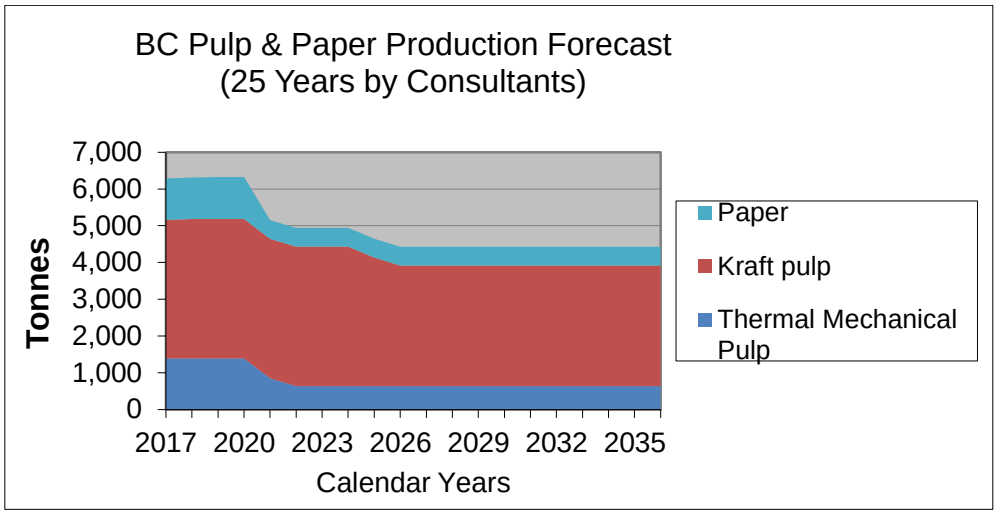
As stated in our response to BCOAPO IR 1.19.2 from our Fiscal 2017 to Fiscal 2019 Revenue Requirements Application (Exhibit B-1-1), BC Hydro's load forecast for the forestry sector is based on external expert analyses that projects continued forestry sector decline. The external sources are specialized and industry recognized consultants who are highly experienced with assessing and forecasting forest industry commodities and individual mill operations. Our consultants are as follows:

- Pulp and paper market:
  - Brian McClay (Brian McClay & Associates Inc.)

- Pulp and paper mills
  - Murray Hall (Murray Hall Consulting Ltd.)
- Wood products:
  - Global market: Russ Taylor (International Wood Markets Group)
  - Fiber supply modeling: Jim Girvan (MDT Ltd.)
  - Mill fiber demand: Murray Hall (Murray Hall Consulting Ltd.)
  - Pestilence, wildfires and log supply: Rob Schuetz (IFS Ltd.).
- Chemical Sector:
  - Temanex Consulting Inc.

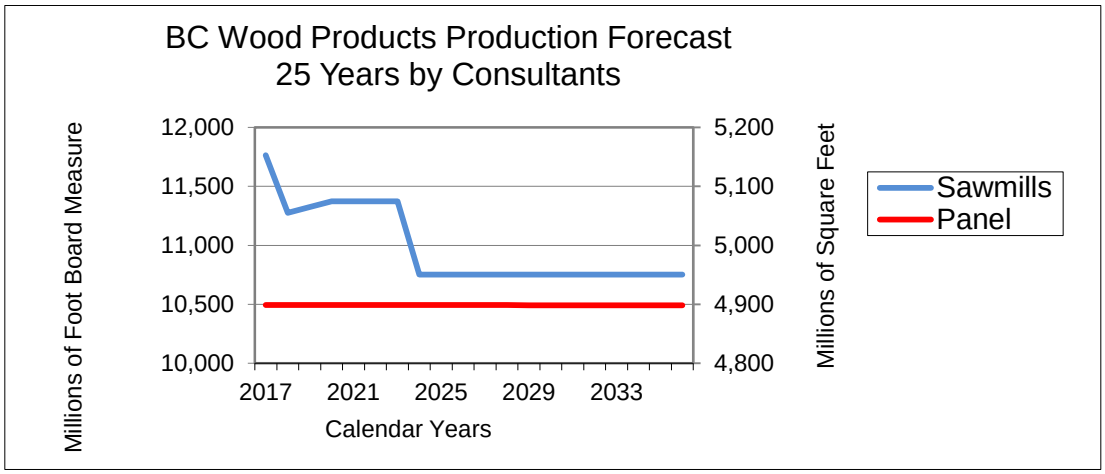
The forestry sector sales forecast largely consists of two main components: pulp and paper and wood products.

