SUBJECT: Capital cost; Keeyask; Conawapa; NPV

REFERENCE: Economic Cash Flow spreadsheet provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information.

QUESTION:

Please justify all the differences in cash flows for the capital cost to construct Conawapa and Keeyask by different in-service dates.

RESPONSE:

Refer to Appendix 11.1 in the NFAT submission pages 9, 11, 13, 15 and 17 of 18.

Keeyask: **($ millions)**

In Service Date	Spent to Date March 31, 2012	2012 Constant Dollar Cash Flow	Escalation	Capitalized Interest	Net Expenditure
Keeyask 2019/20	$501	$3,678	$368	$962	$5,508
Keeyask 2022/23	$501	$3,728	$571	$1,442	$6,242
Difference	$0	$50	$203	$480	$734

The $50 Million difference in the value of the Constant Dollar Cash Flows between a Keeyask ISD of 2019/20 and 2022/23 is a result primarily of Real escalation.

Conawapa: **($ millions)**

In Service Date	Spent to Date March 31, 2012	2012 Constant Dollar Cash Flow	Escalation	Capitalized Interest	Net Expenditure
Conawapa 2025/26	$230	$5,584	$1,136	$2,397	$9,347
Conawapa 2026/27	$230	$5,654	$1,271	$2,531	$9,685
Difference	$0	$70	$135	$134	$338
Conawapa 2031/32	$230	$5,835	$1,997	$3,093	$11,156
Difference	$0	$181	$726	$562	$1,471

The $70 Million difference in the value of the Constant Dollar Cash Flows between the Conawapa ISD of 2025/26 and 2026/27 is a result of $33 Million of Real escalation and $37 Million in costs associated with additional planning and licensing.

The $181 Million increase resulting from a 5 year deferrrel of the Conawapa ISD from 2026/27 to 2031/32 is comprised of $164 Million of Real escalation and $17 Million of incremental licensing and planning costs.

SUBJECT: Dependable energy; exportable surplus; firm exports

REFERENCE: PUB/MH I-031c

QUESTION:

Please provide the numbers used to make the chart labeled "System Energy Supply and Firm Demand". Please provide the analogous numbers used in the 2013 Update analysis.

RESPONSE:

The following tables provide the data for the System Firm Energy and Firm Demand Chart provided in response to PUB/MH I-031c and the corresponding data for the NFAT 2013 Update K19/C26/750MW (WPS Sale & Inv) Development Plan. It should be noted that for the purposes of this chart “Existing Firm Exports” refers to signed and proposed sale agreements that are not contingent on new generation and “New Firm Exports” refers to signed and proposed sale agreements that are contingent on the new generation included in the development plan.

System Energy Supply and Firm Demand - Chart Data
NFAT 2012 Reference
K19/C25/750MW (WPS Sale & Inv)

	Manitoba Net Load	Non Exportable Resources	Existing Firm Exports	New Firm Exports	Exportable Dependable Surplus	Dependable Energy	Average Energy
2018/19	27133	1181	1804	537	271	30926	2716
2019/20	27346	962	1804	537	531	31180	2916
2020/21	27762	370	1803	1574	2946	34455	2955
2021/22	28169	489	1804	2150	2140	34752	3764
2022/23	28595	513	1803	2160	1671	34742	4008
2023/24	29054	513	1803	2160	1212	34742	3927
2024/25	29519	513	1803	2160	737	34732	3940
2025/26	29950	85	188	1758	4233	36214	3866
2026/27	30323	0	145	2571	5396	38435	5317
2027/28	30763	0	145	2737	4781	38426	6400
2028/29	31233	0	145	2737	4300	38415	6592
2029/30	31714	0	145	2737	3819	38415	6661
2030/31	32181	0	145	2737	3402	38465	6849
2031/32	32632	0	145	2737	3041	38555	6926
2032/33	33103	0	145	2737	2560	38545	7049
2033/34	33597	0	145	2737	2056	38535	7127
2034/35	34087	0	145	2737	1566	38535	7220
2035/36	34573	0	145	1701	2107	38526	7174
2036/37	35056	0	145	249	2097	37547	7822
2037/38	35542	0	145	0	1659	37346	8054
2038/39	36030	0	145	0	1210	37385	8091
2039/40	36517	0	145	0	772	37434	8144
2040/41	37003	0	145	0	324	37472	8408
2041/42	37485	0	145	0	1737	39367	6567
2042/43	37971	0	145	0	1300	39416	6669
2043/44	38457	0	145	0	853	39455	6852
2044/45	38942	0	145	0	406	39493	7150
2045/46	39427	0	145	0	1827	41399	5257
2046/47	39911	0	145	0	1381	41437	5448
2047/48	40397	0	145	0	934	41476	5631

