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October 24, 2019

Mr. Patrick Wruck
Commission Secretary and Manager
Regulatory Support
British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC V6Z 2N3

Dear Mr. Wruck:

RE: Project No. 1599038
British Columbia Utilities Commission (BCUC or Commission)
British Columbia Hydro and Power Authority (BC Hydro)
Application for 2019 Letter Agreement with Powerex Corp.

BC Hydro writes in compliance with Commission Order No. G-243-19 to provide its responses to Round 1 information requests (**IRs**) as follows:

Exhibit B-4	Responses to Commission IRs (Public Version)
Exhibit B-4-1	Responses to Commission IRs (Confidential Version)
Exhibit B-5	Responses to Interveners IRs
Exhibit B-6	Responses to Commission Confidential IRs (Confidential)

BC Hydro also provides submissions on further process, as contemplated by that Order. BC Hydro has also prepared amendments to its draft Order to address three issues that became apparent in the course of preparing the IR responses.

BC Hydro is filing the response to BCUC IR 1.5.1 confidentially with the Commission. BC Hydro confirms that an explanation for the request for confidential treatment is provided in the public version of the IR response. BC Hydro seeks this confidential treatment pursuant to section 42 of the *Administrative Tribunals Act* and Part 4 of the Commission's Rules of Practice and Procedure.

First, a number of IRs (including BCUC IR 1.6.4) were issued in regard to the time horizon within which BC Hydro would employ the 2019 Letter Agreement. In particular, there seemed to be a potential concern that BC Hydro might use the 2019 Letter Agreement to procure forward physical electricity outside the operational time horizon, and potentially use it to manage its electricity requirements in the planning horizon. That concern arises because the 2019 Letter Agreement does not specify a maximum Delivery Term (as defined).

To address that concern, BC Hydro commits that it will not specify Delivery Terms greater than three years in its Purchase Interest Requests, as set out in its response to BCUC IR 1.6.4. BC Hydro has reflected this commitment in a revised draft Order (black-line, attached).

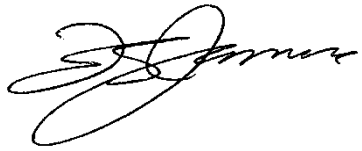
Second, a number of IRs (including BCUC IR 1.6.2) sought to clarify whether BC Hydro could amend the Contract Price to allow for a price other than a wholesale market price. This concern arises because of the language in the 2019 Letter Agreement that gives the parties a broad right to amend the Contract Price. To clarify the intent of the parties in including this language in the 2019 Letter Agreement, BC Hydro has made commitments regarding this amendment right in its response to BCUC IR 1.6.2 which it wishes to confirm. Specifically, BC Hydro commits that it will not amend the Contract Price other than as follows: 1) if the estimate of the fixed and variable transmission costs are no longer reasonable; and 2) to change the wholesale market price to a different wholesale market price if the original is no longer published. BC Hydro has also reflected that commitment in a revised draft Order (black-line, attached).

Lastly, a number of IRs were issued regarding the reporting that BC Hydro proposed in its Application. BC Hydro acknowledges that its description of proposed reporting was unclear. To confirm, BC Hydro proposes to provide a public report that is consistent with Directive 3(a) of BCUC Order E-15-19 regarding the 2018 Letter Agreement (**BCUC 2018 Order**). Specifically, BC Hydro will file, 90 days after the end of each calendar quarter, a public report that specifies the Transactions (as defined in the 2019 Letter Agreement) that occurred during the relevant calendar quarter. BC Hydro confirms that it does not propose to continue the reporting requested in Directives 3(b) to 3(d) of the BCUC 2018 Order because BC Hydro manages its system on a portfolio basis and is therefore not able to generate the information requested. Finally, BC Hydro confirms it will continue filing monthly reports to monitor water levels and inflows at each of the Kinbasket and Williston reservoirs pursuant to Directive No. 4 of the BCUC 2018 Order. BC Hydro has reflected this correction in a revised draft Order (black-line, attached) as well.

In regards to process, BC Hydro submits that no further evidentiary process in regard to the 2019 Letter Agreement is required. Instead, and as noted on page 11 of the August 2, 2019 Application, BC Hydro proposes that the Commission invite submissions from interveners on the narrow question whether the 2019 Letter Agreement can be declared to be in the public interest and accepted for filing or, alternatively, whether some material doubt arises in regard to the proposed request for acceptance such that a full hearing is necessary. Assuming the Commission invites submissions from interveners on this question, then BC Hydro expects it would have a right of reply.

For further information, please contact the undersigned.

Yours sincerely,



Fred James
Chief Regulatory Officer

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Enclosure

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Utilities Commission

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ORDER NUMBER
G-xx-xx

IN THE MATTER OF
the *Utilities Commission Act*, RSBC 1996, Chapter 473

and

British Columbia Hydro and Power Authority (BC Hydro)
Letter Agreement with Powerex Corp. – Forward Electricity Purchases

BEFORE:
Commissioner
Commissioner
Commissioner

on Date

ORDER

WHEREAS:

A. On August 2, 2019, pursuant to section 71 of the *Utilities Commission Act* (UCA), British Columbia Hydro and Power Authority (BC Hydro) filed with the British Columbia Utilities Commission (BCUC) a letter agreement date June 6, 2019, (2019 Letter Agreement) between BC Hydro and Powerex Corp. (Powerex) that provides for the forward delivery and sale of electricty from Powerex to BC Hydro (altogether the Application);

B. By Order G-61-12, dated May 17, 2012, the BCUC established the Rules for Energy Supply Contrcats (ESC) for Electricity (Rules). The Rules are intended to facilitate the BCUC's review of ESCs and proposed ESCs for electricity;

C. BC Hydro requested that certain information contained in the 2019 Letter Agreement be kept in confidence pursuant to Part IV of the Commission's Rules of Practice and Procedure;

D. In its Application BC Hydro sought a determination that the 2019 Letter Agreement is in the public interest and an order accepting it for filing;

E. In response to informations requests regarding the 2019 Letter Agreement, BC Hydro commited that it would not specify Delivery Terms (as defined in the 2019 Letter Agreement) greater than three years, consistent with the operational time horizon within which the agreement is meant to be used (the Delivery Term Commitment);

F. In response to informations requests regarding the 2019 Letter Agreement, BC Hydro commited that it would not amend the Contract Price other than as follows: 1) if the estimate of the fixed and variable transmission costs are no longer reasonable; and 2) to change the wholesale market price to a different wholesale market price if the original is no longer published;

G. In its Application BC Hydro proposed reporting obligations with respect to the 2019 Letter Agreement. BC Hydro proposed to provide a public report that is consistent with Directive 3(a) of BCUC Order E-15-19 regarding the 2018 Letter Agreement (BCUC 2018 Order). Specifically, BC Hydro will file, 90 days after the end of each calendar quarter, a public report that specifies the Transactions (as defined in the 2019 Letter Agreement) that occurred during the relevant calendar quarter. BC Hydro confirms that it does not propose to continue the reporting requested in Directives 3(b) to 3(d) of the BCUC 2018 Order because BC Hydro manages its system on a portfolio basis and is therefore not able to generate the information requested. Finally, BC Hydro confirms it will continue filing monthly reports to monitor water levels and inflows at each of the Kinbasket and Williston reservoirs pursuant to Directive No. 4 of the BCUC 2018 Order;

H. BC Hydro submited that no further evidentiary process in regard to the 2019 Letter Agreement is warranted. Instead, and as noted on page 11 of the August 2, 2019 Application, BC Hydro proposes that the Commission invite submissions from interveners on the narrow question whether the 2019 Letter Agreement can be declared to be in the public interest and accepted for filing or, alternatively, whether some material doubt arises in regard to the proposed relief such that a full hearing is necessary. Assuming the Commission invites submissions from interveners on this question, then BC Hydro expects it would have a right of reply.

NOW THEREFORE pursuant to section 71 of the *Utilities Commission Act* , the Commission orders as follows:

1. On the basis in part of the Delivery Term Commitment, the 2019 Letter Agreement between BC Hydro and Powerex is accepted for filing.

2. BC Hydro is directed to file the following with the BCUC, 90 days after the end of each calendar quarter, a public report that specifies the Transactions (as defined in the 2019 Letter Agreement) that occurred during the relevant calendar quarter.

DATED at the City of Vancouver, in the Province of British Columbia, this (XX) day of (Month Year).

BY ORDER

(X. X. last name)
Commissioner

Attachment Options

1.0 Transfer Pricing Agreement

Reference: Exhibit B-1, pp. 5-6

On pages 5-6 of the Application, BC Hydro describes the relationship between the Letter Agreements and the 2003 TPA as follows:

> Since 2003 BC Hydro and Powerex have purchased and sold wholesale electricity exclusively through the Transfer Pricing Agreement (**2003 TPA**). The 2003 TPA has proved to be a reasonably robust and relatively flexible mechanism to facilitate BC Hydro purchases of imported wholesale electricity from Powerex, and sales to Powerex for export. However, purchases and sales under the 2003 TPA are effected on a day-ahead, pre-schedule basis, and are mechanistically allocated to the account of Powerex (via the Trade Account) or BC Hydro. The 2003 TPA has worked well in the context of a consistently liquid wholesale day-ahead market for electricity in the Pacific Northwest. As such, the 2003 TPA did not provide, and did not need to provide, any mechanism for forward physical sales or purchases between BC Hydro and Powerex.
>
> […]
>
> Finally, it is apparent that an alternative solution to the on-going operational supply issues arising from the liquidity decline in day-ahead markets would be a revised Transfer Pricing Agreement. BC Hydro and Powerex are considering updating the 2003 TPA, including considering how the 2003 TPA might usefully be revised to accommodate forward transactions. That consideration is underway, but is not a trivial exercise because of the central role that the 2003 TPA plays in the BC Hydro-Powerex relationship. Nevertheless, and to the extent that Powerex and BC Hydro do update the 2003 TPA for that purpose, the 2019 Letter Agreement can be considered a bridging mechanism.

AMPC seeks to better understand why BC Hydro is applying for approval of the 2019 Letter Agreement instead of amending the TPA.

1.1.1 Please explain why BC Hydro did not include the ability for BC Hydro to make forward physical wholesale electricity purchases in the 2003 TPA.

RESPONSE:

The statement is correct that the 2003 TPA does not include the ability to enter into forward physical transactions (as section 11.1 of the 2003 TPA has been interpreted to apply only to financial forward contracts).

In 2003, when the TPA was signed, BC Hydro did not expect to have a need to enter into forward physical transactions as the expectation was that the day-ahead market would have sufficient liquidity to enable Powerex to transact energy to meet BC Hydro's import and export needs. Although the day-ahead market (and the day-ahead market index) continues to be one of the most important and active wholesale electricity markets (indicies) in the west, the decline and uncertainty in day-ahead market liquidity in recent years is a key driver for the need for BC Hydro to also be able to purchase forward physical electricity to meets its operational needs and mitigate risks.

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AMPC seeks to better understand why BC Hydro is applying for approval of the 2019 Letter Agreement instead of amending the TPA.

1.1.2 Please explain why BC Hydro is applying for approval of the 2019 Letter Agreement instead of applying to amend the 2003 TPA. In your response, please fully explain why the "central role that the 2003 TPA plays in the BC Hydro-Powerex relationship" is a reason not to amend it at this time to permit BC Hydro to make forward physical wholesale electricity purchases.

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.4.3 where BC Hydro lists the options that were considered including advancing the filling of an updated TPA, and states that "The new agreement was not sufficiently advanced for this to be a viable option, so this option was discarded."

The statement in the preamble "That consideration is underway, but is not a trivial exercise because of the central role that the 2003 TPA plays in the BC Hydro-Powerex relationship" was referring to the status of the new TPA which was not sufficiently advanced.

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AMPC seeks to better understand why BC Hydro is applying for approval of the 2019 Letter Agreement instead of amending the TPA.

1.1.3 Please confirm, that prior to the 2018 Letter Agreement, BC Hydro had never transacted with Powerex for wholesale electricity on a forward basis. If not confirmed, please fully explain your response, including identifying when these transactions occurred, the conditions under which the transactions occurred and why a Letter Agreement was not needed at that time.

RESPONSE:

Confirmed, BC Hydro has not purchased forward physical energy from Powerex prior to the 2018 Letter Agreement. Prior to the commitment made by BC Hydro in the fiscal 2011 Revenue Requirements Application Negotiated Settlement Agreement dated December 2, 2011 (F2011 NSA), BC Hydro did enter into forward financial transactions with Powerex pursuant to the 2003 TPA. However, since making that commitment under the F2011 NSA, BC Hydro has not used that aspect of the 2003 TPA.

Importantly, the 2019 Letter Agreement (like the previous 2018 Letter Agreement) enables BC Hydro to secure additional reliable physical supply from the market to meet BC Hydro's operational needs. The circumstances that led to BC Hydro's F2011 NSA commitment were quite different. At that time, BC Hydro sought to enter into forward financial market electricity purchase arrangements (hedges) to avoid rate volatility.

2.0 Day-Ahead Market

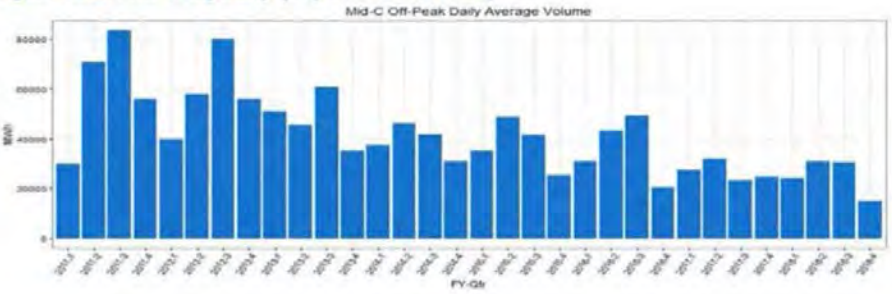
Reference: Exhibit B-1, pp. 5-6

On pages 5 to 6 of the Application, BC Hydro provided the following charts, which reflect declines in liquidity for both on-peak and off-peak hours at the Mid-Columbia wholesale electricity trading hub.

10. Market Liquidity

Figure 10.1: Mid-C Liquidity (Day-Ahead Peak)

Figure 10.2: Mid-C Liquidity (Day-Ahead Off-Peak)



BC Hydro then states:

> In summary, the impending physical supply issue in 2018/2019 was largely caused by low system inflows and the Enbridge pipeline explosion in October 2018. The 2018 Letter Agreement was a response to those conditions and also accounted for the declining liquidity in Pacific Northwest wholesale day- ahead markets by providing for more certainty of supply through the forward physical purchases.
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> On a go-forward basis BC Hydro observes that, since the beginning of the current fiscal year, it has continued to have low system inflows, and has no basis to believe that the long-term decline in day-ahead market liquidity will quickly reverse itself. There are numerous other events that could result in similar supply shortfalls that threatened BC Hydro last winter, which may not reliably be addressed through purchases from

Powerex on a day-ahead basis under the 2003 TPA. In these circumstances, BC Hydro believes it is prudent and in the interests of its ratepayers to have in place an additional mechanism that will allow it to respond to system conditions and reliably manage potential electricity shortages in a timely and cost-effective way. The 2019 Letter Agreement serves this objective.

AMPC wishes to better understand these graphs, BC Hydro's suggestion that day-ahead market liquidity in the Pacific Northwest is in a long-term decline, and BC Hydro's quarterly supply needs under the 2018 and 2019 Letter Agreements.

1.2.1 Please provide updated copies of each graph which extend to the current quarter.

RESPONSE:

The above referenced figures are from a publicly available document produced by the Bonneville Power Administration. BC Hydro can therefore not update the figures and notes that they have not been updated by Bonneville Power Administration.

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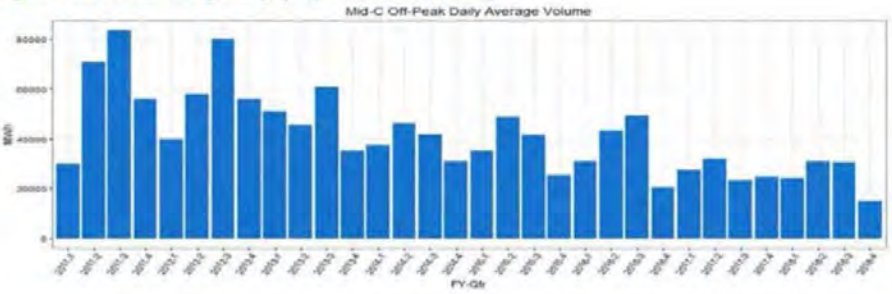

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AMPC wishes to better understand these graphs, BC Hydro's suggestion that day-ahead market liquidity in the Pacific Northwest is in a long-term decline, and BC Hydro's quarterly supply needs under the 2018 and 2019 Letter Agreements.

1.2.2 Please fully explain BC Hydro's understanding of the causes of the long-term decline of liquidity on the day-ahead market. In your response, please identify and discuss:

(a) any regulatory and market factors in the Pacific Northwest jurisdictions that may have contributed to the decline; and
(b) the effects of clean energy policies and the increasing prevalence of solar and wind generation technologies in these jurisdictions.

RESPONSE:

Please refer BC Hydro's response to BCUC IR 1.2.3.

2.0 Day-Ahead Market

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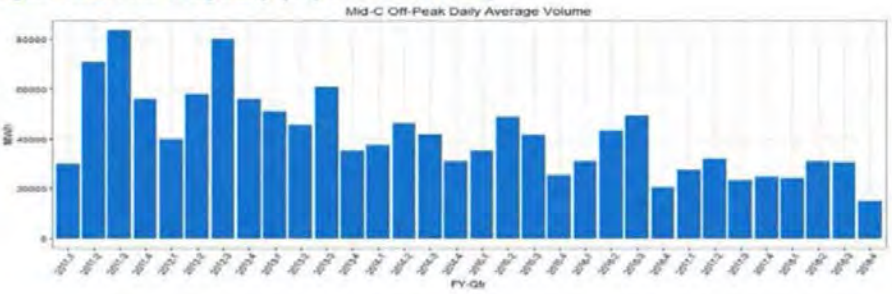

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AMPC wishes to better understand these graphs, BC Hydro's suggestion that day-ahead market liquidity in the Pacific Northwest is in a long-term decline, and BC Hydro's quarterly supply needs under the 2018 and 2019 Letter Agreements.

1.2.3 Please confirm that in each graph Quarter 1 is the period of January – March of each year. If not confirmed, please explain the months included in each quarter presented in the graphs.

RESPONSE:

Since BC Hydro did not produce the graphs, we cannot confirm that Quarter 1 is the period of January to March but assume that the graphs represent calendar quarters.

3.0 Industrial Rate Impacts and Long Term Planning

Reference: Exhibit B-1, pp. 8-10

On page 8 of the Application, BC Hydro states:

> The Commission must also consider BC Hydro's 2013 Integrated Resource Plan (**2013 IRP**). Like the 2018 Letter Agreement, the purpose of the 2019 Letter Agreement is to enable BC Hydro to address electricity supply issues in the operational time horizon. The 2013 IRP is a long-term planning document that, among other things, assumes average inflows and no reliance on imports to serve domestic load, regardless of BC Hydro's needs in the operational time horizon. In BC Hydro's submission the 2013 IRP is not relevant to the Commission's assessment of the 2019 Letter Agreement.

Reference: Province of BC, Ministry of Energy, Mines and Petroleum Resources.

Comprehensive Review of BC Hydro: Phase 1 Final Report.

On p. 16 of the Comprehensive Review of BC Hydro, the Province states:

> The Clean Energy Act required BC Hydro to submit its IRP to government for approval by November 2018. The legislation has significantly limited the BCUC's oversight of BC Hydro's long-term plan, which hampers the BCUC's decision making on various BC Hydro activities, including its applications on capital projects.
>
> The government has amended the deadline for the submission of the next Integrated Resource Plan to February 2021 to allow time for the IRP to be informed by the second phase of the Review and the actions required to support the CleanBC plan.
>
> The government intends to introduce legislation in Spring 2019 to restore the BCUC's oversight authority to review and approve BC Hydro's IRP. Government's policy objectives will continue to inform BC Hydro's development of the IRP under this process moving forward.

AMPC seeks to better understand BC Hydro's view of the relationship between the 2019 Letter Agreement and both the 2013 IRP and future Integrated Resource Plans ("**IRPs**"). Because the 2019 Letter Agreement does not have a set expiration date and is intended to be a continuing tool to address BC Hydro's operational needs in the long-term, AMPC seeks to understand why

BC Hydro states it is not relevant to BC Hydro's long-term integrated resource planning, or implementation of long-term IRPs.

1.3.1 Given that the 2019 Letter Agreement does not have a set expiration date and is intended to address BC Hydro's operational needs in the long-term, please confirm it is reasonable for BC Hydro to consider the 2019 Letter Agreement in its next IRP within long-term planning considerations. If not confirmed, please fully explain your response.

RESPONSE:

Please refer to BC Hydro's response to AMPC IR 1.3.2.1.

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BC Hydro states it is not relevant to BC Hydro's long-term integrated resource planning, or implementation of long-term IRPs.

1.3.2 How does BC Hydro propose to incorporate forward volume transactions into the next IRP?

RESPONSE:

Please refer to BC Hydro's response to AMPC IR 1.3.2.1.

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BC Hydro states it is not relevant to BC Hydro's long-term integrated resource planning, or implementation of long-term IRPs.

1.3.2 How does BC Hydro propose to incorporate forward volume transactions into the next IRP?

1.3.2.1 Please confirm it is reasonable for the BCUC to conduct a review of the 2019 Letter Agreement and its impacts in 2021, when BC Hydro submits its IRP to the BCUC for approval. If not confirmed, please fully explain your response including when BC Hydro proposes for the BCUC to review the 2019 Letter Agreement and its impacts.

RESPONSE:

BC Hydro does not think it is appropriate to delay consideration of the 2019 Letter Agreement until the IRP because the 2019 Letter Agreement is a tool to allow BC Hydro to address supply needs in the operational time frame and the IRP considers supply resources in the planning horizon. Please refer to BC Hydro's response to BCUC IR 1.5.1 where BC Hydro describes how the 2019 Letter Agreement can be used within the three-year operational timeframe. Please also refer to BC Hydro's response to BCUC IR 1.6.4.

The self-sufficiency requirement specified in the *Clean Energy Act* effectively prevents BC Hydro from considering import contracts to meet long-term planning criteria. As a result, and in consideration of the use of the 2019 Letter Agreement in the short-term operational timeframe, the 2019 Letter Agreement is not currently within the scope of the IRP.

BC Hydro's recommendation on the 2019 Letter Agreement process to the BCUC is articulated on page 11 of the Application.

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> The Clean Energy Act required BC Hydro to submit its IRP to government for approval by November 2018. The legislation has significantly limited the BCUC's oversight of BC Hydro's long-term plan, which hampers the BCUC's decision making on various BC Hydro activities, including its applications on capital projects.
>
> The government has amended the deadline for the submission of the next Integrated Resource Plan to February 2021 to allow time for the IRP to be informed by the second phase of the Review and the actions required to support the CleanBC plan.
>
> The government intends to introduce legislation in Spring 2019 to restore the BCUC's oversight authority to review and approve BC Hydro's IRP. Government's policy objectives will continue to inform BC Hydro's development of the IRP under this process moving forward.

AMPC seeks to better understand BC Hydro's view of the relationship between the 2019 Letter Agreement and both the 2013 IRP and future Integrated Resource Plans ("**IRPs**"). Because the 2019 Letter Agreement does not have a set expiration date and is intended to be a continuing tool to address BC Hydro's operational needs in the long-term, AMPC seeks to understand why

BC Hydro states it is not relevant to BC Hydro's long-term integrated resource planning, or implementation of long-term IRPs.

1.3.3 In the long-term, given that the Site C project is coming into service and the energy surplus expected until approximately 2030, has BC Hydro considered longer-term export/import dependable arrangements with Powerex, including for example dependable export contracts with other jurisdictions and/or diversity agreements like seasonal import/export exchanges (e.g., where BC Hydro imports in winter and exports in summer)?

RESPONSE:

Please refer to BC Hydro's response to AMPC IR 1.3.2.1 which describes the 2019 Letter Agreement as a tool to meet supply needs in the short-term operational time frame versus a longer term planning horizon. As such, BC Hydro notes that this topic is outside the scope of the Application.

3.0 Industrial Rate Impacts and Long Term Planning

Reference: Exhibit B-1, pp. 8-10

On page 8 of the Application, BC Hydro states:

> The Commission must also consider BC Hydro's 2013 Integrated Resource Plan (**2013 IRP**). Like the 2018 Letter Agreement, the purpose of the 2019 Letter Agreement is to enable BC Hydro to address electricity supply issues in the operational time horizon. The 2013 IRP is a long-term planning document that, among other things, assumes average inflows and no reliance on imports to serve domestic load, regardless of BC Hydro's needs in the operational time horizon. In BC Hydro's submission the 2013 IRP is not relevant to the Commission's assessment of the 2019 Letter Agreement.

Reference: Province of BC, Ministry of Energy, Mines and Petroleum Resources.

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1.3.3.1 Please explain the potential benefits for ratepayers of these types of export and import arrangements.

RESPONSE:

Please refer to BC Hydro's response to AMPC IR 1.3.3.

4.0 Energy Supply Contract Considerations

Reference: Exhibit B.1, pp. 8-10

On p. 10 of the Application, BC Hydro provides the following explanations of whether the 2019 Letter Agreement meets British Columbia Energy Objectives 2(f) and (k):

- 2(f) – Ensure BC Hydro's rates remain competitive: The 2019 Letter Agreement is a cost-effective means by which BC Hydro plans to manage short-term operational needs, and therefore it advances this energy objective and is in alignment with it.
- 2(k) – Encourage economic development: The 2019 Letter Agreement allows for the management of short-term operational needs and has no bearing on economic development in B.C. The 2019 Letter Agreement neither advances nor conflicts with this objective and therefore is in alignment with it.

AMPC seeks to better understand whether the 2019 Letter Agreement displaces other forms of optional programs that could also meet BC Hydro's operational needs and comply with British Columbia Energy Objectives 2(f) and (k).

1.4.1 Please confirm that at least some of BC Hydro's operational needs could be met by optional programs with industrial customers, such as the Load Curtailment Pilot and other demand response programs. In your response, please discuss why the 2019 Letter Agreement is a preferable means of addressing short term operational electricity requirements as opposed to the alternatives identified above. If not confirmed, please fully explain your response and include any reports or documents that support BC Hydro's conclusions.

RESPONSE:

Not confirmed. The requirement for significant quantities of firm, pre-scheduled, fixed-priced energy deliveries to the system that are provided for by the 2019 Letter Agreement cannot be met with the smaller, higher cost quantities of energy that were available under the Load Curtailment Pilot.

The Load Curtailment Pilot was designed to test whether load curtailment could be used as a planning resource option to meet peak load in winter, as described in BC Hydro's response to BCUC IR 1.183.1 in the F20-F21 RRA. BC Hydro's response to AMPC IR 1.5.1.1 in the F20-21 RRA outlines the reasons why the Load Curtailment Pilot would not have been cost effective relative to market prices during the winter of 2018/2019. These responses are attached. The same rationale can be applied to the period covered by the 2019 Letter Agreement. It is for this reason that the 2019 Letter Agreement is a preferrable mechanism to meet short-term operational electricity requirements instead of the Load Curtailment Pilot.

Association of Major Power Customers of BC Information Request No. **1.5.1.1** Dated: **May 2, 2019** British Columbia Hydro & Power Authority Response issued **June 6, 2019**	Page 1 of 1
British Columbia Hydro & Power Authority **Fiscal 2020 to Fiscal 2021 Revenue Requirements Application**	**Exhibit: B-6**

5.0 Demand Side Management

Reference: Chapter 10 - Demand Side Management

1.5.1 Please provide in tabular format actual and forecast spending for F2017 through F2021 on optional industrial rate programs, such as Freshet and Load Curtailment programs.

1.5.1.1 Please comment on whether offering Load Curtailment during the 2018/2019 winter period would have been cost effective for BC Hydro, had it been available at similar volumes to the 2017/2018 winter.

RESPONSE:

We do not expect that Load Curtailment would have been cost effective relative to market prices during 2018/2019.

Year 3 of the Load Curtailment pilot program in 2017/2018 had several objectives, as discussed in our response to BCUC IR 1.183.1. One of the objectives was to test a different pricing structure and curtailment mechanism compared to Year 1 and Year 2. The pricing in 2017/2018 was separated into 2 parts, an availability payment and a performance payment.

The availability payment was determined based on RFP and there was a range of prices bid. This approach tested the response from the market in terms of price for capacity and planning cost to BC Hydro to have the resource available for a product that could be called up to 72 hours during the winter period.

The performance price of $50 per MWh was determined in order to be competitive with market pricing during winter peak periods, based on the previous year winter peak market prices. As such it was called six times in 2017/2018 when the market price was attractive. The cost of availability was not taken into account when assessing the opportunity to call for a curtailment. The performance price was determined and priced independently in order to test an operationally based Load Curtailment product.

Given that the actual cost to BC Hydro during curtailment events, which includes the performance price and the availability price, would have been greater than the market price, we do not expect Load Curtailment would have been cost effective during 2018/2019.

British Columbia Utilities Commission Information Request No. **1.183.1** Dated: **April 23, 2019** British Columbia Hydro & Power Authority Response issued **June 6, 2019**	Page 1 of 9
British Columbia Hydro & Power Authority **Fiscal 2020 to Fiscal 2021 Revenue Requirements Application**	**Exhibit: B-5**

183.0 R. CHAPTER 10 – DEMAND SIDE MANAGMENT

Reference: DEMAND SIDE MANAGEMENT
Exhibit B-1, Section 10.4.2, pp. 10-21–10-22, Appendix X, p. 3;
BC Hydro F2017-2019 RRA Proceeding, Exhibit B-9,
BCUC IR 192.2, 168.1
Capacity focused DSM

On page 10-21 of the Application, BC Hydro states that "BC Hydro proposed a total budget of $38.6 million for these initiatives from fiscal 2017 to fiscal 2019. This DSM Plan extends that budget to fiscal 2021 but reduces the overall total by 12 per cent to $34 million."

On page 10-22 of the Application, BC Hydro states:

> BC Hydro decided to extend the time period to assess capacity-focused pilots and trial offers due to the complexity of assessing the impacts and value of capacity-focused DSM to BC Hydro's system. This also provides more time to incorporate past learnings into new activities, consider changing technologies and accommodate the long lead times required for some customer projects.

On page 3 of Appendix X to the Application, BC Hydro states:

> Over the fiscal 2020 to fiscal 2022 period, this initiative will identify opportunities to use customer-based, demand-side measures as a resource to manage capacity constraints on the grid. These activities include trials looking at localized demand-side management, behavioural shifting during peak periods, direct control of various technologies, and exploration into the emerging area of Connected Homes and Buildings.

In response to BCUC IR 192.2 in the BC Hydro F2017-2019 RRA proceeding, BC Hydro provided a table outlining planned EM&V activities, which includes a line item for capacity- focused DSM that states that "Fiscal 2017: measurement and verification results and impact evaluations Fiscals 2018 and 2019: To be determined."

In response to BCUC IR 168.1 in the F2017-2019 RRA proceeding, BC Hydro stated that no savings from capacity focused DSM programs were included, as the programs were in the pilot stage, and the savings could not be relied on for planning purposes.

1.183.1 Please report on the progress and results (e.g. capacity savings potential and cost effectiveness) to date, including the results of any evaluations conducted to date.

RESPONSE:

This response also responds to BCSEA IR 1.38.2, BCSEA IR 1.39.1, CEC IR 1.84.1 and INCE IR 1.6.13.

This response provides a summary of BC Hydro's capacity-focused DSM (CFDSM) initiatives to date, including information on the progress, findings and results of the pilots and trials. We have conducted a number of assessments on initiatives that are either completed or ongoing and these are summarized in this response. Further assessment of initiatives are planned which may include Impact Evaluations on local substation pilots.

Attachment 1 to this response provides a more detailed description of the major CFDSM pilots and trials that are underway or have been completed.

<u>Overview</u>

BC Hydro has undertaken a number of initiatives exploring capacity conservation. The pilots are providing information that will inform the savings potential and cost effectiveness of different technologies and behaviours. Information from the pilots will be used to inform potential opportunities at the distribution system level as well as broader potential resource options to inform the next Integrated Resource Plan.

As noted in BC Hydro's response to BCUC IR 2.317.3 in the Previous Application, the primary purpose of BC Hydro's CFDSM pilot activities was to inform contingency resource plans over the next five to 20 years that anticipated the potential for a larger capacity gap than in the base resource plan. In addition, due to load growth in a number of our 306 substations and the need to expand the capacity of those substations and/or their connected transmission and distribution infrastructure, CFDSM activities could reduce peak loads thereby allowing us to defer capital investments in substation upgrades.

BC Hydro's initial focus was on reducing system-wide peaks, which resulted in a load-curtailment pilot with our large industrial customers served via the transmission system. Work also began on testing technologies and behavioural initiatives at the distribution system level that would provide system-wide benefits. We then began to explore the additional benefits of reducing demand in the distribution system by avoiding upgrades to substations or feeders. Through adaptive management we have moved from tests of individual technologies and behavioural initiatives to more pilots at the substation level. In each technology and behavioural initiative, we were testing the potential for capacity benefits, including customer response and acceptance to the initiative.

CFDSM Objectives

Our objectives for the CFDSM initiatives are to:

1. **Understand the dependability/reliability of capacity-focused programs and technologies applicable to the B.C. market;**
2. **Explore how to build customer acceptance of CFDSM concepts;**
3. **Quantify the impacts of various technologies;**
4. **Investigate how these types of programs should be operationalized within the BC Hydro system; abd**
5. **Investigate whether CFDSM and geo-targeted conservation programs could help alleviate peaks on constrained distribution assets to defer capital investments and allow the connection of new customers in these constrained areas.**

Trials and Pilots

The following list represents the main initiatives completed and underway. For a more detailed description of the initiatives and results, please refer to Attachment 1 to this response.

- **Industrial load curtailment**
- **Residential demand response trials**
  - **Wi-fi auto demand response water heater controllers**
  - **3-element water heaters**
  - **Radio-frequency (mesh) auto demand response water heater controllers**
  - **Residential thermostats – Sinope controllers**
  - **Residential thermostats – NEST**
  - **Peak Saver – opt-in pilot**
  - **Electric thermal storage – ceramic bricks**
  - **Smart electric vehicle charging – single family**
  - **High voltage utility charger – MURB and commercial customers**
- **Commercial and industrial demand response trials**
  - **Commercial and industrial manual demand response**

- **Small business water heater auto demand response**
- **Industrial load shaping – greenhouse application**
- **Commercial smart charging – electric buses – BC Transit**
- **Commercial smart charging – electric buses**
- **Commercial smart charging – electric vehicle fleet**
- **Commercial smart charging – forklifts and lift trucks (warehousing)**
- **Peak Saver – small and medium business opt-in pilot**
- **Commercial fleet charging – UBC investigation**
- **Marine electrification charging – ferries**
- **Battery storage – industrial peak management**
- **Energy monitors/energy feedback – business customers**

- **Localized demand-side management pilots**
  - **Pineview Substation**
  - **Hope Substation**
  - **Kent Substation**
- **Connected buildings/facilities trials**
  - **Connected home – Alana trial**
  - **Connected home – Smart speaker trial**
  - **Connected home – Powerley trial**
  - **Connected home – CaSA baseboard thermostats**
- **Infrastructure development**
  - **Distributed Energy Resource Management Systems (DERMS)**
  - **Cybersecurity Verification Program (CVP)**

Key Findings

The following summarizes the findings from the range of trials and pilots that our residential, commercial, and industrial customers have participated in. The industrial customers who participated in the initiatives described below are all served via the distribution system.[1]

Program Behaviour

Overall, residential programs behaved as anticipated with respect to producing demand responses. The reliability is approximately 80 per cent for a fleet of direct load control devices, as demonstrated in the water heater test. Communication issues on both the smart meter mesh and customer-owned Wi-Fi / internet caused the reliability to be less than 100 per cent.

Residential Peak Saver participants in small homes such as condos found it more difficult than larger homes to create meaningful savings due to the size of the overall load.

Connected home trials uncovered complexities with the wide range of available technologies. Utility capacity objectives can be delivered through direct load control or behavioural activities utilizing connected home assets and leveraging the energy consumption feedback delivered by smart devices. Connected home automation allows customers to set routines and actions that can automate and amplify their behavioural load shifting results.

Commercial and industrial demand response programs did not show as much participation and impacts as anticipated.

Customer Acceptance

Customer acceptance of the controllers and events was high in the residential sector, with few opt-outs. Customers expressed interest in new technologies and the idea of helping manage load in their community. Residential customers who signed up for the Peak Saver program were highly engaged.

Connected home products were interesting to participants who readily engaged with them. Engagement levels decayed somewhat over time, but remain strong. The Powerley HydroHome trial currently (May) records around six app interactions per household per day (peaking at over ten in winter). Participants overall are positive (68 per cent of users satisfied or very satisfied with the system) with respect to the energy data presentment and smart device control.

[1] **Our industrial customers served via the transmission system have participated in the load curtailment pilots and the key findings from that initiative can be found in the attachment.**

Commercial and industrial customers are more wary, feeling demand response could negatively impact their business. Some customers did not want to touch their building controls, out of concern that things would break. However, some innovators embraced the program and experienced multiple benefits, including earning incentives for their performance, getting better feedback on their operations, and identifying areas of energy efficiency as a by-product of demand response set up and testing.

Commercial and industrial customers are curious about energy storage and interested in how to bring electric vehicle charging and fleets into their businesses. However, cost effectiveness is a primary barrier to energy storage, while range anxiety and cost continue to be barriers to electric vehicle adoption.

Operational Needs

CFDSM programs will require information technology systems to support ongoing customer relationships, contracts and settlement. These programs must maintain ongoing relationships with customers (similar to Team Power Smart).

Baselines, which enable the comparison between what would have happened, absent the program intervention and what actually happened, can be complicated. They need to be clearly defined and consider the customer's operational behaviour and technology available.

Managing a diverse array of demand response resources is challenging and will require information technology solutions, such as a distributed energy resource management system (DERMS) to make larger scale rollouts feasible.

Internal Stakeholders

This is a learning experience for internal stakeholders who are interested in the concepts and want more knowledge to overcome barriers or concerns. Many stakeholders have been very supportive of this concept and moving it forward as a solution to address needs. However, reliability of the resources is critical to grow acceptance. The substation pilots and implementation of DERMS will increase internal planners and system operators confidence in the reliability of CFDSM.

Technology Experience

There were a variety of challenges with technology, which is not surprising given the newness of some of the implementations.

Providing meter data to customers on a timely basis is critical for performance monitoring, payment settlement, and customer feedback. However, experience to-date is that this can be challenging with respect to timeliness, accessibility and completeness. During our initial trials and pilots we developed a solution by

providing a gateway from the meter to the customer's devices that enabled them to see real-time information.

Internet connectable devices are relatively reliable, but cyber security is more challenging. Cyber security will continue to be an ongoing concern for any connected devices. Insecure devices will not be a viable solution and some vendors do not focus their efforts here. Mesh devices proved to be much less reliable and more technically challenging and resource intensive to implement. The process for getting mesh devices onto our system is more difficult than implementing internet connectable solutions. The first-generation mesh devices implemented turned out to not be fully upgradable over the air. All solutions in the future must meet this base requirement.

Devices should be bench tested prior to field deployments. One device had a "bad batch" of internal chips that caused issues after deployment. These had to be replaced in the field.

Some building management systems are not sophisticated enough or are difficult for a building operator to adjust for demand response events. Some are old and some building operators are reluctant to change anything that is operating currently. This could influence either which customers may be eligible for a program or what the program should be offering in terms of programming or technology support.

Recruitment Experience

Commercial and industrial customers may require up to 12 months from initiation to participation in a demand response program. Because CFDSM offers are new, there is a learning and acceptance curve for customers. Some will need slower, low-risk experiences with these types of programs before accepting more sophisticated offers.

Some residential customers are inspired by the idea of contributing to their community, but some do not understand that demand response doesn't reduce their consumption or their bill (except via incentives), despite the program materials stating this. For full program rollouts, information technology support will be required to accept applications at scale and then manage these relationships over the long term.

BC Hydro would need to adjust customer support channels should these programs be rolled out in full (e.g. who does a customer call if a controller or thermostat seemingly breaks or if they have questions about how the program works or if they want to opt-out of a program after a period of time.)

Operational Considerations

Operational systems, processes and staff will need to be put into place to handle large volumes of customer applications, installations, device tracking, performance reporting, and settlement / payment. In addition, some kind of emergency response support may be required to support some devices, in the event of failure (e.g. if a water heater load controller fails and somehow causes the customer to have no hot water). Bring your own device (BYOD) programs may provide less support, but may still receive calls for assistance. BC Hydro will need protocols to handle these issues.

Future program designs should consider how BC Hydro could work with vendors to help fill these roles and provide support to customers.

The pilots to shift load at the substations have the objective of understanding whether CFDSM can defer an upgrade. On an operational basis, BC Hydro does not currently have a method to forecast at the substation level when a peak is being reached. We have developed a model based on forecasted temperatures to assist in when to execute on CFDSM activities.

Residential behaviour programs would benefit from a more sophisticated information technology platform to efficiently and effectively operate the program on a larger scale. The current tools did not allow for easy personalization of messaging, targeted tips, or performance results.

Customer Experience Feedback

Generally residential customers did not find the control events to be disruptive and they liked the opportunity to do something that directly contributes to their local community. Often, participants reported they liked the new technologies involved in each pilot and were an improvement over their previous systems (e.g. thermostats easier to use or program.)

Commercial customers are interested in demand management but need more help to develop solutions to ensure no business disruptions. They also need better performance feedback and assistance to ease into some demand response programs.

Trial Results

We have been able to estimate capacity savings from some individual technologies and behaviours, where trials have been completed; however, in other cases trials are still in progress and savings cannot be estimated yet. The capacity-focused trials involve different end uses, control systems, and approaches to market that have not yet been aggregated to develop program-level savings estimates. Continuation and completion of planned trials, as well as further experience gained through localized capacity initiatives at the substation

level (combined with DERMS development), are the next steps prior to estimating potential program savings.

Estimated savings from the individual technologies and behaviours which we have quantified to date include:

- **Water heaters: 0.5 kW/unit on average**
- **Thermostats: 1.0 kW/home on average**
- **Residential Peak Saver: 0.3 – 0.4 kW per participant**
- **Connected home Powerley Trial: 0.6 kW to 1.1 kW**
- **Connected home CaSA baseboard thermostat: 0.27 kW to 0.39 kW**
- **Connected thermostat Nest: 0.5 kW to 0.8 kW**
- **Industrial Load Curtailment Pilot: 100 MW to 139 MW**

The pilots are providing information that will inform the savings potential and cost effectiveness of different technologies and behaviours. The results are based on smaller scale pilots that may not translate to broader populations. Information from the pilots will be used to inform potential opportunities at the distribution system level as well as broader potential resource options to inform the next Integrated Resource Plan.

Detailed Description of BC Hydro's Capacity-Focused DSM Pilots and Trials

This attachment provides a detailed description of BC Hydro's capacity-focused DSM pilots and trials. The description of these pilots and trials is structured as follows:

1. **Industrial load curtailment**
2. **Capacity-focused technologies**
    - **A. Residential demand response trials**
    - **B. Commercial and industrial demand response trials**
    - **C. Localized demand-side management pilots**
    - **D. Connected buildings/facilities trials**
    - **E. Infrastructure development**

1. Industrial Load Curtailment Pilot

The initial industrial load curtailment (ILC) pilot ran during the winter and shoulder months of 2015/2016 (Year One) and 2016/2017 (Year Two). It targeted a system level resource that was capable of providing 100 MW for 576 hours of curtailment during those periods. The industrial load curtailment pilot was implemented as two separate one-year commitments with a Request for Proposal (RFP) process before each year commenced. This approach allowed new customers to participate after the initial launch year.