For the pulp and paper sector, our consultants produce mill line production forecasts for all sizable mills in B.C. The chart below summarizes the consultants' production expectations for each of the three main pulp and paper categories, including: Paper, Thermal Mechanical Pulp (**TMP**), and Kraft Pulp.



As seen in the chart above, all types of pulp and paper production are projected to decline.

For the wood products sector, our consultants produce mill production forecasts for nearly all sawmills and panel mills in B.C. The chart below summarizes our consultants' production expectations for each of the two main wood product operations: sawmills and panel mills (plywood and oriented strand board). As shown in the chart, the sawmill production forecasts is projected to decline and the panel mill production forecast is projected to remain flat.



Attached to this appendix are excerpts from our consulting services agreements illustrate the level of analytical effort undertaken to support BC Hydro's forestry sector load forecast.

Attachment

Excerpts from Load Forecast Consulting Services Agreements

Pulp and Paper Market Consultant

The Market Outlook shall satisfy the following requirements regarding: minimum content, timeliness, draft submission, information consistency, information resource and key drivers.

Regarding minimum content, the Market Outlook shall at least include:

- A market analysis:
  - Shall be done for at least the following, major pulp and paper product lines produced in B.C. (BC Product Lines):
    - Newsprint (for the U.S. market);
    - Uncoated paper (for the U.S. market);
    - Coated paper (for the U.S. market);
    - SC-B;
    - BCTMP;
    - Kraft;
    - Dissolving pulp; and
    - Tissue;
- For BCTMP, comment on:
  - Predominant theories for the recent substantial price fall in China;
  - Degree of excess capacity at other mills (example: PE Meadow Lake);
  - Potential for cellulose filament in BC (such as at West Fraser's QRP mill); and

- Potential for new markets for Canfor Taylor (collaborate with Mill Analyst).

- For newsprint, comment on:
  - The effects of foreign exchange; and
  - Trends and market potential in newspaper and magazine advertising;
- For Kraft, comment on:
  - New product development (such as the potential for black liquor as a green fuel product) in collaboration with the Mill Analyst);
- For dissolving pulp, comment on:
  - Potential for Fulida to restart (in collaboration with the Mill Analyst);
- For the BC product lines indicated above, and material global pulp and paper products that compete with B.C. product lines, the analysis shall at least comment on:
  - Size of the market (volume);
  - Drivers of demand and supply;
  - Closure trends; and
  - Direction (whether is the market expected to grow, flatten or decline);
- Price charts for all significant BC product lines, shall at least:
  - Be for all BC Product Lines;
  - Include sufficient history (example: at least two years for BC TMP and 20 years for newsprint);
  - Be annotated with explanations for major price movements; and
  - Extrapolation for ten years and with comments justifying the direction;

- A B.C. mill line threat assessment for B.C. dissolving pulp, BC Kraft, BC TMP and B.C. publication paper:
  - From South American BEK; and
  - Other market and technological developments reasonably foreseen by the Consultant.
- A BC Product Line competitive analysis:
  - The Consultant shall collaborate with the Mill Analyst in producing a B.C. mill quartile system. The Mill Analyst will lead. The Hydro Representative will assist in providing the framework. The purpose of the system is to provide to BC Hydro an advance indicator for B.C. mill and/or B.C. line closures in the context of global competition. The analysis will be based on mill costs, profitability, or other measures indicated by the Hydro Representative;
  - The BC Product Line competitive analysis shall consider:
    - Electricity rates;
    - Natural gas cost and mill application for heating, drying, and power generation;
    - BC Hydro's Electricity Purchase Agreements (**EPA**) with specific BC mills and the materiality of the beneficial effects of these agreements;
    - Fiber supply; and
    - Mountain Pine Beetle and Spruce Beetle impacts;
- An assessment of B.C. mill closure trends:
  - Advice as to trends in pulp and paper line and mill closures and whether these will continue or reverse.