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System Energy Supply and Firm Demand
NFAT 2013 Update
K19/C26/750MW (WPS Sale & Inv)

	Manitoba Net Load	Non Exportable Resources	Existing Firm Exports	New Firm Exports	Exportable Dependable Surplus	Dependable Energy	Average Energy
2018/19	26592	1181	1804	790	504	30871	2862
2019/20	26925	962	1804	790	646	31127	3052
2020/21	27246	370	1804	1616	3376	34412	3089
2021/22	27599	489	1804	2150	2669	34711	3821
2022/23	27988	513	1803	2160	2239	34703	4028
2023/24	28372	513	1803	2160	1855	34703	4000
2024/25	28786	513	1803	2160	1431	34693	3926
2025/26	29194	85	350	1758	2857	34244	4264
2026/27	29568	0	307	2571	3897	36343	4068
2027/28	29894	0	307	2737	5778	38716	5075
2028/29	30307	0	307	2737	5355	38706	6442
2029/30	30745	0	307	2737	4917	38706	6430
2030/31	31149	0	145	2737	4488	38519	6725
2031/32	31561	0	145	2737	4096	38539	6867
2032/33	31970	0	145	2737	3677	38529	6914
2033/34	32404	0	145	2737	3233	38519	6983
2034/35	32835	0	145	2737	2802	38519	7003
2035/36	33264	0	145	1701	3400	38510	6914
2036/37	33689	0	145	249	3311	37394	7584
2037/38	34114	0	145	0	2928	37187	7771
2038/39	34543	0	145	0	2532	37220	7784
2039/40	34972	0	145	0	2146	37263	7792
2040/41	35398	0	145	0	1753	37296	7817
2041/42	35818	0	145	0	1365	37328	7851
2042/43	36239	0	145	0	986	37370	7827
2043/44	36641	0	145	0	614	37400	7879
2044/45	37043	0	145	0	242	37430	8155
2045/46	37444	0	145	0	1738	39327	6254
2046/47	37846	0	145	0	1367	39358	6362
2047/48	38248	0	145	0	995	39388	6517
2048/49	38650	0	145	0	1059	39854	6219

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SUBJECT: Reservoir Operation, Drought Impacts

QUESTION:

Please provide Manitoba Hydro's operating rules governing when to store and release water. Include rules related to seasonal operation, drought mitigation, flood control, etc.

RESPONSE:

Rules and Constraints Governing Manitoba Hydro Operations

Manitoba Hydro's reservoir operations are restricted by a number of licences and agreements that Manitoba Hydro must abide by in the operation of all of its hydro-electric stations and water control structures. The majority of the restrictions are water level based (i.e. maximum or minimum water levels) which drive reservoir release operations. At some locations, there are also explicit constraints on flows.

One example is Manitoba Hydro's Interim Licence for Lake Winnipeg Regulation (LWR) which was issued by the Province of Manitoba as provided for under the Manitoba Water Power Act. In addition to other matters, the Licence sets requirements for the control of outflows from Lake Winnipeg, based on its elevation:

- When the lake level is between 711-715 feet, outflows set to meet the requirements for power production on the Nelson River.
- When the lake level is above 715 feet, Manitoba Hydro must operate at maximum discharge until 715 feet is reached.
- When the lake level is below 711 feet, Manitoba Hydro must operate outflow as ordered by the Minister responsible for the Water Power Act.