Customers were required to respond to the RFP process by bidding the MW of capacity they were prepared to curtail for a fixed $/MW-year payment. BC Hydro simulated system peak events and called on customers to curtail load for up to 16-hours per day to a total of 576-hours per year. This confirmed the reliability of a customer resource being able to deliver dependable capacity via load curtailment and informed future resource planning requirements.

In Year One, BC Hydro entered into agreements with four large industrial customers. The customers submitted proposals for six separate sites to provide a combined total available curtailment resource of 126 MW of load reduction. In Year Two, the ILC pilot had four customers and seven sites to provide a combined total available curtailment resource of 83 MW of load reduction.

The performance of the ILC pilot is summarized in Tables 1 and 2 below.

Table 1 - ILC pilot performance, Year One

Resources	Committed	Provided	Compliance Rate
Resource 1	65 MW	70 MW	93%
Resource 2	22 MW	23 MW	100%
Resource 3	22 MW	28 MW	100%
Resource 4	17 MW	18 MW	100%
Total	126 MW	139 MW	93%

Table 2 - ILC pilot performance, Year Two

Resources	Committed	Provided	Compliance Rate
Resource 1	33 MW	46 MW	100%
Resource 3	22 MW	23 MW	100%
Resource 4	16 MW	15 MW	89%
Resource 5a	2 MW	3 MW	100%
Resource 5b	10 MW	13 MW	89%
Total	83 MW	100 MW	89%

Results of Year One and Year Two Pilots

The average event compliance rate is shown in the tables above. In Year One, the rate was 93%. The compliance rate in Year Two was slightly lower at 89%. On an hourly basis the compliance rate would be higher. Every participant carried a margin in load to ensure compliance. The average reduction provided by each participant is also shown in the tables above. The margin is larger for participants with loads that are more variable. It was important to test the response in BC as our program requirements for duration and total number of hours are unique compared to other jurisdictions.

The primary function of the Year One and Year Two pilots was to test the ability of customers to provide significant load reduction for periods of time that could compare to our next built resource. The results were generally positive, however, in any formal program we would have to ensure we contracted more potential curtailment than needed to overcome the potential for non-compliance. During the pilot, some customers exceeded their committed bids, thereby reducing the impact of those that were non-compliant; however, this may not be sufficiently reliable for planning purposes. Feedback from customers was focused on the requirement to provide 16-hour for the full 36 days (576 hours) and whether that would be representative of a program moving forward.

Year Three Pilot

During 2017, we discussed whether we could adapt the load curtailment pilot and extend our learnings. Year One and Year Two pilots were successful in determining the reliability of load curtailment as a planning resource to meet winter system peaks. It was determined that we could test new concepts not considered in Year One and Year Two by extending the pilot to a third year, such as an operational component. We used Year Three to test and understand a 'competitive' or 'market based' load curtailment pricing structure, from both the operational and planning resource perspectives.

Year Three pricing was separated into two components: performance (operations) and availability (planning). This was to gain an understanding of how the market (transmission voltage customers) would respond and perform based on a revised pricing structure and value determination for capacity.

Customers would be called on to curtail load when BC Hydro had system peak events that coincided with positive market opportunities for dispatching BC Hydro assets, rather

than the simulated events in Year One and Year Two. We wanted to test the market in terms of the market setting the price they required to be available to curtail the MW they would make available for curtailment events, as follows:

- **The load curtailment performance price was set at a level competitive with the operating cost of other resource options during winter peak periods. This would allow for load curtailment to be utilized (i.e. called) by operations during peak periods.**
- **The load curtailment availability price could then be discovered by allowing customers to bid the availability price they expected to receive, in addition to the curtailment amount (i.e. MW) they could provide. This would allow for a cost curve to be developed and compared to other capacity resource options from a planning perspective.**

The performance payment was set at $50 per MWh (for the four consecutive hours per day of curtailment). This was priced competitively based on other options BC Hydro would have to meet peak load requirements on a winter peak day. Curtailment was limited to 72-hours over the 3-month period (a maximum of 18 event days x 4-hour events). Setting the performance price (and total of number of potential curtailment events) allowed customers to bid their capacity available and availability price.

We selected customer bids based on the lowest to highest total $/MW price (including performance plus availability payment). Bids were selected within the budget for the program. We accepted multiple bids per customer and each was considered independently. BC Hydro entered agreements for Year Three with four large customers, at six separate sites, to pilot the development of a resource that could provide reliable demand response in four-hour blocks with same day notification.

Results of Year Three Pilot

During the three months of the pilot, we called on the customers for curtailment six times. The targeted curtailment amounts were met for four out of six events. Even though there were issues during two of the events, the concept of having distinct availability and performance payments was considered a success, from both a customer and BC Hydro perspective and would form the basis for any load curtailment program going forward. There were some communication problems during Year Three that would be corrected during a full program and thereby reduce the likelihood of non-performance.

2. Capacity-Focused Technologies

BC Hydro has investigated a range of technologies and program designs across sectors that provide benefit to system-wide capacity needs and localized constraints.

In-progress pilots are continuing to completion to determine results and incorporate findings to inform potential new program offers for localized DSM.

The detailed findings from the major projects completed or underway follow below and are grouped into five categories:

- **Residential demand response trials**
- **Commercial and industrial demand response trials**

- **Localized demand-side management pilots**
- **Connected buildings/facilities trials**
- **Infrastructure development**

A. <u>Residential Demand Response Trials</u>

This category includes trials of new technologies and behavioural approaches with residential customers to understand if they are acceptable to the customer and technically reliable/viable. Once proven, these technologies could potentially be used to meet system or local needs.

<u>Wi-Fi auto demand response (DR) water heater controllers</u>

- **Status: Launched in November 2014, completed.**
- **Description: This demonstration project tested Wi-Fi water heater controllers (nine households for the first year, 25 households in the second and third years) using the customer's internet connection.**
- **Results: Demand reduction of 0.5 kW/unit (average).**

<u>Three element water heaters</u>

- **Status: launched in November 2014, completed.**
- **Description: This demonstration project involved the installation and testing of three element water heaters. A standard electric water heater has two 3800W elements for heating. The three element water heater has 3800W top, 3000W middle and 800W bottom, allowing temperature stratification within the tank, such that only the bottom water needs to be heated.**
- **Results: No noticeable difference in overall demand shifting from the three element water heaters compared to standard water heaters.**

<u>Radio-frequency (Mesh) auto DR water heater controllers</u>

- **Status: Launched in November 2015, completed.**
- **Description: This demonstration project utilized the BC Hydro smart meter mesh network to provide communication to the water heater controllers.**
- **Results: Demand reduction of 0.5 kW/unit (average). The challenge with this technology was that due to technical and/or software problems only 50% of devices participated in any single event. This product has not been recommended for any further program design until vendors can demonstrate higher connectivity rates and reliability.**

<u>Residential thermostats – Sinope controllers</u>

- **Status: Initiated in fiscal 2017, completed.**
- **Description: The project involved installing baseboard programmable communicating thermostats (PCTs) and water heater load control devices**

manufactured by Sinope, a Canadian company. The devices were configured to connect to the vendor's web application server for customers, which allows the customer to program and control their PCT from the web or smart phone, and also directly from the PCT.

- **Results: Demand reduction of 1.0 kW/home (average).**

Peak Saver – Opt-in pilot

- **Status: Launched Fall 2016, completed.**
- **Description: This is a behavioural or peak time demand response rebate program. Customers sign up ahead of time and are then notified day-ahead of upcoming curtailment events. Customers earn financial incentives based on the amount of load reduction they create during each event, in comparison to a calculated baseline. Although not direct load control, the program is very low cost to implement and operate.**
- **Results: Demand reduction of 0.3 to 0.4 kW/participant. There were 3,500 participants in fiscal 2018 and approximately 5,000 in fiscal 2019 winter season.**

Connected thermostats – NEST

- **Status: Launched September 2016, completed**
- **Description: In partnership with Nest, BC Hydro ran a demand response trial using Nest thermostats in the Okanagan. The trial followed the standard Nest Rush Hour rewards program format, and operated across both heating and cooling seasons. Participants were provided with a $25 incentive to participate. Three hour event windows were used consistently across the seasons. Pre-heating and pre-cooling were always used, but BC Hydro was not in control of set point adjustments, this was managed by the Nest DR system**
- **Results: A total of 1,400 participants were involved over four seasons (winters of 2016, and 2017, and summers of 2017 and 2018). Overall, customers were positive about their trial experience and the impact on comfort levels was not seen as a major concern. Morning events were slightly preferred to PM events and comfort level changes were noticed by 63% of participants, mainly in the second hour of an event, suggesting three hour events might be too long. However only 10% claim to be dissatisfied with comfort levels overall. Summer demand response impacts average 0.6 kW per event. Winter demand response impacts average between 0.5-0.8 kW reductions per event.**

Smart water heater load control – Aquanta controller

- **Status: Initiated July 2018, ongoing for two winter seasons.**
- **Description: This project proposes a test of a smart water heater controller to determine whether learning modes and temperature insight can provide greater peak reductions while still serving occupant needs. The project will install 100 load controllers on existing electric hot water heaters on south Vancouver Island. Learning modes will be observed uninterrupted to compare to baseline operation**

initially. Demand response events will also be enacted to determine whether these devices outperform prior "dumb" units. The project will be operated for two winter seasons to ensure a range of data and scenarios are captured.

- **Results: To be determined in 2020 after completion of the second year.**

Electric thermal storage – ceramic bricks

- **Status: Initiated in February 2018, ongoing.**
- **Description: Electric thermal storage (ETS) is one option for helping to manage the peaks that traditional electric heating systems can create on the grid. ETS is not a new technology and has been quite common in Europe for over 30 years.**
- **Modern ETS units work by heating ceramic bricks to a high temperature and then releasing this heat slowly over time, as the home requires, in order to maintain a comfortable temperature for occupants. The charging of these bricks can be done in off-peak hours (such as overnight) and then slowly released over the course of the day.**
- **Results: We are planning to complete the test during the winter of fiscal 2020. The preliminary result from last winter is not favourable because of the level of disruption to install the ceramic bricks.**

Smart electric vehicle (EV) charging – single family

- **Status: Initiated in May 2017, completed.**
- **Description: The project involved EV owners in single family residential settings. Communicating level 2 electric vehicle supply equipment (EVSE) or charging stations replaced existing level 2 stations installed in each home. This allowed for signals to be sent to the EVSE to enact various smart charging tactics such as randomization of charging times, charge-by settings, decreased power charging etc.**
- **Results: 50 single family residences participated in the pilot that ran over two winters (fiscal 2018 and fiscal 2019). Preliminary results will be available later in 2019.**

High voltage utility charger – MURB and Commercial customers

- **Status: Launched September 2017, ongoing.**
- **Description: Current challenges for potential EV owners who live in multi-unit residential buildings include charger and related infrastructure costs as well as the need to disaggregate metered electricity consumption between EV charging and the building's common facilities (i.e., non-EV loads). An integrated charger, and a metering and billing solution would potentially alleviate these concerns. We will be testing the ability to control the timing of the charge.**
- **Results: Plan is to install 60 chargers in locations in the Lower Mainland. Roll out has been delayed due to testing. Expectations are the pilot will run during the winter of 2019 with results being available later in 2020.**

B. Commercial and Industrial Demand Response (DR) Trials

This category includes the investigation and testing of new technologies for small to medium-sized industrial and commercial customers to understand if they are reliable as part of a future demand response program.

Commercial and Industrial manual DR

- **Status: Launched November 2014, completed.**
- **Description: This demonstration project involved customers manually shutting off equipment in their facility for the duration of the events, and then turning the equipment back on. Since each participant would have different operations and equipment, it was determined that the simplest method to determine demand response potential within the business sector was the manual option.**
- **Results: The results were variable, primarily due to the voluntary nature of the load control. Customers were requested to manually shut off equipment during an event and then turn the equipment back on at the conclusion of the event. During the first year there was only one customer enrolled - this rose to eight in the second year and 14 in the third year. The events in the second and third year had participation rates of 65% and 60% respectively.**

Small business water heater auto DR

- **Status: Launched November 2015, ongoing.**
- **Description: The goal is to determine whether smart water heater controllers deliver demand reduction in small and medium businesses and understand how small and medium business owners may interact with their water heater or if they change their behaviour given greater visibility into their usage.**
- **Results: Program is expected to continue through the winter of fiscal 2020.**

Industrial load shaping – Greenhouse

- **Status: Launched February 2018, ongoing.**
- **Description: This project will involve capacity management by shifting the greenhouse operations (lights and ventilation) outside of evening peak periods.**
- **Results: During the winter of 2018, the greenhouse was able to shift the times that their lights were turned on to hours before sunrise rather than after sunset during BC Hydro's evening peak, which would have been normal activity. Due to the incremental nature of the load growth at this site, we were unable to conduct a full test of this initiative. The customer has agreed to participate during the winter of fiscal 2020 and full results will be available in 2020**

Commercial smart charging – electric buses – BC Transit

- **Status: Initiated February 2018, ongoing.**
- **Description: The demonstration project will include managed charging implementations, demand response program participation, comparing battery**

powered buses from major manufacturers, etc. It seeks to test ways to make the charging load more flexible, in time and quantity with respect to demand on the grid.

- **Results: The trial with the first bus manufacturer has been completed. The model tested was capable of servicing 94% of all routes in Victoria with one charge per day at the depot. There is an opportunity to deploy demand response by shifting charging periods. Timing of further tests depends on coordination between BC Hydro, BC Transit, and bus manufacturers.**

Commercial smart charging – electric buses

- **Status: Initiated August 2018, completed.**
- **Description: This project investigated the impact of bus charging on building energy infrastructure and potential consumption. The initial project will involve an engineering study of the infrastructure required, the load impacts to the facility the buses are charging from, potential metering solutions for the host building to calculate cost of charging and outline the requirements for bi-directional charging.**
- **Results: Confirmed use of high voltage power to 18 charging stations in two locations were estimated, including substation upgrades, AC transformer purchases and installation.**

Commercial smart charging – electric vehicle fleet

- **Status: Initiated March 2018, completed.**
- **Description: The City of Vancouver purchased 20 electric vehicles, to be housed at a single site. They were interested in partnering with BC Hydro to explore smart charging in the following areas:**
  - **addressing building electric panel capacity constraints**
  - **managing demand charges**
  - **providing flexibility to the grid, in the form of participation in utility demand response programs**
  - **understanding connected buildings, by integrating electric vehicle charging with overall building management systems**
- **The project was implemented in two phases: 1) design, installation and testing of communicating charging stations, and 2) integration of charging system into on-site building management system, and design and run smart charging experiments to manage demand.**
- **Results: Initial results show that there is potential for inclusion in any potential demand response program. From the customer perspective, demand charge savings could be significant and load management did not impact vehicle usability.**

Commercial smart charging – forklifts and lift trucks

- **Status: Initiated October 2018, ongoing.**

- **Description: The objective of this pilot is to: understand the impacts of fleet charging on the various levels of electrical systems; test various charging scenarios to understand the capabilities and limitations of smart charging equipment and infrastructure; and test customer acceptance of demand management on long-duration business operations.**
- **Results: Pilot is ongoing at two grocery warehouses involving up to 60 forklifts. No results as of yet.**

Peak Saver – small and medium business

- **Status: Initiated October 2018, ongoing.**
- **Description: The original Peak Saver project was aimed exclusively at residential customers. The dynamic of creating commercial customer participation is expected to be significantly different. Most commercial customers are constrained in how they can continue to run their businesses while reducing load that will not have a negative impact on tenants/occupants/customers.**
- **Results: The first pilot targeting Commercial customers was in the Hope area during the winter of 2018 in support of the localized demand-side management pilots. Plans are to expand the pilot to determine potential for future use.**

Commercial fleet charging – UBC

- **Status: Initiated August 2018, ongoing.**
- **Description: This project will explore the integration of charging infrastructure to building management systems to optimize energy use, and investigate reshaping the charging profile of existing infrastructure. The project will utilize existing UBC buildings and smart charging infrastructure that UBC is installing on campus, along with UBC's existing electric vehicle fleet.**
- **Results: Still in development, the project will explore the integration of charging infrastructure to building management systems to optimize energy use, and investigate the charging profile of existing infrastructure.**

Marine electrification – Ferries

- **Status: Launched in September 2018, ongoing.**
- **Description: The initial step toward marine electrification requires plug-in hybrid vessels, with on-board energy storage integrated with the propulsion system. Passenger and coastal cargo ferries dock for minutes, requiring a fast ship-to-shore connection to recharge at each terminal. The operations profile of a given route determines the size of the hybrid vessel. The size of the on-board energy storage system could be limited by the grid capacity at the terminal locations on the route, coupled with the ability to effectively connect to shore power.**

- **Results: Still in development, this pilot will investigate options to potentially charge plug-in hybrid vessels using shore connections. It will include investigating battery-based energy storage to augment charging options.**

Battery storage – industrial peak management

- **Status: Initiated January 2019, ongoing.**
- **Description: This project will involve studying and installing a 100-kW battery to explore the capabilities of managed or smart charging as a capacity solution.**
- **Results: Still in development. This pilot will allow us to understand the costs and benefits of battery storage in a small industrial setting and quantify the impact of load management on peak loads.**

Energy monitors / energy feedback – business customers

- **Status: Initiated in December 2018, ongoing.**
- **Description: Energy monitoring has been piloted with residential customers as part of the Home Energy Monitor pilot and with a small number of industrial customers. Energy monitoring is one option for customers to monitor their electricity consumption in real time. An energy monitoring device provides direct access to energy information by connecting wirelessly to the Zigbee radio in the smart meter. This trial proposes to test this technology on a small scale with 100 business customers in order to understand the technical requirements in a commercial setting, customer impacts and behavioural changes that my result from real-time energy monitoring.**
- **Results: No direct load shifting is expected from this pilot but it may support load shifting through other programs. This pilot will focus on collecting data in real time and streaming to a smart phone or tablet for monitoring and analysis.**

C. Localized DSM Pilots

This category tests the ability of localized DSM to defer local transmission and distribution investments and the value in doing so. Localized DSM initiatives leverage the capacity-focused DSM options that are being investigated as well as other DSM initiatives. Localized DSM initiatives can include: increased community awareness and training activities, additional energy efficiency incentives, capacity-focused behaviour offers, demand response technologies including residential water heater controls, and a commercial and industrial demand response offer.

Pineview substation

- **Status: Launched fiscal 2018, ongoing.**
- **Description: The Pineview substation in Prince George was identified as a potential good candidate for localized DSM. As a winter peaking substation, the**

Pineview load shape is heavily influenced by the outdoor air temperature (impacting residential space heating) and industrial production by a large sawmill and a chemical manufacturer. There are loads from all three customer sectors in this area.

- **Results: In the first year we were able to contract planned industrial load curtailments. However, residential and commercial/industrial uptake of program offers has been slower than anticipated. Pilot will continue in the winter of fiscal 2020.**

Hope substation

- **Status: Launched fiscal 2019, ongoing.**
- **Description: The Hope substation is nearing its firm capacity limits and customer loads cannot easily be off-loaded to adjacent substations. This substation has loads from all customer sectors, but differs in that it has a large percentage of load from the residential sector.**
- **Results: To-date we are slightly behind on our participation target. One large industrial load was contracted for load curtailment. Results of the first year will be available this summer. It is planned to continue this pilot in the winter of fiscal 2020.**

Kent substation

- **Status: Launched fiscal 2019, ongoing.**
- **Description: This pilot focuses on a single distribution feeder from the Kent substation which is at capacity. The customer base is mostly residential with a small amount of commercial accounts. There are no industrial accounts on the feeder.**
- **Results: Results for the winter of fiscal 2019 will be available in the summer of 2019. It is planned to continue this pilot in the winter of fiscal 2020.**

D. Connected Buildings/Facilities Trials

This category includes trials on a variety of different partnership models with technology providers and retailers/manufacturers to understand what works best for our customers and BC Hydro. The trials are also testing BC Hydro's ability to implement capacity focused initiatives either through direct load control or behavioural/semi behavioural messaging. Smart home technology is changing the way customers manage their homes, and BC Hydro plans to leverage this to mitigate any capacity related impacts.

Connected Home – Alana trial

- **Status: Launched April 2019, ongoing.**
- **Description: This trial will measure customer interest in a BC Hydro branded smart home energy management app (Alana) that provides energy management functionality/features that can be used to replace current third party smart home user interfaces. This is different from other offerings being tested as it is a user**

interface that can be applied over existing smart home assets. This solution allows BC Hydro to provide capacity management functionality (Behavioural DR, Direct Control DR) through the app using devices that already exist in the home. The app provides customers with the energy usage feedback and smart home control they are looking for.

- **Results: The recruitment of up to 500 participants utilizing a BC Hydro branded smart home energy management app (Alana) is underway.**

<u>Connected Home – Smart Speaker trial</u>

- **Status: Launched December 2018, ongoing.**
- **Description: We have developed a smart speaker skill that enables users to analyse their energy usage via their smart speaker. Both Google and Alexa are being tested. The speaker provides energy usage insights into how and when energy is being used in the home, and provides advice on how to reduce consumption. This has potential in behavioural capacity management activities. Over time, the speaker integration will be able to control devices, providing customers with both the information and the means to shift load and manage energy usage. Results: Usage levels (the number of times the 540 participants interrogate the speaker) has averaged 368 per week since inception. Customers require regular communication to remind them of the speaker functionality. While it is still early in the trial, the level of activity indicates it may be a useful tool for customer energy literacy in addition to smart home control**

<u>Connected Home – Powerley trial</u>

- **Status: Launched October 2016, ongoing.**
- **Description: BC Hydro customers with electric air source heat pumps and/or electric baseboards are participating in a trial where they receive a BC Hydro branded app that can control space heating, lighting, plug loads and can monitor and disaggregate their electricity use. All equipment connects to a 'smart hub' controlled by the BC Hydro app which can be accessed from their smartphone/tablet at home or remotely. The app provides energy usage feedback to users and the ability for BC Hydro to perform direct load control DR on space heaters and water heaters. The trials consists of three sub groups; customers who received all the smart home equipment (providing live energy data and device control), customers who only received a smart hub (providing live energy data) and customers who only received the app (providing 1 day old hourly energy data). The trial is investigating the impact the 3 levels of involvement have on engagement and energy conservation levels, as well as the propensity for customers to move between levels through the purchase of equipment.**
- **Results: 32 heat pump customers, 88 baseboard customers, 43 Hub only homes, and 34 App only homes participated. Indications are that energy savings are in the 5-7% range, with load shifting capability between 0.6 to 1.1 kW. Customers had strong engagement with the system despite the limited nature of the connected**

products that are available for the customer to test/connect. The trial continues and the number of participants will be increased.

Connected Home – CaSA baseboard thermostats

- **Status: Launched July 2016, ongoing.**
- **Description: Space and water heating are two primary users of energy in a home. In electrically heated homes, there is an opportunity for capacity reductions through meaningful control of electric baseboards. Communicating line voltage thermostats (CLVTs), such as CaSA, are relatively new to the market. This CaSA trial tests the vendor's DR platform. The trial in 2018/2019 was operated in conjunction with Canmet/NRCan to test enhanced DR signal and event shaping to increase load shifting capability without impacting user comfort**
- **Results: Overall customers who have reliable thermostats enjoy the connected functionality; there are very few concerns regarding privacy or utility involvement. Wi-Fi performance in certain building types is unreliable. Units in multi-family buildings with concrete walls and multiple levels have had the most issues with reliability unless modern mesh Wi-Fi routers are utilised. Demand response impacts range from 0.27 kW to 0.39 kW. Energy conservation impact figures are between 5-10% reduction. The trial also found that the CaSA user interface does not meet customer expectations; a true app version is needed.**

E. Infrastructure Development

This category includes the investigation and implementation of information technology (IT) solutions to allow BC Hydro to better manage a diverse and large group of demand response assets, and the investigation of enhanced analytics for program design, savings reporting and data requirements.

Distributed Energy Resource Management Systems (DERMS)

- **Status: Initiated in July 2018, ongoing.**
- **Description: BC Hydro has been conducting trial projects to test various demand response technologies and program designs in the field across all customer sectors. Currently, the trials utilize disparate software and/or vendor-managed tools and interventions to manage each resource. A DERMS system can manage the various demand response activities as if they were a single resource thereby allowing for better coordination and simplification of load management solutions for our Grid Operations department. The objective of this pilot is to demonstrate the system and test its integration.**
- **Results: Request for Proposal for a DERMS system has been issued on April 13, 2019.**

Cybersecurity Verification Program (CVP)

- **Status: Initiated in F2018, ongoing.**

- **Description: One of the key consumer concerns regarding the internet of things and the connected home is the fear of privacy breaches and cyber security breaches. There are three main areas of cyber security risk:**
    - **breaches that cause customer impacts (data loss/malicious interference);**
    - **breaches that cause utility impacts (attacks on the grid/loads connected to the grid that can cause grid impacts); and**
    - **breaches that impact the internet at large.**

  There is currently no single cybersecurity standard in place that adequately addresses these three risk areas. Accordingly, we are working with industry and piloting a new CSA Cybersecurity Verification Program (CVP) that addresses these risks.
- **Results: work with industry is underway, the CVP program has been tested with 6 vendors, and is now being developed into the CSA –T-200 standard. Approval from the Standards Council of Canada was granted in January 2019 to proceed with the development of a bi-national standard. The Canadian Standards Association has entered the T-200 Cyber standard documentation into the 30 day public review stage of the standards development process.**

4.0 Energy Supply Contract Considerations

Reference: Exhibit B.1, pp. 8-10

On p. 10 of the Application, BC Hydro provides the following explanations of whether the 2019 Letter Agreement meets British Columbia Energy Objectives 2(f) and (k):

- 2(f) – Ensure BC Hydro's rates remain competitive: The 2019 Letter Agreement is a cost-effective means by which BC Hydro plans to manage short-term operational needs, and therefore it advances this energy objective and is in alignment with it.
- 2(k) – Encourage economic development: The 2019 Letter Agreement allows for the management of short-term operational needs and has no bearing on economic development in B.C. The 2019 Letter Agreement neither advances nor conflicts with this objective and therefore is in alignment with it.

AMPC seeks to better understand whether the 2019 Letter Agreement displaces other forms of optional programs that could also meet BC Hydro's operational needs and comply with British Columbia Energy Objectives 2(f) and (k).

1.4.2 Why does BC Hydro conclude that the 2019 Letter Agreement has "no bearing on economic development" in BC? In your response, please discuss the relevance of the 2019 Letter Agreement to BC Hydro's system planning and rate structures.

RESPONSE:

BC Hydro has concluded that the 2019 Letter Agreement has no bearing on economic development in B.C. because it enables BC Hydro to acquire energy from Powerex who in turn acquires the energy from sellers outside of the Province on a forward basis.

Please refer to BC Hydro's response to BCUC IR 1.5.1 which discusses how BC Hydro will use the 2019 Letter Agreement in the short-term operational timeframe, BC Hydro's response to BCUC IR 1.6.4 where BC Hydro commits to not issue a Purchase Interest Request with a Delivery Term greater than three years and BC Hydro's response to BCUC IR 1.3.2 where BC Hydro discusses how the 2019 Letter Agreement mitigates BC Hydro's operational risks in the short to medium term.

Finally, the 2019 Letter Agreement is not relevant to BC Hydro's rate structures.

4.0 Energy Supply Contract Considerations

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AMPC seeks to better understand whether the 2019 Letter Agreement displaces other forms of optional programs that could also meet BC Hydro's operational needs and comply with British Columbia Energy Objectives 2(f) and (k).

1.4.3 Please provide further detail regarding how the 2019 Letter Agreement is a "cost- effective" means for BC Hydro to manage short-term operational needs. In your response, please discuss why the 2019 Letter Agreement is a preferable means of addressing short term operational electricity requirements as opposed to alternatives, such as optional programs with industrial customers.

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.5.6 for a description of "cost-effective" and BCUC IR 1.3.2 for a description of how BC Hydro manages its short-term supply needs.

Please refer to BC Hydro's response to AMPC IR 1.4.1 for a description of how demand response programs such as the Load Curtailment Pilot are not able to provide for significant quantities of firm, pre-scheduled, fixed-priced energy deliveries to the system that are provided for by the 2019 Letter Agreement.

5.0 Reporting of Forward Purchase Transactions

Reference: Final Order E-15-19 regarding the 2018 Letter Agreement

In section 3 of this Order, the BCUC ordered as follows with regard to the 2018 Letter Agreement:

> 3. BC Hydro is directed to file the following with the BCUC no later than August 1, 2019:
>
> (a) All additional transactions made under the Agreement executed between May 23, 2019 and June 30, 2019;
>
> (b) The total volume of purchases made under the Agreement that were re-exported through the Transfer Pricing Agreement (TPA) between BC Hydro and Powerex, and surplus to domestic load requirements;
>
> (c) The dates on which forward purchases made under the Agreement were re-exported through the TPA; and
>
> (d) The total revenues generated by re-exporting volumes purchased under the Agreement through the TPA.

Reference: Exhibit B-1, p. 7

At page 7 of the Application, BC Hydro states:

> Pursuant to paragraph No. 3 of Order E-15-19 BC Hydro is required to report to the Commission information regarding transactions made under the 2018 Letter Agreement (paragraph No. 3). BC Hydro proposes to file the same information in regard to any transactions entered into under the 2019 Letter Agreement, at the end of a 90-day period following the calendar quarter in which any deliveries of electricity are made pursuant to the 2019 Letter Agreement. Such disclosure is accommodated by the 2019 Letter Agreement and appropriately balances transparency objectives and the interests of BC Hydro ratepayers.

Reference: BC Hydro F2020 to F2021 Revenue Requirements Application, Exhibit B-8, pp. 14-16

BC Hydro stated in this submission regarding procedural matters that its updated Cost of Energy forecast should be filed on October 18, 2019, as it expected that by that date the updated Cost of Energy can be made public "without giving rise to undue harm to customers". BC Hydro also stated that at this time it will also publish its previously- confidential responses to the BCUC information requests on the Cost of Energy.

Reference: 2018 Letter Agreement Application Materials, Appendix 2

In Appendix 2 of the 2018 Letter Agreement Application, BC Hydro provided the Confirmations that had been received to date under the 2018 Letter Agreement. BC Hydro has since published the 2018 Letter Agreement Application on its website, now that its non- redacted contents are no longer considered commercially sensitive. In making this Application public, BC Hydro has not redacted the Confirmations set out in Appendix 2.

AMPC understands that as of October, 2019, actual Cost of Energy results from F2019 are no longer deemed confidentially sensitive and as a result the following can be made available publicly. AMPC would like to learn more about the purchases that occurred under the 2018 Letter Agreement, to better assess whether the 2019 Letter Agreement is in the public interest.

1.5.1 Please provide a table, and supporting calculations in excel format, that details all F2019 deliveries (both volumes and dollar values) that occurred under the 2018 Letter Agreement, as BC Hydro was required to provide under s. 3 of Order E-15-19. For greater clarity in our request, please separately identify gross transaction amounts, amounts used for domestic use, and amounts re-exported that were not required for domestic usage.

RESPONSE:

BC Hydro publicly filed trade confirmations for deliveries between January and April 2019 on its website:

https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/corporate/regulatory-planning-documents/regulatory-filings/fep/00-2019-05-23-bchydro-bcuc-wm.pdf

The table below summarizes the transactions that occurred under the 2018 Letter Agreement where contract deliveries totaled 2,428,400 MWh, all of which were used to serve domestic load. One Confirmation dated 28 February 2019 for April 2019 off-peak deliveries was omitted from the submission and is attached to this response to complete the record.

Contract Start Month	Contract End Date	Type	Delivery Month	Contract Price (USD/MWh)	Contract Volume (MWh)	Contract Value (USD)
2019-01-01	2019-01-31	Off Peak	Jan-19	56.31	32,800	1,846,968
2019-01-01	2019-01-31	Off Peak	Jan-19	51.78	32,800	1,698,384
2019-01-01	2019-01-31	Off Peak	Jan-19	50.00	32,800	1,640,000
2019-01-01	2019-01-31	Off	Jan-19	49.49	32,800	1,623,272

Contract Start Month	Contract End Date	Type	Delivery Month	Contract Price (USD/MWh)	Contract Volume (MWh)	Contract Value (USD)
		Peak				
2019-01-01	2019-01-31	Off Peak	Jan-19	51.27	32,800	1,681,656
2019-02-01	2019-02-28	Off Peak	Feb-19	41.44	28,800	1,193,472
2019-02-01	2019-02-28	Peak	Feb-19	55.60	9,600	533,760
2019-02-01	2019-02-28	Off Peak	Feb-19	40.93	28,800	1,178,784
2019-02-01	2019-02-28	Peak	Feb-19	55.09	38,400	2,115,456
2019-02-01	2019-02-28	Peak	Feb-19	57.13	38,400	2,193,792
2019-02-01	2019-02-28	Off Peak	Feb-19	41.74	57,600	2,404,224
2019-02-01	2019-02-28	Off Peak	Feb-19	39.81	14,400	573,264
2019-02-01	2019-02-28	Peak	Feb-19	53.82	9,600	516,672
2019-02-01	2019-02-28	Off Peak	Feb-19	39.04	28,800	1,124,352
2019-03-01	2019-03-31	Off Peak	Mar-19	29.62	32,800	971,536
2019-03-01	2019-03-31	Peak	Mar-19	39.81	10,400	414,024
2019-03-01	2019-03-31	Off Peak	Mar-19	29.62	32,800	971,536
2019-03-01	2019-03-31	Peak	Mar-19	39.81	41,600	1,656,096
2019-03-01	2019-03-31	Peak	Mar-19	40.57	156,000	6,328,920
2019-03-01	2019-03-31	Off Peak	Mar-19	29.82	98,400	2,934,288
2019-03-01	2019-03-31	Off Peak	Mar-19	28.75	16,400	471,500
2019-03-01	2019-03-31	Peak	Mar-19	37.46	20,800	779,168
2019-03-01	2019-03-31	Peak	Mar-19	35.12	10,400	365,248
2019-03-01	2019-03-31	Peak	Mar-19	35.48	10,400	368,992
2019-03-01	2019-03-31	Off Peak	Mar-19	29.62	32,800	971,536
2019-03-01	2019-03-31	Off Peak	Mar-19	28.85	32,800	946,280
2019-03-01	2019-03-31	Peak	Mar-19	51.52	41,600	2,143,232

Contract Start Month	Contract End Date	Type	Delivery Month	Contract Price (USD/MWh)	Contract Volume (MWh)	Contract Value (USD)
2019-03-01	2019-03-31	Off Peak	Mar-19	43.42	16,400	712,088
2019-03-01	2019-03-31	Off Peak	Mar-19	38.79	16,400	636,156
2019-03-01	2019-03-31	Peak	Mar-19	44.80	41,600	1,863,680
2019-03-01	2019-03-31	Peak	Mar-19	43.93	20,800	913,744
2019-03-01	2019-03-31	Off Peak	Mar-19	38.69	32,800	1,269,032
2019-03-01	2019-03-31	Off Peak	Mar-19	41.13	16,400	674,532
2019-03-01	2019-03-31	Peak	Mar-19	60.03	166,400	9,988,992
2019-03-01	2019-03-31	Off Peak	Mar-19	53.05	82,000	4,350,100
2019-04-01	2019-04-30	Off Peak	Apr-19	23.55	7,600	178,980
2019-04-01	2019-04-30	Off Peak	Apr-19	27.58	30,400	838,432
2019-04-01	2019-04-30	Peak	Apr-19	28.39	41,600	1,181,024
2019-04-01	2019-04-30	Peak	Apr-19	29.51	41,600	1,227,616
2019-04-01	2019-04-30	Off Peak	Apr-19	27.58	30,400	838,432
2019-04-01	2019-04-30	Off Peak	Apr-19	31.65	15,200	481,080
2019-04-01	2019-04-30	Off Peak	Apr-19	27.68	197,600	5,469,568
2019-04-01	2019-04-30	Peak	Apr-19	28.65	41,600	1,191,840
2019-04-01	2019-04-30	Peak	Apr-19	32.16	41,600	1,337,856
2019-04-01	2019-04-30	Peak	Apr-19	28.44	41,600	1,183,104
2019-04-01	2019-04-30	Off Peak	Apr-19	22.48	7,600	170,848
2019-04-01	2019-04-30	Peak	Apr-19	28.39	41,600	1,181,024
2019-04-01	2019-04-30	Off Peak	Apr-19	22.74	30,400	691,296

Contract Start Month	Contract End Date	Type	Delivery Month	Contract Price (USD/MWh)	Contract Volume (MWh)	Contract Value (USD)
2019-04-01	2019-04-30	Off Peak	Apr-19	23.20	7,600	176,320
2019-04-01	2019-04-30	Peak	Apr-19	30.13	41,600	1,253,408
2019-04-01	2019-04-30	Peak	Apr-19	28.44	10,400	295,776
2019-04-01	2019-04-30	Peak	Apr-19	33.18	270,400	8,971,872
2019-04-01	2019-04-30	Peak	Apr-19	28.90	31,200	901,680
2019-04-01	2019-04-30	Off Peak	Apr-19	23.76	30,400	722,304
2019-04-01	2019-04-30	Off Peak	Apr-19	22.74	15,200	345,648
2019-04-01	2019-04-30	Off Peak	Apr-19	25.03	7,600	190,228
2019-04-01	2019-04-30	Off Peak	Apr-19	25.03	30,400	760,912
2019-04-01	2019-04-30	Off Peak	Apr-19	23.25	30,400	706,800
2019-04-01	2019-04-30	Peak	Apr-19	28.55	20,800	593,840
2019-04-01	2019-04-30	Off Peak	Apr-19	22.89	15,200	347,928
			Total		2,428,400	91,292,552
			Average Price			37.59

powerex.
Supply. Flexibility. Commitment.

CONFIRMATION AGREEMENT BETWEEN
Powerex Corp.* and British Columbia Hydro and Power Authority
Deal No: GDS080

This Confirmation confirms the Transaction effective the Reference Date regarding the sale and purchase of electricity in accordance with the letter agreement ("Agreement") dated November 23, 2018, between BC Hydro and Powerex with the following terms and conditions:

Reference Date: February 28, 2019

Seller: Powerex

Buyer: BCH

Delivery Period, Delivery Profile, Contract Price and Contract Quantity

Delivery Period	Delivery Profile	Contract Quantity (MW)	Contract Price	Total Quantity (MWh)
April 01, 2019 through April 30, 2019	Off-Peak Hours	50 MW/hr.	USD 31.65 /MWh	15,200 MWh

This Confirmation is provided pursuant to and is subject to the terms and conditions of the Agreement. Capitalized terms that are not otherwise defined herein shall have the meaning given to them in the Agreement.

ACKNOWLEDGED AND AGREED TO:
Powerex Corp.*
By: [signature]
Name: Bob Campbell
Title: Managing Director
Date: Feb 28, 2019

* Powerex Corp., doing business in California as Powerex Energy Corp.

5.0 Reporting of Forward Purchase Transactions

Reference: Final Order E-15-19 regarding the 2018 Letter Agreement

In section 3 of this Order, the BCUC ordered as follows with regard to the 2018 Letter Agreement:

> 3. BC Hydro is directed to file the following with the BCUC no later than August 1, 2019:
>
> (a) All additional transactions made under the Agreement executed between May 23, 2019 and June 30, 2019;
>
> (b) The total volume of purchases made under the Agreement that were re-exported through the Transfer Pricing Agreement (TPA) between BC Hydro and Powerex, and surplus to domestic load requirements;
>
> (c) The dates on which forward purchases made under the Agreement were re-exported through the TPA; and
>
> (d) The total revenues generated by re-exporting volumes purchased under the Agreement through the TPA.

Reference: Exhibit B-1, p. 7

At page 7 of the Application, BC Hydro states:

> Pursuant to paragraph No. 3 of Order E-15-19 BC Hydro is required to report to the Commission information regarding transactions made under the 2018 Letter Agreement (paragraph No. 3). BC Hydro proposes to file the same information in regard to any transactions entered into under the 2019 Letter Agreement, at the end of a 90-day period following the calendar quarter in which any deliveries of electricity are made pursuant to the 2019 Letter Agreement. Such disclosure is accommodated by the 2019 Letter Agreement and appropriately balances transparency objectives and the interests of BC Hydro ratepayers.

Reference: BC Hydro F2020 to F2021 Revenue Requirements Application, Exhibit B-8, pp. 14-16

BC Hydro stated in this submission regarding procedural matters that its updated Cost of Energy forecast should be filed on October 18, 2019, as it expected that by that date the updated Cost of Energy can be made public "without giving rise to undue harm to customers". BC Hydro also stated that at this time it will also publish its previously- confidential responses to the BCUC information requests on the Cost of Energy.

Reference: 2018 Letter Agreement Application Materials, Appendix 2

In Appendix 2 of the 2018 Letter Agreement Application, BC Hydro provided the Confirmations that had been received to date under the 2018 Letter Agreement. BC Hydro has since published the 2018 Letter Agreement Application on its website, now that its non- redacted contents are no longer considered commercially sensitive. In making this Application public, BC Hydro has not redacted the Confirmations set out in Appendix 2.

AMPC understands that as of October, 2019, actual Cost of Energy results from F2019 are no longer deemed confidentially sensitive and as a result the following can be made available publicly. AMPC would like to learn more about the purchases that occurred under the 2018 Letter Agreement, to better assess whether the 2019 Letter Agreement is in the public interest.

1.5.1 Please provide a table, and supporting calculations in excel format, that details all F2019 deliveries (both volumes and dollar values) that occurred under the 2018 Letter Agreement, as BC Hydro was required to provide under s. 3 of Order E-15-19. For greater clarity in our request, please separately identify gross transaction amounts, amounts used for domestic use, and amounts re-exported that were not required for domestic usage.

1.5.1.1 Please identify how the amounts provided in this table are reflected in the line item amounts in BC Hydro's Evidentiary Update in the F2020 and F2021 RRA.

RESPONSE:

Volumes and costs for contract transactions are included in Schedule 4.0 of Appendix A, in rows 8 and 34 respectively of the F20-F21 RRA.

5.0 Reporting of Forward Purchase Transactions

Reference: Exhibit B-1, p. 7

On page 7 of the 2019 Letter Agreement Application, BC Hydro states that:

> BC Hydro will also file a confidential monthly report with the BCUC, commencing at the end of August 2019, disclosing any purchases that have been made under the 2019 Letter Agreement, similar to the information the BCUC has requested under Directive 3(a) of Order No. E-15-19 related to the 2018 Letter Agreement.

AMPC would like additional information on the reporting that BC Hydro will do in relation to purchases made under the 2019 Letter Agreement, and further details on why it is being filed confidentially.

1.5.2 Please confirm that these confidential reports will be made available for public review and consideration after they are no longer commercially sensitive. In your response, please identify what concerns require this information to be filed confidentially and the duration for which these concerns will apply to require confidential treatment of this information.

RESPONSE:

Please refer to BC Hydro's cover letter to these IR responses with respect to its clarified reporting commitments.

5.0 Reporting of Forward Purchase Transactions

Reference: Exhibit B-1, p. 7

On page 7 of the 2019 Letter Agreement Application, BC Hydro states that:

> BC Hydro will also file a confidential monthly report with the BCUC, commencing at the end of August 2019, disclosing any purchases that have been made under the 2019 Letter Agreement, similar to the information the BCUC has requested under Directive 3(a) of Order No. E-15-19 related to the 2018 Letter Agreement.