In terms of timeliness, the Consultant shall endeavor to create the Market Outlook based on the most current available information, and by using credible sources.

Pulp and Paper Mill Consultant

The Mill Outlook, as provided by the Consultant, will be an analysis and outlook for all the pulp and paper mills in B.C. The Mill Outlook shall satisfy the following requirements regarding minimum content, timeliness, draft submission, information consistency, information resource and key drivers.

Regarding minimum content, the analysis and outlook for each mill will include where applicable to complete the analysis for each mill:

- Product line analysis covering:
  - Market size;
  - Market destinations for key products;
  - Key drivers (particularly those indicated in the Market Outlook);
  - Potential of closure risk for five, 10 and 15 years out;
  - Comments on negative industry trends;
  - Future expectations including the possibility of line upgrades;
  - production expansion and change in fiber supply processing;
  - Equipment status (age, risks, etc.);
  - Comments on foreign exchange impact/benefit on B.C. product sales, and the cost of new equipment and maintenance capital; and
  - Incorporate Market Analysis intelligence into mill and/or line analysis (particularly newsprint trends with the analysis for Catalyst);
- Mill operations:
  - Closure risk for five, 10 and 15 years out;
  - Potential for major capital investment;

- Threats (such as Bleached Eucalyptus Pulp and others indicated in the Market Outlook);
- Opportunities (such as natural gas applications and those indicated in the Market Outlook; and
- Mill and/or line cost or profitability or shutdown quartile rating;

- For BCTMP mills:
  - For the PE Chetwynd mill, its restart potential (with consideration to excess capacity at other mills, capacity at PE Meadow Lake, etc.). the Consultant shall provide analysis to support conclusion;
  - For the Canfor Taylor mill, the potential for expansion. Consultant shall provide analysis to support conclusion; and
  - For the WF QRP mill, the potential for cellulose filament production. The Consultant shall provide analysis to support conclusion;
- For publication paper mills:
  - Effects from foreign exchange, newspaper advertising, and magazine advertising should at least be analyzed;
  - For Catalyst mills, comment on efficiency and provide an assessment of their potential for being the among the last mills in operation;
  - For the Catalyst Powell River mill, comment on the SC-B duty and estimate the cost to the mill and its impact;
  - Comment on the potential for new product development; and
  - For the PE HSPP paper line, comment on the potential the restart of paper line and provide justification;

- For Kraft mills:
  - Comment on new product development (for instance the potential for black liquor as a green fuel product);
- For the Fulida mill:
  - Comment on the restart potential; and
  - What would be needed to for the mill to be restarted
- B.C. mill closures:
  - The potential for more pulp and paper lines;
- A B.C. mill product line competitive analysis:
  - The Consultant will produce a BC mill quartile system and work collaboratively with the Market Analyst in producing it. The purpose of the system is to rank BC mills and/or lines relative to their competitors, and provide insight to BC Hydro with respect to potential closures or curtailments. It may be based on mill cost, profitability, or some other measure indicated by the Hydro Representative;
- The BC Product Line competitive analysis shall consider:
  - Electricity rates;
  - Natural gas cost and mill application for heating, drying, and power generation;
  - BC Hydro's Electricity Purchase Agreements (EPA) with specific BC mills, and the materiality of the beneficial effects of these agreements;
  - Fiber supply; and
  - Mountain Pine Beetle and the Spruce Beetle impacts.

The Consultant will make four trips to gain intelligence on mill operations. These trips will be to the following locations:

- Prince George/Quesnel;
- Vancouver;
- Cranbrook; and
- Vancouver Island.

The purpose of the trips will be to gain information to complete the Mill Analysis.

All of the above analysis shall be based on the most reasonably current and credible information.

As part of the Site C inquiry, BC Hydro undertook a review of each of its industrial sector accounts, including those in the forestry. The results of our review are provided in Appendix J of our August 30 Filing. Appendix J describes a number of recent developments that would tend to increase forestry sector load in the short, medium and long term due to a number of mill-specific developments and government policy changes (i.e., PST removal on power consumption). Appendix J also identifies market and prices drivers which pose both downside and upside risks to future forestry sector load.

In short, further analysis of this sector is unnecessary at this time.