In addition to the licence constraints on Manitoba Hydro operations, there are also physical based limits that constrain operations, for example minimum reservoir levels that are required to ensure the structural integrity of a dam, or maximum reservoir drawdown rates that are in

place to maintain the integrity of dyke structures. Manitoba Hydro includes all of these restrictions in planning the operation of its system of reservoirs and generating stations.

IRs from Previous Hearings that Address Operations

Please refer to copies of IR responses from past GRAs and Risk Review (see page 8 of 36 to page 36 of 36) where Manitoba Hydro addressed questions related to its operations; related IR responses are appended to the end of this response and listed in Table 1 below.

Table 1. IR responses from past GRAs and Risk Review where Manitoba Hydro addressed questions related to its operations

PUB Hearing	IR Response
2010-11 and 2011-12 GRA and Risk Review	PUB/MH I-77(a) PUB/MH I-77(c) PUB/MH I-78(b) PUB/MH I-79(b) PUB/MH I-79(c) PUB/MH I-82(b) PUB/MH I-83(a) PUB/MH I-83(c) PUB/MH I-90(c) PUB/MH I-91 PUB/MH I-92(c) PUB/MH I-163(a) PUB/MH I-163(b) PUB/MH II-74(a-c) PUB/MH II-76 PUB/MH II-136(b) PUB/MH II-136(g) PUB/MH RISK-31(a) CAC/MSOS/MH/RISK-13 CAC/MSOS/MH/RISK-83 MIPUG/MH/RISK-2
2012 GRA	MIPUG/MH I-43 PUB/MH I-133 PUB/MH II-92(a) PUB/MH II-92(b) PUB/MH II-92(c) PUB/MH II-92(d)

Quantification of Drought Risk

Related to Manitoba Hydro's quantification of drought risk, the KPMG report (http://www.pub.gov.mb.ca/exhibits/mh-4-7.pdf) concluded at pages xxii and later in the document:

> "On the basis of the policy decisions in place with respect to risk tolerance, Manitoba Hydro quantifies its drought risk appropriately and currently provides for appropriate levels of reserves of risk capital against its projected drought risk."

KPMG went on to state at page 96 of their report:

> "Manitoba Hydro's use of actual flow sequences to measure drought risk is consistent with practices at other utilities and avoids the need to develop statistical models of underlying water flow processes."

On page 119 of the KPMG report, KPMG provided the following conclusion about SPLASH (for planning and estimating the cost of drought) and other Manitoba Hydro models:

> "With respect to the modeling approach at Manitoba Hydro, based on our analysis, we find:
>
> - Manitoba Hydro has developed a suite of models that capture the key characteristics of the Manitoba Hydro system. These models are used to help optimize system operations and to support long-term capacity planning.
> - We are satisfied that MH has taken appropriate care and due diligence in developing and maintaining these models and in using them in its operations planning process.
> - Manitboa Hydro's current approach to forecasting and to calculating dependable energy appears reasonable and is consistent with practices at other North American hydroelectric utilities. It is reasonable to rely on historical flow data for estimating dependable energy."

On page 120 of the September 2009 ICF Report, "Independent Review of Manitoba Hydro Export Power Sales and Associated Risks", ICF concluded:

> "The current methodology of assessment and systems employed by the Corporation to develop the financial estimate of risks associated with an extended drought are reasonable. They reflect a sustained commitment of the organization to quantification of the risks related to droughts, especially related to the amount of hydroelectric power likely to be available and the resulting financial impact from decreased hydroelectric supply. As well, the stress case examined by the Corporation is comparable to practices adopted by other industries."

Also, please refer to page 61 of ICF Direct Evidence (Manitoba Hydro Exhibit #55 - http://www.pub.gov.mb.ca/exhibits/mh-55.pdf) from the 2010-11 and 2011-12 GRA and Risk Review entitled, "Review of MH's Quantification of Risk Exposure Related to an Extended Drought" where ICF concluded that:

> "Manitoba Hydro's quantification of risk exposure to drought via use of a historically based five year episode is reasonable."

