October 18, 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 – Revised Round 2 Information Response  

BC Hydro is writing to provide revised responses to two Round 2 Information Requests as detailed below:

1. BCUC IR 2.6.0 - is revised to correct the amount of “PMB Earned Value” in the table regarding the Main Civil Works to $433.5 million from $456.4 million.

2. BCUC IR 2.45.0 - is revised to correct two amounts in the table in the response.
   (a) The “Benefit vs Termination” amount for “Small Gap – Low Load Forecast, Low DSM” amount is revised to $6.1 Billion PV from $6.4 Billion PV.  
   (b) The “Portfolio UEC without Site C” amount is revised to $83/MWh from $65/MWh.

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

fj/af

Enclosure

2.6.0 the Panel asks BC Hydro to provide a point-in-time assessment of its progress to June 30, 2017 using the earned value method, including analysis of schedule variance, cost variance, schedule performance and cost performance as compared to both the FID and PMB plans.

ORIGINAL RESPONSE:

Earned value methodology requires a project’s work packages to be broken down to a sufficient level of detail for analysis. While BC Hydro can prepare an earned value analysis compared to PMB for major work packages, BC Hydro has not performed an earned value analysis compared to the FID baseline as it lacks sufficient level of detail to assess using earned value methodology.

Further excluded from the analysis are the scopes of work as follows:

(i) Where construction has not yet commenced (Transmission, Generating Station & Spillway, and Highways);

(ii) Level-of-Effort based work packages (e.g. indirect work packages) where earned value is of limited use;

(iii) Turbine & Generators as it is milestone based with no on-site activities completed; and

(iv) Reservoir Clearing as not enough work has been completed to accurately analyze using the earned value methodology.

In response to recommendation #3 in the 2016 Ernst & Young/BTY Cost and Risk Assessment, BC Hydro agreed to “implement Earned Value metrics on sub-projects: main civil works, generating station & spillway, transmission, and turbines & generators, as work commences”. BC Hydro has been adapting the project schedule to enable earned value analysis and plans to commence reporting on earned value metrics in December 2017. We provide here a preliminary assessment of earned value to June 30 based on our earned value implementation work completed to date.
MAIN CIVIL WORKS – PMB EARNED VALUE ANALYSIS

BC Hydro analyzed the Main Civil Works work packages compared to the June 2016 PMB and provides the following analysis.

<table>
<thead>
<tr>
<th>Component</th>
<th>PMB Planned Value ($ million)</th>
<th>PMB Actual Cost at June 30, 2017 ($ million)</th>
<th>PMB Earned Value ($ million)</th>
<th>Cost Performance Index</th>
<th>Schedule Performance Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Civil Works</td>
<td>520.3</td>
<td>441.7</td>
<td>456.4</td>
<td>.98</td>
<td>.89</td>
</tr>
</tbody>
</table>

Main Civil Works PMB Earned Value Variance Explanations

The two most significant schedule performance variances are due to a difference between the planned expenditure profile and the actual work progress. The PMB budget planned for the Approach Channel excavation expenditures to be incurred between January 2016 and August and the Left Bank Excavation expenditures to be incurred between April 2016 and May 2017. Subsequent to the June 2016 PMB, the scope of work was further elaborated and re-sequenced indicating a different work progress profile, impacting the schedule performance.

EARLY WORKS – COST VARIANCE

BC Hydro assessed the cost performance of Early Works compared to the FID and PMB plans based on plan versus actual cost, including draws on contingency, rather than by earned value analysis as the work is complete.

<table>
<thead>
<tr>
<th>FID Budget</th>
<th>PMB Budget</th>
<th>LTD Actual Costs as at June 30, 2017 ($ million)</th>
<th>Variance PMB – Life To Date Actual to June 30, 2017 ($ million)</th>
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<td></td>
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</tr>
<tr>
<td>187.4</td>
<td>170.7</td>
<td>174.6</td>
<td>(3.9)</td>
<td>12.0</td>
</tr>
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</table>

PMB Cost Variance Explanation

- The Early Works PMB scope included excavation activities on the North Bank. Costs increases are attributed to additional work required to address slope stability issues on the North Bank Road Gully and to address increased requirements for erosion control, instrumentation and additional excavation. Additional costs were also incurred as a result of the protest activity at Rocky Mountain Fort which delayed clearing efforts.
FID Cost Variance Explanation

- Portions of the FID budget for Early Works were reallocated to Main Civil Works and Transmission work packages to reflect changes in the planned delivery of the scope resulting in a positive variance for Early Works compared to the FID budget.

