BC Hydro
Power smart

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October 5, 2017

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. 1598922
British Columbia Utilities Commission (BCUC or Commission)
British Columbia Hydro and Power Authority (BC Hydro)
Site C Inquiry – Round 2 Information Responses

BC Hydro is writing to provide further responses to the questions set out in the Commission's Preliminary Report. The Commission asked that we endeavour to provide answers as they become available and we have been doing so. Enclosed with this letter are further responses. There remain some outstanding responses that we expect to have filed on October 6, 2017.

As noted in our previous IR submissions, our approach has been to number all of the requests in the Preliminary Report starting with BCUC IR 2.1.0 (representing the first question in the second round of questions the Commission has posed to BC Hydro). The number of responses enclosed with this letter are non-sequential, as we are providing responses as soon as they become available.

The responses to the following information requests are partially redacted for the reasons set out below. Unredacted versions have been filed with the Commission on a confidential basis:

- BCUC IR 2.7.0 – contains information that fits within Category B of the Commission's existing order regarding contract costs and budgets.
- BCUC IR 2.9.0 – the attachments contain information that fits within Category B of the Commission's existing order regarding contract costs and budgets.
- BCUC IR 2.10.0 – contains information that fits within Category B of the Commission's existing order regarding contract costs and budgets.
- BCUC IR 2.11.0 contains information that fits within Category B of the Commission's existing order relating to contract costs, budgets, and claims.
- BCUC IR 2.14.0 contains information that fits within Category B of the Commission's existing order relating to contract costs, budgets, and claims.

- BCUC IR 2.17.0 contains information that fits within Category C of the Commission's existing order relating to load and business information of individual customers.

In addition to the above, BC Hydro notes its responses to two information requests filed on October 4, 2017 were partially redacted that were not identified as confidential in the cover letter. Unredacted versions were filed with the Commission:

- BCUC IR 2.3.0 contains information that fits within Category B of the Commission's existing order relating to contract costs, budgets, and claims.
- BCUC IR 2.15.0 contains information that fits within Category B of the Commission's existing order relating to contract costs, budgets, and claims.

In the event the Commission requires clarification of any of these responses, we would be pleased to do that.

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

Yours sincerely,

Fred James
Chief Regulatory Officer

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Enclosure

5.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Page 20

2.5.0 The Panel asks BC Hydro to provide an analysis of the risks to the project schedule for construction activities subsequent to the river diversion, including but not limited to the generating station and spillway and the transmission work packages. This risk analysis is to be consistent with the requirements of section 4 (v) of the Commission's 2015 CPCN Guidelines.

RESPONSE:

The material risks across the project related to the project schedule for construction activities subsequent to the river diversion are represented and quantified in Table 1 Post Diversion Schedule Risks below. This analysis is consistent with the Commission's 2015 CPCN Guidelines are as follows (section 4(v)):

> **Risk analysis identifying all significant risks to successful completion of the project, including an assessment of the probability of each risk occurring and the consequences and the cost to mitigate the risk. The applicant should provide a summary description of significant project risks, including an assessment of the impact of each risk, the proposed risk mitigation strategy, and to the extent known, the financial and schedule impacts if the risk is realized. The risk evaluation should incorporate a risk assessment matrix with appropriate levels of severity and probability, a risk register and risk treatment as recommended in the latest revision of AACE International Recommended Practices.**

The Site C risk management practices follow BC Hydro's standard practices and include the use of a risk register to track and manage risks and utilize a risk assessment matrix (see Table 2) in preparation of a risk register. For each risk identified, there is an assessment of the impact of the risk (severity), the probability of its occurrence, the risk mitigation approach or treatment plan, and monitoring activities to be conducted until the risk is closed. For each risk the final risk score determines the project risk zone classification as per BC Hydro's Project Delivery Risk Matrix.

Table 1 below presents the construction-related schedule risks that are Level 10 or higher and related to post diversion activities. Note:

- **The severity assessments are not incremental to contingency amounts – i.e., contingency and/or project reserve would be expected to cover some of the consequences of the below risks;**

- **Assessments of severity and probability are done on a post-mitigation basis. That is, this table includes our assessment of the potential mitigation opportunities and the likelihood of the success of this mitigation; and**

- **Risks in the table are not additive – not all of the risks would be expected to materialize during the project. The risk register is a project management tool used to help mitigate and manage risks by increasing visibility to them.**

Table 1 Post Diversion Schedule Risks

Risk Event Description	Risk and Response Summary	Risk Quantification		
		Severity ($ million)	Probability (%)	Score
Dam Site Construction				
Construction	**Spillway gate construction is delayed due to equipment installation delays (gate guides, anchors, lifting beams, power components and other embedded parts) impacting the turbine and generator Unit 1 in-service date. To mitigate, BC Hydro and the contractor(s) to monitor and expedite equipment deliveries.**	**10-100**	**10**	**10**
Construction	**Spillway and intake gates are not water tight requiring re-work and delaying Unit 1 commissioning. To mitigate, BC Hydro to monitor manufacturing quality, installation work and add schedule float around key gate installation dates.**	**10-100**	**10**	**10**
Construction	**Turbine and Generator Unit 1 commissioning is delayed due to manufacturing, installation and/or safety issues. To mitigate, BC Hydro to actively manage technical and schedule contractor requirements.**	**10-100**	**10**	**10**

Risk Event Description	Risk and Response Summary	Risk Quantification		
		Severity ($ million)	Probability (%)	Score
Contractor Interfaces	**Roller compacted concrete powerhouse buttress and spillways buttress hand-over delay impacts the powerhouse and spillways construction and ultimately delaying the reservoir impoundment and the Unit 1 in-service date. To mitigate, add schedule float around hand-over dates; proactively manage the contract; and if required handover the lower buttress to the contractor prior to the upper buttress being completed. This risk is unrelated to river diversion and may occur both pre- and post-diversion.**	**10-100**	**10**	**10**
Contractor Interfaces	**A contractor delays another contractor due to poor planning or execution of the work causing a contractor schedule delay. To mitigate BC Hydro and the contractors to identify interface points, track interfaces in log, include interface hand-over dates in contracts, and add schedule float around key hand-off dates. BC Hydro to monitor interfaces to ensure contractor performance.**	**10-100**	**10**	**10**
Diversion Tunnel	**Poor tunnel hydraulic performance to accommodate water flows causing cofferdam overtopping and/or failure in a flood event. To mitigate, increase tunnel design capacity to be greater than expected water flows to allow fluctuations in water flows.**	**10-100**	**10**	**10**
Quality	**Equipment manufacturing and design (turbines, generators, gates, cranes, elevators, and other plant equipment) errors and omissions result in re-design or re-manufacturing causing schedule delays and costs increases. To mitigate, contract specifications to include quality assurance and quality control contractor requirements. BC Hydro to complete contractor design and manufacturing reviews to ensure specification adherence.**	**10-100**	**10**	**10**

Risk Event Description	Risk and Response Summary	Risk Quantification		
		Severity ($ million)	Probability (%)	Score
Transmission and Substation Construction				
Construction	**No or poor road access along transmission right-of-way's resulting in contractor construction delays. To mitigate, upgrade existing access roads, construct new roads, and transfer risk of on-going access and maintenance to the line construction contractor. Line contractor may choose to mitigate further by using helicopters, rig matting or rescheduling work to take advantage of frozen ground conditions.**	**10-100**	**10**	**10**
Geotechnical Conditions	**Poor Transmission right-of-way geotechnical conditions impacting transmission tower foundations. To mitigate, pre-design and construction geotechnical investigations and tower contract to include several foundation designs based on a range of ground conditions encountered during construction.**	**10-100**	**10**	**10**
Highway 29 Construction				
Geotechnical Conditions	**Significant settlement of the highway causeways approaching several new bridges due to unstable layer of shale bedrock; design does not meet Ministry of Transportation and Infrastructure design safety requirements. Options to mitigate: revise the causeway design with shear keys excavation/backfilling, flatten the causeway slope and investigate alternate design extending the length of the bridge crossings to full spans and eliminate the need for causeways.** **This risk may occur both pre- and post-diversion.**	**10-100**	**60**	**11**
Reservoir Filling				
Reservoir Filling	**Reservoir fill is delayed, takes longer or the diversion tunnel or gates fail requiring dewatering of the river to repair the tunnel/gates impacting the reservoir fill schedule. To mitigate, prepare reservoir filling plan that includes what-if options that can be executed should an issue arise.**	**10-100**	**10**	**10**

Risk Event Description	Risk and Response Summary	Risk Quantification		
		Severity ($ million)	Probability (%)	Score
Strategic and General Risks				
Regulatory	**During construction unanticipated permits are required and changes to the Environmental Management Plans are needed. This can add unplanned scope, schedule and cost to the project. To mitigate, BC Hydro to proactively works with regulatory agencies to establish clarity to the scope of the mitigation and compensation program.**	**10-100**	**10**	**10**

Table 2 BC Hydro Project Delivery Risk Matrix

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PROBABILITY OF CONSEQUENCE (Duration of Project through Implementation)			BC Hydro PROJECT DELIVERY Risk Matrix					
60%	Likely More than even chance to occur	L7	8	9	10	11	12	13
30%	Fairly Likely Often occurs	L6.5	7.5	8.5	9.5	10.5	11.5	12.5
10%	Possible Could well occur	L6	7.0	8.0	9.0	10.0	11.0	12.0
1%	Remote May occur	L5	6	7	8	9	10	11
0.1%	Very Unlikely Not expected to occur	L4	5	6	7	8	9	10
CONSEQUENCE TYPE			CONSEQUENCE SEVERITY					
			S1	S2	S3	S4	S5	S6
Safety		Worker	First Aid	Treatment by Medical Professional	Temporary Disability	Permanent Disability	Fatality	Multiple Fatalities
		Public	Near Miss	First Aid	Treatment by Medical Professional	Temporary Disability	Permanent Disability	Fatality
Environmental			Minor	Low	Moderate	High	Extreme	Catastrophic
Financial Loss			$10K to $100K	$100K to $1M	$1M to $10M	$10M to $100M	$100M to $1B	$1B to $10B
Reputational			Limited complaints to company or shareholder	Negative local profile	Small but vocal minority of customers critical	Many customers critical	Loss of trust- strategic change imposed by regulator and/or shareholder	Loss of consent to operate
Reliability		Supply	N/A	N/A	Require voluntary load reduction	Localized load shedding	Significant load shedding required	BC load shedding spreads to WECC
		Customer (hours lost per event)	< 5K	5K to 50K	50K to 500K	500K to 5M	5M to 50M	50M to 500M

*NOTE: "Schedule" is not included as a consequence type as a missed schedule must affect the Consequence Types listed to be meaningful.

