BC hydro

BCH 2005 REAP – Exhibit B-6

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June 8, 2005

Mr. Robert J. Pellatt
Commission Secretary
British Columbia Utilities Commission
Sixth Floor – 900 Howe Street
Vancouver, BC V6Z 2N3

Dear Mr. Pellatt:

RE: Project No. 3698388
British Columbia Hydro and Power Authority (BC Hydro)
Resource Expenditure and Acquisition Plan Application (REAP)

Further to BC Hydro's letter of June 3, 2005, please find attached the following:

1. BC Hydro's Information Responses to:

- British Columbia Utilities Corporation Information Request No. 2.85.0 with attachment provided on enclosed CD-ROM;
- Independent Power Producers Association of BC Information Request No. 1.9.0; and
- British Columbia Old Age Pensioners' Organization Information Request No. 1.12.5.

Yours sincerely,

Richard Stout
Chief Regulatory Officer

Enclosures

c. Project 3698388 Intervenors

85.0 Reference: Exhibit B-2, Response to BCUC IR 1.13.0

2.85.0 Using the method outlined in the response to BCUC Information Request 1.13.0, please provide an estimate of the unit cost of energy and capacity for Revelstoke 5. Please show the calculation and assumptions used in the developing the estimates.

RESPONSE:

An estimate of the unit cost of capacity net of energy benefits for Revelstoke Unit 5 (Unit 5) using the method outlined in response to BCUC IR 1.13.0 follows. BC Hydro includes with this response a copy, on CD, of the economic model described in the text below. Finally, a list of assumptions employed in the analysis is set out at the end of this response.

The steps as described in response to BCUC IR 1.13.0 are as follows:

1. **Identify the project costs including the capital costs and ongoing operating costs**
2. **Identify the products being provided**
   a. **Capacity**
   b. **Energy**
   c. **Others**
3. **Calculate the present value of the project costs from (1)**
4. **Calculate the present value of the non-capacity products from (2b) and (2c) The value of some of the products may not be easily monetized.**
5. **Deduct the present value of the non-capacity products from (4) from the present value of the project costs in (3)**
6. **To derive the unit capacity cost, divide the net present value cost from (5) by the dependable capacity (2a)**

<u>Step 1</u>: Project costs including capital and ongoing operating costs.

Unit 5 is entering into the early stages of the Definition phase of project development (see response to BCUC 1.32.1). Since the 2005 REAP application was filed, further work has been completed to update the project and the total capital cost estimate has been revised higher to $172.0 million. The increase in estimated project cost, from $138.9 million, is due primarily to higher estimates of equipment supply and installation costs. It has also been affected by a delay in in-service date due to longer lead time to supply major turbine and generator components.

Although total project costs have increased, the forecast capital spending on Unit 5 in each of F2006 and F2007 has decreased: in F2006, from $1.9M to $1.3M; and in F2007, from $9.4 M to $1.5 M.

Notwithstanding the forecast change in capital expenditures for Unit 5, BC Hydro does not propose to amend its 2005 REAP application. The planning process continues throughout the year, while the REAP will always be a "snapshot in time" of planned expenditures. Since a REAP will be filed annually, BC Hydro expects that generally it would amend a REAP after it has been filed only as a result of a significant change in planned expenditures in the first year covered by the particular REAP application.

Step 2: Products being provided

a) Capacity Gain

To meet instantaneous peak demands, Unit 5 will be able to supply over 500 MW of additional capacity. From a long term planning perspective, the dependable capacity from Unit 5 is determined to be approximately 480 MW. The dependable capacity is slightly lower than the rated capacity because the former is a measure of the sustainable peak capacity over a prolonged winter peak period across a range of water conditions.

b) Energy Related Benefits

The energy related benefits present themselves in three different categories: (1) Energy Gain at Revelstoke GS; (2) System Energy Gain; and (3) System Shaping.

b.1) Energy Gain at Revelstoke GS

Unit 5 will enable an increase in the average annual energy generation from the plant. The additional energy will be derived by preferentially loading the new unit as it will be more hydraulically efficient than the existing four units. This is expected to increase average energy generation at Revelstoke GS by 140 GWh/yr. This value is fairly constant year to year, ranging from 120 GWh/yr (firm energy gain) to 150 GWh/yr depending on water conditions.

b.2) System Energy Gain

Unit 5 also enables energy gains on the entire system. This is achieved by reducing a small amount of spill and improving hydraulic efficiency from the power projects situated on the Columbia River and by enhancing the balance of water and system flexibility during the winter and summer.

b.3) System Shaping

Unit 5 will allow the Revelstoke GS to generate more electricity during the highest value time periods and less electricity during the lower value time periods. This allows improved daily load factoring, and weekly and seasonal shaping. The value of the shaping operation is influenced by the differential in market prices between light load hours and peak load hours.