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Appendix D

Response to Deloitte and Other Parties on Demand-Side Management

Response to Deloitte and Other Parties on Demand-Side Management

This Appendix addresses four points that arise from the Deloitte Report No. 2 and in other submissions filed in this Inquiry:

- A number of the submissions (Deloitte, Bakker et al, CEC, Eliesen) misinterpreted the data and incorrectly concluded that BC Hydro stops investing in demand-side management past 2021. BC Hydro is continuing to invest;
- Examining feasibility alone is insufficient. One must look at cost-effectiveness and risk to ratepayers, which most commenters have not done;
- The cost-effectiveness assessment of Deloitte and Raphals et al is flawed; and
- Total resource costs should also be used to assess the cost of demand-side management relative to other resource options when conducting resource planning as it is more representative of the total cost of the resource

1 BC Hydro's Plan is to Continue Investing in Demand-Side Management Over Time

A number of the submissions (Deloitte, Bakker et al, CEC, Eliesen) incorrectly conclude that BC Hydro stops investing in demand-side management past 2021. One only has to look at BC Hydro's continued projected investment in demand-side management over time to see that this is not the case. BC Hydro's plan is to continue investing in DSM over the long-term.

BC Hydro's current DSM Plan was chosen to retain a broad range of initiatives, to lessen rate impact over the 10 Year Rates Plan and to respond to changing customer needs. DSM continues to be the first resource that BC Hydro considers for

when customer need exceeds existing, planned and committed resources. In considering DSM, BC Hydro looks at both the cost-effectiveness of the resource as well as the risk/uncertainty profile of the energy and capacity savings. In the portfolio results undertaken by BC Hydro in section 8 of the application, cost effective DSM is the first resource added to the portfolios and as a result, DSM additions tend to affect both portfolios with and without Site C similarly. Other resources make up the key alternatives to Site C. Cost effectiveness for BC Hydro's ratepayers includes not only present value benefits but includes ensuring cost effective rates.

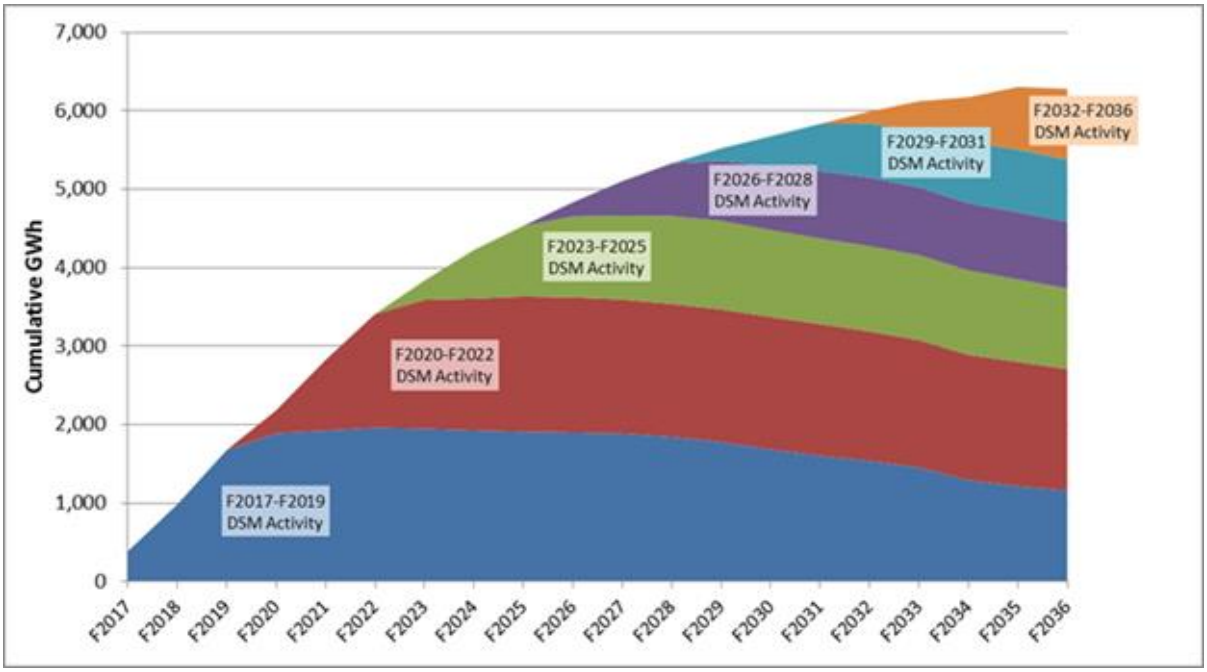
In selecting its DSM Plan for the Fiscal 2017 to Fiscal 2019 Revenue Requirement Application, a key consideration for BC Hydro was to maintain the ability to ramp up to higher levels of energy savings in the future when needed. This future need is evidenced by a number of the portfolios that BC Hydro examined as part of its submission to this Inquiry, which show higher levels of DSM required at future points in time depending on the load resource balance scenario.