AMPC would like additional information on the reporting that BC Hydro will do in relation to purchases made under the 2019 Letter Agreement, and further details on why it is being filed confidentially.

1.5.2 Please confirm that these confidential reports will be made available for public review and consideration after they are no longer commercially sensitive. In your response, please identify what concerns require this information to be filed confidentially and the duration for which these concerns will apply to require confidential treatment of this information.

1.5.2.1 Please specify what other measures or analysis BC Hydro intends to undertake to track and demonstrate that these transactions are financially in the interest of ratepayers.

RESPONSE:

Please refer to BC Hydro's response to AMPC IR 1.6.2.

5.0 Reporting of Forward Purchase Transactions

Reference: Exhibit B-1, p. 7

On page 7 of the 2019 Letter Agreement Application, BC Hydro states that:

> BC Hydro will also file a confidential monthly report with the BCUC, commencing at the end of August 2019, disclosing any purchases that have been made under the 2019 Letter Agreement, similar to the information the BCUC has requested under Directive 3(a) of Order No. E-15-19 related to the 2018 Letter Agreement.

AMPC would like additional information on the reporting that BC Hydro will do in relation to purchases made under the 2019 Letter Agreement, and further details on why it is being filed confidentially.

1.5.2 Please confirm that these confidential reports will be made available for public review and consideration after they are no longer commercially sensitive. In your response, please identify what concerns require this information to be filed confidentially and the duration for which these concerns will apply to require confidential treatment of this information.

1.5.2.2 Please confirm that the same confidentiality concerns, and relative timing at which those concerns dissipate, will apply to reporting under the 2019 Letter Agreement as applied to the confidential reporting done for purchases under the 2018 Letter Agreement. If not confirmed, please fully explain.

RESPONSE:

Please refer to BC Hydro's cover letter to these responses with respect to its clarified reporting commitments. BC Hydro has proposed providing a public report 90 days after each calendar quarter to address its confidentiality concerns.

6.0 F2009 Losses from Forward Electricity Purchase Contracts and the 2011

RRA Reference: 2018 Letter Agreement Application Materials, p. 2, pdf p. 9

At page 2 of the application for the 2018 Letter Agreement, originally filed confidentially, BC Hydro states as follows regarding the F2011 Revenue Requirements Application:

> In the F2011 Revenue Requirements Application Negotiated Settlement Agreement dated December 2, 2011 (F2011 NSA), BC Hydro committed to not enter into any forward market electricity purchase arrangements without the approval of the Commission. The circumstances of that commitment were very different than the current circumstances, as described below, and BC Hydro does not believe that the F2011 NSA commitment is applicable to the current situation. Nevertheless, in the interests of transparency and in recognition of the fact that others may have a different view on the scope of the F2011 NSA commitment, BC Hydro is bringing the F2011 NSA commitment to the Commission's attention. Further, BC Hydro considers that the requested relief above, if granted, amounts to an "approval" as contemplated by the F2011 NSA if determined to be required notwithstanding BC Hydro's view that it is inapplicable. [Emphasis added]

Reference: Order G-180-10, Appendix B, Negotiated Settlement Agreement

In the Negotiated Settlement Agreement that was approved by the Commission as settling all issues arising from BC Hydro's F2011 RRA, BC Hydro committed at section 9(iii) to "not enter into any forward market electricity purchase arrangements (energy hedges) without the approval of the BCUC".

Reference: British Columbia Hydro and Power Authority Fiscal 2011 Revenue Requirements Application, Exhibit B-6, pdf p. 1679

In BC Hydro's F2011 RRA, in response to BCUC IR 1.243.2, BC Hydro stated as follows:

> The $90.2 million of losses in F2009 relate to mark to market losses on various forward contracts BC Hydro enters into with Powerex for the purchase of electricity in order to mitigate some of the commodity risk on domestic energy costs. Generally Powerex matches these forward contracts with a third party but may choose to take on the risks/benefits of these contracts as it uses a portfolio based approach in managing its energy contracts The transactions between BC Hydro and Powerex are eliminated on consolidation. With respect to the Deferral Accounts, any

gain or loss on the derivative instruments on the Powerex side would flow through the Trade Income Deferral Account (assuming actual trade income is between $ zero and $200 million) and the corresponding gain/loss on the BC Hydro side would flow through the Heritage and Non-Heritage Deferral Accounts.

AMPC seeks to better understand what BC Hydro has learned from the $90.2 million loss BC Hydro suffered in F2009 that resulted from forward contracts with Powerex, including the risk that BC Hydro could suffer a similar loss, to the $90.2 million that resulted in F2009, in making forward electricity purchases under the 2019 Letter Agreement.

1.6.1 Please confirm that BC Hydro could, as a result of forward electricity purchases it would make under the 2019 Letter Agreement, incur market losses similar to $90.2 million loss realized in F2009. Please fully explain if not confirmed.

RESPONSE:

Both the pre-2011 hedging program and the 2019 Letter Agreement were designed as risk mitigation tools. However, the pre-2011 hedging program was designed to mitigate financial risks around the variability of pricing of expected purchases under the 2003 TPA (which is based on the day-ahead Mid-C market price), whereas the 2019 Letter Agreement was designed to mitigate physical risks around the variability of the available volume of supply given liquidity concerns in the Mid-C day ahead market.

Please see the response to AMPC IR 1.6.2 for a discussion on mark to market gains and losses.

6.0 F2009 Losses from Forward Electricity Purchase Contracts and the 2011

RRA Reference: 2018 Letter Agreement Application Materials, p. 2, pdf p. 9

At page 2 of the application for the 2018 Letter Agreement, originally filed confidentially, BC Hydro states as follows regarding the F2011 Revenue Requirements Application:

> In the F2011 Revenue Requirements Application Negotiated Settlement Agreement dated December 2, 2011 (F2011 NSA), BC Hydro committed to not enter into any forward market electricity purchase arrangements without the approval of the Commission. The circumstances of that commitment were very different than the current circumstances, as described below, and BC Hydro does not believe that the F2011 NSA commitment is applicable to the current situation. Nevertheless, in the interests of transparency and in recognition of the fact that others may have a different view on the scope of the F2011 NSA commitment, BC Hydro is bringing the F2011 NSA commitment to the Commission's attention. Further, BC Hydro considers that the requested relief above, if granted, amounts to an "approval" as contemplated by the F2011 NSA if determined to be required notwithstanding BC Hydro's view that it is inapplicable. [Emphasis added]

Reference: Order G-180-10, Appendix B, Negotiated Settlement Agreement

In the Negotiated Settlement Agreement that was approved by the Commission as settling all issues arising from BC Hydro's F2011 RRA, BC Hydro committed at section 9(iii) to "not enter into any forward market electricity purchase arrangements (energy hedges) without the approval of the BCUC".

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gain or loss on the derivative instruments on the Powerex side would flow through the Trade Income Deferral Account (assuming actual trade income is between $ zero and $200 million) and the corresponding gain/loss on the BC Hydro side would flow through the Heritage and Non-Heritage Deferral Accounts.

AMPC seeks to better understand what BC Hydro has learned from the $90.2 million loss BC Hydro suffered in F2009 that resulted from forward contracts with Powerex, including the risk that BC Hydro could suffer a similar loss, to the $90.2 million that resulted in F2009, in making forward electricity purchases under the 2019 Letter Agreement.

1.6.2 Please identify and fully explain the steps and measures that BC Hydro has taken to ensure that forward electricity purchases made under the 2019 Letter Agreement will not result in market losses.

RESPONSE:

BC Hydro entered the 2019 Letter Agreement to have a tool available to mitigate physical supply risk and ensure BC Hydro can meet its operational needs as system or market conditions change.

For example, BC Hydro made purchases under the 2018 Letter Agreement, as a prudent risk management decision at the time, regardless of whether BC Hydro system conditions improved or worsened and/or short-term market prices ended up higher or lower over the balance of the winter. Accordingly, the primary purpose and success of the 2018 Letter Agreement was in its risk mitigation. The 2019 Letter Agreement will serve a similar purpose.

Ahead of a given delivery period, no one knows whether the average applicable forward price(s) for a particular delivery period will end up above or below the average applicable day-ahead prices for the same delivery period. Moreover, there is considerable uncertainty as to whether there is sufficient volume available in the day-ahead market as an alternative to the forward physical purchases. It is thus difficult to accurately estimate what the costs would have been had BC Hydro used a combination of spot market purchases and Island Generation to meet energy requirements, as the timing and availability of purchases absent the forward purchases cannot be known. For example, absent the certainty of supply to import the specified volume of firm imports provided by the 2018 Letter Agreement, BC Hydro would have set a higher Threshold Purchase Price and would have purchased more energy as the shortfall position worsened. The table below compares the cost of the 2018 Letter Agreement (US$91.3 million) to the

hypothetical cost of alternative sources of energy from Island Generation and the Spot Market (totaling US$189.5 million).

	Energy (GWh)	Average Price (US$/MWh)	Cost (US$ millions)
2018 Letter Agreement (as of March 1)	**2,428**	**37.59**[1]	**91.3**

Hypothetical Cost of Alternative Sources of Energy	Energy (GWh)	Average Price (US$/MWh)	Cost (US$ millions)
Island Generation (February to April)[2]	**528**	**126.29**	**66.7**
Spot Market (January to April)[3]	**1,900**	**64.61**	**122.8**
Total	**2,428**	**78.04**	**189.5**

A mark-to-market comparison of the forward transaction price under the 2019 Letter Agreement to the day-ahead Mid-C market price for the same period is one metric that can be calculated. However, it has limited practical value. This is because the assumed volume of purchases may not have been available in the spot market at the index price, and as previously mentioned, an estimation of any perfect hindsight gains or losses would require a hypothetical modeling exercise to evaluate what BC Hydro may have done absent such an agreement.

As a result, BC Hydro cannot ensure that forward electricity purchases made under the 2019 Letter Agreement will not result in purchase costs higher than what would have materialized in the day-ahead time frame.

Please refer to BC Hydro's response to CEC IR 1.1.1 for a description of the asymmetric risk related to market purchases and how BC Hydro manages exposure to market price risk.

---

1 **This is the weighted average price BC Hydro paid to Powerex under the Agreement.**

2 **ICG generation costs based on assumed 90 per cent availability, using actual Sumas gas prices to March 7 and forward prices for the balance of the forecast horizon (including gas transportation and carbon tax costs).**

3 **Spot market costs based on average monthly prices and assume imports at levels that result in 660 MW across the January to April period, using actual Mid-C prices to March 7 and forward prices for the balance of the forecast horizon (including wheeling costs).**

6.0 F2009 Losses from Forward Electricity Purchase Contracts and the 2011

In the application for the 2018 Letter Agreement, BC Hydro stated that **"**The circumstances of that commitment were very different than the current circumstances, as described below, and BC Hydro does not believe that the F2011 NSA commitment is applicable to the current situation.**"**

1.6.3 Please discuss how the circumstances surrounding the 2018 Letter Agreement were different than the circumstances surrounding the F2011 NSA commitment.

RESPONSE:

Prior to fiscal 2011, BC Hydro was in an annual deficit position under average inflow conditions that was managed by a combination of generation from Burrard and Island Generation, market electricity purchases, and year-over-year storage operations. Market liquidity was sufficient to provide electricity imports when needed and financial hedges for natural gas and electricity were used to manage the cost risk.

Under the F2011 NSA, BC Hydro agreed to not enter into any forward financial market electricity purchase arrangements without the approval of the Commission. BC Hydro agreed to this concession as part of the wider settlement because BC Hydro didn't consider financial hedging critical to managing the system.

Since fiscal 2011 the system and market conditions have changed. BC Hydro became less reliant on thermal generation as Burrard was retired and the energy replaced with Electricity Purchase Agreements with Independent Power Producers. Load growth was lower than expected and BC Hydro moved to an annual surplus position under average inflow conditions. The additional Electricity Purchase Agreements increased freshet generation and resulted in reduced low-priced freshet imports and increased forced exports/spills, so there is less ability to import on low cost freshet imports to manage deficits.

From a physical supply perspective the reduced market liquidity is the driver for BC Hydro's desire to have the 2019 Letter Agreement in place as a prudent mechanism to manage supply risk when needed. Note, while financial hedging was the subject of the F2011 NSA this form of hedging would mitigate cost risk but not supply risk.

6.0 F2009 Losses from Forward Electricity Purchase Contracts and the 2011

In the application for the 2018 Letter Agreement, BC Hydro stated that **"**The circumstances of that commitment were very different than the current circumstances, as described below, and BC Hydro does not believe that the F2011 NSA commitment is applicable to the current situation.**"**

1.6.3 Please discuss how the circumstances surrounding the 2018 Letter Agreement were different than the circumstances surrounding the F2011 NSA commitment.

1.6.3.1 Please confirm that the differences in circumstances that BC Hydro referred to in the application for the 2018 Letter Agreement are not still present and applicable in relation to the 2019 Letter Agreement. If not confirmed, please fully explain.

RESPONSE:

Not confirmed. The different circumstances referred to in the 2018 Letter Agreement are still present and applicable to the 2019 Letter Agreement.

In both the 2018 Letter Agreement and 2019 Letter Agreement, the circumstances relate to managing the physical risk of meeting domestic supply versus the financial hedging to manage cost risk, which was the topic of the of the F2011 NSA as described in BC Hydro's response to AMPC IR 1.6.3.

6.0 F2009 Losses from Forward Electricity Purchase Contracts and the 2011

In the application for the 2018 Letter Agreement, BC Hydro stated that **"**The circumstances of that commitment were very different than the current circumstances, as described below, and BC Hydro does not believe that the F2011 NSA commitment is applicable to the current situation.**"**

1.6.3 Please discuss how the circumstances surrounding the 2018 Letter Agreement were different than the circumstances surrounding the F2011 NSA commitment.

1.6.3.2 Please compare and contrast the current circumstances against those that surrounded the F2011 NSA commitment, and fully explain why forward electricity purchases from Powerex are in the public interest now when they were not necessary in 2011.

RESPONSE:

Please refer to BC Hydro's response to AMPC IR 1.6.3.

6.0 F2009 Losses from Forward Electricity Purchase Contracts and the 2011

In the application for the 2018 Letter Agreement, BC Hydro stated that **"**The circumstances of that commitment were very different than the current circumstances, as described below, and BC Hydro does not believe that the F2011 NSA commitment is applicable to the current situation.**"**

1.6.4 Please discuss why BC Hydro committed in the F2011 NSA to not enter into any forward electricity market purchase arrangements without the approval of the Commission.

RESPONSE:

Please refer to BC Hydro's response to AMPC IR 1.6.3.

6.0 F2009 Losses from Forward Electricity Purchase Contracts and the 2011

In the application for the 2018 Letter Agreement, BC Hydro stated that **"**The circumstances of that commitment were very different than the current circumstances, as described below, and BC Hydro does not believe that the F2011 NSA commitment is applicable to the current situation.**"**

1.6.4 Please discuss why BC Hydro committed in the F2011 NSA to not enter into any forward electricity market purchase arrangements without the approval of the Commission.

1.6.4.1 Please describe the continuing legal effect, if any, of the F2011 NSA and BC Hydro's commitment therein to not enter into any forward electricity market purchase arrangements without the approval of the Commission.

RESPONSE:

BC Hydro considers the commitment made in the F2011 NSA to be ongoing. However, BC Hydro does not consider the F2011 NSA commitment to be applicable to the 2019 Letter Agreement (nor did it believe it applied to the 2018 Letter Agreement). As BC Hydro stated its response to BCUC IR 1.13.1 in the 2018 Letter Agreement proceeding (attached to this response), BC Hydro interprets the F2011 NSA commitment to apply to forward financial transactions as opposed to forward transactions undertaken to secure the physical supply as is the case under the 2019 Letter Agreement. BC Hydro notes that he Commission did not disagree with BC Hydro's position on this point in its final decision on the 2018 Letter Agreement.

British Columbia Utilities Commission **CONFIDENTIAL** Information Request No. **1.13.1** Dated: **February 8, 2019** British Columbia Hydro & Power Authority **PUBLIC** Response issued **May 23, 2019**	Page 1 of 1
British Columbia Hydro & Power Authority **Letter Agreement between BC Hydro and Powerex Corp.** **Forward Electricity Purchases**	

13.0 D. F2011 NEGOTIATED SETTLEMENT AGREEMENT

Reference: NEGOTIATED SETTLEMENT AGREEMENT (NSA)
Order G-180-10, BC Hydro Application for Review of its F2011 Revenue Requirements, Appendix B, Section 9 (iii), p. 7
BC Hydro Commitments

Page 7 of Appendix B to Order G-180-10, which approved the NSA to the F2011 Revenue Rate Application (RRA), states that BC Hydro shall "…not enter into any forward market electricity purchase arrangements (energy hedges) without the approval of the BCUC".

1.13.1 Please confirm, or otherwise explain, whether BC Hydro entered into any physical energy hedges prior to the NSA to the F2011 RRA.

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RESPONSE:

BC Hydro did not enter into physical energy hedges prior to the NSA to the 2011 RRA. Rather, BC Hydro entered into *forward financial* transactions with Powerex under the Transfer Pricing Agreement (Section 11.1). Those transactions were for the purpose of hedging the market price risk associated with BC Hydro's expected energy needs and achieved this objective by providing price certainty at the time that the transactions were entered into.

In contrast, the transactions under the Agreement for the winter 2018-2019 period were entered into for the primary purpose of securing *physical supply certainty* to meet BC Hydro's expected *physical* energy needs, given the reduced liquidity in the short-term markets and the risk of relying on obtaining sufficient supply availability through purchases from Powerex under the Transfer Price Agreement one day at a time.

1.0 Reference: Exhibit B-1, page 2, Footnote 5

Footnote 5 states: ""In summary, the planning view reflects the capability of resources based on BC Hydro's planning criteria while the operational view shows the forecasted operation of these same resources given market and system conditions." The difference between the two views is the reason BC Hydro can be in surplus from a planning perspective and concurrently in deficit from an operating perspective"".

1.1.1 Please discuss the extent to which BC Hydro's "planning criteria" takes into account potential variations in load and hydro output to weather and, as a result, what conditions could arise from an operating perspective that have not been accounted for from a planning perspective.

RESPONSE:

As required under the *Clean Energy Act* BC Hydro plans its system to be self-sufficient in average water conditions. This is implemented in the planning Load Resource Balance whereby the system is assumed to meet this requirement when the surplus/deficit is zero, in average water conditions, for the mid-level energy load forecast, taking into account demand-side management initiatives.

It is expected that in actual operations, the system will be surplus or deficit depending on short-term operating conditions, including actual water conditions, Electricity Purchase Agreements deliveries, and load. The amount of BC Hydro system inflow variability which BC Hydro can see in actual operations is in the order of +/- 7000 GWh around the position shown in the planning Load Resource Balance as discussed in BC Hydro's response to BCUC IR 1.3.2. As stated in the same response, the variability is what is modeled in the Energy Studies and does not capture the full range of inflow risk that BC Hydro manages due primarily to variability in hydro-based Electricity Purchase Agreement deliveries. In addition, in actual operations there will be variability in the load, but this would generally be expected to be lower than the inflow variability.

2.0 Reference: Exhibit B-1, pages 2 and 4
BCUC Proceeding re: BCH/Powerex 2018 Letter of Agreement, BCUC 1.8.2

The current Application (page 2) states with respect to the 2018 and 2019 Letter Agreements: "Both are enabling agreements that allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon".

The current Application (page 4) states that: "BC Hydro makes such purchase decisions within the usual operational management framework it employs to make all dispatch and other system operation decisions".

The response to BCUC 1.8.2 states: "BC Hydro completes an Energy Study every month as it has done every month since the 1990s. One objective of these studies is to forecast, over a five- year time horizon, an optimal set of reservoir and generating station operations and import/export activity under a variety of equally probable market, inflow and weather conditions".

1.2.1 Is the "operational time horizon" referred to in the current Application (page 2) the same as the timeframe considered by the monthly Energy Study (i.e., 5 years)?

RESPONSE:

Please see BC Hydro's response to BCUC IR 1.5.1 that explains why the operational time horizon is three years. The Energy Studies model the dispatch of the system five fiscal years into the future; running the model for the additional two years allows the forecast for the first three years to account for the impact of longer term operational constraints (e.g., scheduled outages in the fourth and fifth years).

2.0 Reference: Exhibit B-1, pages 2 and 4
BCUC Proceeding re: BCH/Powerex 2018 Letter of Agreement, BCUC 1.8.2

The current Application (page 2) states with respect to the 2018 and 2019 Letter Agreements: "Both are enabling agreements that allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon".

The current Application (page 4) states that: "BC Hydro makes such purchase decisions within the usual operational management framework it employs to make all dispatch and other system operation decisions".

The response to BCUC 1.8.2 states: "BC Hydro completes an Energy Study every month as it has done every month since the 1990s. One objective of these studies is to forecast, over a five- year time horizon, an optimal set of reservoir and generating station operations and import/export activity under a variety of equally probable market, inflow and weather conditions".

1.2.1 Is the "operational time horizon" referred to in the current Application (page 2) the same as the timeframe considered by the monthly Energy Study (i.e., 5 years)?

1.2.1.1 If not, please explain the difference.

RESPONSE:

Please refer to BC Hydro's response to BCOAPO IR 1.2.1.

2.0 Reference: Exhibit B-1, pages 2 and 4
BCUC Proceeding re: BCH/Powerex 2018 Letter of Agreement, BCUC 1.8.2

The current Application (page 2) states with respect to the 2018 and 2019 Letter Agreements: "Both are enabling agreements that allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon".

The current Application (page 4) states that: "BC Hydro makes such purchase decisions within the usual operational management framework it employs to make all dispatch and other system operation decisions".

The response to BCUC 1.8.2 states: "BC Hydro completes an Energy Study every month as it has done every month since the 1990s. One objective of these studies is to forecast, over a five- year time horizon, an optimal set of reservoir and generating station operations and import/export activity under a variety of equally probable market, inflow and weather conditions".

1.2.2 Is the Monthly Energy Study the process by which the need for BC Hydro to acquire forward-wholesale energy (as enabled by the proposed Agreement) will be identified?

RESPONSE:

Yes. The Monthly Energy Study forecasts expected generation, reservoir levels and import/exports from the system. This information is used to estimate the range of possible supply shortfalls. In addition BC Hydro uses other operational tools to estimate changes within the month and may adjust the Purchase Interest Requests or issue new Purchase Interest Requests based on the most up-to-date data.

2.0 Reference: Exhibit B-1, pages 2 and 4
BCUC Proceeding re: BCH/Powerex 2018 Letter of Agreement, BCUC 1.8.2

The current Application (page 2) states with respect to the 2018 and 2019 Letter Agreements: "Both are enabling agreements that allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon".

The current Application (page 4) states that: "BC Hydro makes such purchase decisions within the usual operational management framework it employs to make all dispatch and other system operation decisions".

The response to BCUC 1.8.2 states: "BC Hydro completes an Energy Study every month as it has done every month since the 1990s. One objective of these studies is to forecast, over a five- year time horizon, an optimal set of reservoir and generating station operations and import/export activity under a variety of equally probable market, inflow and weather conditions".

1.2.2 Is the Monthly Energy Study the process by which the need for BC Hydro to acquire forward-wholesale energy (as enabled by the proposed Agreement) will be identified?

1.2.2.1 If not, what is the process by which BC Hydro will identify the need to acquire forward-wholesale energy by means of the Letter of Agreement?

RESPONSE:

Please refer to BC Hydro's response to BCOAPO IR 1.2.2.

2.0 Reference: Exhibit B-1, pages 2 and 4
BCUC Proceeding re: BCH/Powerex 2018 Letter of Agreement, BCUC 1.8.2

The current Application (page 2) states with respect to the 2018 and 2019 Letter Agreements: "Both are enabling agreements that allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon".

The current Application (page 4) states that: "BC Hydro makes such purchase decisions within the usual operational management framework it employs to make all dispatch and other system operation decisions".

The response to BCUC 1.8.2 states: "BC Hydro completes an Energy Study every month as it has done every month since the 1990s. One objective of these studies is to forecast, over a five- year time horizon, an optimal set of reservoir and generating station operations and import/export activity under a variety of equally probable market, inflow and weather conditions".

1.2.3 Given that BC Hydro completes an Energy Study every month based on updates regarding current and future system capabilities and requirements, how far "forward" does BC Hydro anticipate making a commitment to acquiring forward-wholesale energy based on the basis of the results of a given month's Energy Study?

RESPONSE:

Please refer to BC Hydro's response to BCUC IRs 1.3.2 and 1.5.1 for a discussion of how BC Hydro manages its operational needs and for a description of short-term operational requirements. Please also refer to BC Hydro's response to BCUC IR 1.6.4 which discusses how BC Hydro sets its Delivery Terms.

3.0 Reference: Exhibit B-1, pages 2 and 7
Exhibit B-1, Appendix 3, CEABC 1.7.4

1.3.1 Was the information that BC Hydro filed with the BCUC regarding the transactions that occurred under the 2018 Letter Agreement (per page 7, first paragraph under Reporting) confidential or is it available for the public?

RESPONSE:

BC Hydro posted a public version of the 2018 Letter Agreement and all compliance filings made in accordance with BCUC Order No. E-15-19, which can be found at the following links:

2018 Letter Agreement between BC Hydro and Powerex – May 23, 2019

Compliance with Directive 3 of Order E-15-19 - Additional Transactions under the 2018 Letter Agreement – August 1, 2019

Compliance with Directive 4 of Order E-15-19 - Monthly report No. 1 to monitor water levels and inflows at each of the Kinsbasket and Williston reservoirs – August 1, 2019

Compliance with Directive 4 of Order E-15-19 - Monthly report No. 2 to monitor water levels and inflows at each of the Kinsbasket and Williston reservoirs – August 28, 2109

Compliance with Directive 4 of Order E-15-19 - Monthly report No. 3 to monitor water levels and inflows at each of the Kinsbasket and Williston reservoirs – September 30, 2019

Please also refer to BC Hydro's response to AMPC IR 1.5.1 for a summary table of the transactions.

3.0 Reference: Exhibit B-1, pages 2 and 7
Exhibit B-1, Appendix 3, CEABC 1.7.4

1.3.1 Was the information that BC Hydro filed with the BCUC regarding the transactions that occurred under the 2018 Letter Agreement (per page 7, first paragraph under Reporting) confidential or is it available for the public?

1.3.1.1 If available, please provide the "reports" submitted to the Commission regarding the transactions made under the 2018 Letter Agreement.

RESPONSE:

Please refer to BC Hydro's response to BCOAPO IR 1.3.1.

4.0 Reference: Exhibit B-1, pages 5

1.4.1 Can BC Hydro explain why "over the past decade there has been a steady decline in the volume of wholesale electricity traded on a day- ahead basis in the Pacific Northwest"?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.2.3, which provides BC Hydro's understanding of the causes of the long term decline of liquidity.

5.0 Reference: Exhibit B-1, page 7

1.5.1 Will BC Hydro's reporting of transactions made under the 2019 Letter Agreement include explanations as to the reasons for the specific Purchase Interest Requests there were made to Powerex (i.e., what were the circumstances that led BC Hydro to conclude it was necessary from a supply risk management perspective to make such a request)?

RESPONSE:

No. BC Hydro's reporting will not include detailed explanations as to why it issued Purchase Interest Requests. This information is relevant in determining whether BC Hydro should recover its Cost of Energy as part of the Revenue Requirement process. Within that process, BC Hydro answers many IRs on the previous fiscal years' actual and forecast costs for the test period.

6.0 Reference: Exhibit B-1, page 8

1.6.1 Please explain more fully what is meant by the statement "There are neither prescribed targets nor prescribed guidelines and so this factor in not applicable".

RESPONSE:

Section 19 of the *Clean Energy Act* specifies that certain prescribed targets and guidelines regarding clean or renewable resources must be met in planning for the construction or extension of generation facilities and energy purchases. However, no regulation has been issued to specify those prescribed targets and guidelines. As a result, this section has no current legal effect and is therefore not a factor that the Commission must consider in determining whether the 2019 Letter Agreement should be accepted for filing.

7.0 Reference: Exhibit B-1, page 9

The Application states: "The 2019 Letter Agreement is a cost- effective means by which BC Hydro plans to manage short-term operational needs, and therefore it advances this energy objective and is in alignment with it".

1.7.1 If the BCUC were to determine that the 2019 Letter Agreement was not in the public interest, what alternatives would be available for BC Hydro to address these forecast conditions and what alternative actions would BC Hydro likely pursue?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.4.5.

7.0 Reference: Exhibit B-1, page 9

The Application states: "The 2019 Letter Agreement is a cost- effective means by which BC Hydro plans to manage short-term operational needs, and therefore it advances this energy objective and is in alignment with it".

1.7.1 If the BCUC were to determine that the 2019 Letter Agreement was not in the public interest, what alternatives would be available for BC Hydro to address these forecast conditions and what alternative actions would BC Hydro likely pursue?

1.7.1.1 Please explain why the 2019 Letter Agreement is considered to be cost-effective relative to these alternative actions.

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.5.6.

8.0 Reference: Exhibit B-1, Appendix 1, Paragraph #2

1.8.1 The terms of the Letter Agreement do not seem to include provisions as to how far in advance of the requested delivery date a Purchase Interest Request must be submitted. Are there any such requirements and, if not, why not?

RESPONSE:

There is no date by which a Purchase Interest Request must be issued by BC Hydro. However, the Delivery Period specified in the Purchase Interest Request must be for one or more full calendar months which means the Purchase Interest Request must be issued at a minimum before the commencement of the relevant calendar month. That said, BC Hydro is motivated to provide sufficient notice so that Powerex has sufficient time to transact to fulfill a Purchase Interest Request for BC Hydro using commercially reasonable efforts.

9.0 Reference: Exhibit B-1, Appendix 1, Paragraphs #2 and #4
Exhibit B-1, Appendix 3, CEABC 1.7.4

1.9.1 The last sentence in Paragraph #2 suggests that BC Hydro cannot issue multiple Purchase Interest Requests for the same delivery term (i.e., time period). Rather it can submit a revised Purchase Interest Request that would replace the earlier one – subject to the condition that the earlier request has not already be confirmed. Please indicate whether this interpretation of Paragraphs #2 and #4 is correct.

RESPONSE:

Not confirmed. Section 3 of the 2019 Letter Agreement specifies that BC Hydro may issue "multiple Purchase Interest Requests for unique and non-overlapping Delivery Terms". Section 4 of the 2019 Letter Agreement specifies that BC Hydro may revise a Purchase Interest Request so long as it has the same Delivery Term. If a different Delivery Term is required, a new Purchase Interest Request is required.

Any such amendment of a Purchase Interest Request by BC Hydro will not invalidate any Transactions (as defined in Section 5 of the 2019 Letter Agreement) that have been confirmed by Powerex prior to the amendment date. For example, BC Hydro may increase or decrease the Maximum Quantity (as defined in Schedule A to the 2019 Letter Agreement) of energy it requires but if it reduced the Maximum Quantity and Powerex had provided Confirmations in excess of that amount, those Confirmations would not be affected.

9.0 Reference: Exhibit B-1, Appendix 1, Paragraphs #2 and #4
Exhibit B-1, Appendix 3, CEABC 1.7.4

1.9.2 CEABC 1.7.4 references an Appendix 2 to an earlier filing with the BCUC which included a number of Confirmations from Powerex of transactions made under the 2018 Letter Agreement. It is noted that for some periods (e.g., Peak Period of April 2019) there is more than one Confirmation and each has a different Reference Date. Is each of these Confirmations related to a separate Purchase Interest Request?

RESPONSE:

As is the case with the 2019 Letter Agreement, and was the case in the 2018 Letter Agreement, Powerex may provide multiple Confirmations to satisfy a single Purchase Interest Request. The Reference Date is the date on which Powerex confirms a Confirmation which fixes the price paid by BC Hydro for the energy to be delivered in future.

9.0 Reference: Exhibit B-1, Appendix 1, Paragraphs #2 and #4
Exhibit B-1, Appendix 3, CEABC 1.7.4

1.9.2 CEABC 1.7.4 references an Appendix 2 to an earlier filing with the BCUC which included a number of Confirmations from Powerex of transactions made under the 2018 Letter Agreement. It is noted that for some periods (e.g., Peak Period of April 2019) there is more than one Confirmation and each has a different Reference Date. Is each of these Confirmations related to a separate Purchase Interest Request?

1.9.2.1 If yes, please reconcile with Paragraph #2 from the 2019 Letter Agreement.

RESPONSE:

Please refer to BC Hydro's response to BCOAPO IR 1.9.2.

9.0 Reference: Exhibit B-1, Appendix 1, Paragraphs #2 and #4
Exhibit B-1, Appendix 3, CEABC 1.7.4

1.9.2 CEABC 1.7.4 references an Appendix 2 to an earlier filing with the BCUC which included a number of Confirmations from Powerex of transactions made under the 2018 Letter Agreement. It is noted that for some periods (e.g., Peak Period of April 2019) there is more than one Confirmation and each has a different Reference Date. Is each of these Confirmations related to a separate Purchase Interest Request?

1.9.2.2 If no, does this mean that Powerex can respond to a Purchase Interest Request through a series of Confirmations and does not have to provide the deliveries requested in a single Confirmation?

RESPONSE:

Yes. Please refer to BC Hydro's response to BCOAPO IR 1.9.2.

10.0 Reference: Exhibit B-1, Appendix 1, Paragraphs #6, #12 and #18

1.10.1 Is the Contract Price expressed in US dollars?

RESPONSE:

The "Contract Price" referred to in clause 6 of the Agreement is in U.S. dollars.

Please refer BC Hydro's response to BCUC IRs 1.6.9 and 1.6.9.1 where we explain that BC Hydro will settle any transactions made with Powerex in Canadian Dollars, and the exchange rate that will be used.

10.0 Reference: Exhibit B-1, Appendix 1, Paragraphs #6, #12 and #18

1.10.2 Is the invoice from Powerex payable in US dollars?

RESPONSE:

Please refer to BC Hydro's response to BCOAPO IR 1.10.1.

10.0 Reference: Exhibit B-1, Appendix 1, Paragraphs #6, #12 and #18

1.10.2 Is the invoice from Powerex payable in US dollars?

1.10.2.1 If yes, is it BC Hydro that is at risk for any fluctuations in US/Can exchange rate?

RESPONSE:

BC Hydro is at risk for fluctuations in the U.S./Can exchange rate between the time the transactions are entered into under the 2019 Letter Agreement and the time BC Hydro cash settles the transactions with Powerex.

11.0 Reference: Exhibit B-1, Appendix 1, Paragraphs #5 and #6

The Letter Agreement states that, after receiving a Purchase Interest Request, "Powerex (I) will, subject to prevailing market and operating conditions (including transmission availability and third party commitments), use commercially reasonable efforts to sell and deliver electricity on a forward basis to BC Hydro within the limitations set forth in the then current Purchase Interest Request(s) and (II) to give effect to any such sale of electricity, may deliver to BC Hydro one or more written confirmations (each a "Confirmation") of its agreement to sell electricity which, upon receipt by BC Hydro and without any further action by BC Hydro, shall become a binding transaction for the purchase and sale of electricity ("Transaction") effective as of the Reference Date".

1.11.1 Please confirm that there is no obligation on Powerex's part to provide the requested power to BC Hydro until a Confirmation has been delivered.

RESPONSE:

Powerex's obligation under the 2019 Letter Agreement is to use commercially reasonable efforts to acquire the electricity requested by BC Hydro in its Purchase Interest Request(s) subject only to prevailing market and operating conditions. Therefore, Powerex is obligated to provide the requested electricity under the 2019 Letter Agreement unless it was not able to acquire the electricity using commercially reasonable efforts or because of market and operating conditions.

11.0 Reference: Exhibit B-1, Appendix 1, Paragraphs #5 and #6

The Letter Agreement states that, after receiving a Purchase Interest Request, "Powerex (I) will, subject to prevailing market and operating conditions (including transmission availability and third party commitments), use commercially reasonable efforts to sell and deliver electricity on a forward basis to . within the limitations set forth in the then current Purchase Interest Request(s) and (II) to give effect to any such sale of electricity, may deliver to . one or more written confirmations (each a "Confirmation") of its agreement to sell electricity which, upon receipt by . and without any further action by . , shall become a binding transaction for the purchase and sale of electricity ("Transaction") effective as of the Reference Date".

1.11.2 The Letter Agreement does not appear to include any provisions requiring Powerex to notify . , within a specified time in advance of requested delivery date, if it is unable to effect the requested transaction. Are there any such requirements and, if not, why not as in the absence of forward purchase . may need to make alternative arrangements?

RESPONSE:

The 2019 Letter Agreement does not expressly require Powerex to notify BC Hydro by a certain time if it is not able to acquire the electricity that BC Hydro has requested in its Purchase Interest Request. However, Powerex communicates regularly with BC Hydro with respect to its ability to fulfill its obligations under the 2019 Letter Agreement.

1.0 Reference: Exhibit B-1, Application, Cover Letter, page 3 of 11, Description of 2019 Letter Agreement.

BC Hydro states that,

> "… the 2019 Letter Agreement is an additional tool for BC Hydro to employ to address short-term operational requirements. It does so by allowing BC Hydro to secure physical wholesale electricity from Powerex on a forward basis (i.e. outside of the pre-scheduled day-ahead wholesale markets) but still within the operating time horizon. There is no other mechanism currently in place that allows BC Hydro to purchase wholesale electricity in that manner."

1.1.1 What is the definition of "short-term" with respect to operational requirement? How long a period is considered to be short-term?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.5.1.

1.0 Reference: Exhibit B-1, Application, Cover Letter, page 3 of 11, Description of 2019 Letter Agreement.

BC Hydro states that,

> "… the 2019 Letter Agreement is an additional tool for BC Hydro to employ to address short-term operational requirements. It does so by allowing BC Hydro to secure physical wholesale electricity from Powerex on a forward basis (i.e. outside of the pre-scheduled day-ahead wholesale markets) but still within the operating time horizon. There is no other mechanism currently in place that allows BC Hydro to purchase wholesale electricity in that manner."

1.1.2 What is the definition of the "operating time horizon"? How long a period is considered to be the operating time horizon?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.5.1.

1.0 Reference: Exhibit B-1, Application, Cover Letter, page 3 of 11, Description of 2019 Letter Agreement.

BC Hydro states that,

> "… the 2019 Letter Agreement is an additional tool for BC Hydro to employ to address short-term operational requirements. It does so by allowing BC Hydro to secure physical wholesale electricity from Powerex on a forward basis (i.e. outside of the pre-scheduled day-ahead wholesale markets) but still within the operating time horizon. There is no other mechanism currently in place that allows BC Hydro to purchase wholesale electricity in that manner."

1.1.3 What, if anything, is currently preventing BC Hydro from purchasing energy from Powerex for future delivery?

RESPONSE:

The 2003 TPA governs the electricity and natural gas transactions between BC Hydro and Powerex. There are no provisions within the 2003 TPA that permit BC Hydro to purchase physical energy from Powerex farther in advance than the day ahead. While there is a provision to enable forward financial hedges, BC Hydro committed to not undertake these without BCUC approval. Please refer to BC Hydro's response to AMPC IR 1.1.3.

1.0 Reference: Exhibit B-1, Application, Cover Letter, page 3 of 11, Description of 2019 Letter Agreement.

BC Hydro states that,

> "… the 2019 Letter Agreement is an additional tool for BC Hydro to employ to address short-term operational requirements. It does so by allowing BC Hydro to secure physical wholesale electricity from Powerex on a forward basis (i.e. outside of the pre-scheduled day-ahead wholesale markets) but still within the operating time horizon. There is no other mechanism currently in place that allows BC Hydro to purchase wholesale electricity in that manner."

1.1.4 Is there anything currently preventing Powerex from purchasing energy on a forward basis? Has Powerex ever made forward purchases?

RESPONSE:

This Application is in regard to BC Hydro's ability to purchase forward energy from Powerex and therefore these questions are not relevant to this proceeding. In addition, Powerex's business activities are commercially sensitive and thus confidential.

1.0 Reference: Exhibit B-1, Application, Cover Letter, page 3 of 11, Description of 2019 Letter Agreement.

BC Hydro states that,

> "… the 2019 Letter Agreement is an additional tool for BC Hydro to employ to address short-term operational requirements. It does so by allowing BC Hydro to secure physical wholesale electricity from Powerex on a forward basis (i.e. outside of the pre-scheduled day-ahead wholesale markets) but still within the operating time horizon. There is no other mechanism currently in place that allows BC Hydro to purchase wholesale electricity in that manner."

1.1.5 If liquidity is a problem, can't Powerex purchase a hedge to correct this problem?

RESPONSE:

BC Hydro agreed not to do financial hedges as part of the F2011 NSA. BC Hydro is purchasing forward physical energy from Powerex under the 2019 Letter Agreement.

Financial hedges are not a substitute for physical supply to meet operational requirements. As noted on page 4 of the Application, the intention of BC Hydro entering into the 2019 Letter Agreement is to proactively ensure appropriate measures are in place to respond to physical supply issues. Due to the structural changes in the market, particularly the decline in and uncertain liquidity in the Mid-C day-ahead market, the ability to acquire wholesale electricity from Powerex on a forward basis remains a valuable tool for BC Hydro to have available to address short-term operational requirements. No other arrangement is available to BC Hydro to procure physical wholesale electricity on a forward basis to meet load-serving obligations in the operating time horizon as needs evolve.

How Powerex fulfills its obligations under the 2019 Letter Agreement is commercially sensitive and thus confidential.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

On page 2, BC Hydro states that the 2019 Letter Agreement will "… allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon."

On page 4, BC hydro states that,

> "Forward purchases under the 2018 Letter Agreement helped provide BC Hydro with additional supply to allow it to meet its load-serving obligations during the 2018/2019 winter season."This is followed by footnote 7, which states:
>
> "And which also turned out to be financially beneficial for BC Hydro, although that aspect of the arrangement was not a driving factor and could well have turned out to be non- beneficial had circumstances at the time turned out differently."

1.2.1 Please describe the unusual set of circumstances that led to the need for BC Hydro to import large volumes of energy during the 2018/2019 winter season.

RESPONSE:

The physical supply issue in 2018/2019 that prompted BC Hydro to sign the 2018 Letter Agreement was largely caused by:

- **Dry conditions and lower water inflows that decrease planned hydroelectric generation and purchases from Independent Power Producers and long term commitments below forecast;**
- **A cold period in February/March that increased BC Hydro customer demand above forecast; and**
- **Restricted availability of natural gas due to the Enbridge pipeline rupture.**

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

On page 2, BC Hydro states that the 2019 Letter Agreement will "… allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon."

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>
> "And which also turned out to be financially beneficial for BC Hydro, although that aspect of the arrangement was not a driving factor and could well have turned out to be non- beneficial had circumstances at the time turned out differently."

1.2.2 During the last 10 years, how often have circumstances required BC Hydro to make large purchases of energy from the Mid-Columbia day-ahead market in order to meet its load- serving obligations?

RESPONSE:

BC Hydro moved from an annual deficit to a surplus position under average inflows around fiscal 2011. Since that time, fiscal 2014 was the only year prior to fiscal 2019 with an annual deficit. As noted in BC Hydro's response to BCUC IR 1.3.2, BC Hydro has a number of tools for managing deficits. In fiscal 2014, the market electricity purchases made by BC Hydro totalled 900 GWh.