Review of MH Operations During the 2002-2004 Drought

The root cause of Manitoba Hydro's financial losses in 2003/04 was drought as a result of a prolonged period of below normal precipitation across much of the Nelson-Churchill River basin. This resulted in an extended period of below normal inflows to the Manitoba Hydro system, as illustrated in Figure 5.8 of the submission, inflows in 2002/03 were below average and inflows in 2003/04 were only 62% of average. The deficit in hydraulic supply required Manitoba Hydro to secure alternate supplies from the market at market prices in order to meet its firm load obligations.

Risk Advisory in its January 2005 report entitled "2002-2004 Drought Risk Management Review" of Manitoba Hydro's drought operations concluded on page 35:

> "Overall, the Company did an outstanding job in managing the drought. There is an inappropriate tendency to apply 20/20 hindsight to risk management decisions. However, any judgment must be based on market circumstances at the time, and the need to manage both financial and reliability risks. While the Company did incur incremental costs to avoid draining reservoirs, it did so for the sole purpose of protecting the Manitoba consumer from potential outages in the future."

Also, please refer to page 56 of ICF Direct Evidence (Manitoba Hydro Exhibit #55 - http://www.pub.gov.mb.ca/exhibits/mh-55.pdf) from the 2010-11 & 2011-12 GRA and Risk Review entitled, "Review of MH's Management of the 2003/2004 Drought".

What Drought Risk Factors are Different Today/Tomorrow vs. 2002-2004 Drought

Please refer to Manitoba Hydro's responses to LCA/MH II-462 and LCA/MH II-463. In addition, please refer to pages 57 and 59 of ICF Direct Evidence (Manitoba Hydro Exhibit #55 - http://www.pub.gov.mb.ca/exhibits/mh-55.pdf) from the 2010-11 & 2011-12 GRA and Risk Review. On page 59, entitled, "MH's Capability to Respond to a Drought Has Significantly Evolved Since the 2003-04 Drought", ICF highlighted differences between a number of drought risk related factors between 2003/04 and 2010/11. Aside from the water supply and load-dependent factors (which change from year to year) there are a number of other factors that have changed for the better since 2003/04 that reduce Manitoba Hydro's financial drought risks, namely:

- Manitoba Hydro now has access to a liquid open market (MISO) as opposed to being limited to bilateral purchases as it was in 2003/04.

- Manitoba Hydro can now purchase power using brokerage services thereby sheltering itself from non-competitive pricing; in the absence of a broker, the seller may command a higher price from Manitoba Hydro given it would be aware of general water supply conditions in the Manitoba Hydro system.

- Manitoba Hydro now owns all northbound firm transmission service which increases the reliability of imports and reduces Manitoba Hydro's financial exposure related to using another party's transmission service.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-77

Subject: **Tab 8: Energy Supply**

Reference: **Tab 8, Energy Supply, Page 17 of 20, Figure 8.6.2**

a) Please confirm that in February of most years, MH commits to summer peak export energy sales, but only if energy in storage is above 8,000 GWh. Explain what other factors (e.g. actual winter precipitation) are employed.

ANSWER:

Manitoba Hydro may commit to export sales in February for the subsequent spring and summer season, but has no specific requirement related to 8,000 GWh of energy in reservoir storage. The main factor that enables these sales is that under worst case conditions Manitoba Hydro has surplus energy available to serve the sale. The determination of this surplus includes energy-in-storage levels, and basin snow pack conditions. For example in the springs of 2005, 2008 and 2009, near record flood forecasts were issued for the Red River, which meant that MH could with confidence predict that inflows to Manitoba Hydro's reservoirs in those years would be above dependable inflow conditions.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-77

Subject: **Tab 8: Energy Supply**

Reference: **Tab 8, Energy Supply, Page 17 of 20, Figure 8.6.2**

c) Please confirm that MH assumes long-term average energy inflows of 50 GWh/month for the second half of the fiscal year and anticipates drawing about 6,000 GWh from energy in storage. If not, please explain what other factors are employed.