The mistaken claims of Deloitte, Bakker et al, CEC, Eliesen regarding BC Hydro's future intent to pursue DSM appears to be based on a misunderstanding of Table 3-8 of BC Hydro's Fiscal 2017 to Fiscal 2019 Revenue Requirements Application. In particular, (Deloitte, Bakker et al., CEC) subtract the year-over-year cumulative savings to produce a view of annual incremental savings. However, what these submissions fail to understand is that their methodology – the year-over-year difference between cumulative savings – includes the drop off of prior years' energy savings persistence over time which actually determines **net incremental savings. New incremental savings** - which does not include energy savings persistence drop off - is the better indicator of what new DSM activity and expenditures occur in a given year.

The relationship between cumulative energy savings and energy savings persistence drop off can be illustrated by Figure 1-1 below, which is developed from

BC Hydro's current DSM Plan. Each colour represents new energy savings activity for that time period with energy savings persistence drop off. As most evident with the blue wedge for fiscal 2017 to fiscal 2019 energy savings, the energy savings start to decline over time reflecting energy savings persistence drop off. The decline is more notable later on as the portfolio energy savings are 19 years on average. However, what is also evident is that BC Hydro's current DSM Plan continues investing in new DSM over the longer term.

Figure 1-1 Cumulative Energy Savings of BC Hydro's DSM Plan



Based on their misunderstanding of Table 3-8, Deloitte goes on to use the ACEEE 2017 Utility Efficiency Scorecard to provide insight into where additional DSM opportunities may be found. However, in using this scorecard, Deloitte does not mention that while ACEEE identifies 15 emerging program areas for investigation, the pursuit of eight or more of these areas receives the top score (i.e., no utility is pursuing them all, likely because not all utilities would have achievable

potential in all of the emerging areas). BC Hydro is pursuing eight of these areas, which would receive a top score in this category.

2 Higher Levels of DSM Energy Savings May Be Possible, but are Uncertain and are Not Cost-Effective Relative to Site C

BC Hydro agrees that higher levels of demand-side management than our current DSM Plan are possible, but we plan our level of further demand-side management spending so it is timed appropriately in order to meet system needs and keep customer rates low. Questions of 'how much' DSM and 'when' are typically addressed in BC Hydro's Integrated Resource Plans using information from the Conservation Potential Review to determine what is achievable. The question when it comes to DSM above the current DSM Plan is not so much whether it is possible, but rather whether it is cost effective, and the risk associated with it.

Higher DSM is Not Cost-Effective Relative to Site C

BC Hydro addressed higher levels of DSM (beyond its current plan) in our August 30 Filing to the Commission, analyzing two different levels: the 2013 IRP Plan and a high level sensitivity IRP Plan Plus. The highest level of energy savings examined – IRP Plan Plus - would add 5,000 GWh to our current plan by fiscal 2036. Our sensitivity analysis on page 102 of our August 30 Filing shows that Site C is more cost-effective than a portfolio that includes higher levels of demand-side management.

Higher Levels of DSM also Entail Higher Risk for Ratepayers

While BC Hydro agrees that higher levels of DSM are possible, in general, there is increased uncertainty with pursuing higher levels of DSM that rely on higher participation levels and targeting higher percentages of the market. In particular, BC Hydro would consider levels of DSM beyond the 2013 IRP Plan (such as the IRP

Plan Plus) sensitivity to have increased uncertainty. To understand the uncertainty with higher levels of DSM, BC Hydro would need to apply its risk framework (as described in Appendix 4B of the 2013 IRP), which could result in an adjusted savings amount (e.g., reduced) to represent a P50 level.