Note that BC Hydro purchases energy from Powerex under the 2003 TPA and the 2019 Letter Agreement (and previously the 2018 Letter Agreement), not from the Mid-C market.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

On page 2, BC Hydro states that the 2019 Letter Agreement will "… allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon."

On page 4, BC hydro states that,

> "Forward purchases under the 2018 Letter Agreement helped provide BC Hydro with additional supply to allow it to meet its load-serving obligations during the 2018/2019 winter season."This is followed by footnote 7, which states:
>
> "And which also turned out to be financially beneficial for BC Hydro, although that aspect of the arrangement was not a driving factor and could well have turned out to be non- beneficial had circumstances at the time turned out differently."

1.2.3 Why is reference made to "potential electricity shortages"? What probability of occurrence does BC Hydro assign to a "potential electricity shortage"?

RESPONSE:

In any given year, BC Hydro may have an operating surplus or an operating deficit, regardless of the surplus/deficit under average inflow conditions which is approximately 4000 GWh surplus in the fiscal 2020-fiscal 2021 period. Please refer to BC Hydro's response to F20-F21 RRA IRs BCUC IR 1.15.1 (attached to this response) and CEABC IR 2.28.1 (attached to BC Hydro's response to BCUC IR 1.3.2) for a description of planning and operational surplus.

Please refer to BC Hydro's response to BCUC IR 1.3.2 where the variability in the BC Hydro system supply (including Independent Power Producers) is described.

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15.0 D. CHAPTER 4 – COST OF ENERGY

Reference: COST OF ENERGY
Exhibit B-1, Section 4.7, pp. 4-28, 4-32–4-33, Figure 4-2; Appendix C, p. 22;
Zapped: A Review of BC Hydro's Purchase of Power from Independent Power Producers conducted for the Minister of Energy, Mines and Petroleum Resources, dated February 2019[1], p. 2;
BC Hydro F2017-F2019 RRA proceeding, Exhibit B-1-1, Tables 3-6–3-9
IPP renewal assumption

In Exhibit B-1-1 of the BC Hydro F2017-F2019 RRA proceeding, BC Hydro provides the load resource balance in terms of energy and capacity, with existing and committed resources and with planned resources, respectively, in Tables 3-6 through 3-9.

BC Hydro states on page 4-28 of the Application that "BC Hydro has been pursuing the renewal of expiring EPAs to meet future long-term energy needs and has renewed contracts with IPPs at lower prices than under their original contracts."

BC Hydro states on page 4-33 of the Application:

> **EPA Renewals:** This represents the net change in cost (i.e., certain new EPAs to replace existing expiring EPAs are forecast to increase in cost and others are forecast to decrease) from the fiscal 2019 RRA to the fiscal 2021 Plan of those EPAs that have been renewed since the Previous Application and those EPAs that are assumed to be renewed during the test period. This net increase includes the costs of expiring EPAs, the costs for hydro renewals and the costs associated with the Biomass Energy Program.

Figure 4-2 of the Application shows a breakdown of total IPP purchase cost forecast increases from F2019 to F2021, where IPP renewals accounts for $1.3 million increase to the cost of energy from F2019 to F2021.

In the February 2019 report titled Zapped by Ken Davidson, it states on page 2 that "there is an opportunity to address these financial issues when the EPAs for IPP projects expire and can be renewed on a commercial and market rate basis."

[1] https://www2.gov.bc.ca/assets/gov/farming-natural-resources-and-industry/electricity-alternative-energy/electricity/bc-hydro-review/bch19-158-ipp_report_february_11_2019.pdf.

The Phase 1 Final Report filed as Appendix C to the Application states that "[t]he cost of energy procured from Independent Power Producers is now one of BC Hydro's biggest cost drivers and these costs will be recovered from ratepayers. Though BC Hydro has not conducted competitive calls for power since 2011, it is projected to have an energy surplus into the 2030s."

1.15.1 For each EPA included in the "IPP renewal" category, please compare the price and volume of each of the original EPA versus the renewed EPA.

RESPONSE:

The public version of the response to this information request has been redacted to maintain confidentiality. The un-redacted version of this response is being made available to the BCUC only, in order to protect IPPs' commercial interests. The public disclosure of the redacted information could also impact BC Hydro's commercial interests and ongoing negotiations related to the EPAs.

BC Hydro understands the "IPP renewal" category in the question and the "EPA Renewal" category provided in the reference above to be synonymous. BC Hydro notes that the text regarding "EPA Renewals" in the reference explains the basis for $1.3 million value shown in Figure 4-2 of the Application and as such we have provided the table below on that basis. Please refer to BC Hydro's response BCUC IR 1.17.1 for a discussion of the indicative nature of Figure 4-2.

The values presented in the table below are based on the following considerations and assumptions:

- **For biomass projects:**
  - **Except for the NWE Williams Lake and Armstrong Wood Waste EPAs, pre-renewal prices reflect the current firm energy price under the respective EPA, which is subject to adjustment by a time of delivery factor.**
  - **For the Armstrong Wood Waste EPA, the pre-renewal price is the firm energy price for 2017 (prior to the short-term extension agreement which extended the EPA from November 21, 2017 to September 30, 2019). This price is subject to adjustment by a time of delivery factor.**
  - **For the NWE Williams Lake EPA, the pre-renewal price is based on a number of fixed and variable cost factors for 2017 (prior to the short-term extension agreement which extended the EPA from April 1, 2018 to September 30, 2019).**

- **Post-renewal prices are based on the assumed allocation between load offset and energy purchases for each facility under the Biomass Energy Program, and no time of delivery adjustment applies. For load offset and energy purchase costs, please refer to BC Hydro's response to BCUC IR 1.15.2.**

- **For hydro projects, the pre-renewal and post-renewal EPAs[2] do not include a time of delivery adjustment for prices.**

- **For both hydro and biomass EPAs:**
  - **The pre-renewal volume for the original EPA is based on the average annual historical energy volume.**
  - **Fiscal 2022 is used as the representative year for the post-renewal (i.e., renewed EPA) energy volumes and unit costs.**
  - **For ease of comparison, both pre-renewal costs and post-renewal costs (F2022$) have been converted to F2019$.**
  - **The energy volumes for pre-renewal and post-renewal include both deemed and delivered energy.**

BC Hydro notes that, as discussed on page 4-10 of the Application, the EPAs for McDonald Ranch, Seaton Creek and Morehead have now expired without renewal.

Please refer to BC Hydro's response to BCUC IR 1.15.2 for the EPA renewal assumptions in the Application.

[2] **Two expiring EPAs, Morehead Creek and Robson Valley were not captured in the indicative analysis for Figure 4-2 of the Application and as of October 1, 2018 these EPAs were assumed to be renewed. For Morehead Creek, the original EPA price was [redacted] (F2019$); the assumed renewal price was [redacted] (F2019$); the historical annual average energy is [redacted]; and the assumed renewal annual energy is [redacted]. For Robson Valley, the original EPA price was [redacted] (F2019$); the assumed renewal price was [redacted] (F2019$); the historical annual average energy is [redacted]; and the assumed renewal annual energy is [redacted].**

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Table 1 Price and Volume Comparison

Project	Price Prior to Renewal ($F2019/MWh)	Price After Renewal F2022 ($F2019/MWh)	Historical Annual Average Energy (GWh)	F2022Energy (GWh)
Hydro Projects				
Akolkolex	[redacted]	[redacted]	[redacted]	[redacted]
Brown Lake	[redacted]	[redacted]	[redacted]	[redacted]
Boston Bar Hydro	[redacted]	[redacted]	[redacted]	[redacted]
Coats	[redacted]	[redacted]	[redacted]	[redacted]
Doran Taylor	[redacted]	[redacted]	[redacted]	[redacted]
Seaton Creek Hydro	[redacted]	[redacted]	[redacted]	[redacted]
Sechelt Creek	[redacted]	[redacted]	[redacted]	[redacted]
Soo River	[redacted]	[redacted]	[redacted]	[redacted]
Biomass Projects				
Armstrong Wood Waste Co-Gen	[redacted]	[redacted]	[redacted]	[redacted]
Celgar Green Energy	[redacted]	[redacted]	[redacted]	[redacted]
Howe Sound Green Energy	[redacted]	[redacted]	[redacted]	[redacted]
NWE Williams Lake	[redacted]	[redacted]	[redacted]	[redacted]
PGP Bio Energy	[redacted]	[redacted]	[redacted]	[redacted]
Skookumchuck Power	[redacted]	[redacted]	[redacted]	[redacted]

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

On page 2, BC Hydro states that the 2019 Letter Agreement will "… allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon."

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> "Forward purchases under the 2018 Letter Agreement helped provide BC Hydro with additional supply to allow it to meet its load-serving obligations during the 2018/2019 winter season."This is followed by footnote 7, which states:
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> "And which also turned out to be financially beneficial for BC Hydro, although that aspect of the arrangement was not a driving factor and could well have turned out to be non- beneficial had circumstances at the time turned out differently."

1.2.4 If BC Hydro is expecting potential electricity shortages, why isn't it renewing all existing electricity purchase agreements with independent power producers and others?

RESPONSE:

The variability in the energy supply from inflows that BC Hydro can experience is +/- 7000 GWh, as described further in BC Hydro's response to BCUC IR 1.3.2. BC Hydro plans its system so that it is operated efficiently and economically for ratepayers. BC Hydro's planning criteria is used to assess the need and cost-effectiveness for additional resources.

BC Hydro's current planning criteria is based on average water and recognizes that there will be supply deficits in some years. Such supply deficits are managed from an operational perspective with imports and withdrawal from storage. If more stringent planning criteria were adopted, this would result in an increase in required exports in most years and would increase the cost to ratepayers (if the cost of acquiring additional supply in B.C. is greater than the market prices that BC Hydro sells surplus energy to Powerex).

Electricity Purchase Agreements and renewals of Electricity Purchase Agreements are long-term resource commitments, similar to new BC Hydro generation that BC Hydro may choose to pursue if additional resources are determined to be needed using BC Hydro's planning criteria as described above. BC Hydro's planning criteria will be considered in the 2021 IRP.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

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> "And which also turned out to be financially beneficial for BC Hydro, although that aspect of the arrangement was not a driving factor and could well have turned out to be non- beneficial had circumstances at the time turned out differently."

1.2.5 Please describe the circumstances alluded to in footnote 7, which could have led to a "non-beneficial" outcome. What is the approximate likelihood of such circumstances occurring, and what would have been the worst case scenario for the non-beneficial financial impact? Is that likelihood and magnitude expected to be increasing or decreasing in the future, and for what major reasons?

RESPONSE:

Please refer to BC Hydro's response to AMPC IR 1.6.2. for a description of how BC Hydro cannot ensure that forward electricity purchases made under the 2019 Letter Agreement will not result in purchase costs higher than what would have otherwise materialized in the day-ahead time frame, and ahead of a given delivery period, no one knows whether the average applicable forward price(s) will end up above or below the average applicable day-ahead prices for the same delivery period.

Please refer to BC Hydro's response to CEC IR 1.1.1 for a description of price risk.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

On page 2, BC Hydro states that the 2019 Letter Agreement will "… allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon."

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1.2.6 As stated in its response to CEABC IR 2.27.2 in F2020-21 RRA proceeding, BC Hydro claims there will be a forecast system surplus volume of about 4,000 GWh per year over the fiscal 2020 to fiscal 2024 period, from an Operating View? Has this forecast changed?

RESPONSE:

BC Hydro's average forecast operating surplus remains about 4,000 GWH per year. The within year forecast (i.e., fiscal 2020) is constantly changing as the year progresses and an update from June 2019 is provided as part of the F20-F21 RRA Evidentiary Update.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

On page 2, BC Hydro states that the 2019 Letter Agreement will "… allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon."

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1.2.7 Could BC Hydro also acquire an additional 2,000 GWh from Island Generation, should it experience a "potential electricity shortage"?

RESPONSE:

BC Hydro considers Island Generation having the capability to provide up to 2,100 GWH of energy. As discussed in BC Hydro's response to BCUC IR 1.3.2 and CEABC IR 1.3.5, BC Hydro has a number of options for meeting operational supply needs, including running Island Generation.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

On page 2, BC Hydro states that the 2019 Letter Agreement will "… allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon."

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> "And which also turned out to be financially beneficial for BC Hydro, although that aspect of the arrangement was not a driving factor and could well have turned out to be non- beneficial had circumstances at the time turned out differently."

1.2.8 In addition, how much energy could BC Hydro acquire, if needed, by purchasing from Powerex all or part of the Canadian Entitlement?

RESPONSE:

BC Hydro purchases energy from Powerex at the border under the 2003 TPA and the 2019 Letter Agreement (and did under the 2018 Letter Agreement also). BC Hydro does not specify how Powerex fulfills its obligations under those agreements.

The Canadian Entitlement is owned by the Province and assigned to Powerex. Powerex decides, at its discretion, which supply in its portfolio, including the Canadian Entitlement, is used to meet its delivery volumes to BC Hydro at the border in each delivery hour. Powerex's decisions on which supply it chooses to use to serve energy deliveries to BC Hydro (versus Powerex's other delivery obligations) does not affect the price that BC Hydro pays Powerex for its purchases.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

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1.2.9 At https://engage.gov.bc.ca/columbiarivertreaty/faq/ it states: "Powerex sells the Canadian Entitlement at market value to either BC Hydro or utilities in Alberta or the United States." Please explain how sales of the Canadian Entitlement to BC Hydro are transacted? What does "market value" mean?

RESPONSE:

The Canadian Entitlement is included in any net deliveries to BC Hydro that make up volumes under the 2003 TPA. The price for energy delivered under the 2003 TPA is set in the 2003 TPA and is the transfer price value which is considered a "market value". Please refer to BC Hydro's response to CEABC IR 1.2.8.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

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1.2.10 Can sales of the Canadian Entitlement to BC Hydro be in any way adversely impacted by the apparent Mid-Columbia day-ahead market liquidity problem? Please explain.

RESPONSE:

Please refer to BC Hydro's response to CEABC IR 1.2.8 where BC Hydro explains that BC Hydro purchases energy from Powerex at the border and that Powerex decides, at its discretion, which supply in its portfolio is used to meet its delivery volumes to BC Hydro.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

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1.2.11 For each of the past 15 years, how much of the Canadian Entitlement has been delivered to B.C. Hydro and used to serve domestic load?

RESPONSE:

The Canadian Entitlement is assigned to Powerex by the Government of B.C.

Please refer to BC Hydro's response to CEABC IR 1.2.8.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

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> "And which also turned out to be financially beneficial for BC Hydro, although that aspect of the arrangement was not a driving factor and could well have turned out to be non- beneficial had circumstances at the time turned out differently."

1.2.12 Does BC Hydro have any reason to anticipate that a "potential electricity shortage" will arise in the future, to such an extent that it could not be met by the apparent 4,000 GWh of surplus plus the 2,000 GWh from Island Generation, plus Canadian Entitlement energy? If so, what would be the possible cause of such a significant shortage? What probability of occurrence does BC Hydro assign to such a shortage?

RESPONSE:

As noted in BC Hydro's response to BCUC IR 1.3.2, inflows to BC Hydro's system can vary by +/- 7000 GWh, with an estimated probability of occurrence of about once in 20 years. As stated in the same response, the variability is what is modeled in the Energy Studies and does not capture the full range of inflow risk that BC Hydro manages due primarily to variability in hydro-based Electricity Purchase Agreement deliveries.

Please refer to BC Hydro's response to CEABC IR 1.3.5 where we describe that when BC Hydro has an operational deficit, load requirements can be met by a combination of additional generation from a net withdrawal from system storage, by importing electricity, or by dispatching thermal generation.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

On page 2, BC Hydro states that the 2019 Letter Agreement will "… allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon."

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1.2.13 In the 2018/19 winter season, BC Hydro became aware in December that it could experience a shortage but that the shortage would have abated by the following June. How far in advance does BC Hydro expect that it would become aware of any future significant shortages? What is the longest delivery period that BC Hydro would require in order to deal with any anticipated electricity shortage?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.3.2 where BC Hydro describes the supply risk and states that the Delivery Term for the most part is expected to be less than a year. Please also refer to BC Hydro's response to BCUC IR 1.6.4 where BC Hydro commits to not issue a Purchase Interest Request greater than three years in length.

2.0 Reference: Exhibit B-1, Application, Cover Letter, page 2 and 4 of 11, Need for the 2019 Letter Agreement

On page 2, BC Hydro states that the 2019 Letter Agreement will "… allow BC Hydro to acquire forward physical wholesale electricity to manage potential electricity shortages in the operational time horizon."

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> "And which also turned out to be financially beneficial for BC Hydro, although that aspect of the arrangement was not a driving factor and could well have turned out to be non- beneficial had circumstances at the time turned out differently."

1.2.14 Would BC Hydro make use of forward purchases for any other reason than to manage a potential electricity shortage?

RESPONSE:

BC Hydro does not currently anticipate using the 2019 Letter Agreement for reasons other than to manage potential electricity shortages in the operational time horizon.

3.0 Reference: Exhibit B-1, Application, Cover Letter, page 3, Description of 2019 Letter Agreement

BC Hydro describes a Purchase Interest Request as "a binding written offer to purchase wholesale electricity form Powerex on its terms, including the maximum price that BC Hydro is willing to pay, maximum volumes of electricity, and delivery period(s)."

1.3.1 What would be the maximum delivery period BC Hydro would use?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.6.4 where BC Hydro has confirmed that there is no maximum Delivery Term but BC Hydro has committed to not issue a Purchase Interest Request with a Delivery Term greater than three years.

3.0 Reference: Exhibit B-1, Application, Cover Letter, page 3, Description of 2019 Letter Agreement

BC Hydro describes a Purchase Interest Request as "a binding written offer to purchase wholesale electricity form Powerex on its terms, including the maximum price that BC Hydro is willing to pay, maximum volumes of electricity, and delivery period(s)."

1.3.2 How would BC Hydro determine the maximum price it was willing to pay?

RESPONSE:

BC Hydro's decisions regarding the operations of the BC Hydro system are informed by the Energy Studies including determining maximum prices and desired quantities needed.

3.0 Reference: Exhibit B-1, Application, Cover Letter, page 3, Description of 2019 Letter Agreement

BC Hydro describes a Purchase Interest Request as "a binding written offer to purchase wholesale electricity form Powerex on its terms, including the maximum price that BC Hydro is willing to pay, maximum volumes of electricity, and delivery period(s)."

1.3.3 Other than the price, volumes and delivery period, what other "terms" would be included?

RESPONSE:

As set out in section 3 of the 2019 Letter Agreement, the Purchase Interest Request will be substantially in the form of Schedule B to the 2019 Letter Agreement. This reflects the terms upon which BC Hydro is willing to acquire electricity from Powerex under the 2019 Letter Agreement.

3.0 Reference: Exhibit B-1, Application, Cover Letter, page 3, Description of 2019 Letter Agreement

BC Hydro describes a Purchase Interest Request as "a binding written offer to purchase wholesale electricity form Powerex on its terms, including the maximum price that BC Hydro is willing to pay, maximum volumes of electricity, and delivery period(s)."

1.3.4 Would these terms include the carbon intensity of the wholesale electricity to be purchased?

RESPONSE:

No. Please refer to BC Hydro's response to CEABC IR 1.3.3.

3.0 Reference: Exhibit B-1, Application, Cover Letter, page 3, Description of 2019 Letter Agreement

BC Hydro describes a Purchase Interest Request as "a binding written offer to purchase wholesale electricity form Powerex on its terms, including the maximum price that BC Hydro is willing to pay, maximum volumes of electricity, and delivery period(s)."

1.3.5 Can a Purchase Interest Request or a series of Purchase Interest Requests be used as a means of avoiding running the Island Generation thermal plant, and thus avoiding paying the B.C. carbon tax by importing electricity generated outside the borders of B.C.?

RESPONSE:

The 2019 Letter Agreement is a tool available to mitigate physical supply risk.

When BC Hydro has an operational deficit, load requirements can be met by a combination of additional generation from a net withdrawal from system storage, by importing electricity, or by dispatching thermal generation.

The decisions that BC Hydro makes regarding the above mentioned options depends on price, reservoir elevations, size of the deficit, and time frame of the forecast deficit and are informed by the Energy Studies. While the financial implications of the carbon tax factor into BC Hydro's decision-making on the dispatch of thermal generation, there is no separate non-financial objective to avoid paying the B.C. carbon tax.

BC Hydro ran Island Generation in fiscal 2019 and will do so again as needed.

3.0 Reference: Exhibit B-1, Application, Cover Letter, page 3, Description of 2019 Letter Agreement

BC Hydro describes a Purchase Interest Request as "a binding written offer to purchase wholesale electricity form Powerex on its terms, including the maximum price that BC Hydro is willing to pay, maximum volumes of electricity, and delivery period(s)."

1.3.6 The description also states that *"Generally, that price is a wholesale market price."* Please provide the full details of the "wholesale market". How does it differ from the Mid-Columbia day-ahead market price? What other prices might be used, other than a wholesale market price? Please provide BC Hydro's latest wholesale market price forecast.

RESPONSE:

The specific price that BC Hydro pays to Powerex under the 2019 Letter Agreement has been redacted. BC Hydro cannot answer some of these questions without providing reference to the information that has been redacted. BC Hydro also cannot provide the market price forecast because it receives the information required to provide the forecast pursuant to a subscription service which has non-disclosure requirements.

Please refer to BC Hydro's response to BCUC IR 1.6.2 where BC Hydro has provided more information about the Contract Price and amendments to that price.

3.0 Reference: Exhibit B-1, Application, Cover Letter, page 3, Description of 2019 Letter Agreement

BC Hydro describes a Purchase Interest Request as "a binding written offer to purchase wholesale electricity form Powerex on its terms, including the maximum price that BC Hydro is willing to pay, maximum volumes of electricity, and delivery period(s)."

1.3.7 What are the expected wheeling costs and losses in the U.S. or Alberta for delivering firm power to BC Hydro at the border interconnection points? Is it correct to assume that BC hydro will pay Powerex this cost of delivery?

RESPONSE:

As noted in the Application, Appendix 1, clause 7, the pricing mechanisms used in the Agreement may be used by BC Hydro in future agreements and, as such, are commercially sensitive and thus confidential.

3.0 Reference: Exhibit B-1, Application, Cover Letter, page 3, Description of 2019 Letter Agreement

BC Hydro describes a Purchase Interest Request as "a binding written offer to purchase wholesale electricity form Powerex on its terms, including the maximum price that BC Hydro is willing to pay, maximum volumes of electricity, and delivery period(s)."

1.3.8 What is the additional cost of delivering the power from the border to BC Hydro's customers?

RESPONSE:

BC Hydro delivers energy it receives from Powerex at the border to load under its Network Integration Transmission Service contract. There is no incremental cost to BC Hydro. This is the same as how imports are treated under the 2003 TPA.

3.0 Reference: Exhibit B-1, Application, Cover Letter, page 3, Description of 2019 Letter Agreement

BC Hydro describes a Purchase Interest Request as "a binding written offer to purchase wholesale electricity form Powerex on its terms, including the maximum price that BC Hydro is willing to pay, maximum volumes of electricity, and delivery period(s)."

1.3.9 The description also states that *"Powerex's obligation is to deliver electricity on a firm basis."* With BC Hydro's ability to store electricity, why is it necessary for Powerex to deliver electricity on a firm basis? Shouldn't BC Hydro's concern be more for the quantity of energy delivered rather than the specific delivery time? Won't this requirement for firm power result in a price premium?

RESPONSE:

Firm energy is the standard product transacted in wholesale electricity markets and is the most liquid physical product available for purchase which is why BC Hydro is contracting for firm energy. In addition, firm energy provides BC Hydro with additional assurances that the physical energy it is contracting for will be delivered.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

BC Hydro states that the 2019 Letter Agreement is needed to "proactively ensure appropriate measures are in place to respond to future physical supply issues."

BC Hydro also states that there has been, and continues to be, a decline in the liquidity of the Mid-Columbia day-ahead market, making it more advantageous to buy energy on the forward market. BC Hydro illustrates this decline with the following two charts, showing the average quarterly volumes (GWh) in the on-peak and off-peak markets from 2011 to 2018:

Figure 10.1: Mid-C Liquidity (Day-Ahead Peak)

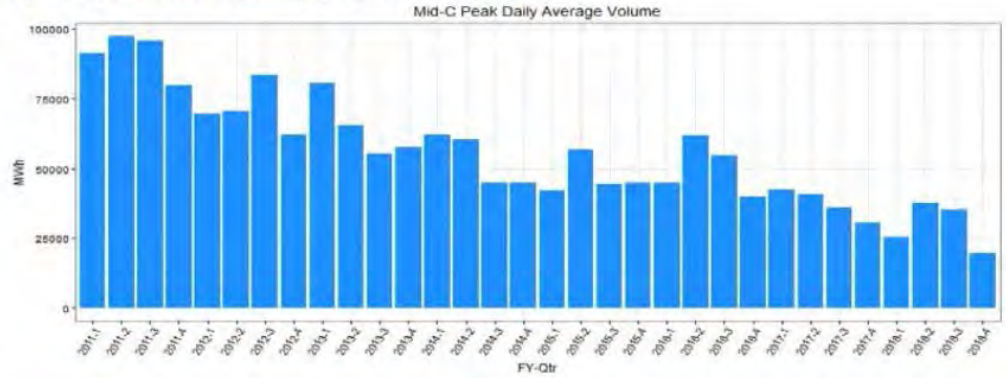
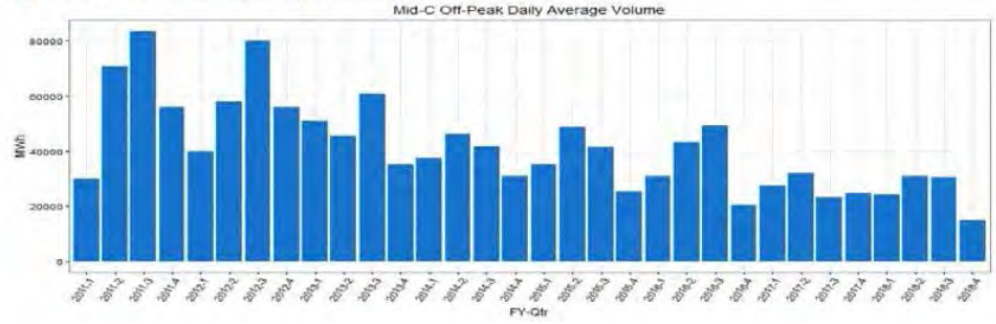


Figure 10.2: Mid-C Liquidity (Day-Ahead Off-Peak)



1.4.1 Can BC Hydro provide independent objective evidence that there has "been a steady decline in the volume of electricity traded on a day-ahead basis in the Pacific Northwest."?

RESPONSE:

The charts above are produced by the Bonneville Power Administration, which is a Federal Power Marketing Agency of the U.S. Government, which BC Hydro

considers to be an independent and objective source of information. In addition, please refer to BC Hydro's response to BCUC IR 1.2.6, which contains reference to publicly available materials produced by Portland General Electric.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

BC Hydro states that the 2019 Letter Agreement is needed to "proactively ensure appropriate measures are in place to respond to future physical supply issues."

BC Hydro also states that there has been, and continues to be, a decline in the liquidity of the Mid-Columbia day-ahead market, making it more advantageous to buy energy on the forward market. BC Hydro illustrates this decline with the following two charts, showing the average quarterly volumes (GWh) in the on-peak and off-peak markets from 2011 to 2018:

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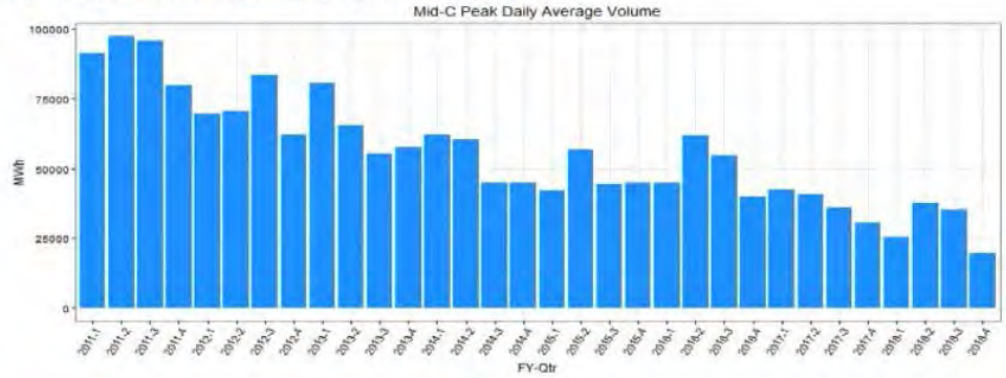
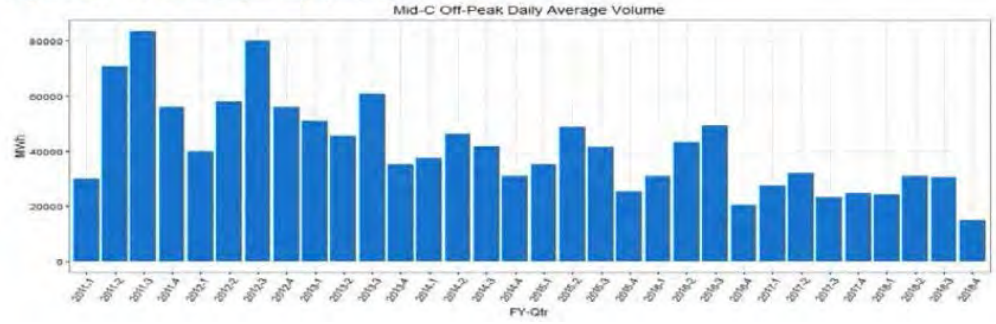


Figure 10.2: Mid-C Liquidity (Day-Ahead Off-Peak)



1.4.2 Please provide the references in the material that BC Hydro filed in the BCUC's Inquiry of the Site C project that indicated there was a steady decline in the volume of electricity being traded in the Mid-Columbia day-ahead market. Are there any other Mid-Columbia Markets other than the day-ahead market? If yes please explain.

RESPONSE:

BC Hydro has been unable to identify evidence in the BCUC Inquiry into Site C that is responsive to the request.

BC Hydro provided details in the Site C Inquiry on market conditions including day-ahead markets in the following IR responses which are attached for convenience:

- **BCUC IR 2.22.1**
- **BCUC IR 2.22.2**
- **BCUC IR 2.22.3**
- **BCUC IR 2.22.4**
- **BCUC IR 2.22.5**
- **BCUC IR 2.22.7**
- **BCUC IR 2.22.8**
- **BCUC IR 2.22.9**
- **BCUC IR 2.22.14**

With respect to the question regarding Mid-C markets, yes there are other Mid-Columbia markets. For example, there are the Mid-Columbia Forward and Real-Time markets.

22.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Pages 72 to 74

2.22.1 BC Hydro is requested to update this information and provide an explanation as to the impact these issues could have on export sales. This issue has been included in the questions that follow.

The Panel requests that BC Hydro respond to the following questions:

- Please provide a breakdown BC Hydro's market price forecast for F2025 (US $36/MWh) and F2034 (US $46/MWh) showing (in Can $ and US $): Mid C price; wheeling costs; real power losses; other (please describe).
    - Please explain whether (i) the market price forecast assumes the Mid C price is set by a CCGT; (ii) whether Mid C prices over the past 5 years support this assumption, and (iii) to what extent lower price renewables may increasingly set the Mid C price at lower levels in the future.

RESPONSE:

The Commission makes several comments on page 72 of the preliminary report seeking additional evidence on the expected future demand in external markets for any surplus capacity and flexibility provided by Site C. The points that follow are meant to provide the Commission context for the 22 series of IRs. We provide additional information regarding both current and future expected opportunities to monetize capacity and flexibility in the external markets in the western interconnect.

Existing and Future Markets for Capacity and Flexibility

Background

- **Site C will become part of the portfolio of resources that form the BC Hydro system. Site C is expected to be operated, and any Site C surplus capabilities monetized, as part of the BC Hydro system, rather than as a stand-alone resource.**

- **BC Hydro builds the system to meet peak needs, resulting in the system having surplus capacity and flexibility in most hours of the year when loads are lower than peak loads. This planning requirement is expected to continue going forward.**

- **BC Hydro makes surplus capacity and flexibility of the BC Hydro system available to Powerex to monetize in the external markets for the benefit of BC Hydro's ratepayers.**

- **Site C will *add* significant capacity and flexibility to the BC Hydro system, helping BC Hydro reliably meet BC Hydro's peak and annual load requirements. It will also increase the surplus capacity and flexibility during hours of the year when loads are lower than peak loads. As a result, all else being equal, Site C can be expected to increase Powerex's ability to generate value for BC Hydro ratepayers from the residual capacity and flexibility of the BC Hydro system. More specifically, the addition of Site C can be expected to increase the ability of Powerex to sell surplus energy in the higher-priced hours of the year, while also increasing the ability of Powerex to purchase energy in the lower-priced hours of the year (enabling additional sales in higher-priced hours). In addition to supporting increased energy sales and purchases, the increase in capacity and flexibility provided by Site C throughout the year can be expected to increase the ability of Powerex to sell capacity and/or flexibility products, whereby Powerex receives an explicit capacity and/or flexibility payment.**

- **In contrast, variable energy resources (wind, solar and run-of-river hydro) typically add a much lower level of capacity to the BC Hydro system, and generally increase the need for flexibility from the BC Hydro system (to follow fluctuations in variable energy resource output). Thus, the addition of variable energy resources generally tends to reduce the residual flexibility of the BC Hydro system, and hence tends to reduce the value that can be earned by Powerex in external markets for the benefit of BC Hydro ratepayers. For example, Powerex has experienced a materially reduced ability to import low-priced energy during the spring freshet in recent years, because the abundance of B.C. IPP run-of-river generation output in that period already uses up much of the ability of BC Hydro's flexible generators to reduce output.[1] Furthermore, the periods in which variable resources produce power may often coincide with periods of lower demand in B.C. and lower prices in external markets, resulting in sales of surplus energy at relatively low prices.**

<u>Current Markets for Capacity and Flexibility</u>

Surplus BC Hydro capacity and flexibility currently can be monetized through multiple different market opportunities, including:

- **To sell surplus energy in higher-priced hours within the year;**

[1] **Please refer to the Transmission Service Freshet Rate Preliminary Evaluation Report for Year 1 – Appendix D, filed January 27, 2017 with the Commission by BC Hydro for more detail.**

- **To sell short-term energy in higher-priced hours while purchasing a similar quantity of short-term energy in lower-priced hours;**
- [redacted]
- [redacted][2]

[redacted]

Markets for Capacity and Flexibility Currently Under Design

There are several initiatives currently under consideration or design to facilitate new markets for capacity and/or flexibility. While some of these initiatives may not succeed, it is currently expected that there will be expanded opportunities to monetize capacity and flexibility in the *near future*. These initiatives are driven by the rapidly growing need for flexibility, as more variable energy resources are added to the western grid, and include:

- **The California Independent System Operator (CAISO), together with the California Public Utilities Commission (CPUC), is exploring re-designing California's Flexible Resource Adequacy Criteria and Must Offer Obligation (FRACMOO) program, which is a program that provides sellers of flexible capacity with an explicit capacity payment (separate from any energy sales revenues) in exchange for a commitment to submit an offer to sell energy in CAISO's short-term markets. The current stakeholder process is examining expanding the eligibility criteria to include intertie participation (external participation). Refer to September 26, 2017 CAISO presentation on FRACMOO at https://www.caiso.com/Documents/Presentation-FlexibleResourceAdequacyCriteria_MustOfferObligationSep26_2017.pdf;**
- **In November 2016, CAISO implemented a Flexible Ramping Product (FRP). This is an enhancement to the CAISO real-time market that allows CAISO to**

[2] [redacted]

procure flexible capacity on a very short-term basis, for which it provides explicit compensation that is separate from any payments for energy deliveries. See https://www.caiso.com/Documents/Jun242016_TariffAmendment-FlexibleRampingProduct_ER16-2023.pdf and https://www.caiso.com/Documents/RevisedDraftFinalProposal-FlexibleRampingProduct-2015.pdf; and

- **Alberta is in the process of designing a capacity market that will be in place by 2019 in time for a capacity auction for 2021. It is still unclear whether Alberta will allow external participation in their capacity market. However, Alberta is looking at the features of the existing eastern U.S. capacity markets in order to learn from their experience, and those markets generally permit external participation.**

Additional developments anticipated by the mid-2020s that are likely to impact opportunities for capacity and/or flexibility

- **In the U.S. Western Interconnect more than 4,500 MW of coal generation capacity is currently planned to be shut down by 2025.[3]**

- **In Alberta more than 6,000 MW of coal generation capacity is currently planned to be shut down by 2030.[4]**

- **In California, an additional 7,500 MW of natural gas and nuclear generation capacity is currently planned to be shut down by 2025, largely to deal with environmental concerns regarding once-through-cooling concerns.[5]**

- **Much of the energy produced from the retiring fossil-fuel plants is expected to be replaced with energy from renewable sources (mostly wind and solar), which generally provide much less capacity, and increase the need for flexible resources to follow fluctuations in variable energy resource output.**

- **If BC Hydro does have surplus capacity, flexibility and/or clean energy in the mid-2020s, there may be opportunities to use this surplus to displace or defer the building of new gas generation resources by other entities in the west. Such an arrangement could enable significant investment savings to the purchaser, which would be expected to be shared fairly with the seller under mutually acceptable terms.**

[3] **Table 6.6 from EIA report at: https://www.eia.gov/electricity/monthly/pdf/epm.pdf.**
[4] **https://www.alberta.ca/climate-coal-electricity.aspx.**
[5] http://www.energy.ca.gov/renewables/tracking_progress/documents/once_through_cooling.pdf.

- **As with any new opportunities, there are significant hurdles to overcome to enter into such transactions, despite potentially strong economic incentives for both BC Hydro and potential purchasers. For example, public power utilities, as well as local governmental agencies generally want to support the building of their own resources within their own state or province to support local jobs. Independently owned, state-regulated, investor-owned utilities also prefer to build or own their own resources in order to earn a return on their associated capital investments.**

- **Powerex is in regular confidential discussions with its customers in the western United States regarding a variety of short term and longer term capacity and flexibility products and services, and actively participates in organized market stakeholder processes on capacity and flexibility. Based on these discussions, Powerex anticipates that demand for such products and services will continue to emerge and grow as the western grid undergoes a substantial transition toward additional variable energy resources.**

- **Finally, it should be noted that there are existing efforts by the current U.S. federal government to maintain the viability of the existing coal and nuclear fleet. On September 29, 2017 the U.S. Department of Energy proposed a "Notice of Proposed Rulemaking" that, if adopted, would support base loaded "fuel secure" resources in organized markets. An ongoing debate is expected between state and federal governments on the future of coal and nuclear resources.[6] Importantly, the NOPR applies to resources within organized markets, whereas most of the coal resources in the western U.S. that are currently slated to retire between 2020 and 2025 are outside of organized markets.**

Transmission Constraints

Some participants in the Commission inquiry have expressed concern over BC Hydro's ability to export Site C energy due to transmission constraints. These concerns are unfounded. The rating of the B.C. to U.S. export path is 3,150 MW and the rating of the B.C. to Alberta path is 1,200 MW. While the operational export capability of these paths are closer to 2,500 MW and 450 MW respectively, the combined operational export capability is still more than what is necessary to support a very large volume of surplus energy. For example, exporting an annual energy surplus of as much as 9,000 GWh, which would only likely occur in a very high water year in B.C., would require only 1,027 MW of average transmission export capability, which is less than one-half of the typical operational rating. Put another way, even in the highly unlikely scenario in which BC Hydro had a very high water year, the existing transmission capacity is still more than enough to

[6] **https://energy.gov/articles/secretary-perry-urges-ferc-take-swift-action-address-threats-grid-resiliency.**

allow Powerex to export all of this energy out of the BC Hydro system during the higher-priced 50 per cent of the hours.[7] In addition to transmission to export power out of B.C., Powerex has long-term U.S. transmission agreements for about 2,500 MW of transmission rights between the Pacific Northwest and California, allowing it to pursue market opportunities throughout the west.

Previous Statement on Export Sales Prospects

On page 72 of the preliminary report the Commission pointed out that the 2012 draft IRP states that "the prospects of export sales of renewable energy in excess of that required to meet self-sufficiency requirements have diminished considerably." The Commission requests that BC Hydro update this information and provide an explanation as to the impact these issues could have on export sales.

This statement in the 2012 draft IRP is still applicable. This statement refers to the opportunity to build renewable resources in B.C. for the purpose of exporting qualifying renewable energy to load serving entities in the Western states to help them meet their Renewable Portfolio Standards (RPS). This statement was not intended to apply to the prospects of export sales of energy more generally, nor to the prospects of generating revenues in external markets from surplus capacity and/or flexibility.

Renewable energy sales opportunities continue to be limited from B.C., and are especially limited in the context of investing capital in new B.C. renewable resources for export, as:

- **RPS programs set a minimum percentage of load that each load-serving entity in the applicable region must serve with energy procured from renewable resources *that meet certain qualification requirements* defined by each particular state.**

- **The only B.C. resources that qualify for California's RPS, the largest market for renewable resources, are B.C. wind resources (despite considerable efforts to gain eligibility as renewable resources for other types of B.C. resources).**

- **The cost of building new wind resources in B.C., and delivering those resources to California (or other western U.S. markets to meet applicable state RPS targets), generally exceeds the cost of building local renewable resources in the destination state – especially with a 30 per cent investment tax credit for U.S. renewables.**

[7] **(9,000,000 MWh per year) ÷ (8760 hours per year * 50%) = 2,055 MW.**

- **Similarly, Alberta has a recently established renewable resource program that has limited eligibility to in-province resources only.**

While there has generally been no improvement in the opportunities associated with building new B.C. resources to supply qualifying renewable energy to external markets, the growth in renewable resources in external jurisdictions (to meet evolving state and provincial renewable resource procurement targets) is having a positive effect on the value of surplus flexibility and capacity in export markets, as discussed above.

Question 22.1

- ***Please provide a breakdown BC Hydro's market price forecast for F2025 (US $36/MWh) and F2034 (US $46/MWh) showing (in Can $ and US $): Mid C price; wheeling costs; real power losses; other (please describe).***

    - ***Please explain whether (i) the market price forecast assumes the Mid C price is set by a CCGT; (ii) whether Mid C prices over the past 5 years support this assumption, and (iii) to what extent lower price renewables may increasingly set the Mid C price at lower levels in the future.***

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Table 1 below shows BC Hydro's Mid C market price forecast for calendar year 2025 and 2034 in CAD and USD. Wheeling costs to and from Mid C are assumed to be constant at current levels of 6.28 CAD/MWh. Losses due to transmission to and from Mid C are 1.9 per cent of power transferred, resulting in in incremental costs for purchase and a loss of revenue for sales.