Project Delivery June-2014 (FINAL.3)

Project Risk Zone	Risk Communication Guidelines
3) Executive	Detailed analysis and discussion at project VP level, with engagement of business group EVP or SVP. Input from Executive Team generally should be sought.
2) Initiator	Analysis and discussion between Portfolio Manager, Project Manager, and Initiator about the risks and appropriate courses of action.
1) Project Manager	Risk generally analysed and discussed with PM at project team level. Safety risks should be reviewed with the Project Initiator.

Purpose of the Project Delivery Risk Matrix

1. To provide a standard representation of the results of risk analyses for use in the evaluation and communication of project delivery risks.

2. As a risk governance tool. The Project Risk Zone relates to the level of management oversight to aid in decision-making.

3. Not used to describe risk tolerance.

4. A comparison of differing risks may also be conducted based on the Risk Levels.

To use the Risk Matrix

1. Select the Consequence Type.

2. Select the highest appropriate Consequence Severity.

3. Select the Probability level of the Consequence Type and Severity.

4. Plot the Consequence severity and Probability level pair to determine the Risk Level and associated Project Risk Zone.

5. Based on the Project Risk Zone, review Risk Communication Guidelines to determine action.

NOTE: The rigour of analysis in analyzing consequence and frequency should be commensurate with the Project Risk Zone. This may be an iterative process.

This Project Delivery Risk Matrix is aligned to the Corporate Risk Matrix.

7.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Page 22

2.7.0 The Panel asks BC Hydro to provide a detailed analysis of the claims outstanding for work completed or in progress as of June 30, 2017, including the amount claimed and BC Hydro's assessment of the final settlement amount.

RESPONSE:

BC Hydro has provided below considerable additional information regarding the merits (or lack thereof) of contractor claims. This information is commercially sensitive and disclosure would prejudice BC Hydro and its ratepayers due to the impact on negotiations and dispute resolution with our contractors. Commercially sensitive information has been redacted in the public version of the response.

BC Hydro has engaged many contractors in support of the delivery of the Site C Clean Energy Project. During construction of infrastructure projects, it is not uncommon for contractors to seek additional compensation for alleged changes to the work, found conditions or in relation to construction delays. It is BC Hydro's practice to consider and evaluate all claims received from its contractors. To date, the significant majority of unresolved claims on the Project relate to the Main Civil Works contract. BC Hydro has received claims totaling approximately $7 million on other contracts associated with the Site C project and forecasts the potential exposure with such claims to be approximately [redacted]. BC Hydro's forecast associated with outstanding claims related to the Main Civil Works contract is further described below.

Main Civil Works Contract

Peace River Hydro Partners, the contractor for the Main Civil Works contract has made several large claims since it was awarded the contract on December 18, 2015. BC Hydro has resolved a significant portion of the claims presented by the contractor at values that are significantly lower than those presented by the Contractor. A summary of the claims filed by Peace River Hydro Partners that have been resolved is set out in the table below.

Claim Description	Contractor Claims:		BC Hydro Accepted Amount ($ million)
	Number	Amount ($ million)	
2016 Right Bank Delay and Acceleration Claims	[redacted]		
Accepted Claims for Change			
Rejected Claims for Change			
Subtotal	**60**	**105.3**	**25.3**

*** The settlement value allowed the contractor to achieve a maximum of [redacted] million in compensation. The contractor did not achieve an interim excavation milestone ([redacted] million) and has not provided substantiation for [redacted] million on account of claimed incremental equipment use.**

The above-listed accepted amounts have been managed through existing allocations of contingency as previously reported by BC Hydro.

The Contractor has raised additional claims that are presently outstanding as summarised below. Several of the claims submitted by the Contractor appear to allege overlapping impacts such that the amounts listed below are partially duplicative. Although the claims listed below total [redacted] million, the Contractor has alleged that aggregate impacts associated with its claims total not less than [redacted] million.

[redacted]

[redacted]

[redacted]

BC Hydro has included forecast values for claims that it does not accept and has made allowances for potential losses associated with such claims to reflect the possibility that the contractor may successfully establish one or more of the claims listed above and may be able to substantiate a portion of the impacts associated with those claims.

Construction Environmental Management Plan Revisions

The claim as submitted on August 24, 2017, by the contractor includes [redacted] in direct costs for the duration of the contract as well as [redacted] in costs claimed in connection with an alleged overall delay [redacted].

The direct costs include costs incurred to date and estimated future costs for the remaining duration of the contract. BC Hydro agrees that certain direct costs arising from additional incremental effort required by revisions to the Construction Environmental Management Plan. The main changes are as follows:

- **As a result of an order issued by the Comptroller of Water Rights on June 24, 2016, the requirements for the project's water management regime changed. This change requires the purchase of new water treatment plants, incremental monitoring, and additional reporting; and**

- **Additional environmental management changes were required following the Environmental Assessment Office order on April 7, 2016 related to incremental site-wide erosion and sediment controls.**

However, BC Hydro does not accept the scope of changes claimed by the contractor or the quantum of direct costs as alleged both with respect to the costs claimed to date and for those that are estimated to be incurred over the remaining duration of the contract.

[redacted] in alleged costs associated with delay reflects an assessment by the contractor of the costs it estimates that it would incur in the event of a [redacted] prolongation of the Project. The estimate reflects an assessment by the contractor of the overall impacts of all events on the project without proper consideration for which party bears responsibility for those events and any associated delays. The Main Civil Works contract precludes the Contractor from compensation for delays caused by the Contractor and in the event of concurrent Contractor and BC Hydro delays. [redacted]

Relocated Surplus Excavation Materials Development

The Contractor has submitted a Claim for Change and related correspondence seeking compensation in the amount of [redacted] associated with additional quantities of material required to construct the rock spoil areas. The rock spoil areas are design-build elements for which the contractor is responsible. The contract requires BC Hydro to pay the Contractor for Work in accordance with the schedule of prices and estimated quantities. No separate payment is required for work that is not listed in the schedule of prices and estimated quantities.
BC Hydro does not accept this claim.

Left Bank

The Contractor has not submitted a claim in relation to certain delays it has encountered in progressing its work on the left bank. The delays have arisen in relation to tension cracks observed in distinct areas of the left bank in February and May 2017. The contractor has alleged that its work has been delayed as a result and that there is a global instability within the left bank works that it anticipates has caused a delay of approximately 1 year to its operations on the left bank. The contractor has alleged that the geotechnical conditions observed on the left bank differ from those disclosed by BC Hydro.

BC Hydro disputes the Contractor's allegations and has directed the Contractor to take all required steps to recover schedule pending the resolution of the dispute and on account of the Contractor's Delay. BC Hydro has notified the Contractor that it considers the Contractor to have failed to apply appropriate factors of safety and appropriately sequence and monitor its work when operating on the left bank, including when constructing its temporary haul roads.

The Contractor has not submitted a claim in relation to the left bank. However, a letter dated August 25, 2017 included an "interim estimated" amount of "not less" than [redacted]. While BC Hydro does not accept that it is responsible for the alleged delays, in the absence of any documentation from the contractor, BC Hydro is unable to provide detailed comments on the interim estimated figure referred to by the contractor.

2016 Left Bank Costs

The Contractor has claimed that it is entitled to receive compensation for delays it encountered on the left bank in 2016. The contractor alleges that BC Hydro caused delays through the introduction of a new "leave to construct" process, allegedly inaccurate grading of submittals produced by the contractor and the delayed issuance of permits which it was BC Hydro's responsibility to secure. The contractor has not formally provided any detailed documentation to substantiate its claims.

BC Hydro disputes that the leave to construct requirement was new or added and does not agree that its grading of submittals was inconsistent. BC Hydro acknowledges that certain permits were received later than anticipated however BC Hydro does not accept that this caused the contractor to be delayed as a result. The contractor experienced numerous delays to its operations in the first 8 months of 2016 including, among other things, with mobilisation, weather impacts and the preparation of its submittals. The Main Civil Works contract precludes the contractor from compensation for delays caused by the contractor and in the event of concurrent contractor and BC Hydro delays.

The contractor recovered the delays but now seeks compensation for the costs it claims to have incurred in doing so. As noted above, BC Hydro does not accept that it is responsible for the delays and also disputes the amount of costs that the contractor claims to have incurred. The parties have referred this claim to a referee for determination.

Overhead Rates

BC Hydro and the Contractor disagree on the manner in which certain owner-initiated changes are valued. In addition to a contractually prescribed mark-up of 15 per cent and its direct costs, the contractor is seeking compensation for site overhead. BC Hydro does not accept that it is required to provide a payment for site overhead in addition to the 15 per cent mark-up.

9.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Page 33

2.9.0 The Panel asks BC Hydro to explain why it chose a contingency amounting to 9.5 percent of project costs, and what factors suggested this would be sufficient. BC Hydro is also requested to provide backup documentation consistent with the requirements of section 5(vi) of the Commission's 2015 CPCN Guidelines.