In terms of specific levels recommended for higher energy savings, some of the submissions assert that:

- Energy savings levels commensurate with "Option 3" from the 2013 IRP are possible (Deloitte);
- Energy savings levels commensurate with "Option 5" from the 2013 IRP are possible (CCPA); and
- Incremental savings levels that achieve a reduction of 50 per cent of load growth on an annual basis are possible (Raphals and Hendriks).

BC Hydro generally agrees with Deloitte on this point, but does not agree with the positions of the Canadian Centre for Policy Alternatives and Raphals and Hendriks.

"Option 3" levels

Deloitte recommends "applying increased level of DSM opportunities above what BC Hydro is currently doing (e.g., using BC Hydro's Option 3 DSM" (page 120). In fact, BC Hydro has looked at increased levels of DSM opportunities in its analysis that even exceed Option 3 levels. For example, Option 3 (fiscal 2016 start year) achieves almost 10,000 GWh in cumulative energy savings by fiscal 2036. BC Hydro's DSM sensitivity considers approximately 12,000 GWh in fiscal 2036. Neither of these options were cost-effective relative to Site C. BC Hydro reiterates that higher levels of energy savings come with increased uncertainty.

In the information provided to Deloitte, BC Hydro noted that it considers Option 3 outdated. The savings estimates for Option 3 are no longer valid as many of the

assumptions that underpin it are outdated, including market information, program performance, evaluation results and the load forecast. Accordingly, there would be little value in running a specific scenario on Option 3 in addition to the sensitivities that BC Hydro has already considered in its analysis.

"Option 5" levels

The Canadian Centre for Policy Alternatives argues on page 10 of its submission that Option 5 levels of energy savings should, in effect, be added to BC Hydro's load forecast projections to extend the planning surplus to 2032 and beyond. The author concludes that: "aggressive conservation and reductions in fossil fuel industries, combined with BC Hydro's underlying electricity generation surplus, leave abundant available supply—on the order of two Site C dams for much of the forecast period."

In recommending Option 5, the CCPA neglect to highlight an important finding of the 2013 IRP, namely that it was a technically unviable option that presented significant government and customer acceptance challenges arising from an aggressive and untested coordinated combination of rate structures and codes and standards. As such, Option 5 was not analyzed as an alternative to Site C.

BC Hydro's position is that Option 5 is still not a technically viable option. Notably, the Deloitte report supports this finding on page 45 of their report: "These substantial shifts in technology adoption (as found in Option 5) are not considered achievable for the purpose of utility planning."

Incremental savings that achieve a reduction of 50 per cent of load growth

Raphals and Hendricks take a different approach to quantifying a future level of DSM savings that is not based on the 2013 IRP. They contend that annual incremental savings targets should be based on a 50 per cent reduction of annual load growth. As rationale for this, they cite the *Clean Energy Act* objective on DSM. BC Hydro does not agree with this approach for setting DSM activity levels.

- First, it is based on a misunderstanding of the *Clean Energy Act* objective, which set a long-term target for DSM based on a specific year (fiscal 2021), not on a year-over-year basis; and
- Second, and more importantly, Raphals and Hendricks have done no assessment of whether these savings are achievable over time – they simply assume they will be there.

Nevertheless, BC Hydro has considered energy savings levels higher than the levels suggested by Raphals and Hendriks with its IRP Plus sensitivity. As mentioned earlier, these additional energy savings did not prove to be cost effective relative to Site C in the analysis.

3 Other Shortcomings in Deloitte and Raphals et al Analysis on the Cost of Higher Levels of Energy Savings

Very few of the submissions make an assessment of the cost of DSM, which is a critical shortcoming, considering that it is important to consider when analyzing whether more DSM is cost-effective relative to Site C. Two submissions that do look at the cost of higher savings are Raphals and Hendriks and Deloitte. However, their respective analyses are flawed.

Raphals and Hendriks suggest that the program utility cost of BC Hydro's current DSM Plan of $22/MWh should be inflated by 50 per cent because it reasonable to assume that the cost of higher levels of DSM savings "would be higher than BC Hydro's DSM plan." The 50 per cent adjustment appears to be an arbitrary assumption.