Table 1 ABB Spring 2016 Mid C Price Forecast, converted to B.C. Buy and B.C. Sell Prices

	Mid C 2016 USD/MWh			Mid C 2016 CAD/MWh			Losses (1.9%) 2016 CAD/MWh			Wheeling 2016 CAD/MWh	B.C. Buy 2017 CAD/MWh			B.C. Sell 2017 CAD/MWh		
Calendar Year	On Peak	Off Peak	Average	On Peak	Off Peak	Average	On Peak	Off Peak	Average	-	On Peak	Off Peak	Average	On Peak	Off Peak	Average
2025	36.46	35.76	36.16	45.70	44.82	45.32	0.87	0.85	0.86	6.28	53.58	52.68	53.20	39.09	38.22	38.72
2034	45.53	45.41	45.47	57.06	56.91	56.99	1.08	1.08	1.08	6.28	65.32	65.17	65.26	50.39	50.24	50.33

Exchange rate assumption: ***Rates based on updates provided by the Treasury Board of the Province of B.C.-May 30, 2017. 1USD = 1.2533CAD***

Inflation assumption: ***CPI from Statistics Canada - updated 2017-01-20. CPI increase in 2016 = 1.4 per cent.***

(i) The market price forecast model results in a forecast where sometimes the Mid C price is set by a CCGT and sometimes it is not. The market price is determined from the ABB PROMOD model, which simulates the operation of each region in North America in order to determine the market clearing price (MCP) at hundreds of locations (referred to as nodes) on an hourly time step. For each region, PROMOD considers:

- **Individual power plant characteristics including heat rates, start-up costs, ramp rates, and other technical characteristics of plants;**
- **Transmission line interconnections, ratings, losses, and wheeling rates;**
- **Forecasts of resource additions and fuel costs over time;**
- **Forecasts of loads for each utility or load serving entity in the region; and**
- **The cost and availability of fuels that supply the plants.**

PROMOD performs an hourly commitment and dispatch algorithm, recognizing both generation and transmission impacts, that minimizes costs. Model outputs include hourly energy prices at each node, unit generation, revenues and fuel consumption, and transmission flows.[8]

BC Hydro subscribes to the ABB reference case database, which is released twice a year (spring and fall), and uses it to model the WECC interconnected area with PROMOD. Over 40 nodes are modelled and the energy price, or MCP, at each node is set by the marginal generating unit at that node (the last unit required to meet load with cost minimized). The MCP varies depending on the season, time of day, transmission constraints, and variations in fuel prices. For example, during the spring freshet, the MCP at the Mid C node can drop to very low levels in some light load hours, indicating that natural gas generation is not the resource type on the margin. At other times prices will be higher, reflecting the fact that CCGT or other resource types are on the margin, or alternatively exports from the Pacific Northwest to other higher-priced regions are on the margin.

The ABB spring 2016 reference case adds significant amounts of variable renewable resources between 2017 and 2030 (about 30,000 MW). However, the reference case also shows significant baseload coal retirements in the Western Interconnect in this timeframe (about 13,500 MW). Given a 25-30 per cent capacity factor for the renewable generation, the energy from the expected renewables is in the same order of magnitude as the

[8] **Source: *ABB Power Reference Case: WECC Spring 2017 Report*. 2017.**

energy that will be lost by the retiring coal. Thus, while the addition of variable renewable resources is expected to lower the average MCP, this effect is largely offset by expected coal retirements raising the average MCP.

(ii) Actual Mid C prices over the past five years appear to reflect the estimated variable production cost of CCGT generation in most hours. In certain other hours, such as during the spring freshet, as well as other periods of high hydro runoff and high wind generation, Mid C prices were below this value, implying that CCGT generation was not required to meet the load in those hours. In certain other hours, however, Mid C prices exceeded the estimated variable production cost of a CCGT.

The appropriate metric for determining whether Mid C prices generally reflect, on average, the estimated variable production cost of a CCGT is the average Mid C market heat rate. The average Mid C market heat rate is equal to the Mid C price divided by the applicable natural gas price in the region, represented by the Sumas gas index price. Generally speaking, a CCGT can be expected to have a total effective heat rate somewhere between 6 MMBtu/MWh and 10MMBtu/MWh (including all variable costs of production and additional delivery costs of fuel). Going back five years to 2012-2016, the average actual market heat rate at Mid C, using Mid C ICE daily index prices and Sumas daily gas index prices, was 8.6 MMBtu/MWh. Going forward, the ABB spring 2016 reference case predicts power prices that reflect a heat rate of 7.9 MMBtu/MWh for 2020 through 2030. Thus, both the historic prices at Mid C and the ABB model generally reflect the estimated variable production cost of a CCGT.

Also, if the Commission is concerned that the pricing model does not reflect actual market conditions, it should be noted that ABB does back test their model to ensure that the model produces prices that are consistent with historical actuals. Every few years ABB performs a back-cast of a historical year to make sure that the model is behaving as expected. For every data release, ABB compares the forecast prices that the model produces to historical prices and market forwards.

(iii) As noted above, the ABB Spring 2016 reference case adds significant amounts of variable renewable resources between 2017 and 2030 (about 30,000 MW). We expect that, consistent with the ABB spring 2016 reference case, more renewables will be built to satisfy legislated renewable resource objectives (typically referred to as Renewable Portfolio Standards, or RPS), as well as to more generally meet energy needs in the Western Interconnect as significant amounts of coal and other baseload fossil fuel generation retires between now and 2030. As a consequence, we expect there to be more occurrences of lower-priced hours in the future. However, we also expect more occurrences of higher-priced hours, and higher prices in those hours. In other words, the combined impact of replacing coal and other fossil fuel generation resources with variable energy resources such as solar and wind, is *higher price volatility* in the applicable region, not

necessarily higher or lower average prices.

This impact is summarized by EDC Associates, for the Alberta marketplace as follows:

> **The volatility of prices will be much higher across the year (more very low priced hours and much higher high-priced hours), although average pool prices will be relatively unchanged from the Pre-CLP case. Generators will have to earn a larger fraction of their revenues in fewer, higher-priced hours. This higher pool price volatility will change perceived risks for new generator developers and could stall or encourage investment, depending on the developer.[9]**

This price impact of additional variable energy resources has already been experienced in California's organized market, operated by the California Independent System Operator (CAISO). In response to aggressive California RPS objectives, the CAISO market footprint has experienced a rapid installation of renewable variable energy resources, with wind resources now totaling approximately 6,000 MW, utility-scale solar resources now totaling approximately 10,000 MW, and behind-the-meter solar totaling approximately 5,000 MW. To provide perspective, the average daily peak load in the CAISO is just over 31,000 MW, with peak summer load reaching 50,000 MW. This impressive installation of renewable variable energy resources has resulted in hourly prices in the middle of the day often becoming depressed, when solar resources are producing at very high levels. But it has also contributed to higher prices in the morning and early evening hours, as CAISO now experiences very high ramping requirements, largely met by dispatchable generation and imports that must quickly respond to hourly load increases that coincide with hourly solar output decreases. Higher California prices during the hours when solar and wind production is lower have also risen as a result of: 1) the introduction of Greenhouse Gas costs, resulting from California's Cap and Trade program, implemented in 2013, and 2) generation retirements resulting in less dispatchable generation online to respond to higher ramping requirements and higher hours of demand. The net result of these combined impacts to average prices in the CAISO market has been a relatively constant average market heat rate over the past five years and slightly rising average market heat rates in the forward markets for the next five years, despite the significant increases in renewable resource generation in the state over this timeframe.

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[9] **EDC is a well-known consulting firm in Calgary, Alberta who has been producing Alberta power market outlooks for a number of clients, including Powerex, for nearly 20 years. In late 2016 EDC produced a multi-client study steered by most of the generation and ratepayer representatives in Alberta, the AESO and Powerex to assess the future market outcomes of the Climate Leadership Plan adopted by the Alberta government in 2016. At page 21 of the Executive Summary found here. http://www.edcassociates.com/files/ClimateLeadership/EDCA_Abbreviated_Multi-Client_GHG_Study(11.7.2016).pdf.**

The Southern California Heat Rate chart, Figure 1 below, shows actual and forward market heat rates (wholesale electricity price divided by applicable gas price). Historic heat rate charts illustrate how wholesale electricity prices have changed, once the effects of gas price changes have been removed. With the effect of gas prices removed, it can be seen that average wholesale electricity prices have not fallen as a result of adding significant amounts of renewables, nor are they expected to fall going forward as a result of adding more renewables.

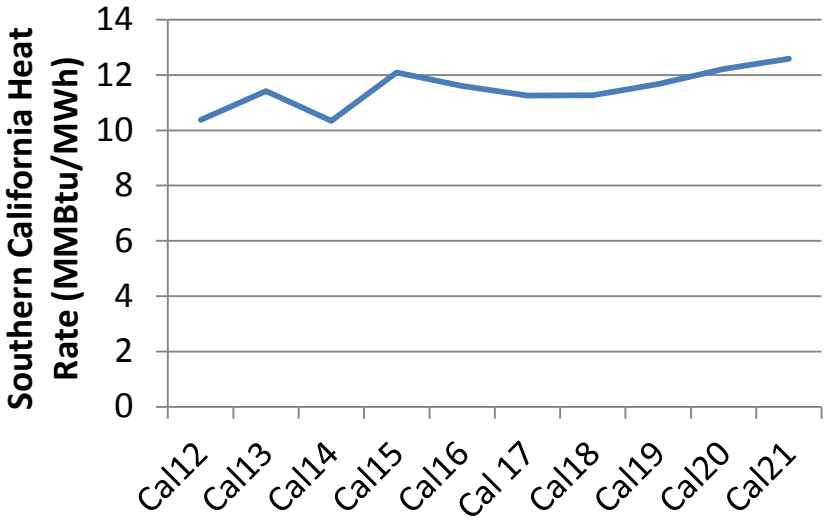

Figure 1 Southern California Heat Rate using CAISO SP15 Day Ahead Locational Marginal Price and Socal Gas Index[10]

Importantly, flexible generation resources are expected to have greater market value than inflexible and/or variable energy resources in the future, because of this continuing trend of increased volatility in hourly prices. Flexible generation resources enable energy to be sold into the market when prices are higher, and also allow sales to be reduced or avoided when prices are low. Conversely, inflexible and/or variable energy resources generally must dispose of their energy at prices that may be equal to, or substantially below, average prices; they generally cannot increase production and sales when prices are high, nor can they reduce output and sales when prices are low.

Finally, it is important to note that the key contributor to the decline in Mid C market prices since 2007 is also the corresponding decline in natural gas prices over this same time period, rather than the addition of renewables. Figure 2 below shows the price of Mid C power alongside the price of

[10] **Historic Prices from CAISO Day Ahead LMP and Intercontinental Exchange (ICE) daily Socal gas index. Forward prices from ICE forward prices for the SP15 and Socal trading hubs.**

Sumas gas from 2007 to 2016. It is clear from this chart that price movements in power have closely followed changes in natural gas prices. The second chart below removes the effect of the natural gas price on the power prices by showing the market Heat Rate at Mid C, which is simply the power price divided by the gas price. This generally stable Mid C heat rate illustrates that once the effects of declining gas prices is removed, average Mid C market prices have remained generally unchanged over the past seven years. It would be incorrect to conclude that average Mid C prices have fallen largely as a result of increased renewable resources.

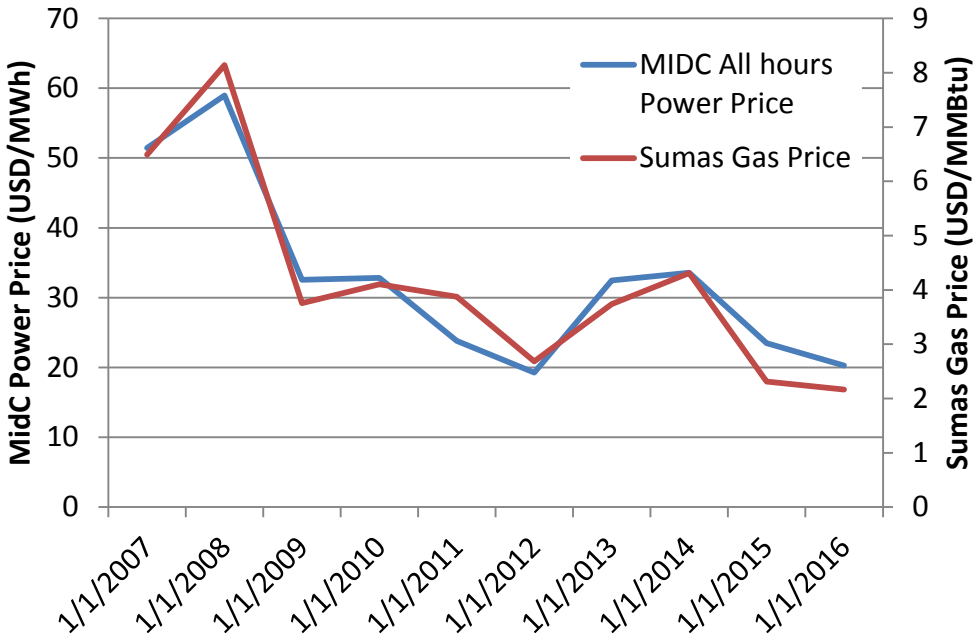

Figure 2 Mid C Power Price and Sumas Gas Price

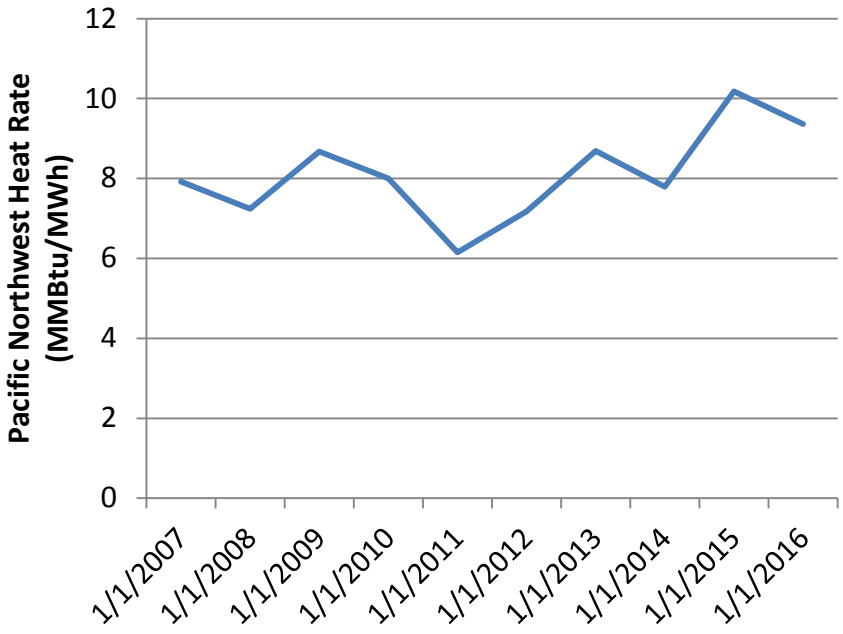

Figure 3 Pacific Northwest Heat Rate, using Mid C Day Ahead Prices and Sumas Gas Index[11]

[11] **Historic Prices from Intercontinental Exchange (ICE) Day Ahead Index and ICE daily MidC gas index.**

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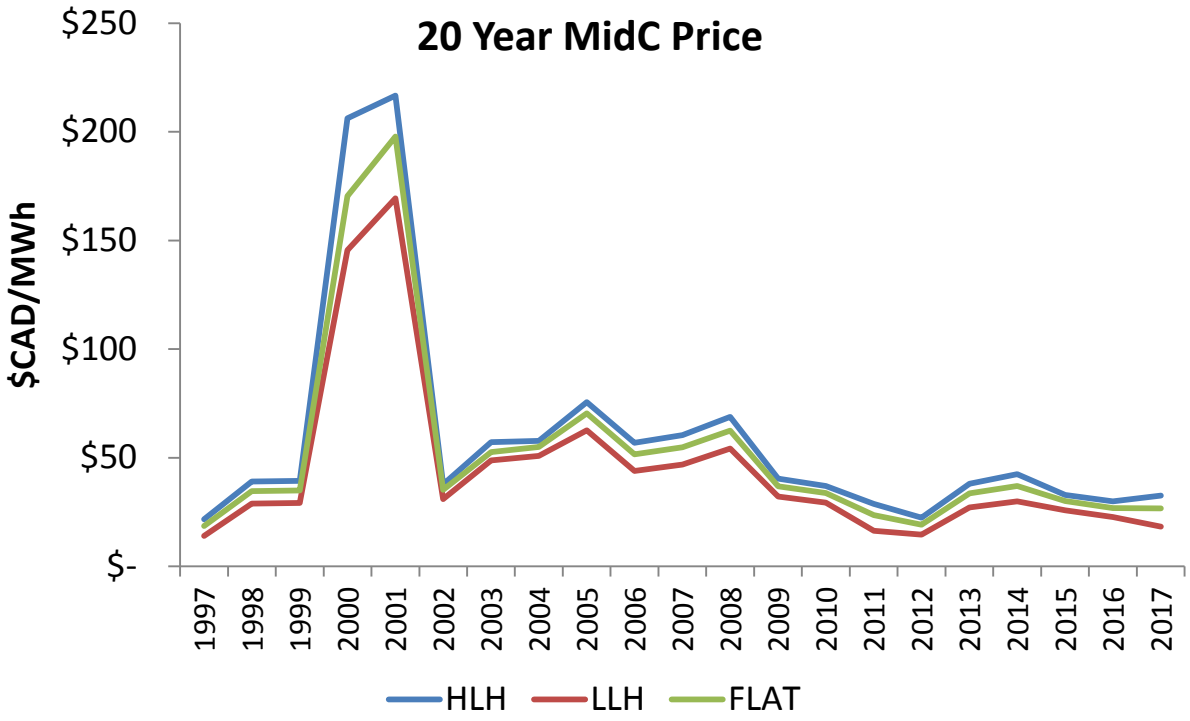
22.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Pages 72-74

2.22.2 BC Hydro is requested to update this information and provide an explanation as to the impact these issues could have on export sales. This issue has been included in the questions that follow. The Panel requests that BC Hydro respond to the following questions:

- Please provide, in graph and table form, the average annual Mid C price (on-peak, off-peak and all hours) for the last 20 years.

RESPONSE:

20 Year Mid C - $CAD/MWh *(Source – [2004-2017] ICE Daily Settles, [1997-2003] Dow Jones)*			
	On-Peak (HLH) ($)	Off-Peak (LLH) ($)	FLAT ($)
1997	21.75	14.10	18.55
1998	39.05	28.85	34.62
1999	39.41	29.25	34.95
2000	206.23	145.57	170.41
2001	216.66	169.36	197.89
2002	37.72	31.01	35.19
2003	57.19	48.79	52.60
2004	57.81	50.91	55.03
2005	75.67	62.61	70.40
2006	56.92	43.87	51.56
2007	60.40	46.93	54.83
2008	68.82	54.25	62.55
2009	40.38	32.16	36.94
2010	37.02	29.40	33.81
2011	28.79	16.41	23.64
2012	22.47	14.70	19.20
2013	38.04	27.17	33.57
2014	42.44	29.91	37.08
2015	32.94	25.87	30.03
2016	29.97	22.72	26.91
2017	32.60	18.31	26.77



(Source – [2004-2017] ICE Daily Settles, [1997-2003] Dow Jones)

British Columbia Utilities Commission Information Request No. **2.22.3** Dated: **September 20, 2017** British Columbia Hydro & Power Authority Response issued **October 4, 2017**	Page 1 of 4
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22.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Pages 72-74

2.22.3 BC Hydro is requested to update this information and provide an explanation as to the impact these issues could have on export sales. This issue has been included in the questions that follow. The Panel requests that BC Hydro respond to the following questions:

- Please provide in graph and table form, for each year from F2013 to F2017, a comparison of (i) the average all hours Mid C price for that year and (ii) the $/MWh price that BC Hydro received (after transaction costs, such as wheeling and power losses) for the sale of its surplus energy.

RESPONSE:

We provide the information requested below. However, it should be noted that the "price that BC Hydro received" is determined by the Transfer Price Agreement, which only reflects the price at which BC Hydro sells surplus energy to Powerex (at Mid C daily index prices adjusted for transaction costs, such as wheeling and power losses), and does not include any additional value that may be earned by Powerex, and returned to BC Hydro, associated with Powerex selling that surplus energy in premium markets.

The following table compares the day-ahead Mid C price across all hours to the weighted average price that BC Hydro received for its surplus from Powerex. It must be noted that, under the Transfer Pricing Agreement between BC Hydro and Powerex, BC Hydro receives from Powerex the On-Peak or Off-Peak Mid C price, as applicable, adjusted for transmission costs between the BC border and Mid C, for any energy that BC Hydro sells to Powerex each hour.

Powerex sells this energy in various temporal and geographic markets across the western interconnect, attempting to capture the best market opportunities as they arise. Powerex receives the revenue associated with these sales, and pays the actual transmission and other costs associated with reaching these markets. The additional revenue that Powerex is able to earn above the price it pays BC Hydro for its surplus energy (net of transmission and other costs associated with accessing Powerex's various markets) is also returned to BC Hydro's ratepayers as Powerex Net Income.

Importantly, the price at Mid C does not reflect the price of transactions in other geographic markets. Across each year, Powerex will sell energy sourced from the BC Hydro system in virtually every geographic region in the western interconnect, including the Pacific Northwest, Alberta, the Desert Southwest, the Rockies, and California. Accordingly, it would be inaccurate to conclude that the total value returned to BC Hydro's ratepayers associated with BC Hydro's surplus energy was the price Powerex paid BC Hydro for its surplus energy, which is based only

on the Mid C price. In fact, most of the exports from the BC Hydro system during the specific period of F2013 to F2017 were delivered to California.

Nonetheless, in order to provide the Commission with information on prevailing prices in these other markets that Powerex participates in, BC Hydro provides an additional table below that shows average California and Alberta market prices for each fiscal year over this period. A third table shows the California and Alberta prices in the highest priced 50 per cent of all hours in each fiscal year, to provide the Commission with a broad indication of the relative value that can be earned by being able to shape surplus energy sales and associated deliveries into the higher-priced hours. It should also be noted that these energy prices do not generally include any explicit or implicit premiums that Powerex may also receive for other value-added attributes (such as renewable resource attributes, resource adequacy commitments, etc.).

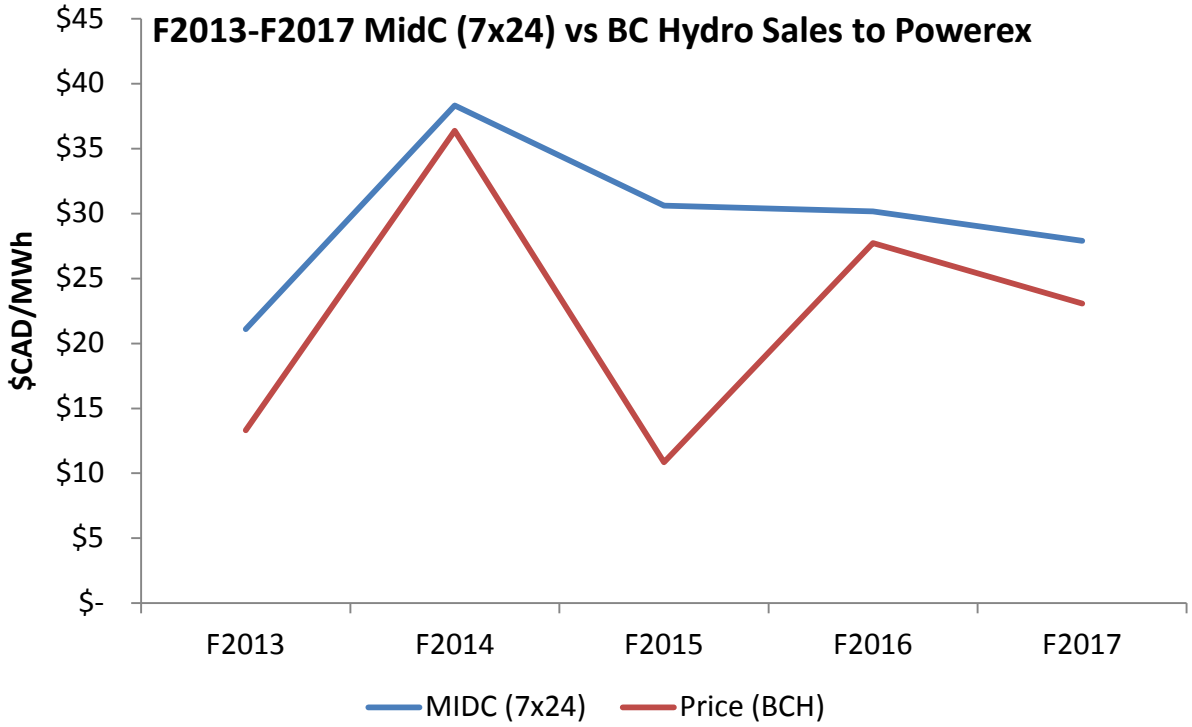
It is also important to identify that the prices reported for F2013 and F2017 may not be directly comparable to the value that can be expected to be earned from surplus energy created by the addition of Site C. This is because surplus energy sales during the F2013 to F2017 period included substantial amounts of surplus sales due to generation resources with limited flexibility and/or storage, often requiring their output to be sold in the same periods that it is produced. For example, much of BC Hydro's Lower Mainland generation, Vancouver Island generation, lower Columbia generation and IPP run-of-river hydro generation occurs during the spring freshet and cannot be stored. This can often result in market sales sourced from the BC Hydro system during relatively low-priced periods of the year. In contrast, Site C generation would benefit from the large upstream storage of the Williston reservoir, and hence surplus energy created by the addition of Site C would generally be able to be stored for sale in more valuable hours.

Mid C Price (7x24) vs. BCH Sales of Surplus to Powerex - $CAD/MWh			
	MID C ($)	**Price (BCH) ($)**	**Domestic Exports (MWh)**
F2013	21.11	13.32	(6,019,503)
F2014	38.31	36.38	(1,008,022)
F2015	30.61	10.84	(14,358)
F2016	30.17	27.73	(6,277,415)
F2017	27.89	23.06	(5,756,393)

Notes: **F2015 domestic export volumes are immaterial, and hence the price in F2015 only reflects a small volume of forced sales in the spring freshet (to deal with an over-supply of run of river generation in a few hours of the period). F2013 volumes reflect a very high water year in B.C. (and the Pacific Northwest) resulting in BC Hydro selling substantial volumes during the spring freshet to avoid system spill in late July, and receiving depressed prices reflective of the very high water in the Pacific Northwest. This resulted in the BC Hydro average sales price in F2013 being uncharacteristically low relative to the average F2013 Mid C price.**

Export Market Prices (7x24) - $CAD/MWh *(Source – CAISO OASIS, AESO)*			
	Southern California ($)	**Northern California ($)**	**Alberta ($)**
F2013	34.99	31.77	65.61
F2014	48.14	46.36	79.05
F2015	46.77	47.18	41.64
F2016	38.67	39.95	30.64
F2017	38.16	39.40	19.33

Export Market Prices (Best 50% Hours) - $CAD/MWh *(Source – CAISO OASIS, AESO)*			
	Southern California ($)	**Northern California ($)**	**Alberta ($)**
F2013	45.00	39.99	115.33
F2014	58.12	55.31	136.38
F2015	56.43	56.18	64.97
F2016	48.10	48.00	45.33
F2017	50.55	50.72	24.18


F2013-F2017 MidC (7x24) vs BC Hydro Sales to Powerex
$CAD/MWh
$45
$40
$35
$30
$25
$20
$15
$10
$5
$-
F2013
F2014
F2015
F2016
F2017
MIDC (7x24)
Price (BCH)

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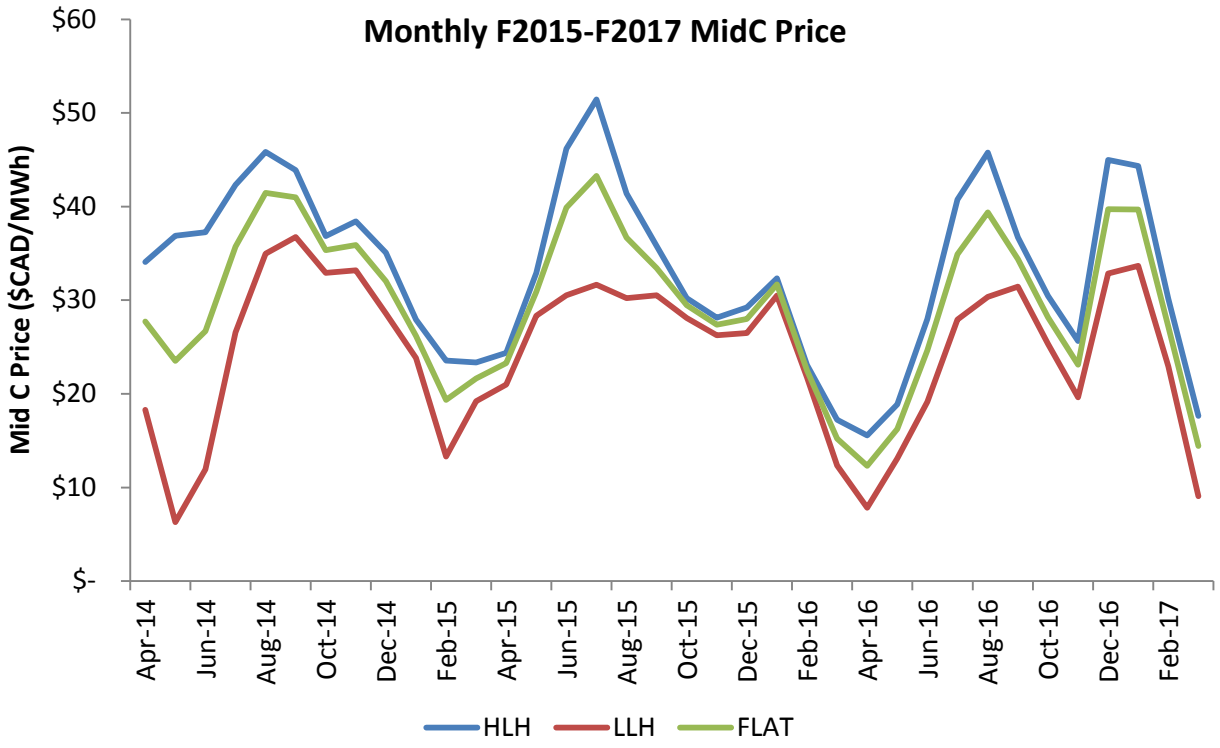
22.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Pages 72-74

2.22.4 BC Hydro is requested to update this information and provide an explanation as to the impact these issues could have on export sales. This issue has been included in the questions that follow. The Panel requests that BC Hydro respond to the following questions:

- Please provide, in graph and table form, for each year from F2015 to F2017, the monthly all hours, on-peak and off-peak Mid C price.

RESPONSE:



British Columbia Utilities Commission Information Request No. **2.22.4** Dated: **September 20, 2017** British Columbia Hydro & Power Authority Response issued **October 4, 2017**	Page 2 of 2
British Columbia Hydro & Power Authority **Site C Inquiry**	**F1-8**

Monthly Mid C Prices - $CAD/MWh *(Source – ICE Daily Settles)*			
	On-Peak (HLH) ($)	**Off-Peak (LLH) ($)**	**Average (FLAT) ($)**
Apr-14	34.07	18.30	27.73
May-14	36.87	6.29	23.51
Jun-14	37.26	11.95	26.69
Jul-14	42.33	26.54	35.72
Aug-14	45.85	34.97	41.46
Sep-14	43.89	36.75	40.99
Oct-14	36.86	32.93	35.33
Nov-14	38.42	33.20	35.91
Dec-14	35.06	28.58	32.02
Jan-15	27.91	23.81	26.19
Feb-15	23.54	13.31	19.35
Mar-15	23.36	19.21	21.64
Apr-15	24.36	21.00	23.30
May-15	32.91	28.32	30.90
Jun-15	46.17	30.51	39.88
Jul-15	51.45	31.64	43.28
Aug-15	41.38	30.22	36.67
Sep-15	35.79	30.54	33.44
Oct-15	30.22	28.10	29.47
Nov-15	28.13	26.25	27.39
Dec-15	29.24	26.48	28.00
Jan-16	32.33	30.48	31.70
Feb-16	23.06	21.76	22.48
Mar-16	17.22	12.35	15.20
Apr-16	15.56	7.84	12.29
May-16	18.89	13.09	16.23
Jun-16	28.00	19.14	24.66
Jul-16	40.75	27.92	34.90
Aug-16	45.77	30.37	39.37
Sep-16	36.73	31.44	34.37
Oct-16	30.46	25.34	28.17
Nov-16	25.62	19.64	23.10
Dec-16	44.97	32.85	39.71
Jan-17	44.34	33.67	39.69
Feb-17	30.15	22.94	27.19
Mar-17	17.65	9.06	14.42

(Source – ICE Daily Settles)

British Columbia Utilities Commission Information Request No. **2.22.5** Dated: **September 20, 2017** British Columbia Hydro & Power Authority Response issued **October 4, 2017**	Page 1 of 1
British Columbia Hydro & Power Authority **Site C Inquiry**	**F1-8**

22.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Pages 72-74

2.22.5 BC Hydro is requested to update this information and provide an explanation as to the impact these issues could have on export sales. This issue has been included in the questions that follow. The Panel requests that BC Hydro respond to the following questions:

- Please describe the energy and capacity markets in the US and Alberta that BC Hydro considers it will be able to participate in.

  Please describe any key difficulties BC Hydro might face in participating in the US and Alberta market, such as access to transmission and regulatory approvals required.

  - Please explain if any of BC Hydro's key export markets (such as California, Alberta) have, or are currently considering, legislative or regulatory requirements that would restrict BC Hydro from selling into their markets (such as self-sufficiency requirements, renewable compliance market), or the price BC Hydro could offer (such as a requirement to bid in at zero).

RESPONSE:

BC Hydro does not participate in external markets. BC Hydro's wholly owned subsidiary, Powerex, is an active participant in external markets.

Please refer to the introduction narrative of the response to BCUC IR 2.22.1 for an explanation of the markets in which Powerex participates and some of the potential challenges it faces.

With regard to concerns associated with a requirement to bid at zero in some markets, BC Hydro does not expect this to have a material effect on BC Hydro's ability to sell any surplus energy, capacity or flexibility. Sales in organized markets are generally paid a market clearing price, not the bid price submitted by the seller. Even participants required to submit a zero bid price can still express their willingness to sell power into the market through the volume of energy offered in each hour, which would be expected to receive the market clearing prices in that hour. For example, the Alberta organized market operated by the Alberta Electric System Operator (AESO) requires that all intertie offers to sell are priced at zero dollars. Accordingly, intertie participants offer a volume of supply reflective of their expectation of the AESO market clearing price. The key impact of this rule is that it can result in a lower volume of sales during those hours in which intertie participants' estimates of the clearing price are too low or are uncertain.

British Columbia Utilities Commission Information Request No. **2.22.7** Dated: **September 20, 2017** British Columbia Hydro & Power Authority Response issued **October 4, 2017**	Page 1 of 1
British Columbia Hydro & Power Authority **Site C Inquiry**	**F1-8**

22.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Pages 72-74

2.22.7 BC Hydro is requested to update this information and provide an explanation as to the impact these issues could have on export sales. This issue has been included in the questions that follow. The Panel requests that BC Hydro respond to the following questions:

- Please provide additional details on the transmission line to (a) the US and (b) Alberta, including (i) the maximum rating (for BC exports), (ii) the extent to which it is constrained to a lower level (and if so what is the lower level); (iii) how much firm and non-firm transmission capacity is generally available; and (iii) what percentage of the time the transmission line is on average constrained.

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 2.22.1, specifically the "Transmission Constraints" section.

British Columbia Utilities Commission Information Request No. **2.22.8** Dated: **September 20, 2017** British Columbia Hydro & Power Authority Response issued **October 4, 2017**	Page 1 of 2
British Columbia Hydro & Power Authority **Site C Inquiry**	**F1-8**

22.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Pages 72-74

2.22.8 BC Hydro is requested to update this information and provide an explanation as to the impact these issues could have on export sales. This issue has been included in the questions that follow. The Panel requests that BC Hydro respond to the following questions:

- Has BC Hydro considered restoring the capacity of the tie-line to Alberta? Similarly, has BC Hydro considered building additional transmission capacity to the US? Would either of these transmission projects offer additional economic opportunities for the sale of surplus energy/capacity provided by Site C? Please elaborate.

RESPONSE:

The capacity of existing interties to the U.S. and Alberta is sufficient to move any surplus energy from Site C to other utilities as described in BC Hydro's response to BCUC IR 2.76.0. BC Hydro has not, in recent history, considered building additional transmission capacity to the U.S. However, from 2006 to 2011 at the initiative of Pacific Gas & Electric, there was an exploration of building a transmission line to transport power from new renewable resources in British Columbia and the Pacific Northwest to northern California. This was named the Canada to Northern California transmission project (CNC project). The CNC project was to have carried up to 3,000 megawatts (MW) of power from renewable resources along an almost 1,000 mile transmission path running through three states and crossing the international border. The early cost estimates on this project was in the range of $3 billion (2005 US$). However, this project was abandoned by the proponents in 2011 due to the expense of the facilities and an inability to reach a commercial agreement.

The restoration of the capacity of the tie-line to Alberta is being looked at as part of a federal funded study on GHG reductions (https://www.aeso.ca/market/market-updates/regional-electricity-cooperation-and-strategic-infrastructure-initiative-recsi/). BC Hydro is part of this study effort.

Alberta is in the process of shutting down more than 6,000 MW of coal generation capacity and building large volumes of renewables. A significant amount of gas fired capacity will need to be built in Alberta alongside the buildout of renewables such as wind and solar. The gas fired generation is critical to provide the dependable capacity necessary to integrate the renewables and maintain grid stability, given Alberta lacks dispatchable, large hydro facilities that provide a similar function in B.C., albeit without the GHG emissions.

Given the current restrictions on intertie capacity with Alberta, an expanded intertie would allow BC Hydro to provide additional amounts of surplus capacity, flexibility and/or clean energy to Alberta and provide opportunities to displace or defer the building of new gas generation. However, the incremental economic benefits to BC Hydro of an expanded intertie to Alberta may be marginal given the significant capacity of the interties to the U.S. and the market opportunities available in the U.S. An expanded intertie to Alberta could however provide significant GHG reductions in Alberta and assist Canada in meeting its climate action goals. A long-term commercial arrangement between the parties that provided an appropriate sharing of the benefits accruing to Alberta would be necessary to support the costs of new transmission facilities.

British Columbia Utilities Commission Information Request No. **2.22.9** Dated: **September 20, 2017** British Columbia Hydro & Power Authority Response issued **October 4, 2017**	Page 1 of 3
British Columbia Hydro & Power Authority **Site C Inquiry**	**F1-8**

22.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Pages 72-74

2.22.9 BC Hydro is requested to update this information and provide an explanation as to the impact these issues could have on export sales. This issue has been included in the questions that follow. The Panel requests that BC Hydro respond to the following questions:

- With regards to the flexibility benefits of Site C, please explain whether technological advances could impact the market value of these flexibility benefits (for example, advancements in smart inverter technology).

RESPONSE:

Yes, technological advances could impact the market value of flexibility benefits, both positively and negatively. Technological advances that may impact the market value of the flexibility benefits, as discussed in Appendix S of our August 30 Filing, can be placed in one of two categories, (1) those that have the potential to enhance the benefits of the flexibility of Site C and (2) those that have the potential to reduce the benefits of the flexibility of Site C.

Aggressive renewable portfolio standards in the United States have led to the mass installation of wind and solar resources over the past decade, and this is expected to continue in both the United States and Alberta as renewable portfolio standards continue to be implemented and/or increased. This rapid renewable resource buildout has contributed to technological advances in these resources, particularly solar technologies, reducing the per-unit total cost of solar energy. Although wind and solar resources have generally been added to the level required to meet prevailing renewable portfolio standards in each jurisdiction, there is the potential that further technological advances could reduce solar and/or wind energy costs to a level that makes them considerably more economic than traditional resources such as coal or natural gas generation. If this happens, it could result in some jurisdictions choosing to add variable energy resources in excess of the required quantity (under prevailing renewable portfolio standards) to meet demand growth and/or replace traditional generation resources, such as coal and natural gas generation resources, when they retire. This would increase the need for capacity and flexibility.

At the same time, flexible resources such as Site C, or more generally, the residual flexible capabilities of the BC Hydro Heritage hydroelectric system, currently face competition in providing flexibility in the external markets from a variety of resources including other hydro resources and systems, natural gas resources, coal resources, pumped-storage hydro resources, demand response, and the gradual emergence of battery technologies. Looking forward, however,

the practical choices for flexible resource additions are likely to be more limited, particularly in the context of expanding GHG reduction policies. Few, if any, western jurisdictions are likely to add coal resources, and there is growing concern over the addition of new natural gas resources, particularly in California.[1] Additions of flexible resources are likely to reflect the growing desire to explore clean flexible resource technologies that are also able to provide storage, for the purpose of shaping excess renewable resource production (in excess of local demand) into hours of lower renewable resource production. The new clean flexible resource technologies that are clearly able to provide both flexibility and storage (other than large storage hydro, such as Site C) are new pumped-storage hydro resources and battery technologies.

It is difficult to accurately forecast how technological advances will impact the cost of any resource technology, including pumped-storage hydro resources and emerging battery technologies. However, there are several important points that indicate that the external demand for surplus flexibility and storage attributes of the BC Hydro system, including the addition of Site C, will continue to be valuable in the future, notwithstanding potential technological advances in pumped-storage hydro and/or battery technologies:

- **The demand for flexibility and storage technologies is already large, and is expected to grow rapidly, likely requiring multiple solutions.**

- **Pumped-storage hydro is not a new technology, there are limited sites where pumped-storage resources may be installed, and thus there may be limited ability to dramatically reduce the cost and/or increase the availability of pumped-storage resources.**

- **Battery technologies will likely experience continued technological advancements that will reduce their costs significantly. However, the timing of these advancements and the magnitude of these cost reductions costs is highly uncertain. Moreover, existing battery technologies can only provide approximately 8 hours of dependable capacity, and are not able to provide the same flexibility and storage attributes as large storage hydro resources, such as the ability to store energy across longer time periods and the ability to provide grid support services such as inertia.**

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[1] **For example, in the California Public Utilities Commission Proposed Reference System Plan, the CPUC envisions no new natural gas resources developed in order to meet California's 2030 carbon emission reduction targets. *Administrative Law Judge's Ruling Seeking Comment on Proposed System Plan and Related Commission Policy Actions*, September 19, 2017 at page 11 available at http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M195/K910/195910921.PDF.**

BC Hydro's understanding of Smart Inverters:

- **Inverters are electrical equipment that converts DC to AC and are typically found as part of a small generation resource installation (e.g., rooftop solar installation for a residential home).**

- **Smart inverters have additional communications and control capabilities.**

- **Smart inverters enable an owner of the generation source to see the energy being generated and often control the device remotely or give control of the device to a third party.**

At this time, BC Hydro is not aware of any evidence that smart inverter technologies will be able to provide the attributes, or scale to the required level, to provide the flexibility, storage and capacity that are expected to be required to meet the rapidly growing needs associated with renewable resource integration.

British Columbia Utilities Commission Information Request No. **2.22.14** Dated: **September 20, 2017** British Columbia Hydro & Power Authority Response issued **October 4, 2017**	Page 1 of 2
British Columbia Hydro & Power Authority **Site C Inquiry**	**F1-8**

22.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Pages 72-74

2.22.14 Please discuss the potential implications and impact of Powerex joining, or potentially not joining, the Energy Imbalance Market and how that relates to the value of Site C energy and capacity. Include an analysis and discussion of the potential impact resulting from an expansion of Energy Imbalance Market.

RESPONSE:

The Western Energy Imbalance Market (EIM) is a voluntary intra-hour wholesale electricity market located in the U.S. Powerex's participation in the EIM will complement its continued participation in other wholesale electricity markets in the western interconnect, including the forward, next day and hourly bilateral energy markets, as well California's next day and hourly organized markets and Alberta's hourly organized market. Powerex expects to continue to decide its level of participation in each of its available markets, including the EIM, based on the relative opportunities in each market.