ANSWER:

Manitoba Hydro can confirm that the referenced Figure 8.6.2, entitled "Daily Gross Energy from Inflow Indicator" indicates that on average, the daily inflow is around 50 GWh/day or 1,500 GWh/month for the second half of the fiscal year.

In addition, Manitoba Hydro can confirm that Figure 8.6.3 entitled "Total Energy in Reservoir Storage" indicates that there is an average storage draw down of almost 7,000 GWh for the period of October 1 to April 1.

However, Manitoba Hydro does not use either of these numbers in planning its power system operations.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-78

Subject: **Tab 8: Energy Supply**

Reference: **Tab 8, Energy Supply, Page 17 of 20, Lines 7 and 8**

b) Why does MH no longer consider the 10,000 GWh as of April as a constraint benchmark for increased export sales? Was the energy in storage calculation revised after 2003/04?

ANSWER:

Manitoba Hydro is not aware of a reference to 10,000 GWh in April as a constraint for export sales. Interruptible export sales are predominantly a function of the spring and summer water supply. Also, refer to PUB/MH I-82(d).

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-79

Subject: **Tab 8: Energy Supply**

Reference: **2008/09 Power Resource Plan and Tab 8 (Pages 16/17/18 of 20)**

b) Explain what specific weighting is given to the spring flow conditions and energy-in-storage in each watershed.

- **Winnipeg River.**
- **Red River.**
- **Saskatchewan River.**
- **Burntwood River.**
- **Other inflow.**

ANSWER:

Manitoba Hydro does not apply weights to spring flow conditions nor to energy in storage in its various watersheds.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-79

Subject: **Tab 8: Energy Supply**

Reference: **2008/09 Power Resource Plan and Tab 8 (Pages 16/17/18 of 20)**

c) Does MH regularly monitor or define on a watershed basis the following:

- **Precipitation (October to February)?**
- **Spring precipitation (March/April)?**
- **Summer precipitation (May to September)?**
- **Summer evaporation from reservoirs (May to September)?**

ANSWER:

Manitoba Hydro generally monitors precipitation on a business-day basis. Each week Manitoba Hydro reviews the system and basin weighted average precipitation reports for varying durations:

1. the past week;
2. the past 60 days; and
3. seasonal cumulative values (April 1st through October 31st or November 1st through March 31st).

Evaporation is implicitly monitored through a lake local inflow which is calculated using measured inflow, outflow and water level.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-82

Subject: **Tab 8: Energy Supply**

Reference: **Exhibit #17 (2007/03/11) Tab 8 – Energy Supply**

b) Please explain the role that energy in storage plays as a significant input to MH's annual hydraulic generation forecasts.

ANSWER:

Illustrating and tracking storage in terms of energy is meaningful to monitor aggregate storage conditions for a system of reservoirs used for hydro-electric production.

Energy in storage is not an explicit input to the annual hydraulic generation forecast. Instead, energy in storage is modeled by using current water levels, consistent with actual conditions at the time of the forecast. To this water supply is added the forecast of inflows to the system, which in combination is the available water supply used to produce hydraulic generation forecasts.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-83

Subject: **Tab 8: Energy Supply**

Reference: **Exhibit #17 27/03/11**

a) Does MH contemplate a zero energy in storage scenario during

i. A one-year drought? Explain.

ii. A two-year drought? Explain.

iii. A five-year drought? Explain.

iv. A seven-year drought? Explain.

ANSWER:

Manitoba Hydro does not contemplate a zero energy in storage situation either from a planning or operating perspective regardless of the extent of drought. Without water in storage, Manitoba Hydro could not operate its hydraulic system.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-83

Subject: **Tab 8: Energy Supply**

Reference: **Exhibit #17 27/03/11**

c) What minimum energy in storage level April 1, May 1, and June 1 would MH look for in contemplating the annual achievement of:

i. 33,000 GWh of hydraulic generation?

ii. 29,000 GWh of hydraulic generation?

iii. 25,000 GWh of hydraulic generation?