Deloitte appears to suggest that a utility cost of $23/MWh is appropriate as this is the average cost of delivering energy efficiency programs over 2009 to 2013 in the U.S. BC Hydro considers this cost estimate low as the IRP Plan (similar to Option 2) has

an updated program utility cost of $29/MWh (fiscal 2016 to fiscal 2024). As Option 3 advanced energy savings relative to Option 2, BC Hydro does not agree with Deloitte's conclusion that higher levels of energy savings could be achieved at a lower cost than Option 2.

Other limitations with using this as a cost estimate include:

- Cost estimates should be converted to Canadian dollars;
- There is a high level of inconsistency in numbers that are reported to regulators. Savings could be net or gross, deemed or evaluated, measured at the customer meter or generator. Costs being captured at the program level and at the portfolio level are not clearly defined. For example, some include evaluation, marketing and outreach costs within program spending, others at the portfolio level, others don't specify; and
- Each jurisdiction operates in a different market, with different baselines, different maturity of demand-side management programs, and different program delivery types. For example, by fiscal 2014 BC Hydro had eliminated incentives for compact fluorescent lamps (**CFLs**) due to existing or upcoming regulations. This creates an apples-to-oranges comparison with historical lighting data from jurisdictions whose main activity involved incenting CFLs. Additional factors could include differing labour costs across jurisdictions, and the scale of a utility's demand-side management program.

4 Total Resource Cost Should Be Considered

BC Hydro does not agree with either the suggestions of Raphals and Hendriks and Deloitte to consider only the utility costs of demand-side management and not total resource costs. BC Hydro's view is that total resource costs should also be used to assess the cost of demand-side management relative to other resource options when conducting resource planning as it is more representative of the total cost of

the resource (i.e., includes customer costs and benefits). To just consider utility costs presents a narrow and incomplete view of DSM cost-effectiveness and is inconsistent with how many utilities and regulators evaluate DSM in North America. It is also inconsistent with the DSM Regulation, which states that the Commission must make determinations of cost effectiveness by applying the total resource cost test.

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Appendix E

Review of Impact of Revisions Made by Deloitte in Response to BC Hydro Questions

Review of Impact of Revisions Made by Deloitte in Response to BC Hydro Questions

Response to Question 2 - Alternate Portfolio Capital and Operating Costs

(all values in $ millions)

	Annual Costs - Original (Deloitte Report #2, page 107-108)			Annual Costs - Revised (Deloitte Response to BC Hydro Questions)			
Year	**Capital**	**Operating**	**Total**	**Capital**	**Operating**	**Total**	**Difference**
2018	-	-	-	-	-	-	-
2019	6	-	6	8	1	9	3
2020	-	-	-	-	1	1	1
2021	37	1	38	51	1	52	14
2022	33	1	34	45	1	46	12
2023	39	1	40	52	2	54	14
2024	48	3	51	65	4	69	18
2025	-	3	3	-	4	4	1
2026	-	3	3	-	4	4	1
2027	255	15	270	339	21	360	90
2028	496	29	525	661	40	701	176
2029	648	48	696	863	65	928	232
2030	583	65	648	778	87	865	217
2031	445	78	523	593	104	697	174
2032	501	92	593	668	123	791	198
2033	605	107	712	806	143	949	237
2034	796	127	923	1,061	169	1,230	307
2035	946	152	1,098	1,261	203	1,464	366
2036	951	177	1,128	1,269	237	1,506	378
Totals to F2034:							
PV at 4% (real) discount rate			3,092			4,129	1,036
Difference as percent of revised PV							25%

Response to Question 4 - Upgrades to BC Hydro Facilities

(all values in MW)

Capacity Additions to F2034	1,121
Reduction in GMS 1-5 Capacity	(120)
Removal of Strathcona	(31)
Increase in Seven Mile Capacity	16
Revised Total	985
Percent reduction	-12%

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Appendix F

Interpretation of Greenhouse Gas Emission Requirement in Terms of Reference

Interpretation of Greenhouse Gas Emission Requirement in Terms of Reference

This Appendix addresses the proper interpretation of the requirement in the Order in Council ("Terms of Reference") regarding "maintenance or reduction of 2016/17 greenhouse gas emission levels".