RESPONSE:

The Commission's 2015 CPCN Guidelines have the following requirements (section 5(vi)):

(vi) If a Monte Carlo analysis was used to model and provide justification for the amount of project contingency included in the cost estimate, then provide the following:

- (i) the base estimate
- (j) the P50 expected value estimate
- (k) the P-value including contingency and the dollar value
- (l) the P-value including reserves, if any, and the dollar value
- (m) the P90, the input probability curves
- (n) the relationship between the inputs and the output
- (o) the output histogram and cumulative curves
- (p) tornado graphs

We prepared our contingency analysis according to BC Hydro practice, and in accordance with BCUC CPCN Guidelines. This contingency analysis provided for a 14.2 per cent contingency when taken as a proportion of the relevant costs, rather than 9.5 per cent as posited by the IR.

Note that work at the time included all elements required by the CPCN guidelines other than the tornado graphs and histograms (items (o) and (p)). These items are purely for presentation purposes. However, we have prepared these items for this response based on the model prepared in 2014.

At the time of the Final Investment Decision, the Site C budget was as follows:

Table 1 Final Investment Decision, Site C Project Budget

	Element	Estimated Cost ($ million)[1]
1	Direct Construction Costs	$4,468
2	Indirect Costs:	
3	BC Hydro Personnel and Consultants	315
4	Other and Sunk[2]	815
5	Total Indirect Costs	$1,130
6	Total Construction Cost Without Contingency *($2014, real)*	$5,598
7	Contingency	679
8	Total Construction Cost *($2014, real)*	$6,277
9	Inflation	651
10	Interest During Construction	1,407
11	Total Project Cost Loaded ($ nominal)[3]	$8,335
	Contingency (line 7) as percentage of lines 1 and 3	14.2%

Notes:
1 – Refer to Appendix D, Table D-1, column C, "Board Approved Plan (2014$)
2 – Excluded from the calculation of contingency as a percentage of project costs
3 – Totals may not add exactly due to rounding

In accordance with BC Hydro's PPM practice, contingency is expressed as a percentage of the Total Construction Cost Without Contingency. Sunk costs are excluded as they are actual costs that do not present a risk of variation, and inflation and interest during construction are based on the cost including contingency, and so these components are inclusive of the inflation and interest during construction components of contingency.

Based on BC Hydro's standard practice for expressing contingency, the project contingency as a percentage of Total Construction Cost Without Contingency prior to the Final Investment Decision was 14.2 per cent, not 9.5 per cent as indicated in the Commission's question.

BC Hydro and its consultants estimated project contingency in 2010 using range estimating methods in a Monte Carlo model.

As part of the updated estimating work in 2014, BC Hydro undertook a validation of sufficiency of the available contingency.

First, BC Hydro determined the available contingency from the remaining funds available following these estimating activities. Then, BC Hydro performed an updated assessment of contingency to determine whether the available budget contingency was adequate to cover residual risks.

- **A Monte Carlo model was prepared to assess the required contingency for the direct construction costs.**

- **A 10 per cent contingency was assumed for BC Hydro staff indirect costs based on BC Hydro experience with previous projects.**

- **No contingency was included for mitigation, compensation or benefits budgets, as these estimates were mandated figures inclusive of any applicable contingencies, and represented a 'not to exceed' budget.**

Based on this updated contingency assessment, BC Hydro determined that the available budget contingency was sufficient for a P50 estimate.

Attachment 1 provides tables summarizing the P50 and P90 contingency assessment as prepared prior to the final investment decision budget update. These tables contain information related to the risk assessment of contracts currently under procurement or undergoing negotiations. Release of this information could materially harm ratepayers by affecting contractor bid or negotiation behaviour.

With respect to the Commission's 2015 CPCN Guidelines, the tables above provide the following information:

i. The base estimate (prior to the updates completed as part of the Final Investment Decision process): refer to Table 2 of Attachment 1

j. The P50 expected value estimate: refer to Table 2 of Attachment 1

k. The P-value including contingency and the dollar value: not shown. The balance of contingency at the time the Monte Carlo model was prepared was $647.6 million (in 2010 dollars) and represented approximately a P48 output.

l. The P-value including reserves, if any, and the dollar value: not shown. The Project Reserve was established by Government subsequent to the preparation of the Monte Carlo contingency model.

m. The P90, the input probability curves: refer to Table 2 for the P90 amount, and Table 3 provides the input low, most likely and high values, where the low and high values are expressed as a percentage of the most likely amount.

n. The relationship between the inputs and the output: the inputs generally used the @Risk 'Trigen' formula, and the output was the sum of the values of the input risk variables. A correlation factor of 30 per cent was used for all input functions.

o. The output histogram and cumulative curves: these were not prepared at the time but have been produced to respond to this IR and are included in confidential Attachment 2. These graphs used the same Monte Carlo model as the 2014 analysis but a different simulation seed, and thus values in the figures may differ slightly from Attachment 1.

p. Tornado graphs: these were not prepared at the time but have been produced to respond to this IR and are included in confidential Attachment 2. These graphs used the same Monte Carlo model as the 2014 analysis but a different simulation seed, and thus values in the figures may differ slightly from Attachment 1.

During the final investment decision process, the project budget was updated from $7.96 billion to $8.335 billion. The key changes were the inclusion of PST and the incorporation of a delay in the start of construction and authorized in-service date. Additionally, a project reserve of $440 million was also authorized, with such reserve funding to be held by the Shareholder. These adjustments impacted the Total Construction Cost Without Contingency, the contingency amount and the Total Project Amount. An updated Monte Carlo model was not prepared at the time of Final Investment Decision.

CONFIDENTIAL ATTACHMENT

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CONFIDENTIAL ATTACHMENT

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10.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Page 33

2.10.0 The Panel asks BC Hydro to estimate the total price of its two major outstanding procurements, generator station and spillway and transmission, in light of its experience with the main civil works procurement, to identify possible cost overruns as a consequence, and to identify whether these possible cost overruns are already accounted for in the $1 billion anticipated contingency usage.

RESPONSE:

This response includes commercially sensitive information which has been redacted in the public version of the response.

Generating Station and Spillway

The Generating Station and Spillway scope of work has been divided into several large procurements, as follows:

Contract	Procurement Status	Anticipated Year of Award
Generating Station and Spillway – Civil	**In Progress**	**2018**
Hydromechanical Equipment	**In Progress**	**2018**
Cranes	**In Progress**	**2018**
Balance of Plant Equipment Supply	**Planning Underway**	**2018-2019**
Completion Contract	**Planning Underway**	**2019**

The total budget for the Generating Station and Spillway scope of work listed above is $[redacted] million, plus an allocation of $[redacted] million of contingency, for a total value including contingency of $[redacted] million, before any adjustments required due to River Diversion occurring in 2020. The $[redacted] million is included in the forecast allocation of contingency at August 31, 2017 (please refer to BC Hydro's response to BCUC IR 2.11.0).

The estimated incremental cost related to the Generating and Spillway scope of work attributable to River Diversion occurring in 2020 is approximately $[redacted] million (included in the cost impact estimated in BC Hydro's response to BCUC IR 2.15.0).

Bids for the Generating Station and Spillway Civil contract, representing the largest proportion of the contracts listed above, are expected to be received in

late October 2017. Given the change in expected timing of River Diversion, there is a risk that the bids may be received several weeks later than planned, due to required amendments.

As indicated by Deloitte[1] and BC Hydro[2], for the larger procurements that are currently in process, there are risks that bids may be higher than budget due to changes in commodity prices (concrete, steel), labour rates, productivity rates and increased costs for environmental protection measures.

The material post-award risks with the Generating and Spillway Civil contract for BC Hydro are related to interface risk with other vendors such as the Hydromechanical, Main Civil Works contractor, Turbines and Generators and the Completion contractor.

Transmission and Substation

The Transmission and Substation scope of work relates to construction of transmission lines 5L5 and 5L6, as well as construction of the Site C substation, and is divided into several procurements, as follows:

Contract	Procurement Status	Anticipated Year of Award
Procurement of towers and equipment	Awarded	2017
Line Construction (5L5/5L6)	In Progress	2018
Site C Substation Construction	In Progress	2018
Clearing and access	Awarded/In Progress	2017/2018
Peace Canyon Switchgear Building and Other Station Upgrades	Awarded	2017

The total budget for the Transmission and Substation scopes of work is $[redacted] million, plus a forecast allocation of $[redacted] million of contingency, for a total value including contingency of approximately $[redacted] million. The cost estimate of $[redacted] million including contingency reflects information from the contracts already awarded. The $[redacted] million is included in the forecast allocation of contingency at August 31, 2017 (please refer to BC Hydro's response to BCUC IR 2.11.0).

Going forward, most of the risk retained by BC Hydro will be in establishing access and clearing prior to commencement of construction of the foundations for the transmission line towers. The transmission line is 75 kilometers long and the environmental compliance and geotechnical issues cannot be completely known in advance of the construction.

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[1] **Deloitte Report #1, page 33.**
[2] **BC Hydro August 30 Filing, page 33.**

The possible cost overruns related to the procurement of these contracts are:

1. **Market conditions: There are a limited number of contractors in Canada with the capability and capacity to bid on the 500 kV transmission and high voltage substation work; and**

2. **Commodity prices for conductor: bid prices will depend on the market prices of aluminum and steel at the time.**

BC Hydro adds that the "additional costs" of $494 million stated by Deloitte on page 29 of their Report #1 appears to be a typographical error. Deloitte references BC Hydro's July 2017 monthly report which actually shows a potential cost variance of $[redacted] million, consistent with the forecast allocation of contingency noted above.

11.0 11. Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Page 33

2.11.0 The Panel asks BC Hydro to provide a quantitative and qualitative analysis of its contingency allocated and committed to June 30, 2017, and its projections for how it expects contingency to be allocated and committed as the remainder of the project progresses.

RESPONSE:

Given the scale of the Site C Project, the full value of contingency has not been delegated to management. In September 2015, the Board of Directors approved a Site C Contingency Framework, as follows:

- **On an annual basis (or more frequently if required), management must request approval from the Board for the portion of the project contingency required to manage the risks for that period;**
- **Prior to making any project reserve request to Treasury Board, management will review such request with the Board of Directors; and**
- **Contingency usage, allocation and a summary report will be provided to the Board on a quarterly basis.**

A forecast allocation of the forecast usage of contingency, by scope of work, through to the end of the project is provided as part of the quarterly reporting to both the Board and the Commission.