The EIM enables the purchase and sale of energy in 15-minute and five-minute increments. The EIM provides a new opportunity to monetize the residual capabilities of the BC Hydro system and affords several key advantages over other market opportunities that are available to monetize sub-hourly flexibility. First, the EIM removes transmission hurdle rates that generally exist today in other U.S. markets, through its transmission reciprocity framework, thereby lowering the cost of delivering energy across the EIM footprint. Under this transmission reciprocity framework, each participating entity voluntarily brings transmission rights ahead of each applicable hour to connect to the EIM footprint, with no further fixed transmission charges applying to EIM transactions within the applicable hour. Second, the EIM allows the automated purchasing and selling of sub-hourly energy, through the EIM's sophisticated software processes. This is an important improvement over the bilateral sub-hourly markets, due to the limited time available to identify trading counterparties, and to negotiate and schedule transactions for each sub-hourly period. While Powerex expects to continue to negotiate longer-term bilateral contracts that also monetize the hourly and sub-hourly flexibility of the BC Hydro system, the EIM presents a new and growing opportunity to do this for discrete intra-hour transactions.

The EIM is one of the last temporal markets available for Powerex to participate in, as it operates after energy has been transacted in the larger forward and day ahead markets in the western U.S. As such, the volume of energy transacted in the EIM is generally limited by the residual U.S. transmission rights voluntarily made available to the EIM each operating hour, as well as by the residual

purchase and sale capabilities of the participants voluntarily offered into this sub-hourly market. Powerex anticipates that its participation, scheduled to commence in April 2018, will typically include approximately 300 MW of import and export transmission rights to and from B.C., as well as approximately 300 MW of purchase and sale bids and offers, which will be supported by the residual capabilities of the BC Hydro system. Although Powerex may increase its level of participation as opportunities arise, it is currently expected that Powerex's level of participation in the EIM will not frequently be limited by the capacity or flexibility of the BC Hydro system, but rather by the level of market opportunities and transmission transfer capability in the EIM. Therefore, at this time, there is no direct connection between Powerex's participation in the EIM and Site C.

With respect to future market evolution, the EIM is likely to continue to grow both in terms of its geographic footprint as well as the volume of voluntary bids and transmission transfer capability. This growth could afford Powerex greater opportunities to monetize the residual flexible capabilities of the BC Hydro system in the future. Nonetheless, the EIM is expected to continue to remain just one market amongst several by which Powerex can monetize the residual flexible capability of the BC Hydro system.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

BC Hydro states that the 2019 Letter Agreement is needed to "proactively ensure appropriate measures are in place to respond to future physical supply issues."

BC Hydro also states that there has been, and continues to be, a decline in the liquidity of the Mid-Columbia day-ahead market, making it more advantageous to buy energy on the forward market. BC Hydro illustrates this decline with the following two charts, showing the average quarterly volumes (GWh) in the on-peak and off-peak markets from 2011 to 2018:

Figure 10.1: Mid-C Liquidity (Day-Ahead Peak)

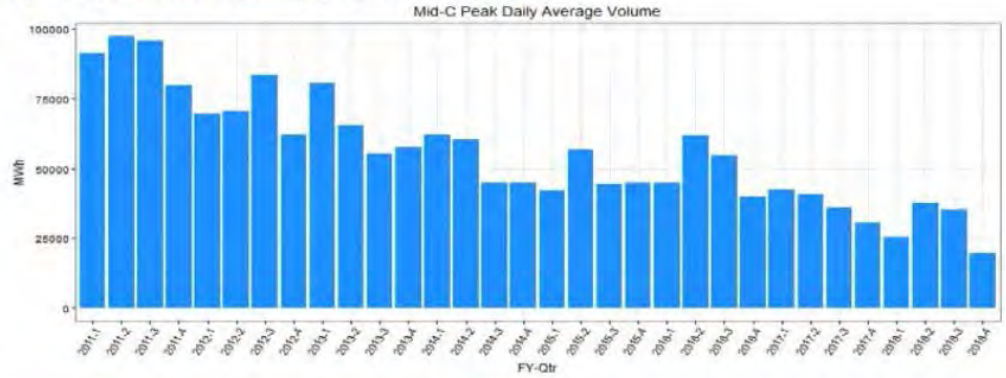
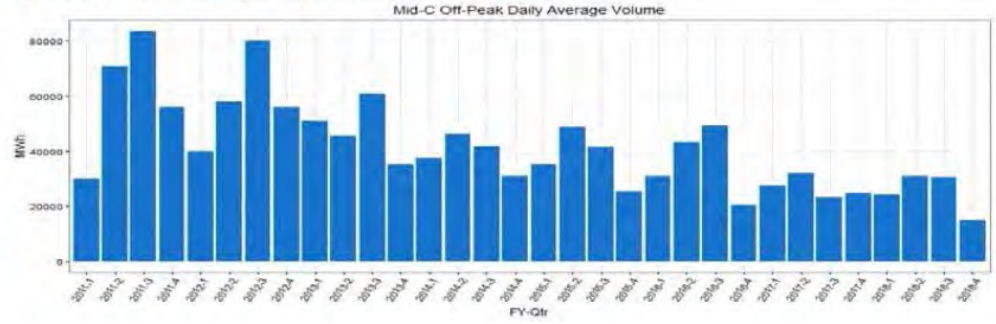


Figure 10.2: Mid-C Liquidity (Day-Ahead Off-Peak)



1.4.3 If the peak and off-peak volumes shown on the above two charts for all 4 quarters of 2018 are added together and averaged, it appears that the average daily volume for the whole year was approximately 50,000 MWh per day. If that is approximately correct, then the total annual volume was about 18,000 GWh for whole year of 2018. Can BC Hydro please confirm what the total annual Mid-Columbia day-ahead market trading volume was for 2018?

RESPONSE:

As the referenced charts were not produced by BC Hydro, it cannot confirm the calculations requested.

Refer to BC Hydro's response to CEC IR 1.3.2.1 for a link to publicly available peak volumes for Mid-C and for an explanation of where off-peak volumes may be obtained.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

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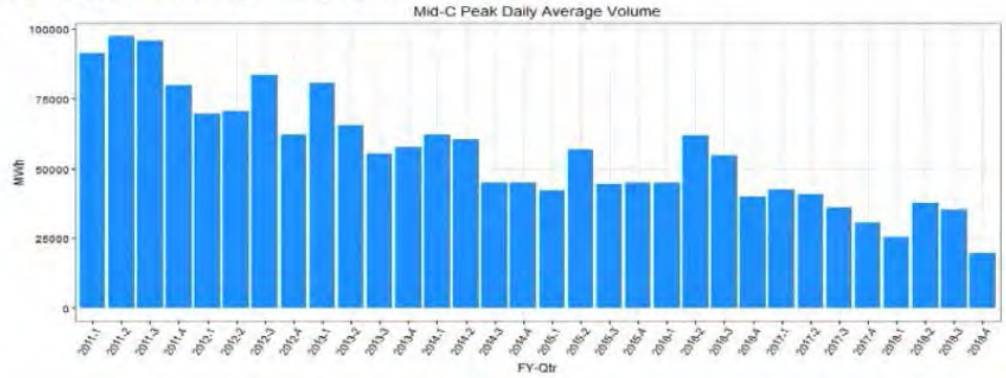
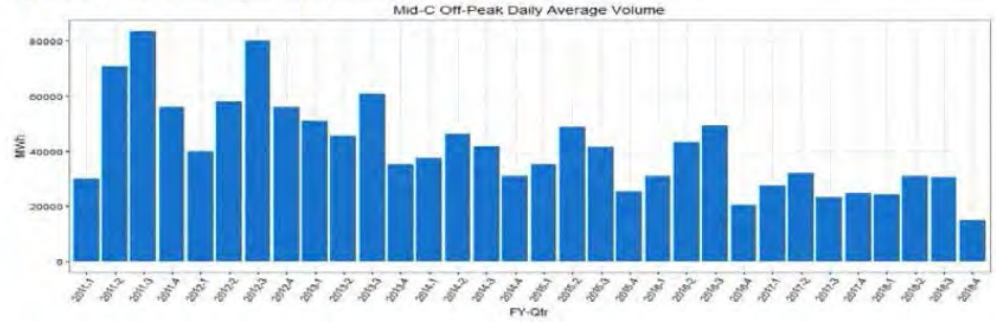


Figure 10.2: Mid-C Liquidity (Day-Ahead Off-Peak)



1.4.4 Can BC Hydro provide the numerical data that produced these charts (preferably in the form of a working Excel model)?

RESPONSE:

The referenced charts were produced by the Bonneville Power Administration. Therefore, BC Hydro cannot provide the data used to produce the charts.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

BC Hydro states that the 2019 Letter Agreement is needed to "proactively ensure appropriate measures are in place to respond to future physical supply issues."

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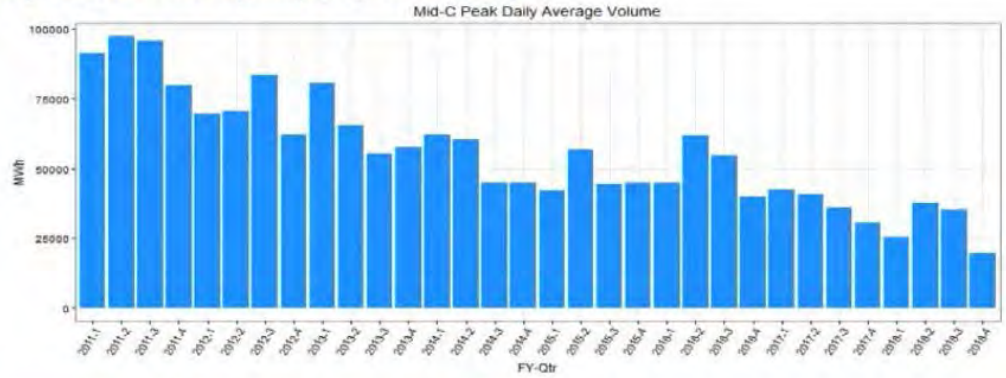
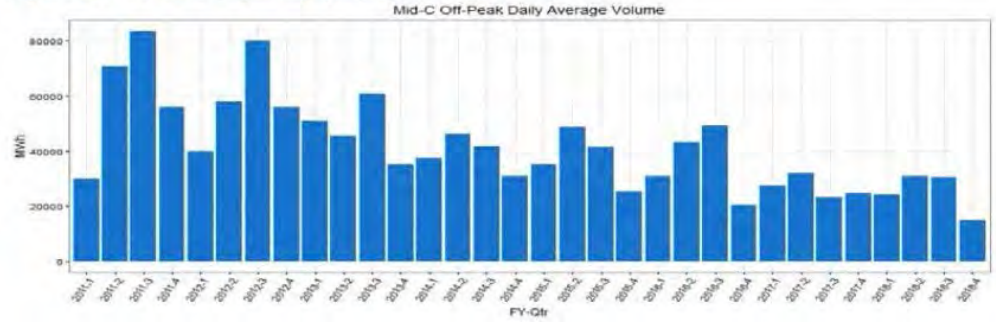


Figure 10.2: Mid-C Liquidity (Day-Ahead Off-Peak)



1.4.5 Are BC Hydro's purchases and sales (through Powerex) included in the total volumes shown for the Mid-Columbia day-ahead market? How much of the annual volume for 2018 was represented by BC Hydro's purchases? And how much was represented by BC Hydro's sales?

RESPONSE:

BC Hydro does not transact in external markets and hence none of the volume represents BC Hydro's transactions. BC Hydro transacts with Powerex at the B.C.-U.S. border. To the extent that Powerex served BC Hydro purchases or sold BC Hydro surplus using ICE day-ahead Mid-C market transactions, it will be reflected in the graphs.

Details of Powerex's business activities, including any Powerex transactions at Mid-C, are commercially sensitive to Powerex and thus confidential.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

BC Hydro states that the 2019 Letter Agreement is needed to "proactively ensure appropriate measures are in place to respond to future physical supply issues."

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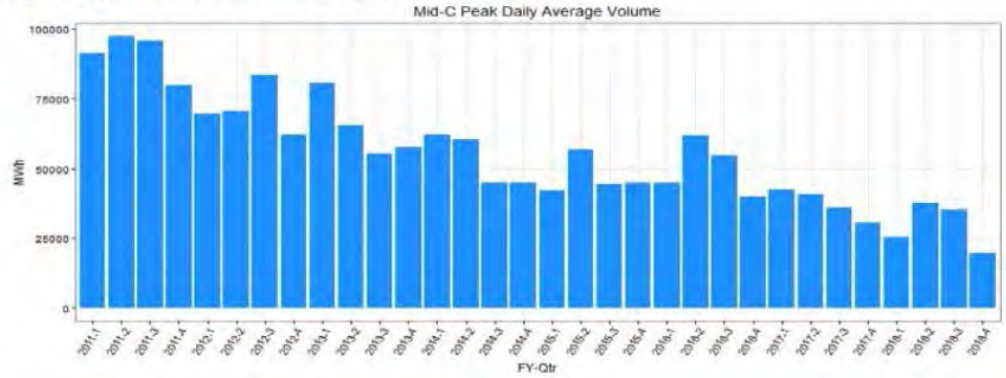
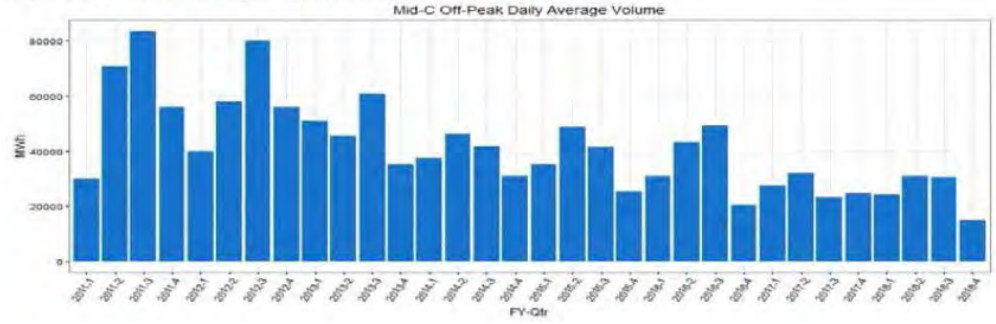


Figure 10.2: Mid-C Liquidity (Day-Ahead Off-Peak)



1.4.6 How much of that 2018 annual volume was represented by Powerex's sales of the Canadian Entitlement?

RESPONSE:

Please refer to BC Hydro's response to CEABC IR 1.2.8.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

BC Hydro states that the 2019 Letter Agreement is needed to "proactively ensure appropriate measures are in place to respond to future physical supply issues."

BC Hydro also states that there has been, and continues to be, a decline in the liquidity of the Mid-Columbia day-ahead market, making it more advantageous to buy energy on the forward market. BC Hydro illustrates this decline with the following two charts, showing the average quarterly volumes (GWh) in the on-peak and off-peak markets from 2011 to 2018:

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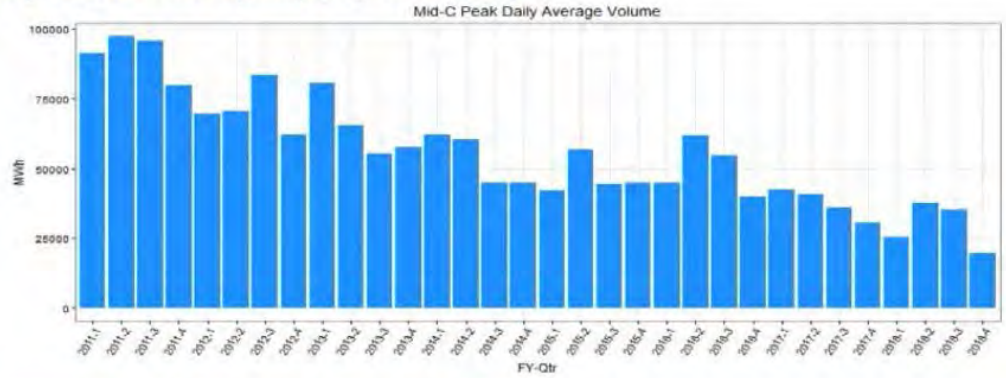
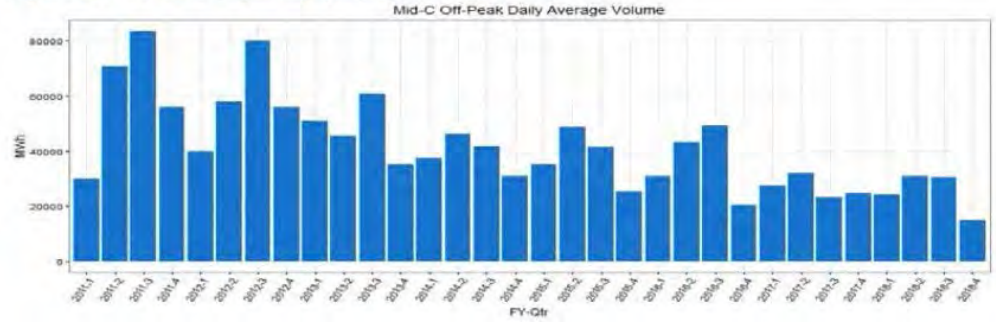


Figure 10.2: Mid-C Liquidity (Day-Ahead Off-Peak)



1.4.7 According to the NEB (at https://www.neb-one.gc.ca/nrg/sttstc/lctrct/rprt/2016cndrnwblpwr/prvnc/bc- eng.html), in 2018 B.C.'s total imports (International plus Interprovincial) were 10,528,056 GWh. How much of this was due to Powerex's purchases (either on behalf of BC Hydro or otherwise)?

RESPONSE:

BC Hydro did not find the specific reference on the website. Refer to Schedule 4 of the Evidentiary Update in BC Hydro's F20-F21 RRA where BC Hydro's Market Energy transactions are provided.

https://www.bcuc.com/Documents/Proceedings/2019/DOC_55184_B-11-BCH-Evidentiary-Update-Public.pdf

Powerex's activities are commercially sensitive and thus confidential.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

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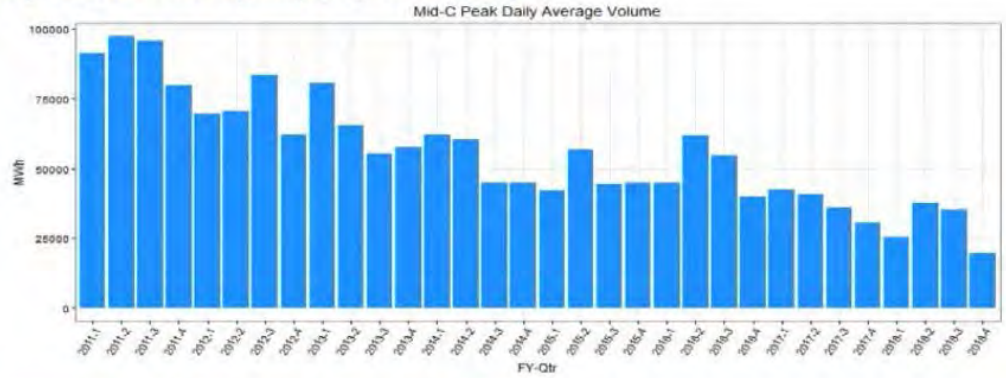

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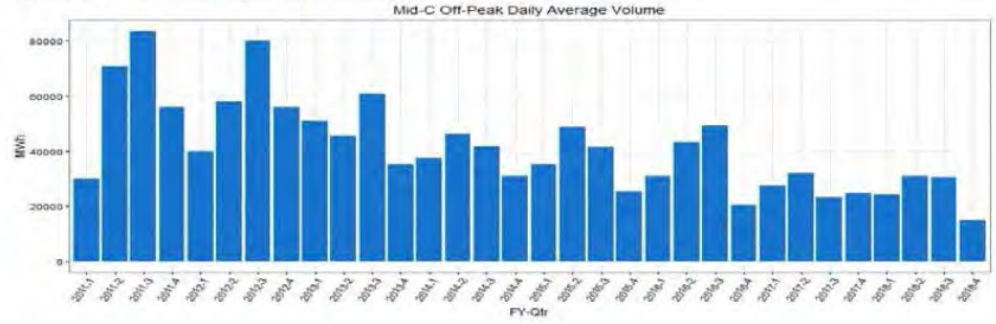

1.4.8 According to the NEB (as cited above), B.C.'s total imports of 10,528,056 GWh in 2018 were the highest since 2009. Please explain why the volume of electricity imported into B.C. has increased while the volume of trading, as reflected in the liquidity charts above, has decreased.

RESPONSE:

BC Hydro did not find the specific reference on the website.

The question appears to be based on an erroneous premise that the volume of electricity imported into B.C. (by all importers) is purchased solely in the Day Ahead Mid-C market. Imports into B.C. could be sourced from a variety of geographic and temporal markets.

Please note that the import values typically reported by the NEB are gross volumes that are scheduled and do not reflect the net imports into B.C.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

BC Hydro states that the 2019 Letter Agreement is needed to "proactively ensure appropriate measures are in place to respond to future physical supply issues."

BC Hydro also states that there has been, and continues to be, a decline in the liquidity of the Mid-Columbia day-ahead market, making it more advantageous to buy energy on the forward market. BC Hydro illustrates this decline with the following two charts, showing the average quarterly volumes (GWh) in the on-peak and off-peak markets from 2011 to 2018:

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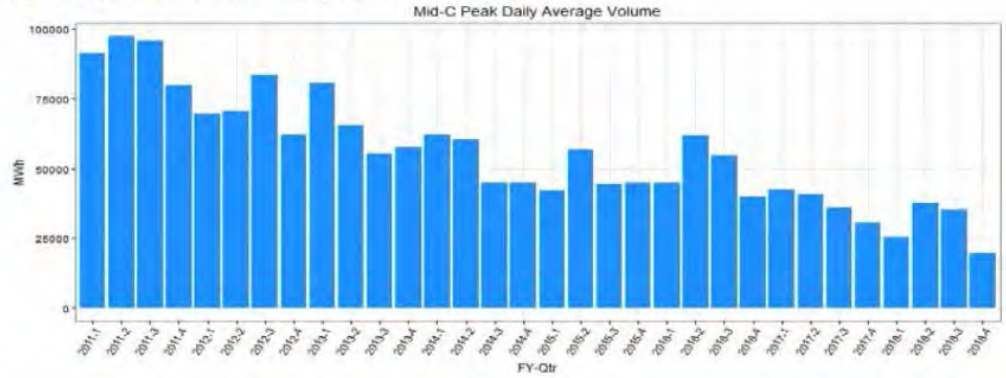

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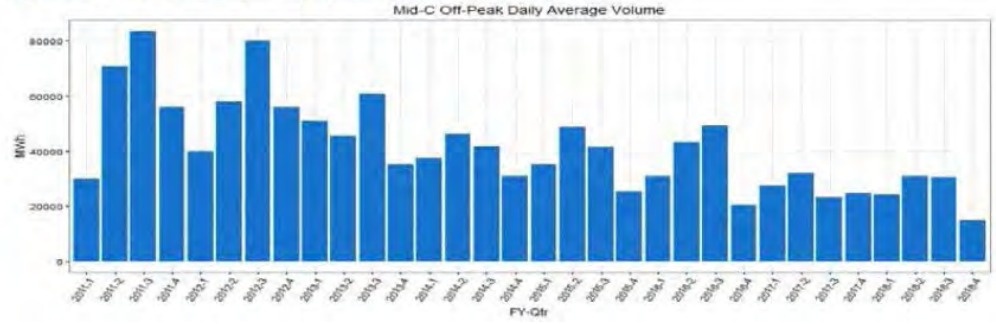

1.4.9 Approximately what is the total annual generation of all the utilities that trade in the Mid- Columbia day-ahead market? Has it changed materially since 2011 - the first year shown on the graphs?

RESPONSE:

BC Hydro does not have the information to respond to the request, as BC Hydro does not have information on all the entities that trade in the Mid-C Day Ahead market.

Western Electric Coordinating Council's (WECC) State of the Interconnection Report provides net generation by Balancing Authority and fuel type across the WECC. This report can be found at the following link:

https://www.wecc.org/epubs/StateOfTheInterconnection/Pages/Net-Generation.aspx

Public information on the load resource balance of the U.S. Pacific Northwest can also be found in Bonneville Power Administration's White Book publications on their website:

https://www.bpa.gov/p/Generation/White-Book/Pages/White-Book.aspx

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

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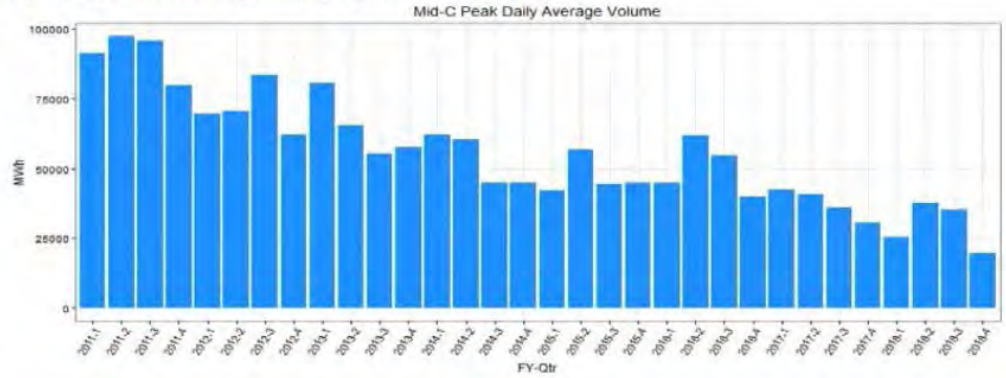

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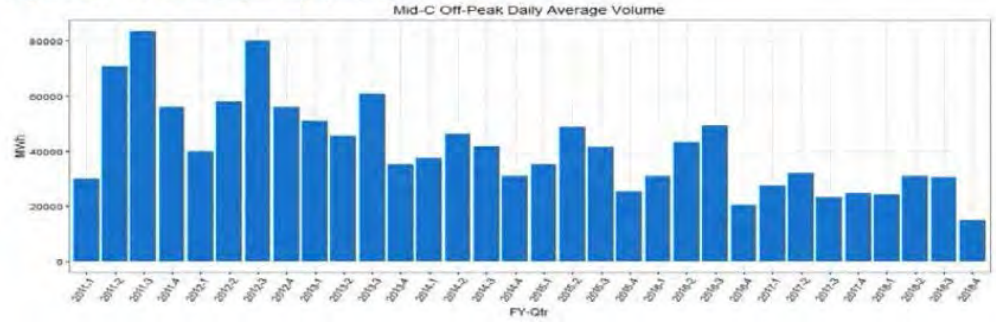

1.4.10 What is the reason for the decline in volumes shown in the above figures 10.1 and 10.2? Has the total generation in the region decreased? If not, then where did all of that missing energy go?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.2.3, which provides BC Hydro's understanding of some of the potential causes of the long-term decline of liquidity.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

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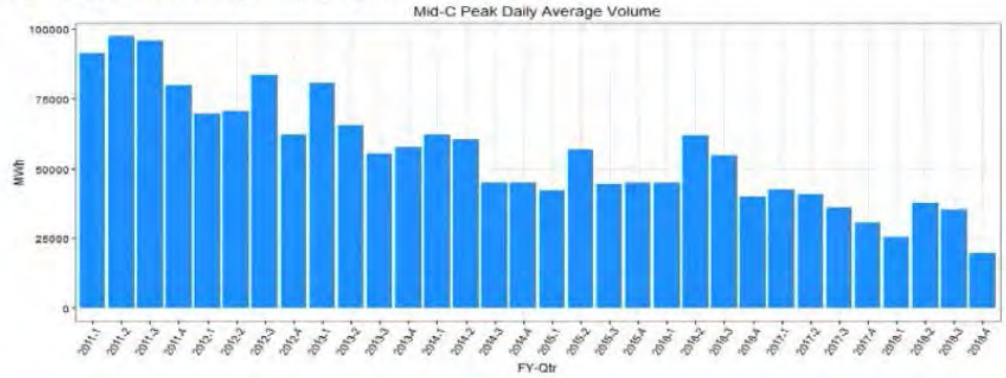

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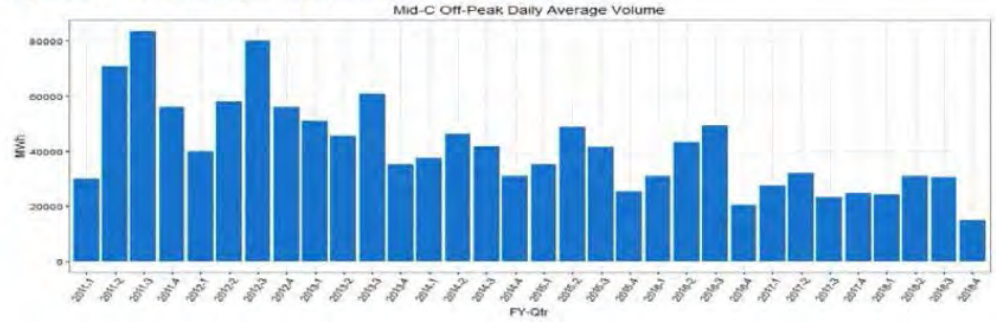

1.4.11 It appears that one of the main reasons BCH is applying to extend the 2018 Letter Agreement is based on its expectation of a continuation of a decline in liquidity. Does BC Hydro expect the volume in the Mid-Columbia day-ahead market to continue to decline? If so, why will it decline further?

RESPONSE:

BC Hydro is not applying to extend the 2018 Letter Agreement. The 2019 Letter Agreement is a new agreement.

Please refer to BC Hydro's response to BCUC IR 1.2.3, which provides BC Hydro's understanding of the causes of the long-term decline of liquidity.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

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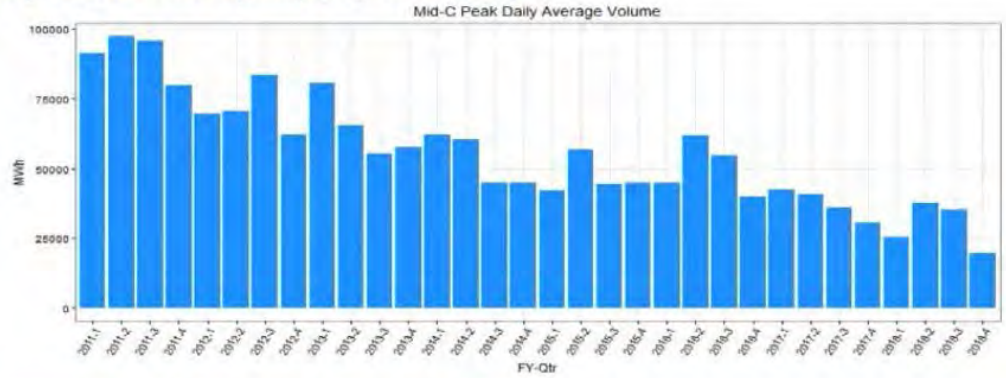

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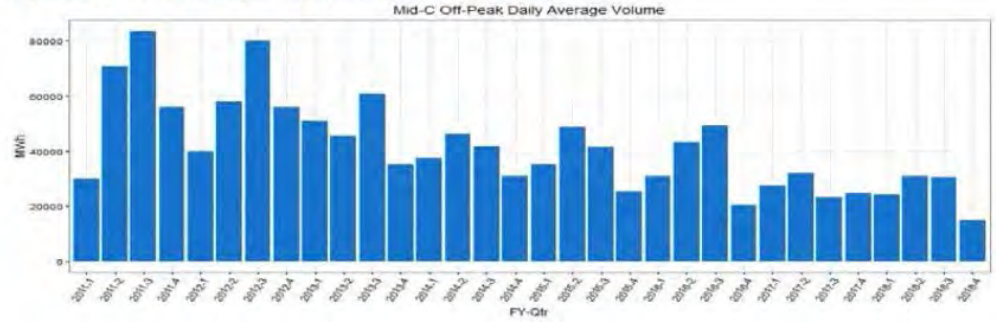

1.4.12 Please advise as to the impact and risks that a continuation of the decline of liquidity will have on BC Hydro and Powerex's increased reliance on importing.

RESPONSE:

Please refer to BC Hydro's response to CEABC IR 1.2.3. The risk pertaining to declining liquidity in the spot market can be mitigated by providing access to forwards markets, as is contemplated under the 2019 Letter Agreement.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

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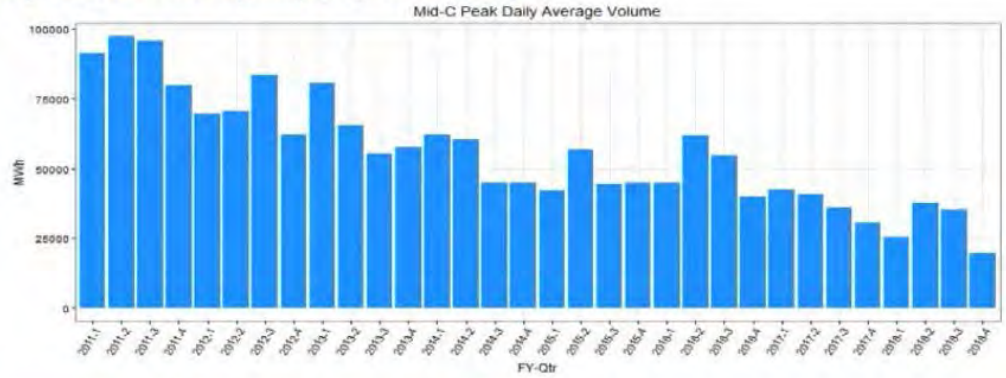

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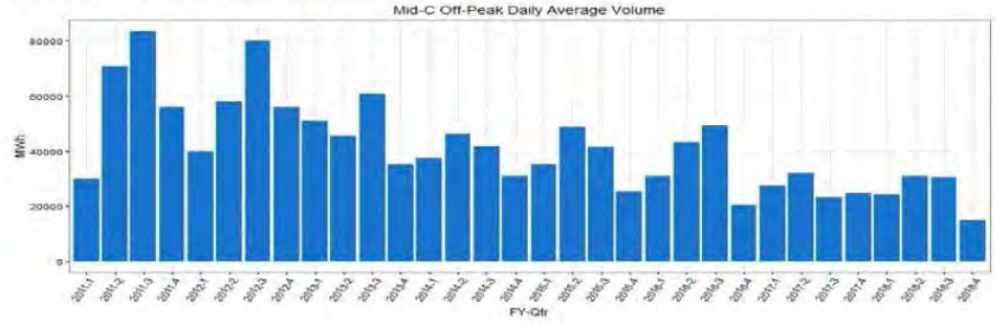

1.4.13 What was the volume traded in the Mid-Columbia forward market during the years 2011 to 2018? Has the forward market volume exhibited a similar decline to that in the day- ahead market? Can BC Hydro provide the data, and a similar chart to those above, showing the quarterly volumes traded on the forward market over that same time period?

RESPONSE:

BC Hydro cannot provide the requested forward data because this data is provided by ICE to its subscribers who are subject to their strict confidentiality restrictions over the use and reproduction of this data.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

BC Hydro states that the 2019 Letter Agreement is needed to "proactively ensure appropriate measures are in place to respond to future physical supply issues."

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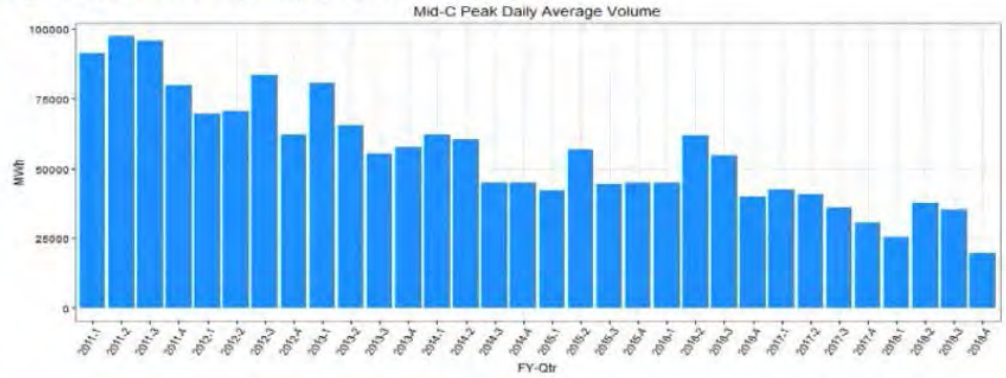

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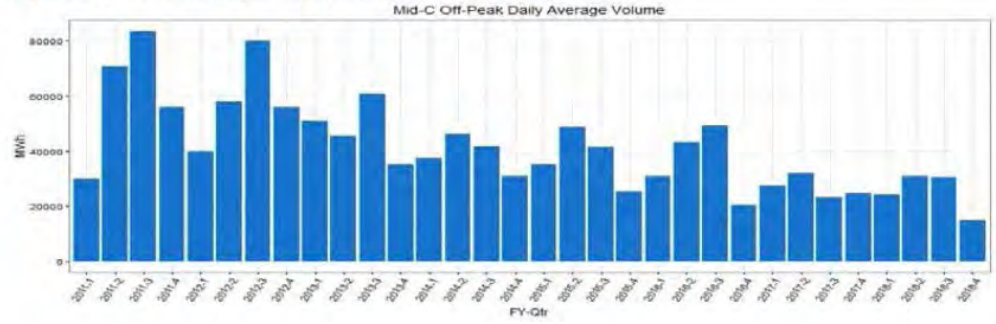

1.4.14 What forward time periods are used for transactions in the Mid-Columbia forward market? What is the longest forward time period available? What forward time period has the most liquidity in the Mid-Columbia forward market? What volume is typically traded in the most liquid forward time period? Can BC Hydro please break down the trading volumes given in the previous question, with respect to the forward time periods?

RESPONSE:

Please refer to BC Hydro's response to CEABC IR 1.4.13.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

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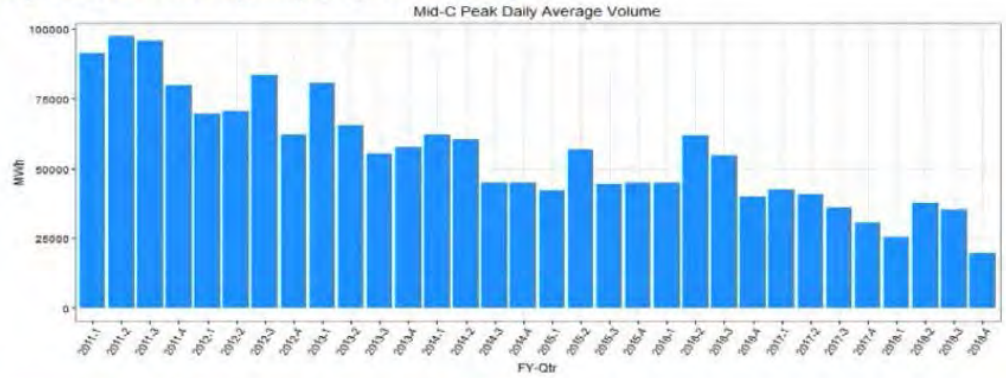

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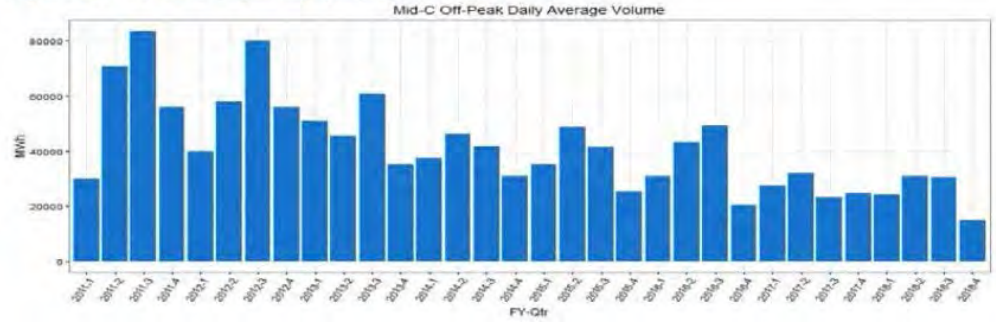

1.4.15 Please describe how the various forward time periods are normally priced relative to the day-ahead market. Are they normally at a premium or a discount to the day-ahead price? Please provide numerical examples taken from recent experience over the past 2 years.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.1.1 for a discussion on price risk and the forward price curve.

Please see BC Hydro's response to CEABC IR 1.4.13 with respect to providing forward data.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

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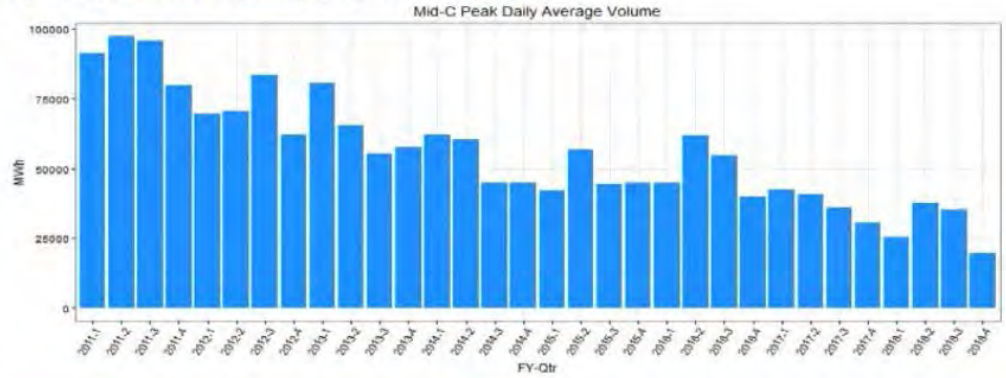

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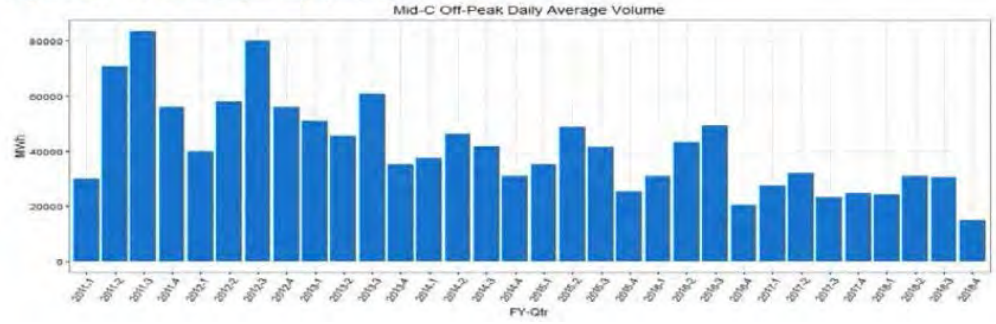

1.4.16 What forward time period would BC Hydro expect to be using for its forward energy purchases under the 2019 Letter Agreement? Why? What price premium would typically be associated with that forward time period relative to the day-ahead market?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.3.2 where BC Hydro describes the supply risks and how the 2019 Letter Agreement is expected to be used.

Please refer to BC Hydro's response to CEC IR 1.1.1 for a description of the forward price curve.