REVISED RESPONSE:

Earned value methodology requires a project’s work packages to be broken down to a sufficient level of detail for analysis. While BC Hydro can prepare an earned value analysis compared to PMB for major work packages, BC Hydro has not performed an earned value analysis compared to the FID baseline as it lacks sufficient level of detail to assess using earned value methodology.

Further excluded from the analysis are the scopes of work as follows:

(v) Where construction has not yet commenced (Transmission, Generating Station & Spillway, and Highways);

(vi) Level-of-Effort based work packages (e.g. indirect work packages) where earned value is of limited use;

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In response to recommendation #3 in the 2016 Ernst & Young/BTY Cost and Risk Assessment, BC Hydro agreed to “implement Earned Value metrics on sub-projects: main civil works, generating station & spillway, transmission, and turbines & generators, as work commences”. BC Hydro has been adapting the project schedule to enable earned value analysis and plans to commence reporting on earned value metrics in December 2017. We provide here a preliminary assessment of earned value to June 30 based on our earned value implementation work completed to date.
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FID Cost Variance Explanation

- Portions of the FID budget for Early Works were reallocated to Main Civil Works and Transmission work packages to reflect changes in the planned delivery of the scope resulting in a positive variance for Early Works compared to the FID budget.
2.45.0 BC Hydro is requested to clarify which portfolio(s) were used in its alternate portfolio UEC calculation.

ORIGINAL RESPONSE:

Note that this also responds to BCUC IR 2.32.0, which requests all assumptions associated with the Alternative Portfolio Block UEC calculation.

Block UEC

It is useful to provide some context regarding the Block UECs described in section 5.6 of our August 30 Filing, what information those Block UECs provide (and don’t provide), and how they relate to the portfolio analysis as described in section 5.5 and with the sensitivity analyses set out in section 8.

BC Hydro’s main tool to compare resources is a portfolio present value cost analysis, and not Block UECs. This was described in our August 30 Filing in section 5.5: “Portfolio present value cost analysis (Portfolio PV Analysis) is BC Hydro’s main tool to compare resource options, and is standard utility practice for resource planning.”

The use of simplified Block UEC analysis provides assistance in explaining the results of the Portfolio PV Analysis. A simplified Block UEC has the advantage of being easy to relate to in relation to the cost of a single resource, but is not able to account for a number of factors, including, for example,

- the timing of when resource are required;
- the value of surpluses in the electric system as difference resources are built;
- the relative value of a resource in the context of seasonal and daily market prices; and
- how well the particular resources meet the timing and shape of the load.

It is also important to recognize that resources that may appear to be “alternatives” to Site C, but are not because they would be built whether or not Site C is completed, are not incorporated into the Block UEC analysis. This includes:

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1 August 30 Filing, section 5.5, page 60, lines 5 to 7.
2 August 30 Filing, section 5.6, page 60, lines 20 to 22.
• A significant amount of DSM (consistent with DSM Option 2) that is very cost effective but limited by the ability to ensure its delivery; and

• Revelstoke Unit 6.

The Block UEC analysis in section 5.6 shows the cost differences for those resources that are not in the Site C portfolio but are in a portfolio without Site C (i.e., truly alternative resources). Those resources are a number of wind and pumped storage projects. The Block UEC does not, and was not intended to, account for all of the differences that can be reflected in a Portfolio PV Analysis, and as a result do not align directly with any of the portfolio runs shown in Section 8.

In Exhibit 29-6, BCSEA’s comments on the Commission’s Preliminary Report, counsel for BCSEA does a good job of characterizing the benefits of utilizing portfolio PV analysis versus UEC analysis.

Portfolio Analysis and UECs

Site C is not a solution to B.C.’s future energy needs on its own. Site C provides a significant amount of clean, firm energy with dependable capacity, but it must be combined with other resources to meet our future needs. What the portfolio analyses show is the group of resources that would likely be built in a world with Site C (portfolios with Site C), versus what would likely be built in a world without Site C (portfolios without Site C).

BC Hydro interprets the BCUC IRs 2.46.0, 2.47.0 and 2.48.0 as requesting UEC analysis that recognizes the above factors. Given that the simplified Block UEC analysis is unable to account for the same details as a portfolio, BC Hydro has translated the portfolio costs used to calculate the PV differentials into Portfolio UEC values. These Portfolio UECs represent the net present cost of resources added to a portfolio (inclusive of timing to add resources, costs of resources, and trade impact of adding resources) divided by the net present volume of energy generated. The resource prices in these portfolio UECs include supply side resources as well as demand side resources.