Contingency Committed to Contracts, at June 30, 2017

Of the total contingency of $509.4 million delegated and released to management to June 30, 2017, approximately $355.8 million (or 30 per cent of the total contingency budget of $1,194.6 million) had been committed to contracts at June 30, 2017. The table below presents, by category of work, the amount of contingency committed by management at June 30, 2017, the forecast allocation of contingency at June 30, 2017 (presented in Deloitte Report #1), and the updated forecast allocation of contingency at August 31, 2017.

Contingency Category	Contingency Committed by Management, June, 2017 ($ million)	Forecast Allocation of Contingency		
		June, 2017[1] ($ million)	August, 2017 ($ million)	Variance ($ million)
Main Civil Works	[redacted]			
Generating Station and Spillway				
Rights, Taxes and Grants				
Highway 29 Relocation				
Clearing				
Early Civil Works				
Turbines and Generators				
Transmission				
Miscellaneous				
Worker Accommodation				
BC Hydro Construction Management				
Indirect Costs				
Insurance Savings				
Total Contingency Budget before Interest During Construction	**355.8**	**999.7**	**1,051.3**	**51.6**
Savings on Interest- During- Construction / Other Unallocated Budget	**N/A**	**194.9**	**143.3**	**51.6**
Total Contingency	**355.8**	**1,194.6**	**1,194.6**	**0.0**

Contingency Committed by Management

Contingency committed by Management represents the amount that has been released to management and committed (i.e., will be spent) through a project change notice in order to fund contract award and/or contract contingency.

Forecast Allocation of Contingency

Over time, management updates the allocation of contingency to particular scopes of work, based on contracts awarded to date, work completed, and updated forecasts for scopes of work yet to be completed. Allocations may be increased or decreased. Contingency forecast allocation adjustments are based on current forecasts of project expenditures through to project completion. The

[1] **Deloitte Report #1, page 31.**

forecast allocation of contingency includes contingency already committed as well as contingency yet to be released to management.

Explanation of Variances in Forecast Allocations between June and August 2017

The following explanations are provided for the variances in forecast allocations between June and August 2017:

- **Clearing (Reservoir) – Increase in forecast allocation relates to costs for Moberly River and Eastern Reservoir Clearing and Halfway River Debris Boom.**

- **Transmission – Increase in Indirect Costs, primarily related to Construction Management.**

- **Indirect Costs – Increase in expected Detailed Design costs related to Highway 29, additional Project Services and Environmental Oversight support costs.**

This response includes commercially sensitive information which has been redacted in the public version of the response.

14.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Page 33

2.14.0 The Panel asks BC Hydro to provide the cost of its new approach to the Highway 29 realignment, the degree to which the cost is higher than budgeted, and the degree to which any cost overrun will need to be covered by contingency.

RESPONSE:

Highway 29 connects Hudson's Hope to Fort St. John and runs along the north side of the Peace River. Six segments of the highway totalling approximately 30 kilometres need to be realigned. Four of the six segments include river or creek crossings. All realignments will be designed to Ministry of Transportation and Infrastructure (MoTI) approved standards, and developed in cooperation with MoTI, the Highway owner.

Definition design estimates were used for budgeting purposes in 2014. All road segments require further geotechnical investigation and analysis to finalize alignments, bridge and roadwork design. This work has been conducted for the Bear Flat/Cache Creek segment, has begun for the Halfway River segment and is planned for later for the other four segments.

Bear Flat / Cache Creek Segment

The Bear Flat/Cache Creek segment is located approximately 49 kilometres east of the Hudson's Hope town site and 31 kilometres west of Fort St. John. In this area, the existing highway would be flooded by the reservoir, requiring relocation of approximately 8.5 kilometres of highway.

As described in our August 30 Filing, BC Hydro initially planned to begin construction of this segment in summer 2017, but has postponed the commencement of this work, following completion of this Inquiry and further consultation with Aboriginal groups.

Through geotechnical work and consultation that has occurred to date, BC Hydro is re-designing and re-scheduling highway work resulting in the following changes that result in increased cost pressures:

- **Geotechnical investigations, carried out in 2016 and 2017, required the design to be modified to accommodate subsurface conditions. The design change resulted in a longer bridge (404 metres) and a shorter causeway;**

- **The bridge was further extended to 455 metres and raised pursuant to further geotechnical work and to avoid an area identified by several First Nations as a potential (unconfirmed) burial site; and**

- **A mitigation measure of a temporary detour in the event the highway is not realigned prior to river diversion.**

Halfway River Segment

The Halfway River segment is located approximately 37 kilometres east of the Hudson's Hope town site and 47 kilometres west of Fort St. John. Approximately 4 kilometres of highway will be inundated and therefore needs to be realigned. The realignment follows the reservoir shoreline, and crosses over the Halfway River.

The first phase of geotechnical field investigations and slope stability analyses commenced in June 2017 at Halfway River. Initial geotechnical investigations have indicated that there appear to be stability issues, which would impact the design of the Halfway River crossing. This is expected to increase the cost for this segment.

Farrell Creek East Segment

The Farrell Creek East segment of Highway 29 is located approximately 20 kilometres east of the Hudson's Hope town site, and 60 kilometres west of Fort St. John. The highway is located within the preliminary stability and erosion impact lines for the Site C reservoir. BC Hydro is planning to relocate up to 6 kilometres of highway in this segment, further from the top of the bank, behind the preliminary stability and erosion impact lines. Additional geotechnical investigations will be required prior to construction.

Farrell Creek Segment

The Farrell Creek segment is located approximately 15 kilometres east of the Hudson's Hope town site and 70 kilometres west of Fort St. John. The realignment would be approximately 2 kilometres long, and would cross Farrell Creek. Additional geotechnical investigations will be required prior to construction.

Dry Creek Segment

The Dry Creek segment is located between Lynx Creek and Farrell Creek, approximately 14 kilometres east of the Hudson's Hope town site and 73 kilometres west of Fort St. John. Approximately 1.5 kilometres of highway would be realigned or raised. The existing culvert would be replaced by a larger culvert, to allow water to pass underneath. Additional geotechnical investigations will be required prior to construction.

Lynx Creek Segment

The Lynx Creek segment is located approximately 5 kilometres east of the Hudson's Hope town site and 75 kilometres west of Fort St. John. The realignment is approximately 8 kilometres long, and would cross Lynx Creek, and then run along an existing road (Millar Road). Additional geotechnical investigations will be required prior to construction.

Hudson's Hope Berm

In addition to the six segments of Highway 29 referred to above, the scope of the Highway 29 Realignment sub-project also includes construction of a berm at Hudson's Hope.

Highway 29 Realignment Budget

The total direct cost budget for the Highway 29 scope of work (including the six Highway 29 realignment segments and the Hudson's Hope Berm) is [redacted], plus an allocation of [redacted] of contingency ([redacted]), for a total value including contingency of [redacted]. The [redacted] is included in the forecast allocation of contingency at August 31, 2017 (please refer to BC Hydro's response to BCUC IR 2.11.0).

None of the procurements for the Highway 29 scope of work have been completed, therefore risk remains that bids may be higher than budget due to the design changes identified above and the results of the geotechnical investigations to be conducted. Any amounts in excess of the Highway 29 budget of [redacted] would be drawn from contingency.

17.0 Reference: BCUC Inquiry Respecting Site C Preliminary Report dated September 20, 2017 – Page 59

2.17.0 **The Panel finds that the historical instances of over-forecasts are greater than under-forecasts, especially in the industrial load and that the accuracy of BC Hydro's historical industrial forecasts looking out three and six years have been considerably below industry benchmarks. However, the Panel finds that we cannot yet assess the reasonableness of BC Hydro's industrial load forecast due to insufficient information**.

The Panel invites submissions from BC Hydro and other parties on the implications of the historical overestimates on the Panel's assessment of the accuracy of the industrial load included in the Current Load Forecast.

RESPONSE:

BC Hydro understands the Commission's concern to be about the likelihood the Current industrial sector Load Forecast will occur as projected given BC Hydro's history of over-forecasts in the sector. We address the Commission's concerns in three parts:

- **We provide overall context for how the industrial sector forecast is developed and relevance of historical load forecast variances when assessing future load forecasts.**
- **We provide general comments on BC Hydro's historical industrial load and our rationale for focusing on recent ten year history.**
- **For each of BC Hydro major industrial sectors:**
    - **We further explain BC Hydro's recent industrial load forecast history beyond what is already provided in Appendix H of our August 30 Filing.**
    - **We further demonstrate the continued reasonableness and robustness of the Current industrial sector Load Forecast. Additional information with respect to the justification for continued inclusion of LNG-related load is provided in BC Hydro's response to BCUC IR 2.16.1.**

We conclude that:

- **The drivers of previous industrial forecast variances are not relevant to the expected accuracy of the Current industrial load forecast as they are not drivers of our expected load growth.**

- **The information on the direction of the industrial load changes over the short term, near and long term that we have included in our August 30 Filing and response to BCUC IR 2.16.1 is well supported and indicative of future load trends.**

<u>Overall context of industrial sector load forecast methodology</u>

BC Hydro's industrial sector makes up approximately one-third of total system demand. The industrial sector load forecast methodology is based on applying a probability (risk) assessment to specific accounts within each industrial sub-sector to quantity their individual contribution to the total system forecast. The objective of this approach is to develop an expected aggregate total system industrial sector forecast based on a balance of probabilities which considers the risk associated with each customer or sub-sector. A statistical assessment of the industrial load forecast variance without understand the causes of these variances is not meaningful for assessing the industrial sector load forecast performance given the diverse nature of the industrial sector and the methods used to develop the industrial sector load forecast.