4.0 Reference: Exhibit B-1, Application, Cover Letter, page 4 and 5 of 11, Need for the 2019 Letter Agreement

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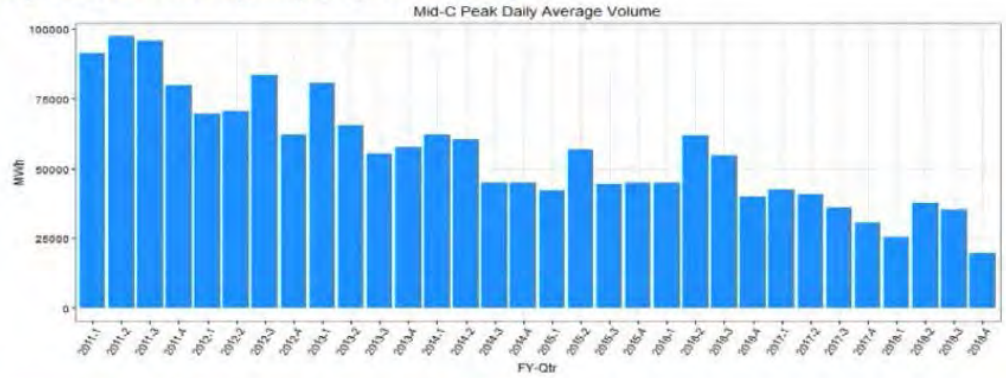

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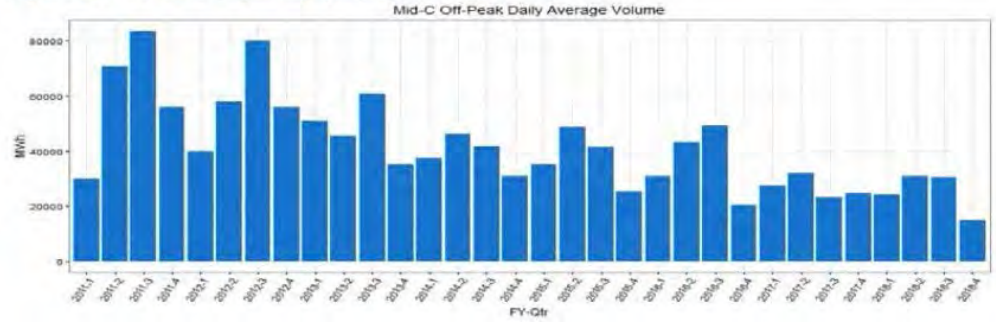


1.4.17 Would BC Hydro ever contract for a period longer than 6 months? If so, what longer period? Why? And under what circumstances?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.3.2 where BC Hydro describes the supply risk and states that the Delivery Term for the most part is expected to be less than a year.

While BC Hydro has not identified specific circumstances that would require a Delivery Term of more than a year, it is possible that some of the examples provided in BC Hydro's response to CEC IR 1.4.1 could result in a need for a longer delivery term. The 2019 Letter Agreement is an enabling tool to ensure BC Hydro can respond to future physical supply issues.

Please refer to BC Hydro's response to BCUC IR 1.6.4 were BC Hydro has committed to not request a Delivery Term of greater than three years.

5.0 Reference: Exhibit B-1, Application, page 4, under Roles of BC Hydro and Powerex

BC Hydro states that:

> BC Hydro makes such purchase decisions within the usual operational management framework it employs to make all dispatch and other system operation decisions.

1.5.1 Is there anything in the "usual operational management framework" that prevents BC Hydro's senior management or the BC Hydro Board of Directors from making any decisions they decide appropriate in relation to dispatch and other system operations decisions? If yes, please provide copies of the BC Hydro policies and procedures or like material that would cause this.

RESPONSE:

There are no restrictions in BC Hydro's operational management framework that would prevent BC Hydro from making decisions it decides are appropriate with respect to the operation of its system.

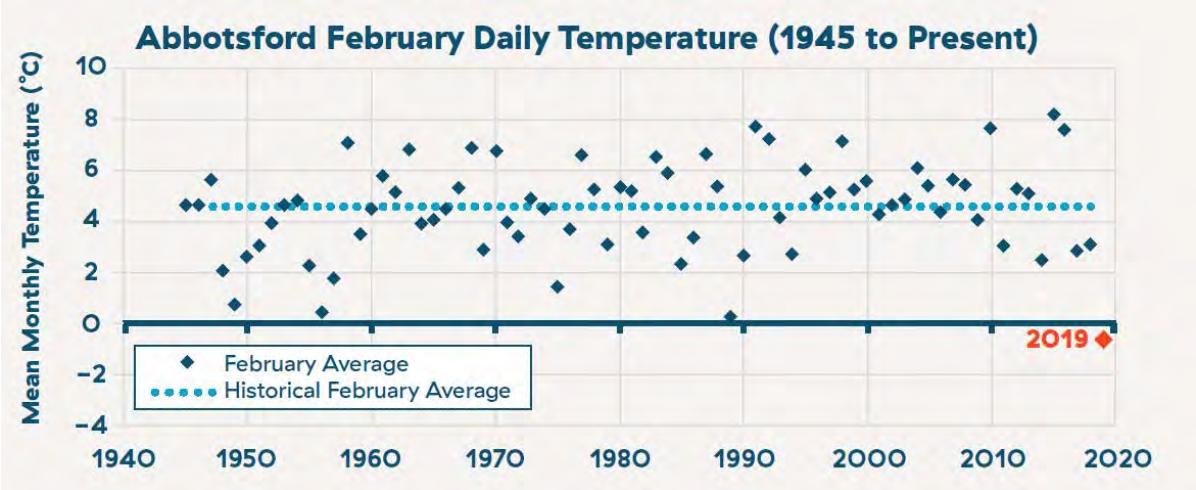
6.0 Reference: Exhibit B-1, Application, page 11, footnote 11

Footnote 11 states, "Later a particularly cold winter and resulting increased heating loads exacerbated the situation"
In Exhibit B-11 of the BC Hydro F2020 to F2021 Revenue Requirement Application, the "Evidentiary Update", in Appendix G, page 2, BC Hydro states "and temperatures were slightly colder than normal during the year"?

1.6.1 Please provide independent objective evidence of what the term "particularly cold winter" means, as compared to the term "slightly colder than normal."

RESPONSE:

The specific wording in the two references do not have an independent and objective meaning for comparison. The statement in Footnote 11 on 'a particularly cold winter' is referring specifically to February 2019, which was the coldest February on record in Metro Vancouver since 1937 as demonstrated in the figure below. The average February temperature was more than two standard deviations below the normal, which is objectively "particularly" or unusually cold.
Exhibit B11 is referring to temperature influence on residential sales over a longer period in fiscal 2019, for which the temperature deviation was not as extreme as in the single month of February 2019.



7.0 Reference: Miscellaneous

1.7.1 As an alternative to purchases under the 2019 Letter Agreement has BC Hydro examined the possibility of industrial customers curtailing load? If not, why not?

RESPONSE:

Please refer to BC Hydro's response to AMPC IR 1.4.1 for a description of why the Load Curtailment Pilot and other demand response programs are not alternatives to the 2019 Letter Agreement.

8.0 Reference: Terms of Reference for the Comprehensive Review of BC Hydro (Phase 2), issued in July, 2019

The Ministry of Energy, Mines and Petroleum webpage describes the Review. In the Terms of Reference, it states that:

> "The recommendations from the Phase 2 Review will be used to inform BC Hydro's Integrated Resource Plan that will be filed with the British Columbia Utilities Commission in early 2021."

The Terms of Reference includes an "Area of Interest" called Leveraging Our Strengths. It states the following:

> "BC Hydro's wholly-owned subsidiary Powerex currently buys and sells electricity in other markets throughout the Western Interconnection. The Phase 2 Review will consider whether there are opportunities to enable increased participation in external markets to the benefit of BC Hydro ratepayers. The Phase 2 final report will make recommendations that consider each of the following questions:
>
> What constraints, if any, reduce Powerex's ability to trade electricity in the Western Interconnection today or in the future?
>
> Is there an opportunity or actions that can be taken that will enable Powerex to expand its business in markets outside of BC, further leveraging BC Hydro's clean generation and/or Powerex's expertise in energy markets?
>
> How should cost effective clean energy located outside of BC be considered in BC Hydro's planning and operations? (emphasis added)
>
> Is there an opportunity to own and/or operate assets outside of BC Hydro's current service area that would benefit BC Hydro's ratepayers?" (emphasis added)

The Ministry of Energy, Mines and Petroleum **webpage** describing the Review states:

> "Phase 2 will leverage BC Hydro's strengths and focus on:
> - BC Hydro's role in supporting CleanBC and meeting the Province's legislated 2030, 2040 and 2050 greenhouse gas reduction targets;
> - future opportunities or new roles for Indigenous Nations and for communities in the energy sector;
> - integrating new technologies and electricity market trends into BC Hydro's structure, services and assets while keeping rates affordable; and

- new opportunities for BC Hydro to expand its business in markets outside B.C. to the benefit of ratepayers." (emphasis added)

1.8.1 Please describe examples of and how "cost effective clean energy located outside of BC be considered in BC Hydro's planning and operations?"

RESPONSE:

The references refer to the ongoing and uncompleted Comprehensive Review of BC Hydro (Phase 2) conducted by the Government of B.C. BC Hydro cannot speculate on the outcomes of the uncompleted Government Review. The Government Review is unrelated to the 2019 Letter Agreement.

Please refer to BC Hydro's response to BCUC IR 1.3.2 regarding BC Hydro's approach to addressing supply needs in the operational time frame. Please also refer to BC Hydro's response to CEC IR 1.6.1 were BC Hydro discusses that the 2019 Letter Agreement does not address supply needs in the planning time frame.

8.0 Reference: Terms of Reference for the Comprehensive Review of BC Hydro (Phase 2), issued in July, 2019

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> - integrating new technologies and electricity market trends into BC Hydro's structure, services and assets while keeping rates affordable; and

- new opportunities for BC Hydro to expand its business in markets outside B.C. to the benefit of ratepayers." (emphasis added)

1.8.2 Is BC Hydro aware of any "opportunity to own and/or operate assets outside of BC Hydro's current service area" that would result in BC Hydro or Powerex generating, storing or procuring electricity that could be brought into B.C.? If so, please identify them. If some projects are too commercially sensitive please describe what type of asset (i.e. wind generation, solar generation, energy storage) and general location (i.e. U.S. state, Alberta).

RESPONSE:

Please refer to BC Hydro's response to CEABC IR 1.8.1 where we describe how BC Hydro cannot speculate on the outcomes of the uncompleted Government Review.

8.0 Reference: Terms of Reference for the Comprehensive Review of BC Hydro (Phase 2), issued in July, 2019

The Ministry of Energy, Mines and Petroleum webpage describes the Review. In the Terms of Reference, it states that:

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- new opportunities for BC Hydro to expand its business in markets outside B.C. to the benefit of ratepayers." (emphasis added)

1.8.3 If there does become an "opportunity to own and/or operate assets outside of BC Hydro's current service area" that would generate, store or procure electricity that could be brought into BC, will BC Hydro file an Energy Supply Contract for that opportunity or will that fall under the ESC constituted by the 2019 Letter Agreement?

RESPONSE:

Please refer to BC Hydro's response to CEABC IR 1.8.1 where we describe how BC Hydro cannot speculate on the outcomes of the uncompleted Government Review. As a result, BC Hydro cannot comment on how the 2019 Letter Agreement may be impacted by any such outcomes.

8.0 Reference: Terms of Reference for the Comprehensive Review of BC Hydro (Phase 2), issued in July, 2019

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> Is there an opportunity to own and/or operate assets outside of BC Hydro's current service area that would benefit BC Hydro's ratepayers?" (emphasis added)

The Ministry of Energy, Mines and Petroleum **webpage** describing the Review states:

> "Phase 2 will leverage BC Hydro's strengths and focus on:
> - BC Hydro's role in supporting CleanBC and meeting the Province's legislated 2030, 2040 and 2050 greenhouse gas reduction targets;
> - future opportunities or new roles for Indigenous Nations and for communities in the energy sector;
> - integrating new technologies and electricity market trends into BC Hydro's structure, services and assets while keeping rates affordable; and

- new opportunities for BC Hydro to expand its business in markets outside B.C. to the benefit of ratepayers." (emphasis added)

1.8.4 Is BC Hydro considering expanding Powerex's role from being "an energy marketing company" to adding "own and/or operate assets outside of BC Hydro's current service area" that could generate, store or procure electricity that could be brought into B.C.?

RESPONSE:

Please refer to BC Hydro's response to CEABC IR 1.8.1 where we describe how BC Hydro cannot speculate on the outcomes of the uncompleted Government Review.

1.0 Reference: Exhibit B-1, page 3 and page 8

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In summary, the 2019 Letter Agreement is an additional tool for BC Hydro to employ to address short-term operational requirements. It does so by allowing BC Hydro to secure physical wholesale electricity from Powerex on a forward basis (ie outside of the pre-schedule day-ahead wholesale markets) but still within the operating time horizon. There is no other mechanism currently in place that allows BC Hydro to purchase wholesale electricity in that manner.

Energy Supply Contract Considerations: Section 71(2.21) of the UCA

Section 71(2.21) of the UCA describes the factors the Commission must consider when assessing whether an ESC filed by BC Hydro is in the public interest.

Interests of BC Hydro Ratepayers

The first enumerated factor is whether the ESC is in "the interests of persons in British Columbia who receive or may receive service from the authority" (i.e., is the ESC in the

interest of BC Hydro's customers). BC Hydro submits that the 2019 Letter Agreement is in the interests of BC Hydro's customers for the reasons set out above.

1.1.1 Is it appropriate to state that an intent of the Letter Agreement is to maximize the value to ratepayers from energy purchases? Please explain why or why not.

RESPONSE:

BC Hydro's objective is to maximize the value to ratepayers from the operation of our system. That remains true whether we are purchasing energy using the 2003 TPA or by using the 2019 Letter Agreement.

The more specific purpose of the 2019 Letter Agreement is to mitigate physical supply risk and ensure BC Hydro can meet its operational needs as system or market conditions change. Risk mitigation is an important part of maximizing value to ratepayers.

The success of the 2019 Letter Agreement should be viewed by its risk mitigation as described in BC Hydro's response to AMPC IR 1.6.2.

Price Risk

Although the primary purpose of the 2019 Letter Agreement is to manage physical supply risk, not price risk, the 2019 Letter Agreement also mitigates price risk as a secondary benefit.

To the extent BC Hydro has an operational deficit or surplus, it is exposed to price risk because the price that BC Hydro pays to (receives from) Powerex for its purchases (sales) is based on market prices. This is the case under both the 2003 TPA and the 2019 Letter Agreement. In either case, BC Hydro leverages the flexibility in how it can operate its system storage to help minimize the cost to ratepayers.

Under the 2003 TPA, BC Hydro does this by setting the Threshold Purchase Price to acquire the economic import volumes during the expected lower priced days in a given time frame. Likewise, the Threshold Sale Price is set to target Surplus Sales in the expected higher priced days. BC Hydro uses the Energy Studies to inform the Threshold Purchase Price and Threshold Sale Price. The forward price curve information is an input to the Energy Studies.

However as noted above, the more specific purpose of the 2019 Letter Agreement is to mitigate physical supply risk and ensure BC Hydro can meet its operational needs as system or market conditions change.

Ahead of a given time period, no one knows whether the average day-ahead price for a given time period will be above or below the forward price curve for the same time period, nor how many days within that time period the day-ahead price will be above or below the forward price. The forward market curve merely represents the market's expectation of prices within a given delivery period as of a given date. These expectations change continuously up until the given period is complete,

based on numerous changing factors such as weather, natural gas prices, snow pack, etc. BC Hydro's assumption is that in general the forward price curve, which is based on financial forward contracts, has neither a premium nor a discount to the spot market (as these financial contracts settle against spot market prices).

However, the nature of price risk surrounding the average day-ahead price for a given period is not symmetric. In other words, of all the possible day-ahead prices that might materialize in a given period, there is generally the potential for prices to go much higher than the forward price curve than much lower. That is, the distribution of prices is skewed with a "longer tail" on the higher price side of the average expected price, as represented by the forward curve. For example, if the forward price for a given delivery period is $30/MWh, it may also turn out to be $100/MWh or $200/MWh or $500/MWh in the day-ahead market. Whereas prices in the day ahead market can only be below the $30/MWh by a more limited amount (i.e., prices may only be below $10-$15/MWh in very limited conditions such as the spring freshet). This is because generators can always curtail output rather than pay significantly negative prices for parties to take their energy. The consequence of this asymmetry is that the additional cost to BC Hydro of needing to purchase energy at day-ahead market prices (instead of on a forward basis) during a high priced tail event is much greater than the amount that may potentially be saved by purchasing energy at day-ahead market prices in a low-price environment (assuming sufficient liquidity is available).

The 2019 Letter Agreement provides price risk mitigation against this asymmetry in addition to the mitigation of the physical supply risk. However, in any given delivery period, BC Hydro may still end up procuring energy at higher prices under the 2019 Letter Agreement than the prices that ultimately transpire in the day-ahead time frame (notwithstanding the liquidity challenges and risk).

1.0 Reference: Exhibit B-1, page 3 and page 8

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In summary, the 2019 Letter Agreement is an additional tool for BC Hydro to employ to address short-term operational requirements. It does so by allowing BC Hydro to secure physical wholesale electricity from Powerex on a forward basis (ie outside of the pre-schedule day-ahead wholesale markets) but still within the operating time horizon. There is no other mechanism currently in place that allows BC Hydro to purchase wholesale electricity in that manner.

Energy Supply Contract Considerations: Section 71(2.21) of the UCA

Section 71(2.21) of the UCA describes the factors the Commission must consider when assessing whether an ESC filed by BC Hydro is in the public interest.

Interests of BC Hydro Ratepayers

The first enumerated factor is whether the ESC is in "the interests of persons in British Columbia who receive or may receive service from the authority" (i.e., is the ESC in the

interest of BC Hydro's customers). BC Hydro submits that the 2019 Letter Agreement is in the interests of BC Hydro's customers for the reasons set out above.

1.1.2 Is it appropriate to state that ratepayers can expect to experience significant benefits from the Powerex Letter Agreement? Please explain and quantify any benefits to the extent possible.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.1.1.

1.0 Reference: Exhibit B-1, page 3 and page 8

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1.1.2 Is it appropriate to state that ratepayers can expect to experience significant benefits from the Powerex Letter Agreement? Please explain and quantify any benefits to the extent possible.

1.1.2.1 Please discuss any benefits that BC Hydro expects may or may not accrue to ratepayers as a result of the Letter Agreement and explain why those benefits might or might not occur.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.1.1.

1.0 Reference: Exhibit B-1, page 3 and page 8

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1.1.2 Is it appropriate to state that ratepayers can expect to experience significant benefits from the Powerex Letter Agreement? Please explain and quantify any benefits to the extent possible.

1.1.2.2 Please identify any risks that could accrue to ratepayers as a result of the Letter Agreement and explain why those risks might or might not occur.

RESPONSE:

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1.1.2.2 Please identify any risks that could accrue to ratepayers as a result of the Letter Agreement and explain why those risks might or might not occur.

1.1.2.2.1 Please quantify any risks to the extent possible.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.1.1.

1.0 Reference: Exhibit B-1, page 3 and page 8

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1.1.3 Please confirm that Powerex will work to purchase wholesale electricity at the lowest possible price on behalf of BC Hydro, up to the maximum specified by BC Hydro, rather than purchasing at the maximum if possible.

RESPONSE:

The principles behind of the Contract Price in the 2019 Letter Agreement, similar to the Transfer Price in the 2003 TPA, is to reflect the price at which third parties would be willing to transact act for a similar product. In other words, for a given product it reflects the price that Powerex could sell to any party in the Pacific Northwest. Consequently, it also reflects the price at which BC Hydro could purchase from a third-party if it were a participant directly in the market. It is a price established by the market, not by Powerex. As stated in the paragraph 5 of the 2019 Letter Agreement: "Powerex will … use commercially reasonable efforts to sell and deliver electricity on a forward basis to BC Hydro within the limitations set forth in the then current Purchase Interest Request(s)…".

1.0 Reference: Exhibit B-1, page 3 and page 8

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1.1.3.1 If not confirmed, please explain why not.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.1.3.

2.0 Reference: Exhibit B-1, page 3 and 4 and Appendix 3, page 4-15

Roles of BC Hydro and Powerex

The decisions from time to time to acquire forward wholesale electricity from Powerex through the issuance of a Purchase Interest Request are solely those of BC Hydro.

BC Hydro makes such purchase decisions within the usual operational management framework it employs to make all dispatch and other system operation decisions. BC Hydro's operational management framework is described in the F20-F21 RRA. To avoid duplicating evidence already before the Commission on the same topic, BC Hydro has attached as Appendix 3 to this application section 4.4 of the F20-F21 RRA ("Maximizing the Value of Our Energy Supply") and the IR responses in regard to that section. That evidence provides a fulsome account of how BC Hydro manages its generation system in the operational time horizon to cost-effectively meet its load-serving obligations.

At the beginning of each Energy Study, Powerex provides BC Hydro with forward market price curves for electricity at Mid-C and gas prices at Sumas. The Energy Study uses these forward curves as a starting point and then adds variability to these prices to capture an expected range of price uncertainty.

1.2.1 Please comment on the presumed accuracy of the forward market price curves provided to BC Hydro.

RESPONSE:

BC Hydro is unsure of what the requestor means when they refer to "presumed accuracy" of the forward market price curves. The forward market price curves used by BC Hydro in its energy studies are from the Intercontinental Exchange (ICE). Please refer to BC Hydro's response to CEC IR 1.1.1 for a description of the forward price curve.

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1.2.2 Do BC Hydro and Powerex communicate beyond the provision of the forward market price curves and the ordering process in order to maximize the potential benefits to BC Hydro and ratepayers? Please explain why or why not.

RESPONSE:

BC Hydro Generation System Operations and Powerex regularly discuss a variety of topics including current and future system operations, current and future market conditions, and current and future potential import and export activity. This communication is essential to supporting BC Hydro's objective to maximize the value of the BC Hydro system and Powerex's role as the entity that participates in external wholesale electricity markets.

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1.2.2 Do BC Hydro and Powerex communicate beyond the provision of the forward market price curves and the ordering process in order to maximize the potential benefits to BC Hydro and ratepayers? Please explain why or why not.

1.2.2.1 What, if any, other types of information other than forward price curves are, or could be, provided to BC Hydro.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.2.2.

3.0 Reference: Exhibit B-1, pages 5-6 and Southern Intertie Data Report page 27

Over the past decade there has been a steady decline in the volume of wholesale electricity traded on a day-ahead basis in the Pacific Northwest; that was one of the factors that prompted the 2018 Letter Agreement as a solution to the impending electricity supply issue BC Hydro faced in winter of 2018/2019, rather than attempting to rely on day-ahead purchases under the 2003 TPA. In response to BCUC IR 1.8.1.1 in the proceeding regarding that agreement, BC Hydro filed graphs showing declines in liquidity for both on-peak and off-peak hours at the Mid-Columbia wholesale electricity trading hub. Those graphs are reproduced here:[10]

10. Market Liquidity

Figure 10.1: Mid-C Liquidity (Day-Ahead Peak)

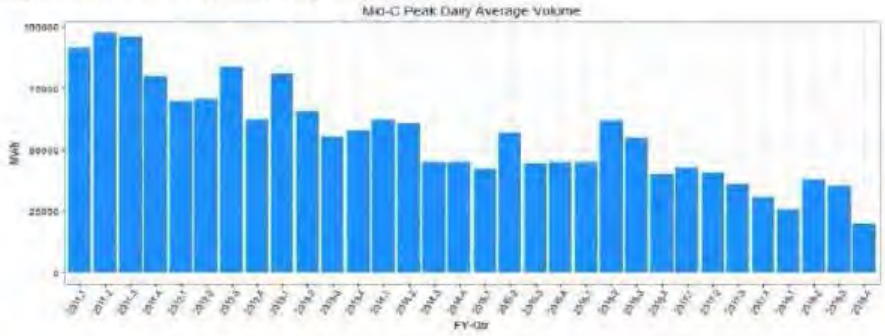
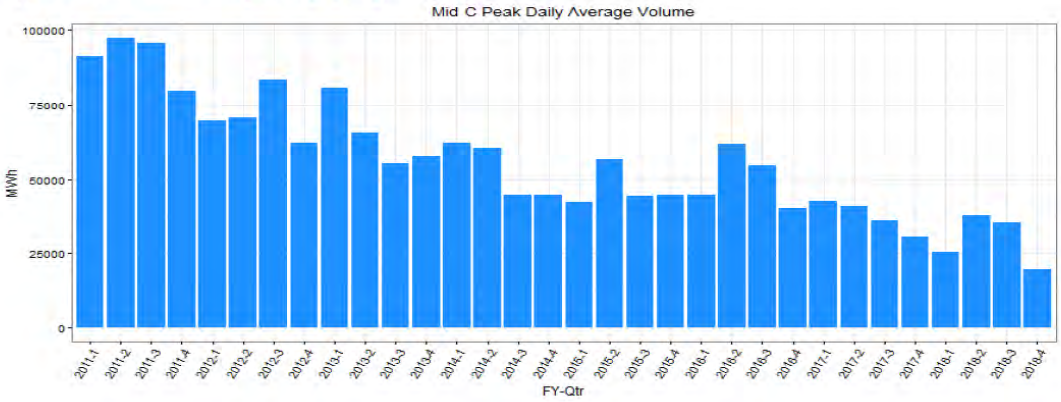


Figure 10.2: Mid-C Liquidity (Day-Ahead Off-Peak)

10. Market Liquidity

Figure 10.1:Mid-C Liquidity (Day-Ahead Peak)



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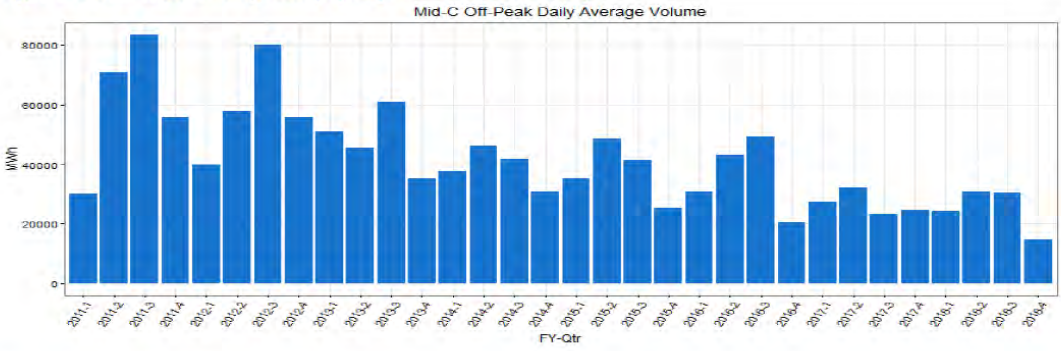
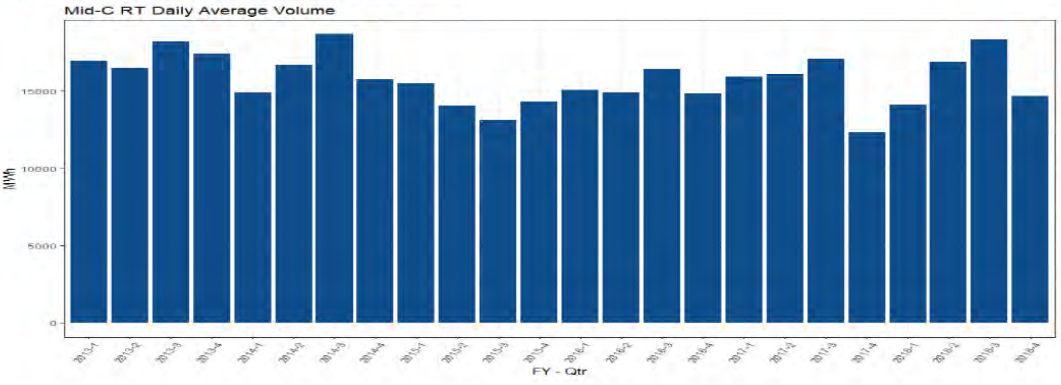


Figure 10.3: Mid-C Liquidity (Real Time)



Day-Ahead volume based on ICE data. Real time volume based on Powerdex.

1.3.1 Please confirm that trading volumes are a good proxy for market liquidity.

RESPONSE:

Trading volumes are a good metric for the volumetric depth of the market as they are indicative of the opportunities available to market participants to purchase or sell wholesale electricity, as needed or desired, which is generally considered the applicable market's market liquidity.

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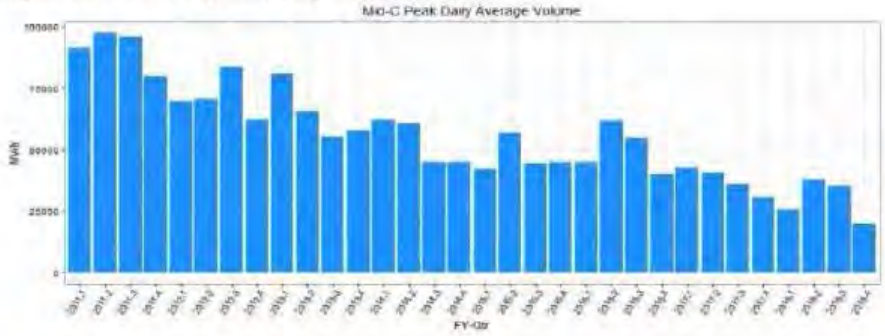

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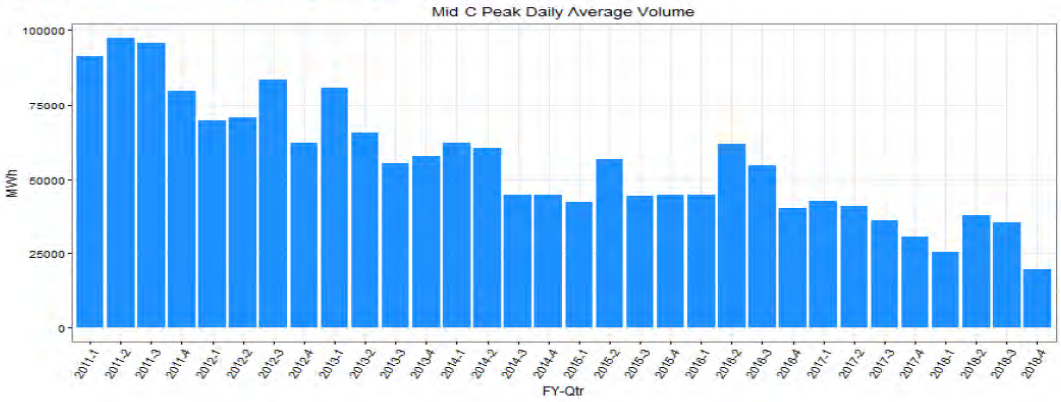

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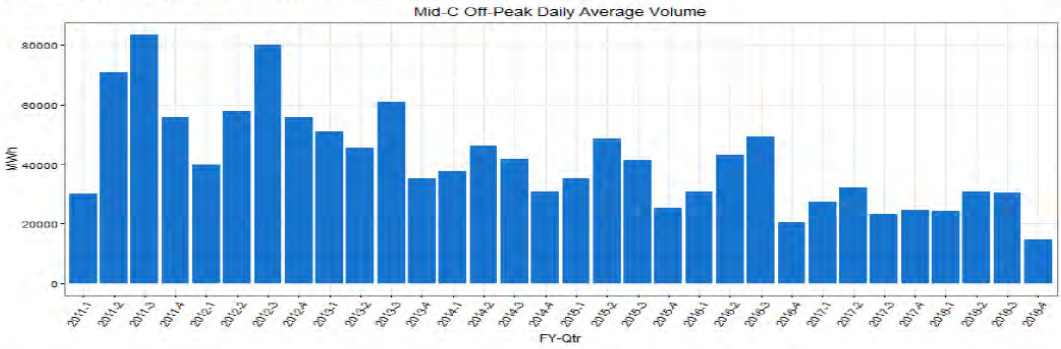
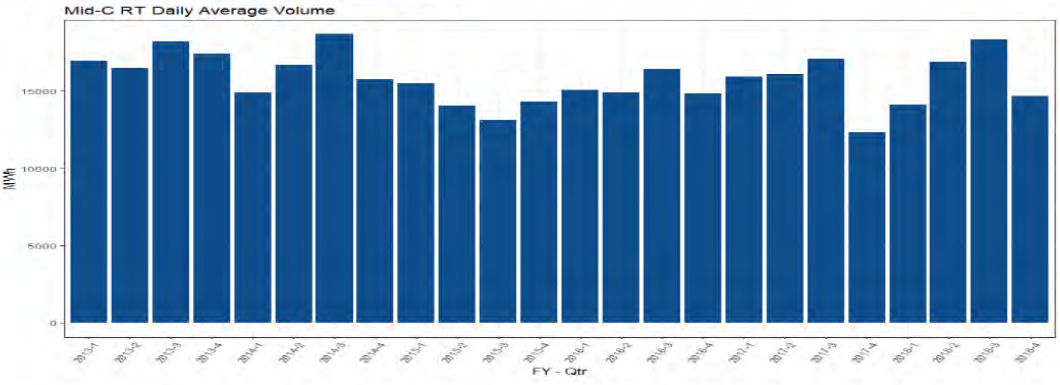


Figure 10.3: Mid-C Liquidity (Real Time)



Day-Ahead volume based on ICE data. Real time volume based on Powerdex.

1.3.2 Please provide BC Hydro's views as to why Day-Ahead Peak trading volumes have been declining for a decade.

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.2.3, which provides BC Hydro's understanding of the causes of the long-term decline of liquidity.

3.0 Reference: Exhibit B-1, pages 5-6 and Southern Intertie Data Report page 27

Over the past decade there has been a steady decline in the volume of wholesale electricity traded on a day-ahead basis in the Pacific Northwest; that was one of the factors that prompted the 2018 Letter Agreement as a solution to the impending electricity supply issue BC Hydro faced in winter of 2018/2019, rather than attempting to rely on day-ahead purchases under the 2003 TPA. In response to BCUC IR 1.8.1.1 in the proceeding regarding that agreement, BC Hydro filed graphs showing declines in liquidity for both on-peak and off-peak hours at the Mid-Columbia wholesale electricity trading hub. Those graphs are reproduced here:[10]

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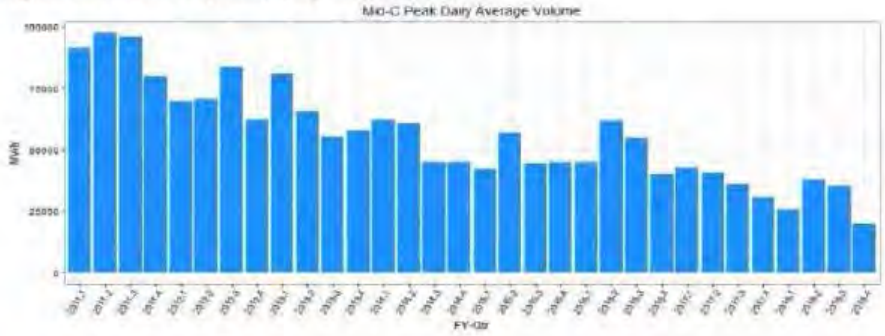

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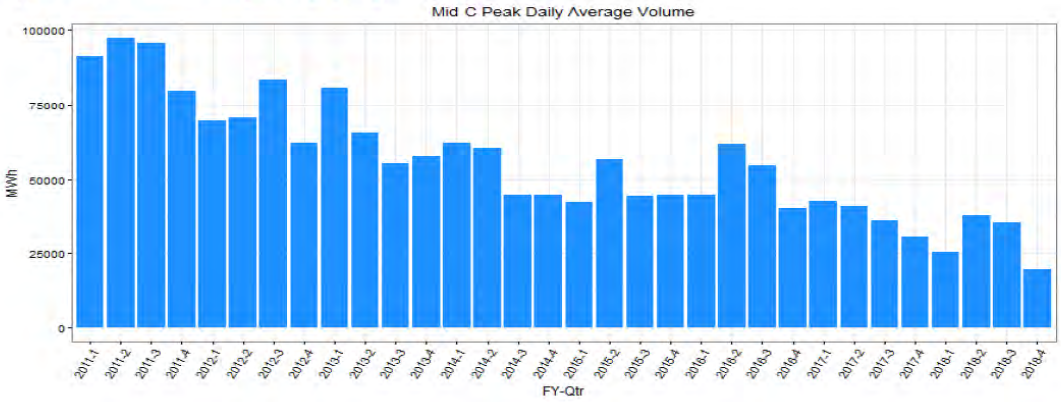

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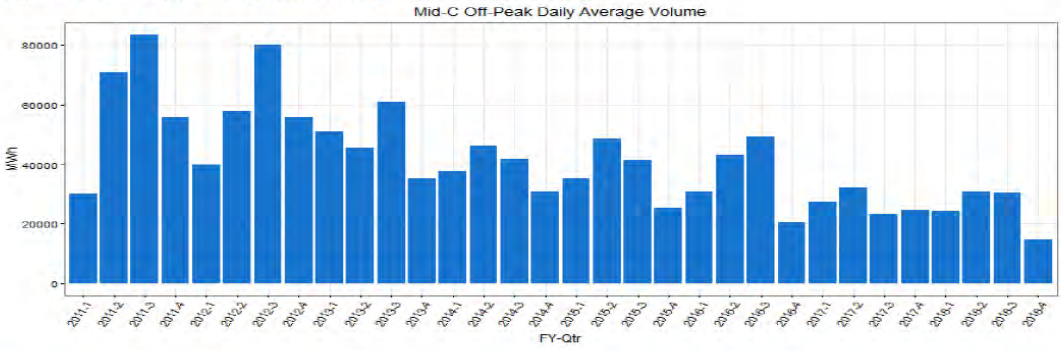

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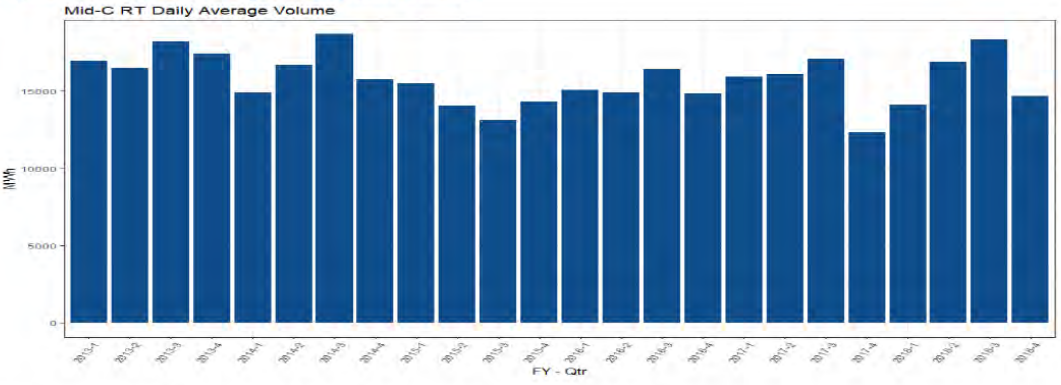

Day-Ahead volume based on ICE data. Real time volume based on Powerdex.

1.3.2 Please provide BC Hydro's views as to why Day-Ahead Peak trading volumes have been declining for a decade.

1.3.2.1 Please provide historical reports dating back 20 years if available.

RESPONSE:

The above referenced figures are from a publicly available document produced by the Bonneville Power Administration. The U.S. Energy Information Administration (EIA) publicly posts wholesale electricity data back to 2001 which includes Mid-C trade volumes for peak hours.

https://www.eia.gov/electricity/wholesale/#history

Off-peak trade volumes are not available on the EIA website. ICE publishes off-peak trade volumes for Mid-C which are available to their paid service subscribers who are subject to their strict confidentiality restrictions over use of this data. Accordingly, BC Hydro is not able to provide those Mid-C off-peak trade volumes.

3.0 Reference: Exhibit B-1, pages 5-6 and Southern Intertie Data Report page 27

Over the past decade there has been a steady decline in the volume of wholesale electricity traded on a day-ahead basis in the Pacific Northwest; that was one of the factors that prompted the 2018 Letter Agreement as a solution to the impending electricity supply issue BC Hydro faced in winter of 2018/2019, rather than attempting to rely on day-ahead purchases under the 2003 TPA. In response to BCUC IR 1.8.1.1 in the proceeding regarding that agreement, BC Hydro filed graphs showing declines in liquidity for both on-peak and off-peak hours at the Mid-Columbia wholesale electricity trading hub. Those graphs are reproduced here:[10]

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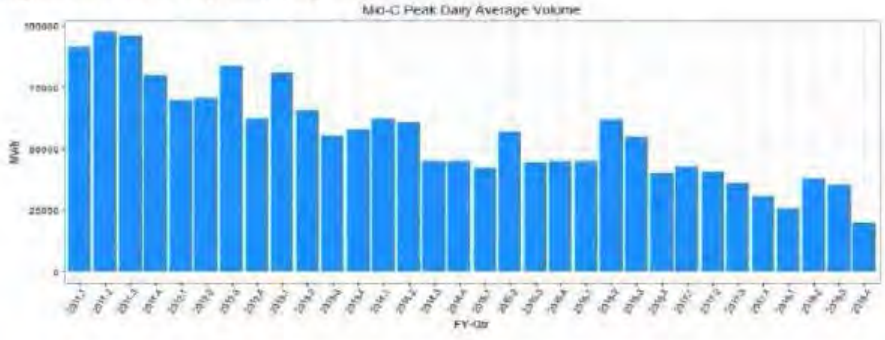

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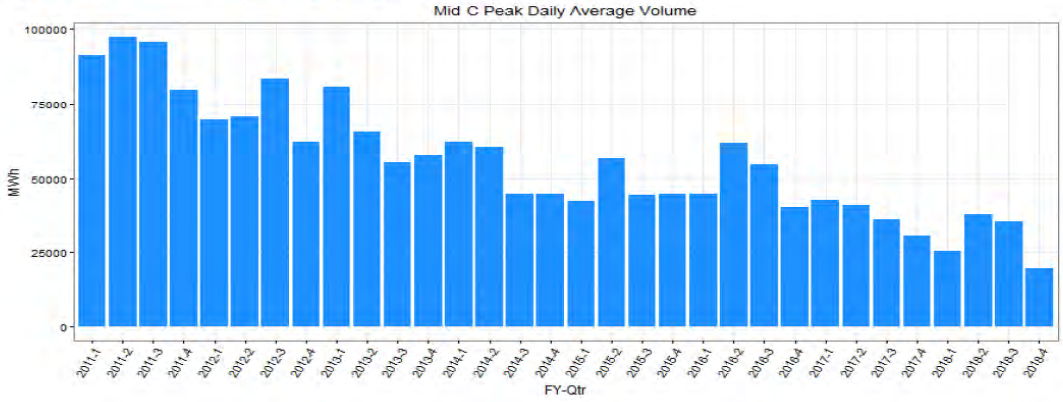

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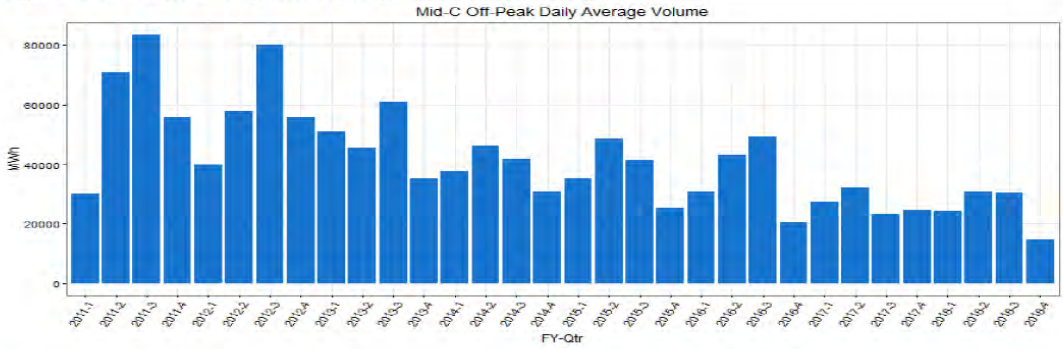
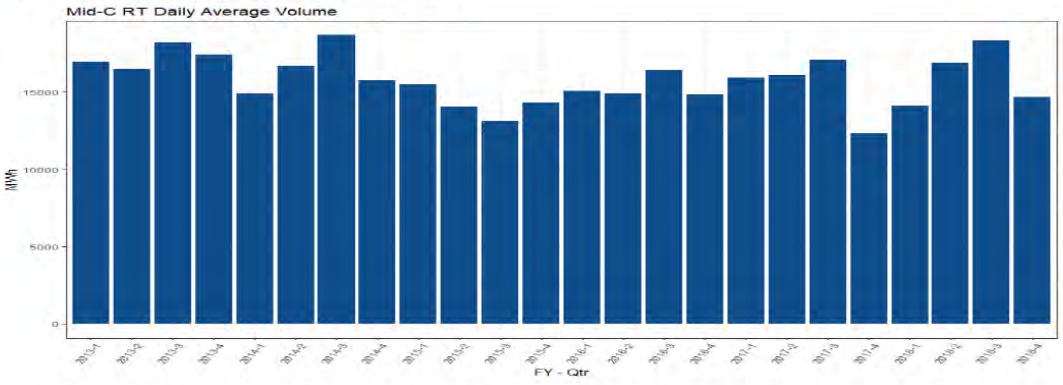


Figure 10.3: Mid-C Liquidity (Real Time)



Day-Ahead volume based on ICE data. Real time volume based on Powerdex.