The primary factors affecting the amount of energy related benefits are (1) BC Hydro's supply/demand balance and (2) electricity market price conditions:

(1) When BC Hydro has greater annual energy supply relative to demand, there is more energy available for Unit 5 to shape to higher value periods.
(2) Unit 5 creates more value when electricity market prices have greater differentials between peak load hours and light load hours (refer to discussion b.3 from above), and when market prices are strong in both the winter and summer seasons. Market prices peak during the winter because of the supply/demand influence of the Pacific Northwest while market prices peak during the summer because of the supply/demand influence of other markets, such as California. Overall, BC Hydro system operation tends to be more constrained in the winter than in the summer. Therefore, when and if significant market strength exists during the summer, Unit 5 adds flexibility in operations to capture additional value.

Four Scenarios are presented to test a range of expected energy benefits of Unit 5.

Scenario 1

Scenario 1 is designed to represent an annual energy surplus condition, and is based on the 2004 IEP 2008/2009 load/resource balance. There are sufficent capacity resources to meet peak demands without Unit 5. Market prices are based on the September 2004 BC Hydro electricity and gas price forecast.

Scenario 2

Scenario 2 is on the same resources as in Scenario 1, but the load has been increased by 2000 GWh to represent a system that is energy constrained. Market prices are assumed to be less favourable for Unit 5 (ie. less differential between peak and light load hours, winter peak price only). To model this market pricing scenario, BC Hydro used the unescalated price forecast from September 2001.

Scenario 3

Scenario 3 is based on the 2004 IEP 2016/2017 load/resource balance. In this Scenario, there is an annual energy balance but Unit 5 is required to meet domestic capacity requirements. Market prices are based on the September 2004 BC Hydro electricity and gas price forecast.

Scenario 4

The load and resource balance is the same as in Scenario 3, however, the September 2001 price forecast is used.

The Scenarios were chosen to test a wide range of possible conditions that BC Hydro may face in the future. The focus was on the more conservative cases and scenarios that deal with the benefits of Unit 5 should it be in-service before system capacity is needed. This provides the basis to test the decision that is currently faced in the Unit 5 project – the appropriateness in moving the project forward into the Definition phase.

The table below shows the estimated allocation of the sources of value of Unit 5 for the Scenarios described above. The energy gains at Revelstoke GS and across the system are fairly constant across all scenarios. The value of system shaping varies significantly across scenarios, ranging from $3 to $22 million/year. When there is market opportunity, the system would be operated to maximize shaping opportunities. However, when market opportunities are less prevalent, the system would be operated to maximize system energy gains. The energy values are lower for the scenarios that have a capacity deficit without Unit 5 because it reflects the additional cost of purchasing spot supply to meet peak demands.

	Scenario 1	Scenario 2 (Ref. Case)	Scenario 3	Scenario 4
Energy Supply / Demand Balance	Surplus	Constrained	Balance	Balance
Capacity Supply / Demand Balance	Sufficient without Unit 5	Sufficient without Unit 5	Deficit without Unit 5	Deficit without Unit 5
Market Conditions	Strong summer and winter heavy load price Higher margin between peak and light load prices	Softer summer peak prices Lower margin between peak and light load prices	Strong summer and winter heavy load price Higher margin between peak and light load prices	Softer summer peak prices Lower margin between peak and light load prices
Value of Energy Gain at Revelstoke (b.1)	$7 M/yr	$7 M/yr	$7 M/yr	$7 M/yr
Value of System Energy Gains (b.2)	$2 M/yr	$3 M/yr	$5 M/yr	$5 M/yr
Value of Shaping (Time Shifting) (b.3)	$22 M/yr	$3 M/yr	$6 M/yr	
Total Value of Energy Related Benefits	$31 M/yr	$13 M/yr	$18 M/yr	$12 M/yr

While it is expected that the above Scenarios can all be considered representative of conditions that may exist through the life of Unit 5, Scenario 2 has been chosen as the Reference Case. This Scenario contains conservative energy supply/demand and market assumptions for Unit 5, and tests the appropriateness of proceeding through the Definition phase and planning to its earliest F2011 in-service date.