BC Hydro has been using a probability weightings methodology to develop each of its various industrial sub-sector forecasts for many years. This methodology has been reviewed and accepted by the Commission in a number of regulatory applications. Each of the major large industrial sub-sector mid forecasts (Forestry, Mining, Oil and Gas, Other) are developed independently since they are influenced by different macro-economic and commodity price drivers; and different uncertainties. BC Hydro uses third party subject matter expertise that is specific to each of those sub-sectors and each resulting sub-sector forecast is the result of a bottom-up assessment of expected future sales by individual accounts. They are not the result of a statistically generated probability distribution curve that produces a median probability (P50) forecast. As a result, the objective of the aggregate load forecast outcome is not to be equally over and under forecast over time but rather to develop an accurate forecast on an annual basis.

Notwithstanding the forecast methodology reliance on credible third party expert market analyses, there is uncertainty associated with future economic growth, commodity supply and demand, and related electricity demand over the long term. The degree of uncertainty not only varies across subsectors, but also over time within a given subsector. For example, sub-sectors experiencing rapid growth or rapid decline are likely to have greater uncertainty to where subsector growth has been relatively stable. Given the inherent overall uncertainty associated with

forecasting the industrial sector load, BC Hydro develops both high and low forecast uncertainty bands for each of its three major industrial sub sectors. The Site C project assessment includes sensitivity analysis that incorporates this load forecast uncertainty.

The drivers of previous industrial forecast variances are not relevant to the expected accuracy of the Current industrial load forecast for the following reasons.

- **The load forecast drivers of the past are not the load forecast drivers of today. As an illustrative example, a previous forecast that may have reflected future aluminum smelter load has no relevance today since there is no such sector within the Current Load Forecast.**

- **Load forecast methods and processes have changed over time.[1] The Current Load Forecast is based on in-depth and current market analysis, reliable and supportable sources; and a reasonable set of assumptions. While we can compare our current processes to those employed in relatively recent load forecasts to better understand if variances were caused by methodological differences or input assumptions, we are unable to undertake a comparison of industrial load forecasts from previous decades.**

- **To the extent previous forecast assumptions are relevant to the Current Load Forecast, historical variances have been largely due to inherent volatility and uncertainty in global markets which impacts B.C.'s industrial sector. In BC Hydro's case these elements are focused on one or two of the large sub-sectors. In this response, we will indicate where the key uncertainties exist and why they are significantly lower in the Current industrial sector Load Forecast relative to previous forecasts. We demonstrate that despite these uncertainties, we believe the Current projection is sound.**

As a final general comment regarding BC Hydro's industrial load forecast methodology, our approach does not attempt to forecast future recessions. We rely on credible third party experts for their assessments of global supply and demand and market cycles over the near and long term. The extent to which these experts project commodity down and up cycles based on global supply and

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[1] **For example, in the 2005 load forecast BC Hydro used liner regression models to develop the industrial sector and made adjustments to the regression-base forecast for account for large closures and expansions. In contrast, our current method applies a probabilistic-based approach, which has also evolved over time. As we explained in BCUC IR 2.200.2, Exhibit B-14, in the F2017-F2019 Revenue Requirements Application, the Current Load Forecast was developed with an expanded and improved suite of external expert sources providing market intelligence in each of the major industrial sectors.**

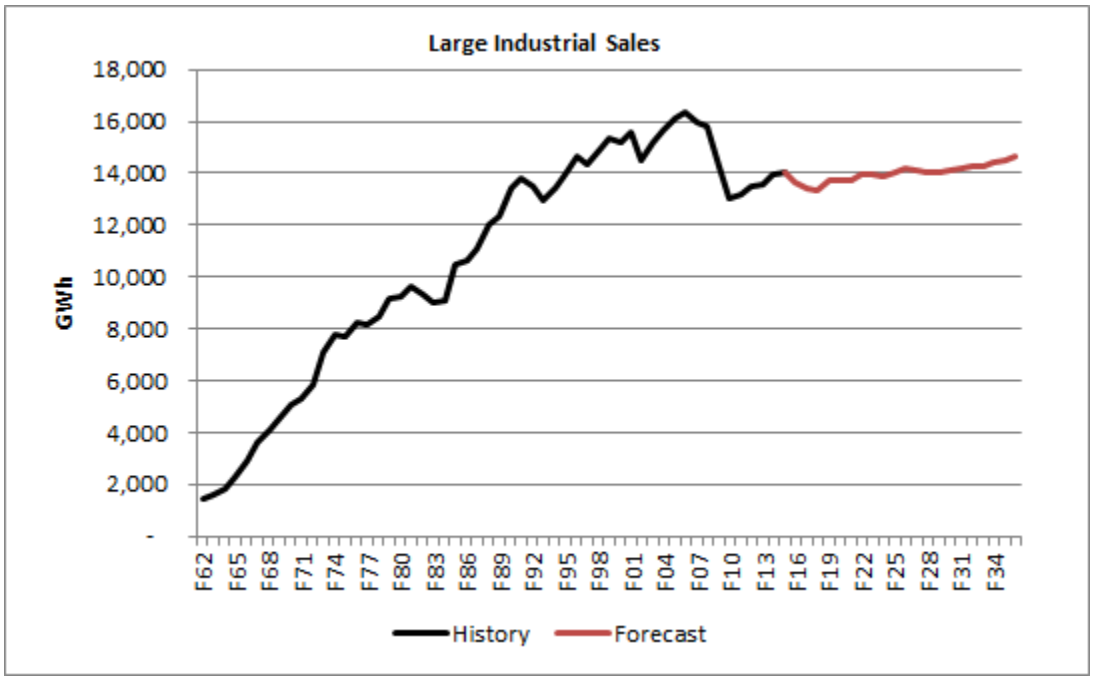
demand which is linked to global economic performance is already reflected in BC Hydro's large industrial sector forecasts.

We also rely on credible third party expert sources for its long term economic forecasts (BC Ministry of Finance, Robert Fairholm Economic Consultant). The Ministry of Finance is predicting GDP growth over the next five years, not a recession. With respect to longer term economic forecasts, BC Hydro is not aware of any credible economic forecasting entity with the ability to predict the timing or magnitude of future economic cycles (both recessions and boom cycles) over the long term. Alternative sources that develop global country specific GDP forecasts such as the World Bank or the Conference Board of Canadian which does U.S and Canadian National forecasts and provincial B.C. 20-year GDP forecast, do not project recessions and periods of extended boom.

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

<u>General Comments on Industrial Load Forecast History and Rationale for Focusing on Recent Ten-Year History</u>

BC Hydro's actual industrial load from fiscal 1962 – 2015 and Current Load Forecast is presented in the following figure. BC Hydro does not believe the variance in our industrial load forecasts over the five decades is useful or meaningful for predicting future loads. The provincial economy, its industrial sectors and methods and assumptions such as commodity prices used to forecast industrial load growth have changed too much over that period to allow for an appropriate comparison.



Note: Figure does not include LNG Plant load forecast, however we classify these loads as industrial.

What this figure shows is that the industrial sector load has grown substantially over the past 50 years (approximately 6 per cent per year on average from F1962 to F2006).

During and subsequent to the major economic downturn of 2007-2008, we saw a dramatic decline in BC Hydro's forestry sector, which was largely attributed to four pulp mill closures. During this period, the previously stable pulp and paper sector experienced a significant restructuring, the effects of which continue today.

Over the past ten years we have also seen significant growth in a nascent shale gas industry, driven by North American demand, the advancement in technology in shale gas extraction, and more recently, the potential emergence of new LNG industry in B.C. The mining sector experienced both boom and bust cycles during this period, which highlights the inherent uncertainty associated with mining commodities.

Developments in each of these sub-sectors (forestry, mining, shale gas (including LNG)) over the past ten years are relevant to understanding and assessing the reasonableness of BC Hydro's Current Load Forecast. Further information on BC Hydro's load forecasts that were developed during the period can be found in:

- **BC Hydro's load history included in Appendix H of our August 30 Filing.**

- **The external audit of BC Hydro's Current Load Forecast, included in Appendix I of our August 30 Filling.**

- **BC Hydro's response to BCUC IRs 1.4.2 and 1.4.3 contained in Exhibit B-12 of BC Hydro's F2017 - F2019 Revenue Requirements Application.**

<u>Industrial Sub-Sector Assessment</u>

The three major sub-sectors which have the greatest influence on BC Hydro's ten-year load history; and the greatest implications regarding the Current industrial sector Load Forecast accuracy are mining, pulp and paper, and gas (including LNG). For each of these sub-sectors, BC Hydro provides:

- **Further explanation of BC Hydro's recent industrial load forecast history beyond what is already provided in Appendix H of our August 30 Filing.**

- **Further information demonstrating the continued reasonableness and robustness of the Current industrial sector Load Forecast.**

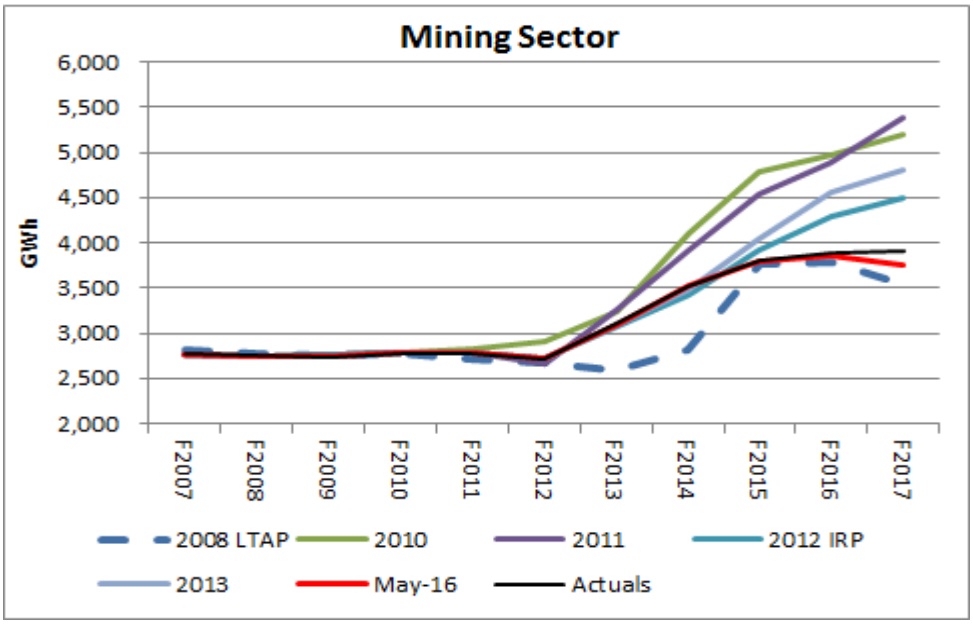
We focus on these three large industrial sectors because the other segments of the forestry sector (i.e., wood, chemical), the oil component of the oil and gas sector and remaining large industrial customers only make up about 35 per cent of the history and forecasted sales, they only constitute about 25 per cent of the total growth in the Current Load Forecast and they have smaller historical variances.