1.3.2 Please provide BC Hydro's views as to why Day-Ahead Peak trading volumes have been declining for a decade.

1.3.2.1 Please provide historical reports dating back 20 years if available.

1.3.2.1.1 Please comment on the trends seen dating back 20 years and their relevance to the application.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.3.2.1 where we explain that BC Hydro is not able to provide Mid-C off-peak volumes and BCUC IR 1.3.2. As explained in the Application, declining day-ahead Mid-C liquidity continues to be a concern and is one of the reasons for the 2019 Letter Agreement. Please also refer to BC Hydro's response to BCUC IR 1.2.6 where we note that a representative of Portland General Electric also addressed the issue at the Spring 2019 Joint CREPC-WIRAB Meeting in a session discussing Portland General's integrated resource planning approach.

3.0 Reference: Exhibit B-1, pages 5-6 and Southern Intertie Data Report page 27

Over the past decade there has been a steady decline in the volume of wholesale electricity traded on a day-ahead basis in the Pacific Northwest; that was one of the factors that prompted the 2018 Letter Agreement as a solution to the impending electricity supply issue BC Hydro faced in winter of 2018/2019, rather than attempting to rely on day-ahead purchases under the 2003 TPA. In response to BCUC IR 1.8.1.1 in the proceeding regarding that agreement, BC Hydro filed graphs showing declines in liquidity for both on-peak and off-peak hours at the Mid-Columbia wholesale electricity trading hub. Those graphs are reproduced here:[10]

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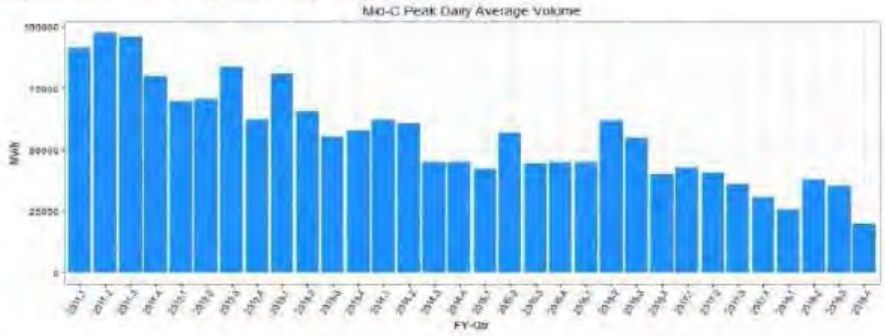

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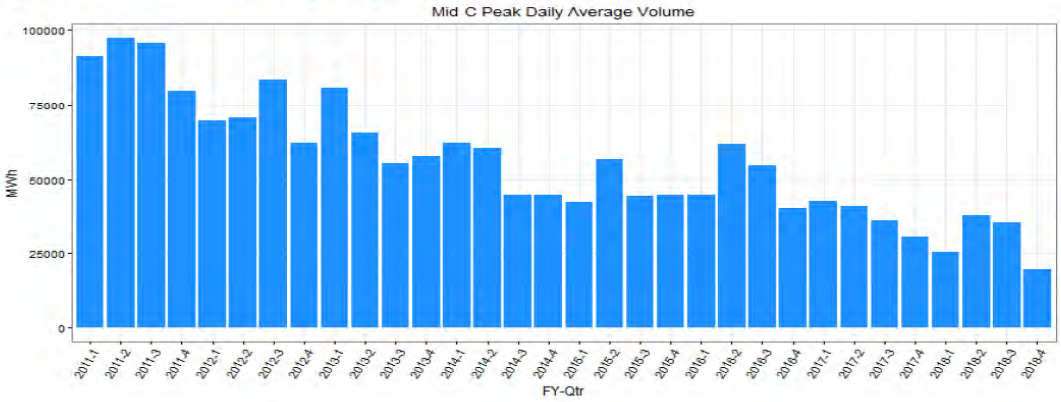

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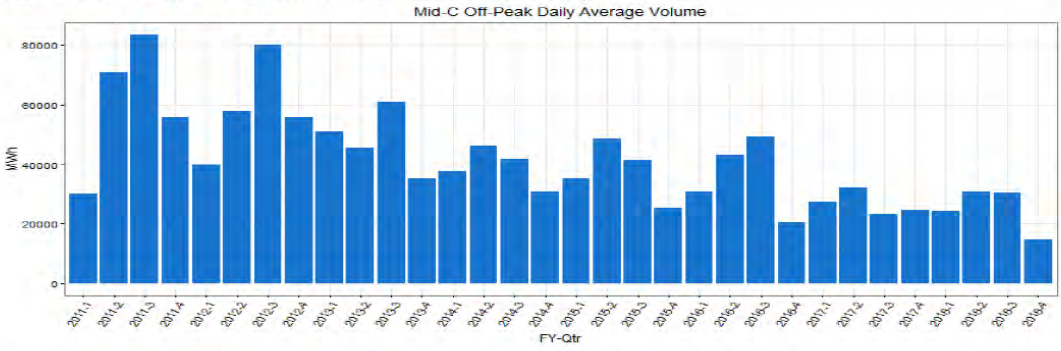
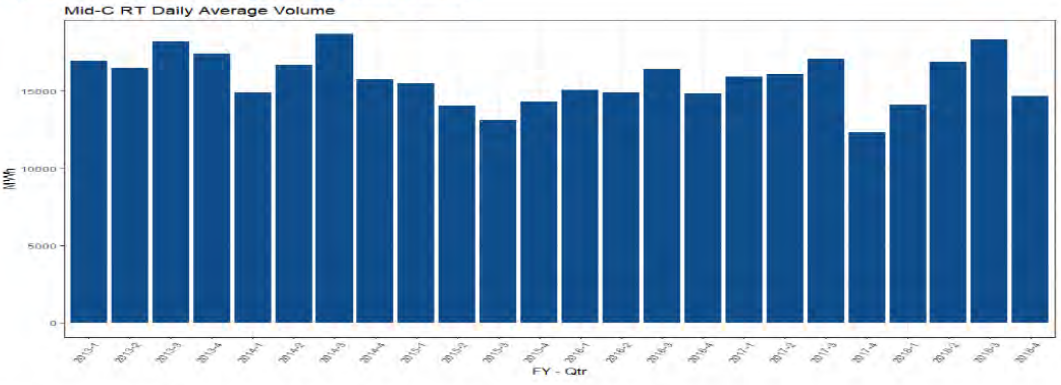


Figure 10.3: Mid-C Liquidity (Real Time)



Day-Ahead volume based on ICE data. Real time volume based on Powerdex.

1.3.3 Please provide BC Hydro's views as to why Day-Ahead Off-Peak trading volumes have been declining since about 2012.

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.2.3, which provides BC Hydro's understanding of the causes of the long-term decline of liquidity.

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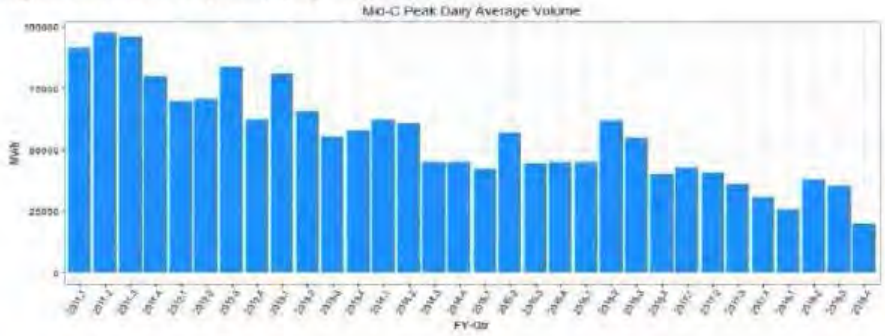

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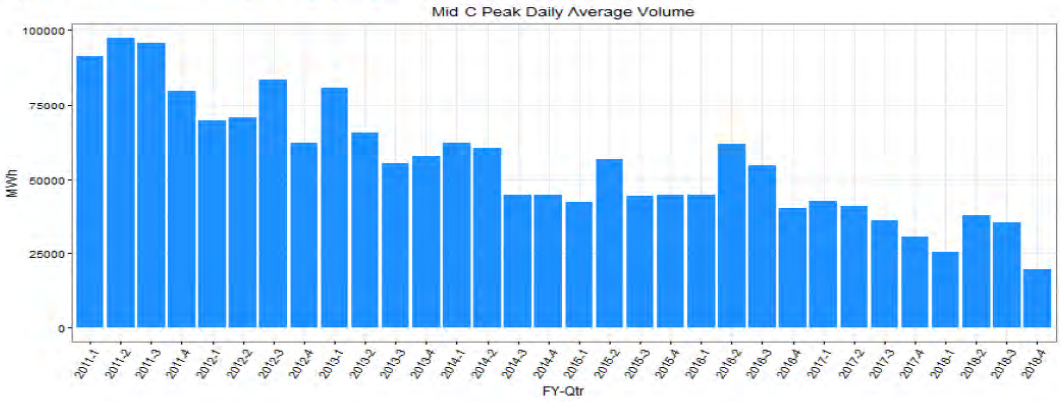

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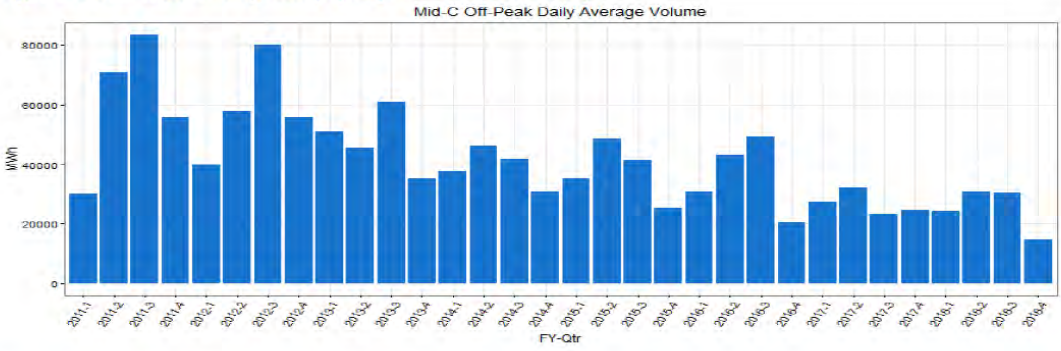

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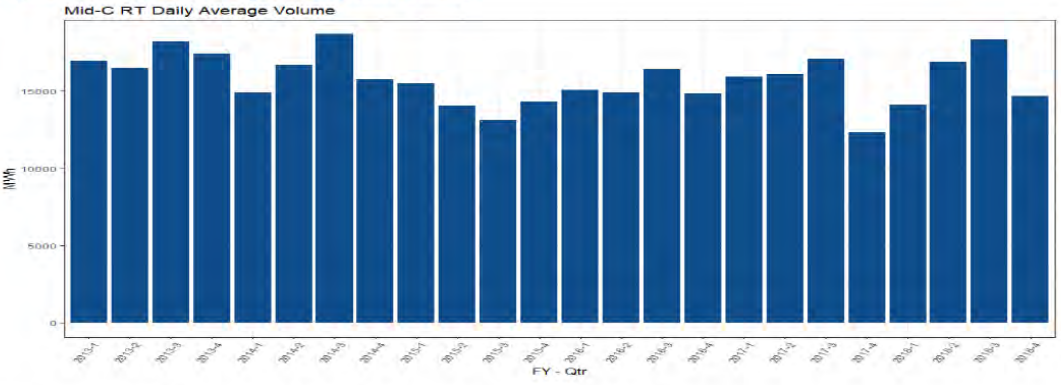

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1.3.3 Please provide BC Hydro's views as to why Day-Ahead Off-Peak trading volumes have been declining since about 2012.

1.3.3.1 Please provide historical reports dating back 20 years if available.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.3.2.1.

3.0 Reference: Exhibit B-1, pages 5-6 and Southern Intertie Data Report page 27

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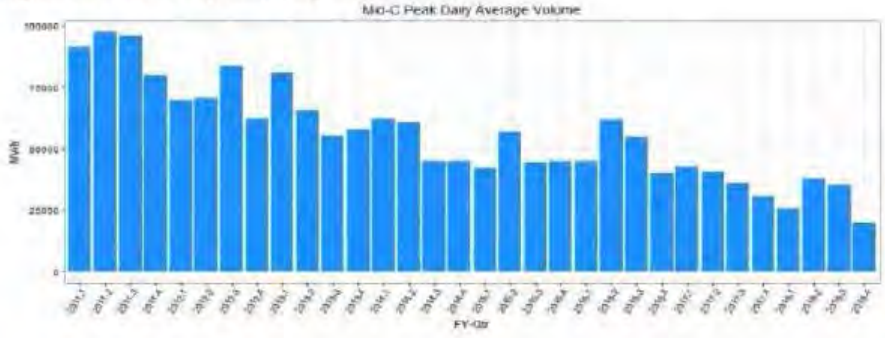

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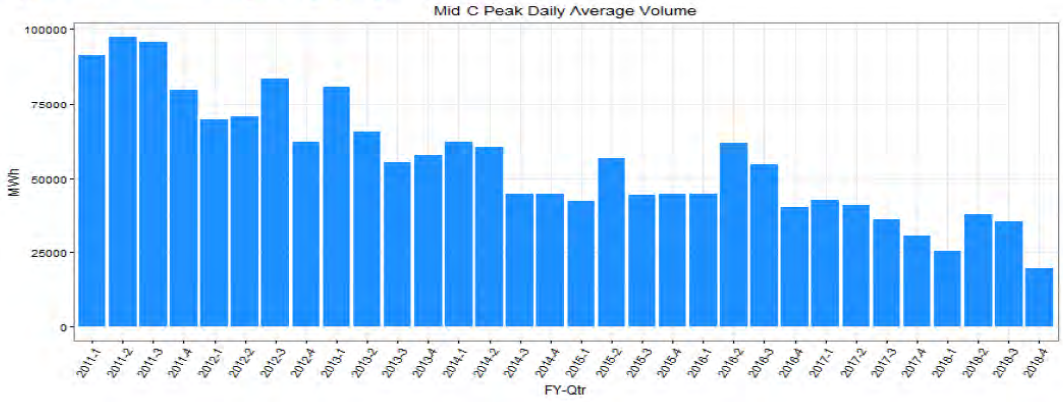

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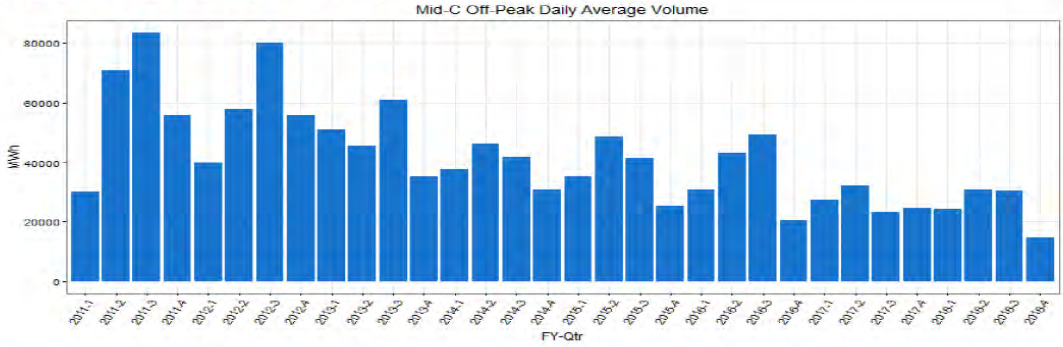

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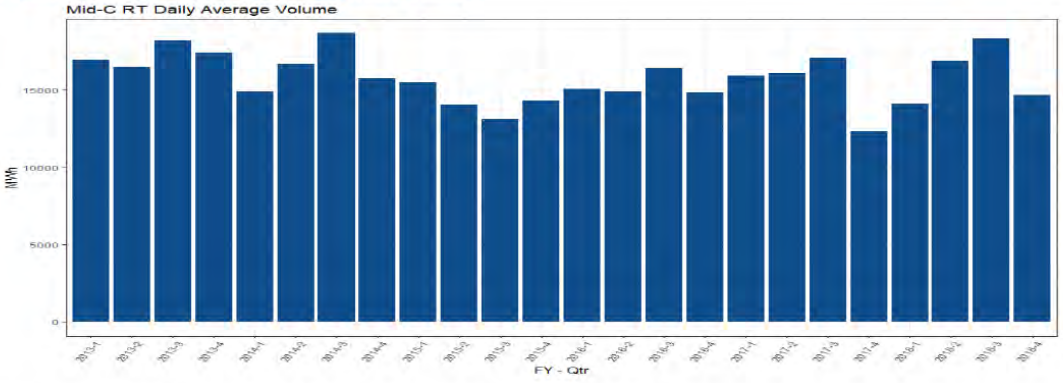

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1.3.3.1 Please provide historical reports dating back 20 years if available.

1.3.3.1.1 Please comment on the trends seen dating back 20 years and their relevance to the application.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.3.2.1.1.

3.0 Reference: Exhibit B-1, pages 5-6 and Southern Intertie Data Report page 27

Over the past decade there has been a steady decline in the volume of wholesale electricity traded on a day-ahead basis in the Pacific Northwest; that was one of the factors that prompted the 2018 Letter Agreement as a solution to the impending electricity supply issue BC Hydro faced in winter of 2018/2019, rather than attempting to rely on day-ahead purchases under the 2003 TPA. In response to BCUC IR 1.8.1.1 in the proceeding regarding that agreement, BC Hydro filed graphs showing declines in liquidity for both on-peak and off-peak hours at the Mid-Columbia wholesale electricity trading hub. Those graphs are reproduced here:[10]

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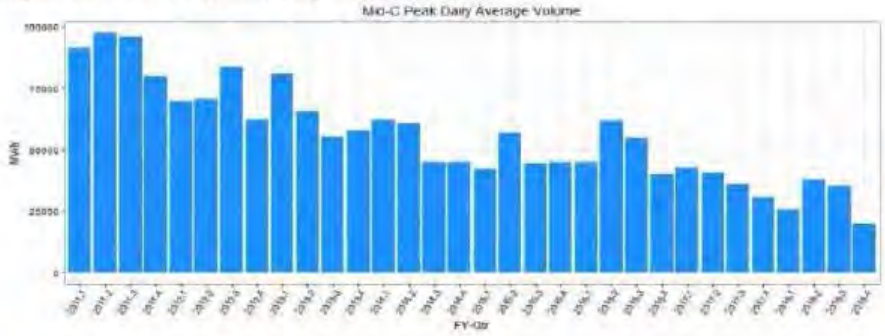

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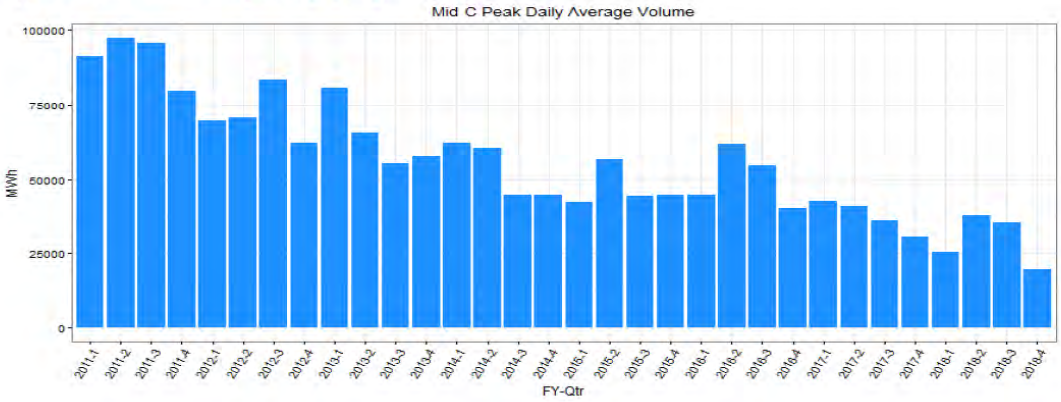

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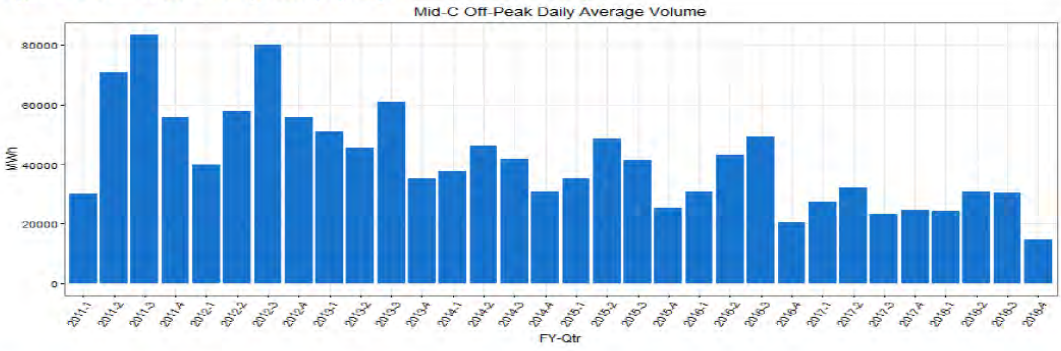

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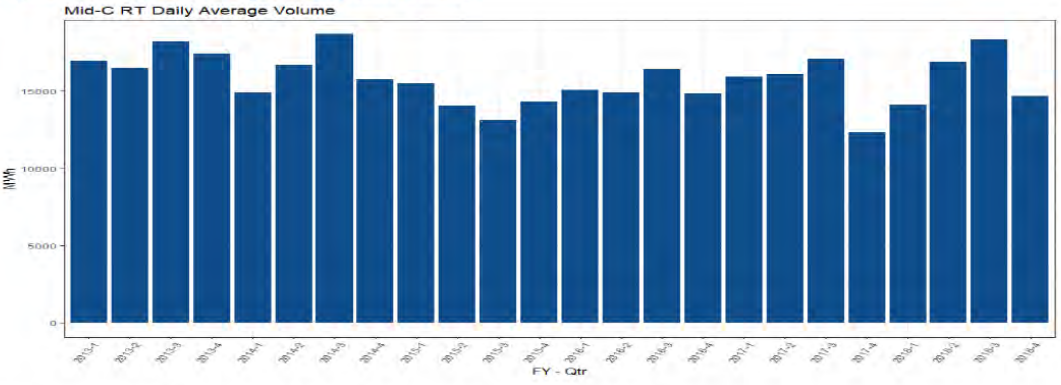

Day-Ahead volume based on ICE data. Real time volume based on Powerdex.

1.3.4 Please explain the relevance of Figure 10: Mid-C Liquidity (Real Time) provided in the Southern Intertie Data report and how its relative stability relates to Day-Ahead volumes, if at all.

RESPONSE:

The Real Time bilateral market is an additional, but limited, opportunity to purchase and sell wholesale electricity. The Real Time bilateral market is predominantly an imbalance market where entities may seek to purchase or sell wholesale electricity in response to changing conditions relative to the day ahead expectations (e.g., weather, demand, unit outages, etc.). As a result, in some hours in the Real Time bilateral market, entities may be predominantly seeking to sell energy, in other hours, entities may predominantly be seeking to purchase energy, and in some hours there may be little, if any, entities seeking to transact. The key driver of Real Time bilateral market opportunities are changes in conditions from day ahead expectations, and it is thus best viewed as a market with potential opportunities to transact, but not a market with consistent opportunities to purchase or sell significant volumes.

The Day-Ahead market, in contrast, is the primary opportunity for each entity to purchase and sell physical energy to meet their individual needs each day, including making transactions that increase or decrease their unit commitment decisions. Unlike the Real Time bilateral market where most transactions occur through bilateral phone calls, Day-Ahead market activity primarily occurs through electronic exchanges and broker markets.

These key differences means that the factors that may be contributing to the decline of day-ahead liquidity, as noted in BC Hydro's response to BCUC IR 1.2.3, do not apply necessarily in the same way to the Real Time bilateral market.

In addition, it is important to note that the scales on each chart are different. For the Real Time chart the daily average volume shown is lower than in the Daily Off-Peak chart for all but the last quarter (Fourth Quarter of 2018) and well below any quarter of the Daily On-Peak chart.

4.0 Reference: Exhibit B-1, page 6

> On a go-forward basis BC Hydro observes that, since the beginning of the current fiscal year, it has continued to have low system inflows, and has no basis to believe that the long-term decline in day-ahead market liquidity will quickly reverse itself. There are numerous other events that could result in similar supply shortfalls that threatened BC Hydro last winter, which may not reliably be addressed through purchases from Powerex on a day-ahead basis under the 2003 TPA. In these circumstances, BC Hydro believes it is prudent and in the interests of its ratepayers to have in place an additional mechanism that will allow it to respond to system conditions and reliably manage potential electricity shortages in a timely and cost-effective way. The 2019 Letter Agreement serves this objective.

1.4.1 Please elaborate on the 'numerous other events' that could result in similar supply shortfalls and provide their potential impact.

RESPONSE:

BC Hydro plans its system to meet reliability planning standards. There are always additional low probability and high consequence events that could occur for which having the ability to make forward physical energy purchases would be beneficial, including but not limited to the following examples:

- **A significant and prolonged unplanned outage of generating equipment at a major BC Hydro plant;**
- **A significant and prolonged unplanned outage on all lines within one of BC Hydro's 500 kV transmission corridors; or**
- **A significant dam or powerhouse incident at one of the BC Hydro dams on the Peace or Columbia rivers.**

Each of these events has a range of severity and timing implications depending on the specific situation.

4.0 Reference: Exhibit B-1, page 6

> On a go-forward basis BC Hydro observes that, since the beginning of the current fiscal year, it has continued to have low system inflows, and has no basis to believe that the long-term decline in day-ahead market liquidity will quickly reverse itself. There are numerous other events that could result in similar supply shortfalls that threatened BC Hydro last winter, which may not reliably be addressed through purchases from Powerex on a day-ahead basis under the 2003 TPA. In these circumstances, BC Hydro believes it is prudent and in the interests of its ratepayers to have in place an additional mechanism that will allow it to respond to system conditions and reliably manage potential electricity shortages in a timely and cost-effective way. The 2019 Letter Agreement serves this objective.

1.4.2 BC Hydro states that it 'has no basis to believe that the long-term decline… will quickly reverse itself'. Does BC Hydro have any basis to believe that it will continue to decline, or stabilize? Please explain and provide any evidence BC Hydro has available.

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.2.3, which provides BC Hydro's understanding of the causes of the long-term decline of liquidity.

Please also refer to BC Hydro's response to BCUC IR 1.2.6 where BC Hydro notes that a representative of Portland General Electric also addressed the issue at the Spring 2019 Joint CREPC-WIRAB Meeting in a session discussing Portland General's integrated resource planning approach.

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1.4.3 What information does BC Hydro use to make determinations as to whether or not market liquidity will continue current trends, stabilize or reverse?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.2.3 for a discussion on BC Hydro's views on market liquidity. Powerex, as the external market participant, monitors market trends and provides this information to BC Hydro.

4.0 Reference: Exhibit B-1, page 6

> On a go-forward basis BC Hydro observes that, since the beginning of the current fiscal year, it has continued to have low system inflows, and has no basis to believe that the long-term decline in day-ahead market liquidity will quickly reverse itself. There are numerous other events that could result in similar supply shortfalls that threatened BC Hydro last winter, which may not reliably be addressed through purchases from Powerex on a day-ahead basis under the 2003 TPA. In these circumstances, BC Hydro believes it is prudent and in the interests of its ratepayers to have in place an additional mechanism that will allow it to respond to system conditions and reliably manage potential electricity shortages in a timely and cost-effective way. The 2019 Letter Agreement serves this objective.

1.4.3 What information does BC Hydro use to make determinations as to whether or not market liquidity will continue current trends, stabilize or reverse?

1.4.3.1 When and how does BC Hydro seek out such information and make its determinations?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.2.3. Powerex, as the external market participant, monitors market trends and provides this information to BC Hydro.

5.0 Reference: Exhibit B-1, page 6

> Finally, it is apparent that an alternative solution to the on-going operational supply issues arising from the liquidity decline in day-ahead markets would be a revised Transfer Pricing Agreement. BC Hydro and Powerex are considering updating the 2003 TPA, including considering how the 2003 TPA might usefully be revised to accommodate forward transactions. That consideration is underway, but is not a trivial exercise because of the central role that the 2003 TPA plays in the BC Hydro-Powerex relationship. Nevertheless, and to the extent that Powerex and BC Hydro do update the 2003 TPA for that purpose, the 2019 Letter Agreement can be considered a bridging mechanism.

1.5.1 Please discuss the advantages and disadvantages of a revised Transfer Pricing Agreement versus the proposed Powerex Letter Agreement.

RESPONSE:

Both the 2019 Letter Agreement as well as a revised TPA are workable approaches to enabling BC Hydro to secure import supply on a forward basis from Powerex to meet BC Hydro's operational needs and risks. Both approaches provide BC Hydro with a means to addressing the challenges with the declining and uncertain day ahead market liquidity in the context of BC Hydro's periodic operational need to secure import supply.

However, the 2019 Letter Agreement is limited in its applicability and usefulness as it is only available for BC Hydro purchases not sales, and is only applicable to forward import commitments that are made pursuant to requests issued by BC Hydro (in response to operational supply needs and risks).

In contrast, a revised TPA may provide several additional benefits to the 2019 Letter Agreement. For example, it could be structured to also enable forward export commitments in response to operational surplus energy needs and risks. In addition, a revised TPA could also be used to enable Powerex to utilize the residual capabilities of the BC Hydro system to import and export power on a forward basis for trade in response to market opportunities, addressing the limitations inherent in the one day at a time approach of the 2003 TPA. This is in contrast to the 2019 Letter Agreement where such forward activity is limited by the timing and volume of BC Hydro's requests to secure forward supply commitments.

For all of these reasons, BC Hydro and Powerex are currently working on a revised TPA, which is expected to be filed this winter. The key advantage of the 2019 Letter Agreement to a revised TPA is that it was able to be crafted and implemented quickly, whereas a revised TPA takes more time to develop and implement. Accordingly, the 2019 Letter Agreement is expected to be a bridging agreement until a revised TPA is finalized and implemented.

5.0 Reference: Exhibit B-1, page 6

> Finally, it is apparent that an alternative solution to the on-going operational supply issues arising from the liquidity decline in day-ahead markets would be a revised Transfer Pricing Agreement. BC Hydro and Powerex are considering updating the 2003 TPA, including considering how the 2003 TPA might usefully be revised to accommodate forward transactions. That consideration is underway, but is not a trivial exercise because of the central role that the 2003 TPA plays in the BC Hydro-Powerex relationship. Nevertheless, and to the extent that Powerex and BC Hydro do update the 2003 TPA for that purpose, the 2019 Letter Agreement can be considered a bridging mechanism.

1.5.2 Please explain why BC Hydro believes it would be useful to update the 2003 TPA and treat the 2019 Letter Agreement as a bridging mechanism, rather than relying on the Powerex Letter Agreement indefinitely.

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.5.1.

5.0 Reference: Exhibit B-1, page 6

> Finally, it is apparent that an alternative solution to the on-going operational supply issues arising from the liquidity decline in day-ahead markets would be a revised Transfer Pricing Agreement. BC Hydro and Powerex are considering updating the 2003 TPA, including considering how the 2003 TPA might usefully be revised to accommodate forward transactions. That consideration is underway, but is not a trivial exercise because of the central role that the 2003 TPA plays in the BC Hydro-Powerex relationship. Nevertheless, and to the extent that Powerex and BC Hydro do update the 2003 TPA for that purpose, the 2019 Letter Agreement can be considered a bridging mechanism.

1.5.3 When does BC Hydro expect that it would update the 2003 TPA?

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.5.1 where BC Hydro states that it is targeting submitting an application for an updated TPA this winter.

5.0 Reference: Exhibit B-1, page 6

> Finally, it is apparent that an alternative solution to the on-going operational supply issues arising from the liquidity decline in day-ahead markets would be a revised Transfer Pricing Agreement. BC Hydro and Powerex are considering updating the 2003 TPA, including considering how the 2003 TPA might usefully be revised to accommodate forward transactions. That consideration is underway, but is not a trivial exercise because of the central role that the 2003 TPA plays in the BC Hydro-Powerex relationship. Nevertheless, and to the extent that Powerex and BC Hydro do update the 2003 TPA for that purpose, the 2019 Letter Agreement can be considered a bridging mechanism.

1.5.4 Please elaborate on the difficulties faced updating the 2003 TPA.

RESPONSE:

Updating the 2003 TPA is a significantly longer process than implementing the 2018 or 2019 Letter Agreements due to the complexity of the TPA. The 2018 and 2019 Letter Agreements considered only one type of transaction between BC Hydro and Powerex - a forward physical purchase by BC Hydro from Powerex.

In contrast, the 2003 TPA encompasses a broader relationship between BC Hydro and Powerex. This includes both purchase and sale transactions, both electricity and natural gas transactions, as well as accounting attribution between entities for these transactions. So the considerations required to update the 2003 TPA are much broader than the forward physical purchase issue considered under the 2019 Letter Agreement.

In addition, there are currently resource constraints limiting work on updating the 2003 TPA, as the BC Hydro Operations and Finance employees working on updating the 2003 TPA have been working on the F20-F21 RRA.

6.0 Reference: Exhibit B-1, page 8

> 2013 IRP
>
> The Commission must also consider BC Hydro's 2013 Integrated Resource Plan (**2013 IRP**).[12] Like the 2018 Letter Agreement, the purpose of the 2019 Letter Agreement is to enable BC Hydro to address electricity supply issues in the operational time horizon. The 2013 IRP is a long-term planning document that, among other things, assumes average inflows and no reliance on imports to serve domestic load, regardless of BC Hydro's needs in the operational time horizon. In BC Hydro's submission the 2013 IRP is not relevant to the Commission's assessment of the 2019 Letter Agreement.

1.6.1 Please elaborate on BC Hydro's statement that: 'The 2013 IRP is a long-term planning document…regardless of BC Hydro's needs in the operational time horizon.' Is BC Hydro implying that the proposal is inconsistent with the current IRP? Please explain.

RESPONSE:

No. The IRP is a long-term planning document that uses the long-term Load Resource Balance to identify when resource additions are required based on planning criteria. BC Hydro stated that the IRP was not relevant to the BCUC's assessment of the 2019 Letter Agreement because the 2019 Letter Agreement assists BC Hydro in mitigating its operational needs in the short-term operational timeframe and not in the planning timeframe.

6.0 Reference: Exhibit B-1, page 8

2013 IRP

The Commission must also consider BC Hydro's 2013 Integrated Resource Plan (**2013 IRP**).[12] Like the 2018 Letter Agreement, the purpose of the 2019 Letter Agreement is to enable BC Hydro to address electricity supply issues in the operational time horizon. The 2013 IRP is a long-term planning document that, among other things, assumes average inflows and no reliance on imports to serve domestic load, regardless of BC Hydro's needs in the operational time horizon. In BC Hydro's submission the 2013 IRP is not relevant to the Commission's assessment of the 2019 Letter Agreement.

1.6.2 When does BC Hydro expect to provide its next IRP?

RESPONSE:

BC Hydro plans to file its next IRP with the BCUC at the end of February 2021.

6.0 Reference: Exhibit B-1, page 8

2013 IRP

The Commission must also consider BC Hydro's 2013 Integrated Resource Plan (**2013 IRP**).[12] Like the 2018 Letter Agreement, the purpose of the 2019 Letter Agreement is to enable BC Hydro to address electricity supply issues in the operational time horizon. The 2013 IRP is a long-term planning document that, among other things, assumes average inflows and no reliance on imports to serve domestic load, regardless of BC Hydro's needs in the operational time horizon. In BC Hydro's submission the 2013 IRP is not relevant to the Commission's assessment of the 2019 Letter Agreement.

1.6.3 Please confirm that the Integrated Resource Plan is used by BC Hydro as the basis for many of its annual decisions, such as the levels of DSM to be pursued.

RESPONSE:

The IRP is used by BC Hydro as the basis for long-term planning, including establishing long-term Demand Side Management target levels. While the IRP can provide context to inform shorter-term actions, it generally is not of a granular enough level to inform decisions in the short-term operational timeframe.

6.0 Reference: Exhibit B-1, page 8

2013 IRP

The Commission must also consider BC Hydro's 2013 Integrated Resource Plan (**2013 IRP**).[12] Like the 2018 Letter Agreement, the purpose of the 2019 Letter Agreement is to enable BC Hydro to address electricity supply issues in the operational time horizon. The 2013 IRP is a long-term planning document that, among other things, assumes average inflows and no reliance on imports to serve domestic load, regardless of BC Hydro's needs in the operational time horizon. In BC Hydro's submission the 2013 IRP is not relevant to the Commission's assessment of the 2019 Letter Agreement.

1.6.4 How, if at all, could the Letter Agreement be expected to impact BC Hydro's plans for IPP purchases as established in the next Integrated Resource Plan?

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.6.6.

6.0 Reference: Exhibit B-1, page 8

2013 IRP

The Commission must also consider BC Hydro's 2013 Integrated Resource Plan (**2013 IRP**).[12] Like the 2018 Letter Agreement, the purpose of the 2019 Letter Agreement is to enable BC Hydro to address electricity supply issues in the operational time horizon. The 2013 IRP is a long-term planning document that, among other things, assumes average inflows and no reliance on imports to serve domestic load, regardless of BC Hydro's needs in the operational time horizon. In BC Hydro's submission the 2013 IRP is not relevant to the Commission's assessment of the 2019 Letter Agreement.

1.6.5 How, if at all, could the Letter Agreement be expected to impact BC Hydro's proposed long term Demand Side Management plans as established in the next Integrated Resource Plan?

RESPONSE:

Please refer to BC Hydro's response to CEC IR 1.6.6.

6.0 Reference: Exhibit B-1, page 8

> 2013 IRP
>
> The Commission must also consider BC Hydro's 2013 Integrated Resource Plan (**2013 IRP**).[12] Like the 2018 Letter Agreement, the purpose of the 2019 Letter Agreement is to enable BC Hydro to address electricity supply issues in the operational time horizon. The 2013 IRP is a long-term planning document that, among other things, assumes average inflows and no reliance on imports to serve domestic load, regardless of BC Hydro's needs in the operational time horizon. In BC Hydro's submission the 2013 IRP is not relevant to the Commission's assessment of the 2019 Letter Agreement.

1.6.6 How, if at all, could the Letter Agreement impact other elements of the next IRP? Please explain.

RESPONSE:

The 2019 Letter Agreement does not impact any elements of the IRP, including plans for Independent Power Producer purchases or the long term Demand Side Management plan which will be established in the next IRP. Please refer to BC Hydro's response to AMPC IR 1.3.2.1 which explains why the 2019 Letter Agreement is not within scope for the IRP.

The 2019 Letter Agreement is a tool for the short-term operational time frame that enables BC Hydro to secure physical forward energy. Please refer to BC Hydro's response to BCUC IR 1.5.1 for a description of how the 2019 Letter Agreement could be used in the short-term operational time frame.

7.0 Reference: Exhibit B-1, page 9

Section/Objective	Explanation
2(a) – Self Sufficiency	Self-sufficiency is a criteria BC Hydro uses in its long term planning efforts and is not relevant to supply issues in the operational time horizon. The 2019 Letter Agreement neither advances nor conflicts with this objective, and is therefore in alignment with it.

1.7.1 How long is the operational time horizon that BC Hydro is referring to in this instance?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.5.1 for a description of the operational time horizon.

8.0 Reference: Exhibit B-1, Appendix 1 page 5 of 11

15. Term; Survival. This Agreement shall be effective as of the date first written above and shall remain in effect until terminated by either party upon thirty (30) days' prior written notice; provided, however, that such termination shall not affect or excuse the performance of either party under any provision of this Agreement that by its terms survives any such termination and, provided further, that this Agreement and any other documents delivered pursuant hereto shall remain in effect with respect to the Transaction(s) entered into prior to the effective date of such termination until both parties have fulfilled all of their obligations with respect to such Transaction(s).

TPA. Nothing in this Agreement is intended to amend or modify the rights and obligations of BC Hydro or Powerex under the Transfer Pricing Agreement between them dated as of April 1, 2003 (as amended) ("TPA"), and Transactions shall not be considered transactions or transfers under the TPA. All deliveries to BC Hydro of electricity will first be deemed to be deliveries on account of Transactions confirmed under this Agreement and any remaining volumes will be deemed to be deliveries under the TPA, and any damages or remedies for undelivered electricity under this Agreement are hereby waived.

1.8.1 Please comment on any repercussions that BC Hydro might experience if Powerex were to terminate the agreement without an updated TPA.

RESPONSE:

If Powerex were to terminate the agreement without an updated TPA, BC Hydro would no longer have the flexibility to request that Powerex acquire wholesale energy in the forward markets for BC Hydro's short-term operational requirements. As such, BC Hydro would use the 2003 TPA to manage the supply risk through day-ahead transactions.

8.0 Reference: Exhibit B-1, Appendix 1 page 5 of 11

15. Term; Survival. This Agreement shall be effective as of the date first written above and shall remain in effect until terminated by either party upon thirty (30) days' prior written notice; provided, however, that such termination shall not affect or excuse the performance of either party under any provision of this Agreement that by its terms survives any such termination and, provided further, that this Agreement and any other documents delivered pursuant hereto shall remain in effect with respect to the Transaction(s) entered into prior to the effective date of such termination until both parties have fulfilled all of their obligations with respect to such Transaction(s).

TPA. Nothing in this Agreement is intended to amend or modify the rights and obligations of BC Hydro or Powerex under the Transfer Pricing Agreement between them dated as of April 1, 2003 (as amended) ("TPA"), and Transactions shall not be considered transactions or transfers under the TPA. All deliveries to BC Hydro of electricity will first be deemed to be deliveries on account of Transactions confirmed under this Agreement and any remaining volumes will be deemed to be deliveries under the TPA, and any damages or remedies for undelivered electricity under this Agreement are hereby waived.

1.8.2 Please provide the circumstances which BC Hydro believes might Powerex to terminate the agreement.

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 1.4.1, where BC Hydro states that the 2019 Letter Agreement will terminate when BC Hydro and Powerex revise the 2003 TPA.