c) Ancillary Service Benefits

In addition to the system benefits discussed above, Unit 5 provides other ancillary service benefits:

- **Any unloaded capacity of Unit 5 and any displaced capacity of the other existing four units as a result of Unit 5 is available to provide operating reserve.**
- **During times of low load and high imports (occurs when the cost of imports are low), BC Hydro is occasionally limited from further imports by the amount of rotational energy in the system. Unit 5 would be capable of operating in synchronous condenser mode to provide the rotational energy which would facilitate importing additional low cost energy.**

While these ancillary services provide value, there is no economic value assigned to ancillary services benefits for the purposes of the analysis contained in this information response.

<u>Steps 3 to 6:</u> Present Value Results:

Based on the new estimate of capital costs and using the steps outlined in the response to BCUC IR 1.13.0, the estimated annualized (levelized) unit cost of capacity is as follows:

	Scenario 1	Scenario 2 (Ref. Case)	Scenario 3	Scenario 4
Dependable Capacity	480 MW	480 MW	480 MW	480 MW
PV of Dep. Capacity	5,619 MW	5,619 MW	5,619 MW	5,619 MW
PV of Project Costs	$ 140.1 M	$ 140.1 M	$ 140.1 M	$ 140.1 M
PV of Energy Related Benefits	$ 363.9 M	$ 155.2 M	$ 215.1 M	$ 140.5 M
NPV Capacity Cost Net of Energy Related Benefits	$ (223.8) M	$ (15.0) M	$ (74.9) M	$ (0.4) M
Unit Capacity Cost Net of Energy Related Benefits	$ (39.8)/ kW-y	$ (2.7)/ kW-y	$ (13.3)/ kW-y	$ (0.1)/ kW-y

The unit cost of capacity for Unit 5, after accounting for system benefits, is negative in all Scenarios, including the Reference Case. This means that the energy related savings are expected to be sufficient to justify the estimated capital and operating expenditures, leaving no net cost to providing dependable capacity from Unit 5. As Unit 5 proceeds through the Definition phase, the analysis are expected to be refined.

Key Modelling Assumptions:

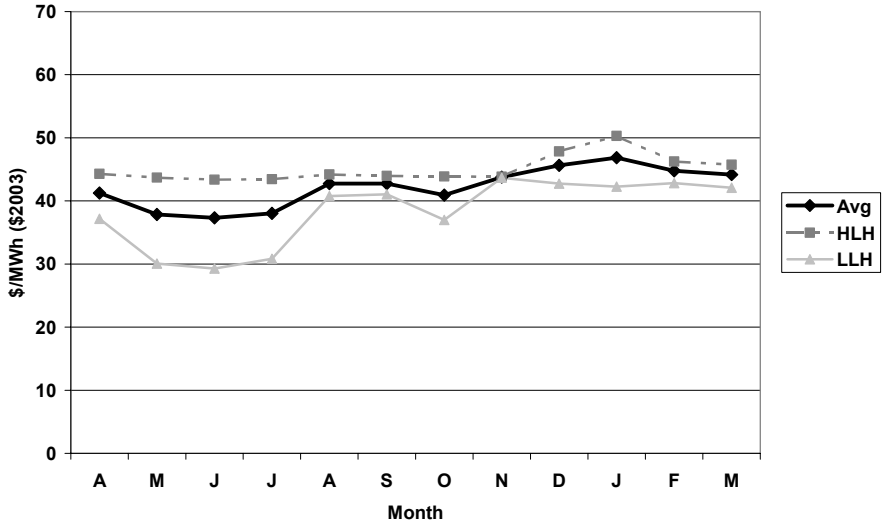
- **A 10 year streamflow was used, from 1 October 64 to 30 September 73, which period contains wet and dry water years as well as some dry and wet sequences.**

- **The operations of major plants of the Peace and Columbia Rivers were modelled incorporating their operating characteristics and operating constraints.**

- **Hourly market prices were derived from the September 2004 electricity and gas price forecast and used for Scenarios 1 and 3. Hourly market prices reflecting the softer market conditions were derived from the unescalated September 2001 electricity and gas price forecast and used for Scenarios 2 and 4. The prices are presented in the following charts:**