Mining Sector

Although B.C.'s mining sector has historically reflected boom and bust commodity cycles, the total load has increased substantially (almost 40 per cent) since fiscal 2007. It is important to note that despite a prolonged period of low commodity prices in recent years, BC Hydro's mining load has not experienced a decline over the past last two years (fiscal 2016 and fiscal 2017), as recent shutdowns were entirely offset by new mining load ramping up and increased production at existing mines.

Since fiscal 2011, the mining sector has been operating within a very dynamic business environment, which included a significant commodity boom (fiscal 2011-2012), followed by a prolonged commodity downturn (fiscal 2013-2016). During this period, the mining sector load forecasts, which were part of regulatory applications to the Commission (i.e., December 2008 Forecast for 2008 LTAP Update, December 2012 Load forecast for the 2013 IRP, and Current Load Forecast) have performed well when compared to actuals. The relatively small overestimate for the fiscal 2016 – 2017 period for December 2008 and December 2012 forecast can be explained by the unforeseen accident at Mt.

Polley mine and the shutdown of Endako mine due to a significant drop in molybdenum prices.



Other forecast vintages such as the December 2010 and December 2011 load forecasts are well above actuals. However these forecasts were reflective of several new mines requesting electricity service led by a commodity price boom. For example, at the time of the December 2011 forecast, there were 20 new mines requesting 2,300 GWh (on a probability weighted basis) by fiscal 2017. Of these new mines, four mines have materialized for an aggregate load of 1,300 GWh. As such, the vast majority of the variance for fiscal 2017 from the December 2010 and December 2011 load forecast vintages is attributed to new mine load not materializing (as well as Mt. Polley and Endako mine shutdowns previously noted).

At the time the Current Load Forecast was issued in May 2016, there was only one new mine, Brucejack, that was anticipated to take service in the near term. This mine is now energized and in production. The Current Load Forecast does not include any new projects over the next five years. This lack of new mine activity reflects three developments relative to prior load forecasts:

- **All mines that made a positive final investment decision in recent years (Brucejack, Red Chris, Mt Milligan, New Afton and Copper Mountain) are now in production.**

- **The low price environment over recent years has decreased exploration and development activity, causing delays in most new mining projects. The number of new projects and total probability weighed new load in the**

Current Load Forecast is lower than in any other historical load forecast vintage of the past five years.

- **The recent low commodity price environment has already caused higher cost operators to shutdown indefinitely (i.e., Endako or Huckleberry). Existing mines have demonstrated their resiliency to operate within a sustained low price environment and we do not anticipate another wave of large mining closures given that companies have been operating in this lower price environment since fiscal 2011.**

Since the Current Load Forecast was completed in May 2016, both spot prices and the near term outlook for copper and metallurgical coal have improved. This has led to a slight under- forecasting of mining load for fiscal 2017 and fiscal 2018 year-to-date, as indicated in Appendix J, Tables J-2 and J-4. The change in the pricing environment has also bolstered our expectations that the remaining existing mines have a low probability of future shutdown, since current spot prices and five year commodity price outlook are higher than the Current Load Forecast assumptions.

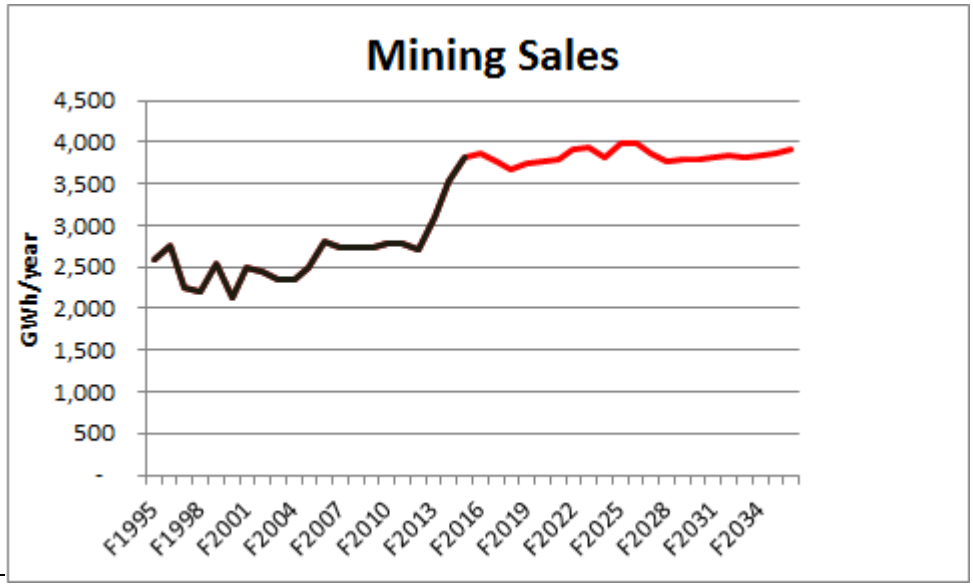
Finally, B.C. holds immense mineral and coal reserves. Although not all these reserves are economically recoverable, it reflects the long term mining potential in the province. Various third parties (i.e., IMF and World Bank) are projecting moderate long term economic growth for countries which import B.C.'s mining commodities. In BC Hydro's view, there is an upside risk that sustained commodity price increases will trigger positive investment decisions to develop large new mines (such as KSM) which are currently not included in the Current Load Forecast.

In summary, BC Hydro believes the Current mining sector Load Forecast is reasonable because:

- **Historical variance was largely driven by a commodity boom cycle where several mines requested service and less than half a dozen came into service.**

- **The risk profile for the sector has changed over the forecast horizon. The risk associated with whether new mines will develop as per requests for electricity service has diminished since the Current Load Forecast no longer includes services requests from numerous new mining projects. On the other hand the risk associated with existing mine shutdowns has increased due to the current low commodity price environment. We believe this risk to be low given the information we have provided in our August 30 Filing on the improved pricing outlook.**

- **B.C. has an abundance of the various metal and coal reserves and it is likely that these reserves will eventually be developed over the long term.**



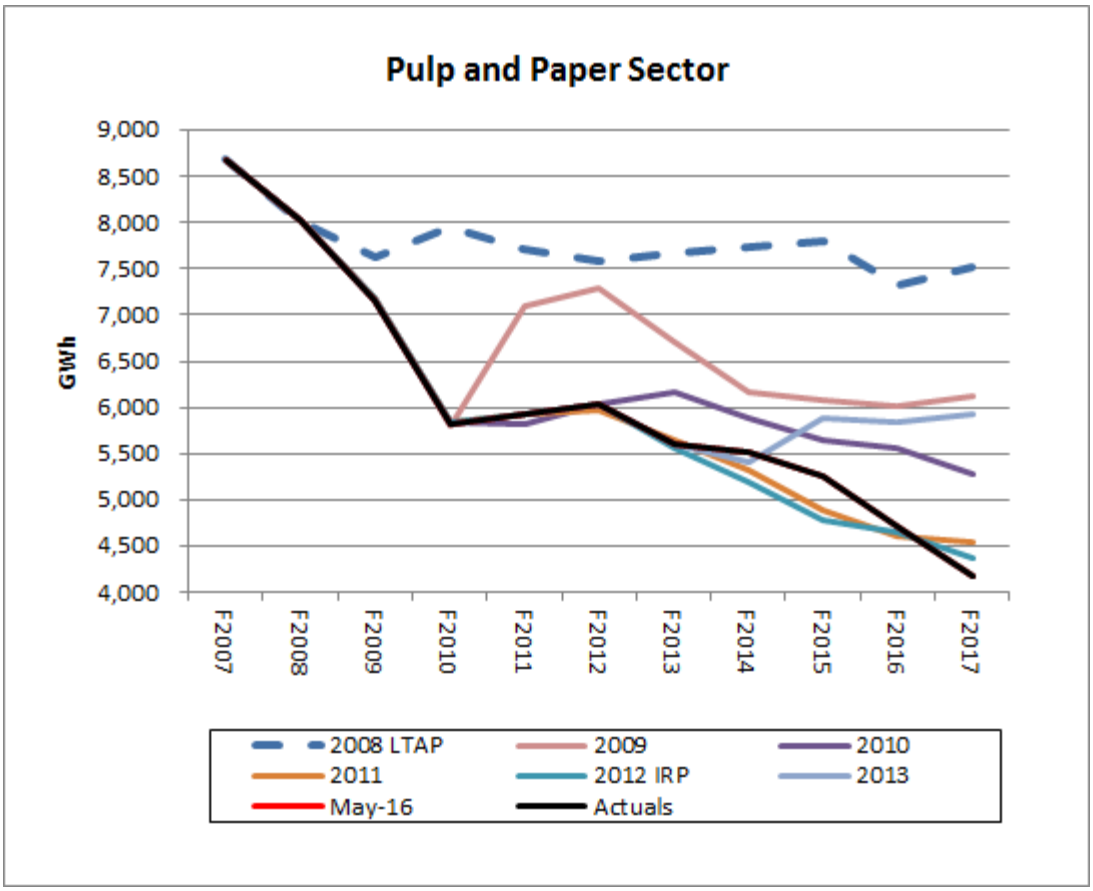
Pulp and Paper Sector

Over the past decade, the pulp and paper sector has been impacted by several major factors including:

- **The major economic downturn of 2007-2008 and slower than expected economic recovery, led to a decline in commodity prices, a tightening of capital markets and appreciation in the Canadian dollar because of a lack of confidence in the U.S. economy.**
- **Operational challenges of aging facilities and access to low cost fibre in B.C.**
- **Market preference changes of electronic media over B.C.'s publication paper products in the North American market,**
- **Global competitor challenges from new, super-large mills in the Southern hemisphere intensifying competition in B.C.'s Asian market**
- **Pulp and paper customers continuing to take part in DSM programs and incentives to enhance operations; and**
- **Additional electricity sales to customers to support their existing operations and expansion into various markets such as specialty papers where B.C. produces have an advantage because the nature of the hardwood fiber than can be extracted.**

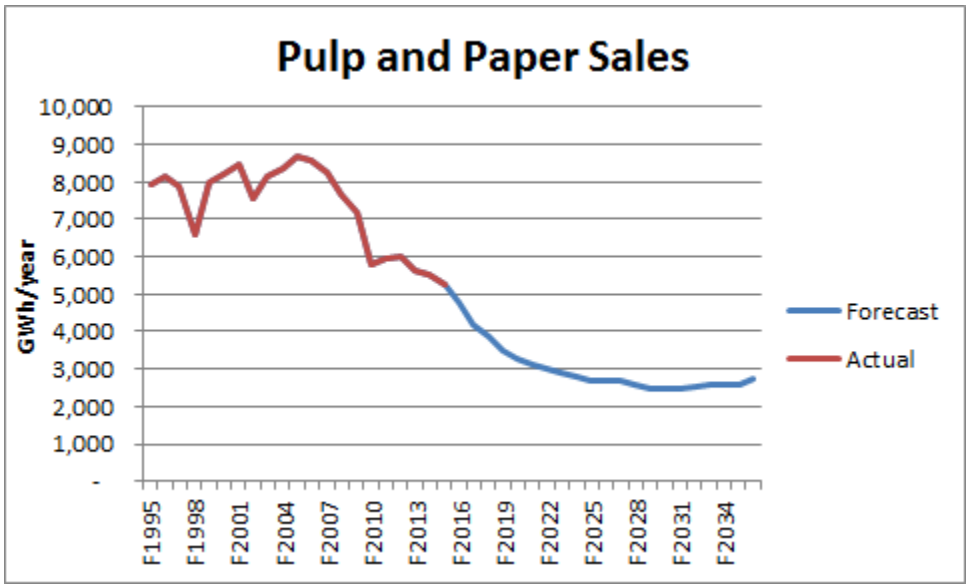
Our view on our or anyone else's ability to forecast recessions and their impacts on the load forecast over the long term has already been provided earlier in this response. For the other elements listed above, our current models take these into account. For instance, in term of downside risk, BC Hydro's model applies risk probabilities to each mill's product lines. The challenge is identifying potential downside risk and assigning a risk probability. Ultimately, the responsibility lies with BC Hydro to: 1) manage the consultants it employs to identify and quantify these risks and 2) validate and assign the risks. Since 2010, we have employed four different consulting groups to assist in forecasting mill line production, mill line closure and fibre availability for the pulp and paper sector. These consulting changes illustrate our ongoing efforts to expand and improve our forecasting capabilities in this area.

The major elements identified above (excluding the impact of forecasting recessions) have shaped the development of the Current pulp and paper Load Forecast as well as recent previous forecasts. These forecasts reflect an expected continued decline in forestry sector, which is shown in the figure below.



The reasons for the variances in the forecast vintages can be generally attributed to discrete permanent closures of four pulp mills, much of which coincided with the major economic downturn of 2007-2008. This is described in detail in Appendix H of BC Hydro's August 30 Filing. Neither the closures or recession were foreseen by many industry experts. The recent decline in sales over the past two fiscal years is attributed to the closure of newsprint related lines at Howe Sound Pulp and the BCTMP mill at Chetwynd.

The 2009 load forecast over forecast variance is largely attributed to the unexpected temporary closure of the Tembec Chetwynd mill. The 2010 and 2013 load forecasts also resulted in over forecast variances as expected restarts of the Tembec Chetwynd mill did not occur. Unexpected closures of a Kruger paper line, the Norampac mill and the Buckeye mill also contributed to the 2010 load forecast variance. The under forecasting in 2011 and 2012 were due to forecasted production reductions at Catalyst Powell River (that did not occur).



For the Current pulp and paper Load Forecast, BC Hydro and its team of experts considered the major elements identified above as part of a global market analysis coupled with a mill by mill and line by line analysis. The result is a probability assignment for every production line for each one of BC Hydro's pulp and paper mill customers.

An aggregated view (by major product category) of BC Hydro's probability analysis is shown in the table below. BC Hydro believes our probability analysis is an unbiased and accurate review based on expert consultant reports, information from customers and consideration of future electricity rates. The probability analysis shows that the major pulp mill loads (i.e., integrated mills with specialty papers, calendars, newsprint operations and TMP operations) are at very close to

[redacted] operational expectation over the long-term of the forecast. As such, should a major shake out occur in the future our current forecast indicates that large loads would be impacted by about only [redacted]. As for the B.C. Kraft mills, the aggregate probability weighting is as high as [redacted] as most of these mills are situated in stable markets and have onsite generation with contracts for power which provides them stability during times of extended market downturns .

Any utility that undertakes individual large customer probability analysis to develop its forecast can never be 100 per cent accurate. It is in the mill owner's self-interest to be limiting expectations on closure to utilities, governments, or bond agencies to protect their business, employees, and shareholders. BC Hydro seeks to mitigate this risk by using several sources of information to formulate our probability weightings.

Mid Pulp and Paper Forecast Before DSM and Rates (GWh)											
	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27
Total	[redacted]									
Integrated Mills										
BCTMP										
Kraft										
Tissue										

BC Hydro Forecast of Operating Probabilities										
	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27
Integrated Mills	[redacted]									
BCTMP										
Kraft										
Tissue										

In summary, our Current pulp and paper Load Forecast (that makes up on average about 21 per cent of total large industrial load over the long-term) is reasonable because:

- **The probability weights applied to each of the mill production lines are unbiased, balanced and supported by expert consultants, information from customers via BC Hydro key account managers, as well as various BC Ministry analysis contained in industry reports such as the impact of pine beetle on the wood fiber supply.**

- **The Current pulp and paper Load Forecast is downward trending consistent with actual historical load trend over the past decade. The Current forecast, along with recent previous forecasts, are founded on solid market and mill analysis which factor in the challenges of completion, globalization, digital media substitution, and the potential expansion for some mills into niche markets such as packaging and cardboard containers. We believe we have reasonably captured this downward trend in our risk profile analysis of the pulp and paper sector.**

Gas Sector (Shale Gas and LNG)

The natural gas sector has been volatile over the last ten years, largely impacted by U.S. natural gas prices and global supply and demand for LNG. Hurricane Katrina (2005) and oil prices beyond $100 per barrel in 2008 caused natural gas prices to rise beyond $10 per million BTU. These two factors contributed to the U.S. shale gas revolution which in turn carried over to developing the B.C. shale basins and the B.C. LNG industry (as will be shown below in the 2008 and 2009 load forecasts).

Regarding global demand for LNG, the Fukushima earthquake (March 2011) led to Japan beginning to replace its nuclear generation fleet with natural gas generation (as well as coal and oil). As a result, global LNG demand jumped and prices for LNG rapidly rose. This incented global LNG suppliers to look to B.C. as a LNG supplier, which led to a significant expected load increase in BC Hydro's 2011 Load Forecast. However, as years passed, opposing market factors led to the slowdown in B.C.

Global supply from Australia and future LNG development from the U.S. caused current and future prices for LNG to rapidly decline; moreover, natural gas and liquids prices in the U.S. declined due to the success of multistage hydraulic fracturing techniques. Consequently, customer service requests were pushed out in the 2013 and the Current Load Forecasts. From late 2016 to mid-2017, these two developments led B.C. LNG project proponents and B.C. upstream gas producers to further defer project development.