The Terms of Reference require the Commission to consider alternative resources with regard to "maintenance or reduction of 2016/17 greenhouse gas emission *levels*." The Deloitte Report No. 2 and the Commission's Preliminary Report (p. 76) interpret this requirement as meaning maintaining the same carbon *intensity* (tonnes of greenhouse gas emissions per unit energy), as opposed to maintaining or reducing total greenhouse gas emissions. This interpretation would allow for:

- An increase in the total contribution to greenhouse gas emissions as load increases; and
- Resources with significantly higher greenhouse gas emissions than Site C (such as natural gas) to be used in the alternative portfolio; and

Although this interpretation still favours Site C as the resource with the lowest carbon intensity, BC Hydro submits that the Terms of Reference were intended to focus the Commission on alternative portfolios that are not comprised of resources that would lead to substantial increases in greenhouse gas emissions.

Levels vs. Intensity

Though they are related, greenhouse gas emission *levels* and greenhouse gas emission *intensity* are two different concepts. "Levels" generally refers to the amount of greenhouse gas emissions in a given period and location (generally measured in

tonnes). Whereas “intensity” is akin to concentration, and a measure of the amount of greenhouse gas emissions produced by an energy resource per unit of energy produced. A resource with a particular carbon intensity will produce more or less greenhouse gas emissions as the output increases or decreases.

Greenhouse Gas Emissions of Site C

The greenhouse gas emissions associated with Site C are largely associated with construction. Once the Project is constructed, it produces very low carbon emissions over its long life. This was the subject of considerable review in the environmental assessment (see Environmental Impact Statement, Section 15, Volume 2, Appendix S, and Technical Memo: Greenhouse Gas Emissions Merits of the Project, included at Appendix G of our August 30 Filing).

The analysis conducted in the environmental assessment showed that the Project will result in a net benefit from a GHG perspective, producing electricity with substantially lower GHG emissions compared to other forms of firm electricity generation, and by supporting the integration of other low emission, renewable intermittent resources into the BC Hydro system.

Site C emissions per unit of energy (i.e., greenhouse gas emission intensity) are also less than other resources. Site C’s emission intensity is less than 2 per cent the intensity of gas or diesel generation. As the Joint Review Panel found, Site C also has the lowest carbon intensity of any resource other than nuclear.

Principles of Statutory Interpretation Support Interpreting “Levels” to Mean Levels

The Terms of Reference are a regulation, and as such should be interpreted consistent with principles of statutory interpretation. Giving legislation its plain meaning within the overall context of the legislation is one such principle. Consistency with other relevant legislation is another such principle.

Interpreting the Terms of Reference requirement as a cap on total emissions is also consistent with the statutory definitions in related legislation enacted by the legislature. In referring to the "maintenance or reduction of 2016/17 greenhouse gas emission levels", the Terms of Reference (s. 3(b)(iv)) require this consideration be done with reference to the *Clean Energy Act,* S.B.C. 2010, c. 22, objectives.

The *Clean Energy Act*, s. 2(g), defines British Columbia's energy objectives to include reductions in BC greenhouse gas emissions relative to "the level of those emissions in 2007". (Similar language is also used in the *Greenhouse Gas Reduction Targets Act*, S.B.C. 2007, c. 42.) "Intensity" is used to describe emissions proportionate to the energy provided in the *Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act*, S.B.C. 2008, c. 16. The statute defines "carbon intensity" in part as follows:

> the greenhouse gas emissions attributable…to the fuel proportionate to the energy provided by the fuel in its expected use for transport or another prescribed purpose…expressed as grams of carbon dioxide equivalent emissions per megajoule of energy… (Emphasis added.)

Similarly, the *Renewable and Low Carbon Fuel Requirements Regulation*, B.C. Reg. 394/2008 promulgated under that statute sets limits for carbon intensity at amounts in g CO2e/MJ (for example, ss. 11.02 and 11.04), which represents a measurement emissions relative to a unit (megajoule) of energy.

Accordingly, BC Hydro submits the Commission should be interpret "maintenance or reduction of 2016/17 greenhouse gas emission *levels*" to mean greenhouse gas emission levels, rather than greenhouse gas emission intensity. Such an interpretation is logical and consistent with the wording of related statutory language. In the end, Site C is favoured on both the measure of emission levels and emission intensity.