The Portfolio UEC results are shown in the following table. As shown, in all sensitivity scenarios, the UEC of the portfolio with Site C is lower than the UEC of the alternative portfolio meaning that ratepayers are better off with continuing construction of Site C as compared to termination. BC Hydro will provide the same portfolio PV and portfolio UEC results for additional sensitivity scenarios requested by the Commission in future IR responses.

| Table | Sensitivity Analysis: Summary |
What these Portfolio UEC results show is:

- The underlying cost of individual resources is necessarily somewhat masked by the other resources that are built into the portfolio. The UEC of the Site C portfolio is the UEC of all resources and not just Site C. This is why the UEC of the Site C portfolio changes in sensitivity scenarios;

- Reducing costs in sensitivities like IPP costs reduces both portfolios, but reduces the Alternative Portfolio more since it has more IPP resources added. As seen in the table, when looking at a 15 per cent reduction in wind costs, the UEC of the portfolio with Site C drops by $5/MWh while the portfolio without Site C drops by $6/MWh which is due to different volumes of wind in each portfolio;

- The Alternative Portfolio includes the costs of the Site C sunk costs, termination and remediation. As a result, when fewer additional future resources are added to the portfolio, the UEC cost of that portfolio increases;
• As demand decreases, the gap between the Portfolio UEC decreases, but even in the low load scenarios, the portfolio with Site C has a lower UEC; and

• Note that Site C termination and remediation costs are included as costs in the “without Site C” portfolios rather than providing a credit to the “with Site C” portfolios. Site C sunk costs are in both portfolios.

REVISED RESPONSE:

BC Hydro notes that it has revised the benefit for the small gap sensitivity in the table below.

Note that this also responds to BCUC IR 2.32.0, which requests all assumptions associated with the Alternative Portfolio Block UEC calculation.

Block UEC

It is useful to provide some context regarding the Block UECs described in section 5.6 of our August 30 Filing, what information those Block UECs provide (and don’t provide), and how they relate to the portfolio analysis as described in section 5.5 and with the sensitivity analyses set out in section 8.

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### Table  Sensitivity Analysis: Summary

<table>
<thead>
<tr>
<th>Sensitivity Input Assumptions</th>
<th>Benefit vs Termination ($ billion present value)</th>
<th>Portfolio UEC with Site C ($/MWh)</th>
<th>Portfolio UEC without Site C ($/MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case – Expected Load and Available</td>
<td>7.3</td>
<td>76</td>
<td>110</td>
</tr>
<tr>
<td><strong>Project Cost Sensitivities</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budget plus Project Reserve of $440 million</td>
<td>7.1</td>
<td>77</td>
<td>110</td>
</tr>
<tr>
<td>Budget plus Project Reserve of $440 million, plus 10% increase to total costs</td>
<td>6.8</td>
<td>78</td>
<td>110</td>
</tr>
<tr>
<td>Termination and Suspension Costs Less 35%</td>
<td>7.0</td>
<td>76</td>
<td>109</td>
</tr>
<tr>
<td>Termination and Suspension Costs plus 100%</td>
<td>8.1</td>
<td>76</td>
<td>114</td>
</tr>
<tr>
<td><strong>Load Sensitivities</strong></td>
<td></td>
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</tr>
<tr>
<td>Small Gap – Low Load Forecast, Low DSM</td>
<td>6.46.1</td>
<td>36</td>
<td>6583</td>
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<tr>
<td>Base Case Less LNG Loads</td>
<td>6.7</td>
<td>42</td>
<td>73</td>
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<tr>
<td>Large Gap – High Load Forecast, Low DSM</td>
<td>10.6</td>
<td>129</td>
<td>158</td>
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<tr>
<td>Add Low Carbon Electrification section 5.2.3</td>
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<td>144</td>
<td>164</td>
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<tr>
<td><strong>Alternative Resource (Cost and Availability) Sensitivities</strong></td>
<td></td>
<td></td>
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<tr>
<td>IPP Costs -15% Reduction</td>
<td>6.2</td>
<td>74</td>
<td>103</td>
</tr>
<tr>
<td>Base Case with Additional DSM</td>
<td>6.9</td>
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<td>113</td>
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<tr>
<td>Base Case with Max 7% Gas</td>
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<td>106</td>
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<td><strong>Market Price Sensitivities</strong></td>
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<tr>
<td>30% Higher Returns in the Market For Site C</td>
<td>7.6</td>
<td>76</td>
<td>110</td>
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<tr>
<td>Low Electricity Market Price Scenario</td>
<td>7.1</td>
<td>78</td>
<td>111</td>
</tr>
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