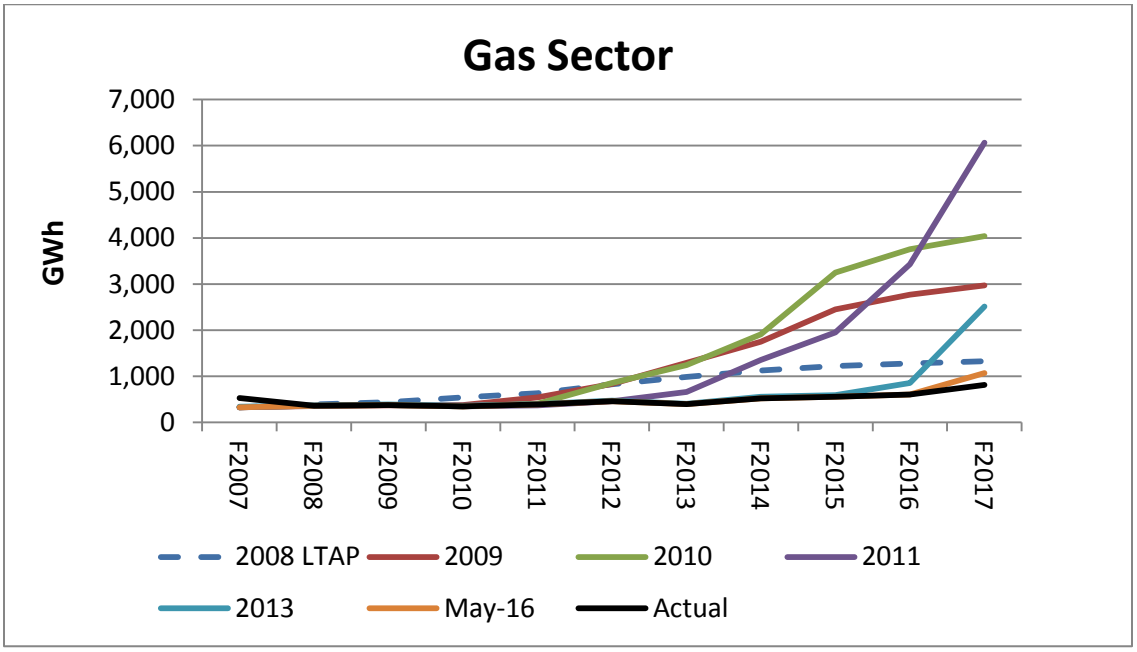
Current macroeconomic assessments for LNG and the North American gas and liquids are generally consistent with assumptions used to inform the Current Load Forecast. For further information on the LNG market, please refer to BC Hydro's response to BCUC IR 2.16.1. B.C. shale gas producers supplying the North American market are completing construction projects and concluding electrification agreements. New customers are applying for electrical service. For further information on these projects refer to Appendix J of our August 30 Filing as well as our response to BCUC IR 2.16.1. BC Hydro remains confident in the assumptions underpinning its Current gas and LNG Load Forecast.

From a load forecast perspective it is worth repeating that BC Hydro's gas forecast model primarily relies on third party information sources to develop B.C. gas production forecasts for gas exports to the North American market and B.C. LNG exports. For the load forecasts developed prior to the 2011 Load Forecast, customer upstream gas requests were insufficient to meet the gas volumes needed to supply all B.C. LNG terminal projects requesting service. In order to align the upstream gas production to satisfy forecasted LNG needs, generic (or non-customer requested) load provisions were added to these load forecasts. However, in 2011, these generic loads were replaced with specific customer load requests. These same customer requests made up the bulk of subsequent load

forecasts on a probability-weighted basis. For the Current Load Forecast, many of these same projects are now in-service or under construction. At present, seven forecasted shale plants materialized and are now receiving service. There are also four other shale plants that were forecasted to receive distribution service (but these are generally smaller sites).

BC Hydro acknowledges there was significantly more uncertainty associated with previous gas sector load forecasts. However, current third party expert assessments continue to expect the development of B.C. LNG. Furthermore, uncertain risk probabilities for major upstream customer requests for North American export (that existed before in the Current Load Forecast) have been reassessed as highly likely as these projects have advanced to the construction stage.

The chart below shows the various vintages of BC Hydro's forecasts and the narrative that follows conveys ties in vintage evolution with the industry economics.



The reasons for the variances in the various forecast vintages can be generally attributed to deferred requests for LNG terminal service, deferred upstream requests for shale gas production for meeting LNG and North American gas demand. These project deferrals are due to the impacts stated above and have led to over forecasting. More specifically, the reasons for and breakdown of previous variances for the various forecast vintages compared to F2017 actuals are provided below:

- **2008 Load Forecast: The over forecast is minimal (300 GWh). Elevated gas prices (from Hurricane Katrina and high oil prices) and improving multistage hydraulic fracturing technology starts incenting shale development.**

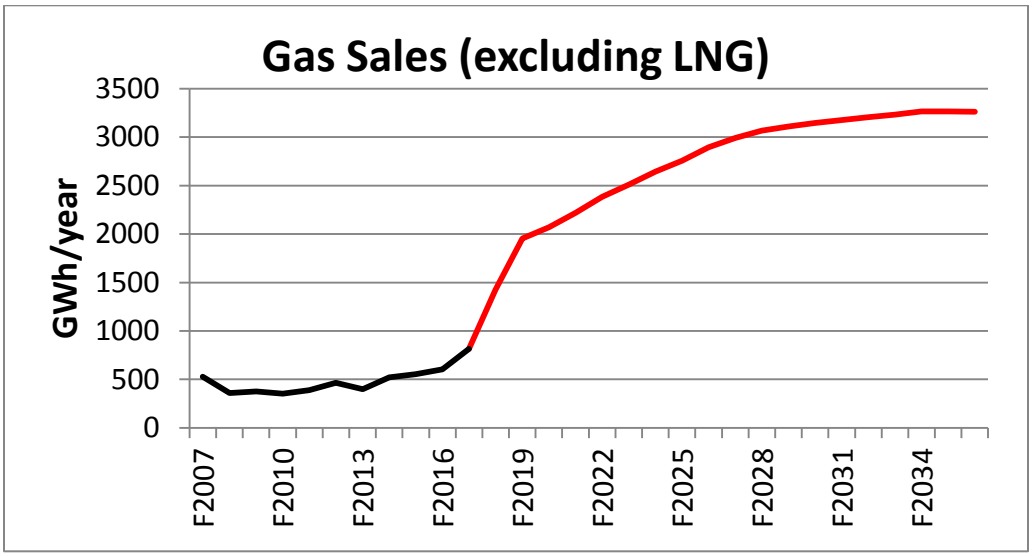
- **2009 Load Forecast: The over forecast (1,900 GWh) is due to LNG requested load (350 GWh), shale gas requested load (700 GWh), shale generic load (400 GWh) and gas processing load (300 GWh). The "LNG requested load" was for [redacted] and [redacted]). The "shale gas requested load" are loads requested by the customer (these loads are generally highly discounted given their relatively early stage of development). The "shale generic load" are for additional load provisions for other customers anticipated in the area. The "gas processing load" are customer requested loads for other non-shale gas plant loads (for instance, gas pipelines, shale gas processing facilities and conventional gas related loads).**

- **2010 Load Forecast: The over forecast (3,000 GWh), is due to LNG requested load (800 GWh), shale gas requested load (1,500 GWh), shale generic load (300 GWh) and gas processing load (400 GWh). The prospect of exporting LNG from B.C. starts to look more attractive.**

- **2011 Load Forecast: The over forecast (5,000 GWh) is due to LNG requested load (3,500 GWh), shale gas requested load (1,300 GWh), shale generic load (30 GWh) and gas processing load (200 GWh). As a result of the Fukushima earthquake (March 2011), LNG demand became more likely. Note that the LNG requested load, as detailed in Appendix H, was largely based on the customer's request of 2 train full load requirements.**

- **2013 Load Forecast: The over forecast (1,400 GWh) is due to LNG requested load (300 GWh), shale gas requested load (1,000), shale generic load (0 GWh) and gas processing load (100 GWh). With increasing competitiveness of global LNG and North American gas producers, load requests were pushed out. Notice that generic loads were entirely replaced by specific customer requested load.**

At the time of preparing the Current Load Forecast, there was material uncertainty in B.C. LNG prospects (due to competition from Australia and the U.S.), and BC Hydro customers supplying to North American markets. In regards to B.C. LNG, global markets were oversupplied and expert expectations were for markets to reach supply-demand balance in 2026. Accordingly, the Current Load Forecast reflects deferred customer requested loads and discounted upstream load requests to better align with expert downstream B.C. LNG forecasts. Customers targeting over-supplied NA markets have also been discounted to better align with market expert expectations.



Circumstances in both the LNG market and with BC Hydro's upstream customers continue to be consistent with what is assumed in the Current Load Forecast (as described in Appendix J to BC Hydro's August 30 Filing). Both LNG expectations and B.C. upstream customer construction plans and customer commitment to electrification are advancing. As stated in Appendix J, upstream B.C. shale gas circumstances are better than what was assumed in the Current Load Forecast. For instance, the collective loads for the those customer sites in the final stages of construction or who have committed to electrification comprises 163 MW (see below) or approximately 80 per cent of the new load forecasted in fiscal 2030. This is because customer loads in this sector of the Current Load Forecast are generally highly discounted for start-up and electrification probability risk. These customer developments not only add certainty to the Current Load Forecast, but, it also suggests that a large portion of the current forecasted load is already accounted for.

Revised Probabilities

As per BCUC IR 16.0 - reassigned with a 100% likelihood

[redacted]

[redacted]

Subtotal

[redacted]

[redacted]

Subtotal

Total 163MW

[redacted]

LNG dependent load as a percent of the total oil and gas sector load makes up only 21 per cent of the total gas sector load by 2030. As a result, we do not anticipate a large variance to the Current Load Forecast if upstream LNG dependent load are not realized.

In summary, BC Hydro is confident with the Current Load Forecast for the following reasons:

- **No generic customer loads. In the Current Load Forecast there are no generic customer loads. Earlier forecast vintages relied on uncertain generic customer loads to support LNG terminal and North American export markets. So, the Current Load Forecast adds a higher level certainty over previous vintages.**

- **Improving load likelihood. As noted in the response to BCUC IR 2.16.1, a large number of loads have been reassigned with a 100 per cent probability. This is an improvement to the Current Load Forecast which was mostly comprised of probabilistically weighted loads. As a result, these reevaluated probabilities add a great deal of certainty to the Current Load Forecast.**

- **The lion's share of the Current gas sector Load Forecast is certain. The revised loads reassigned 100 per cent probability comprise approximately 80 per cent of the new shale gas load forecasted by F2030. As assured loads, comprising approximately 80 per cent of new forecasted load by fiscal 2030, the Current Load Forecast is practically already realized.**

- **Upstream LNG dependent load is small. As noted above LNG dependent load makes up only 21 per cent of the oil and gas sector component of the Current Load Forecast. So, if the LNG dependent upstream gas load is not realized, it is not a major risk to not realizing the Current Forecasted Load.**

- **Confirmation of the LNG forecast. As noted in BC Hydro's response to BCUC IR 2.16.1, recent expert sources are confirming the LNG expectations in the Current Load Forecast. This suggests reasonable likelihood that the LNG dependent upstream gas forecast will be realized.**