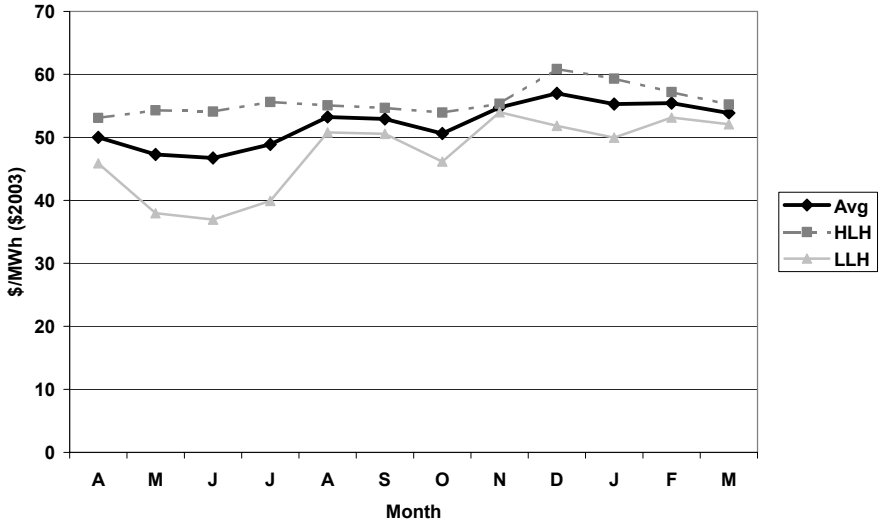
Scenario 1:

September 2004 Forecast for 2008/09



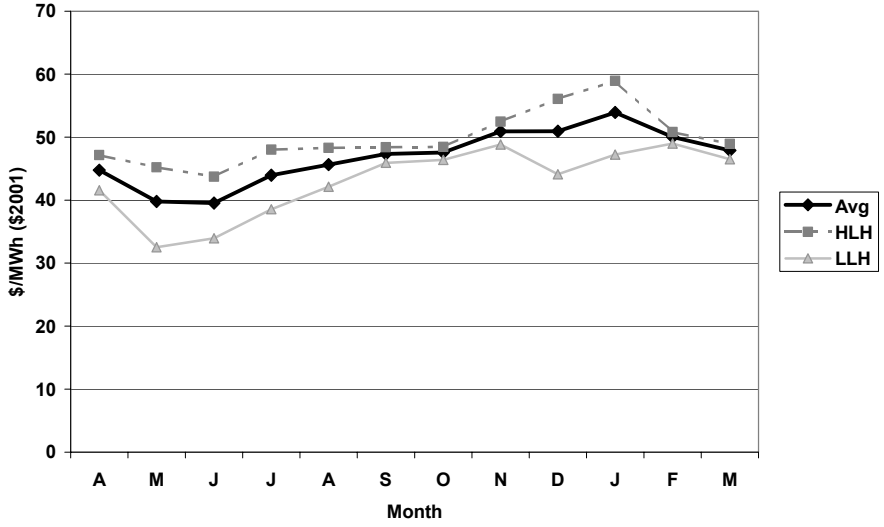
Scenario 3:

September 2004 Forecast for 2016/17



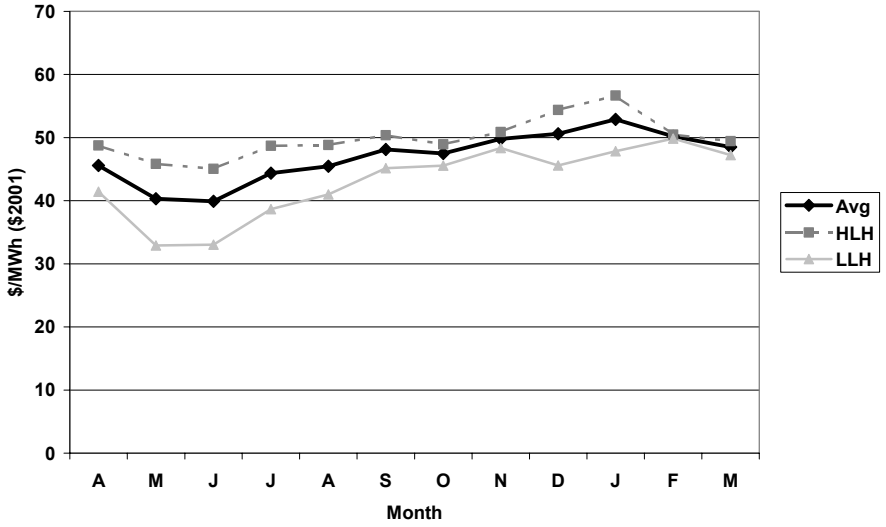
Scenario 2:

September 2001 Forecast for 2008/09



Scenario 4:

September 2001 Forecast for 2016/17



Economic Analysis

Project: Revelstoke Unit 5
In-Service Date: October 2010

Real Discount Rate: 5.88% (Based on 8% nominal discount rate and 2%
Capital Cost: $137.6 M $2004 unloaded (without IDC, OH and Inflatic
$172.0 M Loaded with IDC, OH and inflation for Octob

	Unit	NPV	$/kW-yr*	F2005	F2006
Year				0.0	0.0
Output					
Rated Capacity	MW	5,853		0	0
Dependable Capacity	MW	5,619		0	0
Costs					
Growth Capital	$k 2004	105,466	18.8	300	800
Cost of Energy: Capacity Water Rentals	$k 2004	21,210	3.8	-	-
Operating Costs					
O&M	$k 2004	1,908	0.3	-	-
G&A	$k 2004	0	0.0	-	-
Taxes and Grants	$k 2004	3,284	0.6	-	-
Sustaining Capital	$k 2004	3,627	0.6	-	-
Total Generation Costs	$k 2004	135,495	24.1	300	800
Ashton Creek 250 MVAR MSC					
Capital	$k 2004	3,875	0.7	-	-
O&M	$k 2004	740	0.1	-	-
Total Costs	$k 2004	140,111	24.9	300	800
Benefits					
Energy Gain at Rev	$k 2004	(85,344)	(15.2)	0	0
System Gain	$k 2004	(40,201)	(7.2)	0	0
Time Shifting/Shaping	$k 2004	(29,606)	(5.3)	0	0
Total Benefits	$k 2004	(155,151)	(27.6)	0	0
Net Costs	$k 2004	(15,040)	(2.7)	300	800

* $/kW-yr based on Dependable Capacity

inflation)
on)
er 2010 in-service

F2007	F2008	F2009	F2010	F2011	F2012	F2013	F2014	F2015
0.0	0.0	0.0	0.0	0.5	1.5	2.5	3.5	4.5
0	0	0	0	250	500	500	500	500
0	0	0	0	240	480	480	480	480
1,300	9,400	44,200	58,300	18,800	4,500	-	-	-
-	-	-	-	906	1,812	1,812	1,812	1,812
-	-	-	-	82	163	163	163	163
-	-	-	-	-	-	-	-	-
-	-	-	-	140	281	281	281	281
-	-	-	-	-	-	-	-	-
1,300	9,400	44,200	58,300	19,928	6,755	2,255	2,255	2,255
-	-	435	1,839	3,026	-	-	-	-
-	-	-	-	32	63	63	63	63
1,300	9,400	44,635	60,139	22,986	6,819	2,319	2,319	2,319
0	0	0	0	-3645	-7290	-7290	-7290	-7290
0	0	0	0	-1717	-3434	-3434	-3434	-3434
0	0	0	0	-1265	-2529	-2529	-2529	-2529
0	0	0	0	-6627	-13253	-13253	-13253	-13253
1,300	9,400	44,635	60,139	16,359	(6,435)	(10,935)	(10,935)	(10,935)

F2016	F2017	F2018	F2019	F2020	F2021	F2022	F2023	F2024
5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5
500	500	500	500	500	500	500	500	500
480	480	480	480	480	480	480	480	480
-	-	-	-	-	-	-	-	-
1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812
163	163	163	163	163	163	163	163	163
-	-	-	-	-	-	-	-	-
281	281	281	281	281	281	281	281	281
-	-	-	-	-	-	-	-	-
2,255	2,255	2,255	2,255	2,255	2,255	2,255	2,255	2,255
-	-	-	-	-	-	-	-	-
63	63	63	63	63	63	63	63	63
2,319	2,319	2,319	2,319	2,319	2,319	2,319	2,319	2,319
-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290
-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434
-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529
-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253
(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)

F2025	F2026	F2027	F2028	F2029	F2030	F2031	F2032	F2033
14.5	15.5	16.5	17.5	18.5	19.5	20.5	21.5	22.5
500	500	500	500	500	500	500	500	500
480	480	480	480	480	480	480	480	480
-	-	-	-	-	-	-	-	-
1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812
163	163	163	163	163	163	163	163	163
-	-	-	-	-	-	-	-	-
281	281	281	281	281	281	281	281	281
-	-	-	-	-	-	2,000	-	-
2,255	2,255	2,255	2,255	2,255	2,255	4,255	2,255	2,255
-	-	-	-	-	-	-	-	-
63	63	63	63	63	63	63	63	63
2,319	2,319	2,319	2,319	2,319	2,319	4,319	2,319	2,319
-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290
-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434
-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529
-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253
(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(8,935)	(10,935)	(10,935)

F2034	F2035	F2036	F2037	F2038	F2039	F2040	F2041	F2042
23.5	24.5	25.5	26.5	27.5	28.5	29.5	30.5	31.5
500	500	500	500	500	500	500	500	500
480	480	480	480	480	480	480	480	480
-	-	-	-	-	-	-	-	-
1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812
163	163	163	163	163	163	163	163	163
-	-	-	-	-	-	-	-	-
281	281	281	281	281	281	281	281	281
-	-	-	-	-	-	-	10,715	-
2,255	2,255	2,255	2,255	2,255	2,255	2,255	12,970	2,255
-	-	-	-	-	-	-	-	-
63	63	63	63	63	63	63	63	63
2,319	2,319	2,319	2,319	2,319	2,319	2,319	13,034	2,319
-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290
-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434
-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529
-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253
(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(220)	(10,935)

F2043	F2044	F2045	F2046	F2047	F2048	F2049	F2050	F2051
32.5	33.5	34.5	35.5	36.5	37.5	38.5	39.5	40.5
500	500	500	500	500	500	500	500	500
480	480	480	480	480	480	480	480	480
-	-	-	-	-	-	-	-	-
1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812
163	163	163	163	163	163	163	163	163
-	-	-	-	-	-	-	-	-
281	281	281	281	281	281	281	281	281
-	-	-	-	-	-	-	-	16,000
2,255	2,255	2,255	2,255	2,255	2,255	2,255	2,255	18,255
-	-	-	-	-	-	-	-	-
63	63	63	63	63	63	63	63	63
2,319	2,319	2,319	2,319	2,319	2,319	2,319	2,319	18,319
-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290
-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434
-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529
-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253
(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	5,065

F2052	F2053	F2054	F2055	F2056	F2057	F2058	F2059	F2060
41.5	42.5	43.5	44.5	45.5	46.5	47.5	48.5	49.5
500	500	500	500	500	500	500	500	500
480	480	480	480	480	480	480	480	480
-	-	-	-	-	-	-	-	-
1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812	1,812
163	163	163	163	163	163	163	163	163
-	-	-	-	-	-	-	-	-
281	281	281	281	281	281	281	281	281
-	-	-	-	-	-	-	-	-
2,255	2,255	2,255	2,255	2,255	2,255	2,255	2,255	2,255
-	-	-	-	-	-	-	-	-
63	63	63	63	63	63	63	63	63
2,319	2,319	2,319	2,319	2,319	2,319	2,319	2,319	2,319
-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290	-7290
-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434	-3434
-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529	-2529
-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253	-13253
(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)	(10,935)

F2061	F2062	F2063	F2064
50.0	0.0	0.0	0.0
250	0	0	0
240	0	0	0
-	-	-	-
906	-	-	-
82	-	-	-
-	-	-	-
140	-	-	-
16,000	-	-	-
17,128	-	-	-
-	-	-	-
32	-	-	-
17,159	-	-	-
-3645	0	0	0
-1717	0	0	0
-1265	0	0	0
-6627	0	0	0
10,533	-	-	-

9.0 Reference: General

1.9.0 Please provide, in electronic from, a copy of the financial model for the Revelstoke 5 project.

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 2.85.0.

12.0 Capital Expenditures – Generation LOB

Reference: BCH's 2005 REAP – Chapters 3.3 to 3.9; BCUC IR 1.51.0 & 1.52.0; BCH RRA – Sierra Club Supplemental IR 2.24.0; BCH Stepped Rate Application, page 1-9

1.12.5 What is BCH's estimate as to the unit cost (i.e., $/kW) of new capacity supply, what is it based on and how does it compare with the estimated unit costs for the GM Shrum Capacity increase ($16/kW/year – page 3-57) and the Revelstoke – Unit 5 project ($21/kW/year – page 3-62)?

RESPONSE:

Please refer to BC Hydro's response to BCUC IR 2.85.0.