ANSWER:

The amount of hydro-electric energy Manitoba Hydro can produce in a year is largely dependent on the amount of precipitation and resulting runoff (or inflow) occurring in that year. It is therefore not possible to respond to this question without defining the inflow conditions.

In general, Manitoba Hydro does not contemplate a specific annual achievement of hydraulic generation in any given year. However, Manitoba Hydro does plan its operations to ensure storage levels are, at minimum, sufficient to supply firm domestic and export load under the most severe drought of record inflow condition. For a single year worst drought commencing on April 1st, the minimum useable energy storage amount is approximately 3 TWh.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-90

Subject: **Tab 8: Energy Supply**

Reference: **PUB/MH I-3(f)**

d) Can MH confirm that above average Winnipeg River and Red River spring runoff would typically ensure average or above average overall hydraulic output? Explain.

ANSWER:

No. Above average spring runoff does not guarantee above average hydraulic output for the year. Other significant factors include: spring precipitation, summer precipitation, fall precipitation, and carry over reservoir storage from the previous year. Moreover, the Winnipeg and Red River basins only make up a portion of the larger Nelson / Churchill River Basin that supplies Manitoba Hydro's hydraulic generation stations.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-91

Subject: **Tab 8: Energy Supply**

Reference: **Tab 8 – Energy Supply Page 17/18.**

Please confirm that MH's operational decision process relies on:

i. Actual flows (unweighted) within the major stream system (Winnipeg River, Red River, Saskatchewan River, and Burntwood River).

ii. Spring and summer peak flow hydrographs that are of a predictable shape so that by reference to a peak discharge, the upcoming fall and winter hydraulic generation can be predicted.

iii. Local inflows (other than four major streams) being more than sufficient to counter evaporation losses from reservoirs (e.g., Lake Winnipeg).

iv. Limiting the size of the individual export sales commitments that can be made without reference to the Division Manager.

v. Please provide any additional factors.

ANSWER:

i. Confirmed. Actual river flows within the major stream system (*that includes* Winnipeg River, Red River, Saskatchewan River, and Burntwood River) are a key input to the operations planning process.

ii. No. Upcoming fall and winter hydraulic generation is not predicted by reference to a peak discharge experienced in the spring and summer periods. Refer to 2010 GRA PUB/MH I-81 for further explanation.

iii. No. The operations planning process relies on a water supply forecasting technique utilizing regression analysis that accounts for all the inputs and losses in the hydrologic cycle.

iv. No. Operations planning decisions are separate from management controls that limit export sales commitments. The operations planning process does require that all export sale and purchase commitments be included.

v. There are numerous other non-technical factors and technical factors that are considered in the operations planning process. These include but are not limited to:

a. License, legal and citizenship obligations to all stakeholders affected by Manitoba Hydro's operations,
b. Public safety, energy security and environmental stewardship considerations which all involve the exercise of professional judgment and experience,
c. Current storage levels, near term weather forecasts, equipment maintenance schedules, domestic load forecasts, ice conditions, availability of extra-provincial tie-line capacity and short term market trends and needs.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-92

Subject: **Tab 8: Energy Supply**

Reference: **Tab 8 – Energy Supply (Page 17, Figure 8.6.2)**

c) Is winter and spring precipitation directly employed as an input into MH's operational modelling? Explain.

ANSWER:

No. Precipitation is not a direct input into Manitoba Hydro's operations planning models. Precipitation is implicitly included in Manitoba Hydro's modeling in the form of observed stream flows. Very recent precipitation information is used qualitatively to monitor overall basin conditions.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-163

Subject: **Tab 12: Corporate Risk Management**

Reference: **ICF Report, Chapter 9.0 (Pages 118 to 120)**

a) Please provide an overview of MH's planning approach to defining system constraints in drought years, average years, and high flow years.

ANSWER:

Manitoba Hydro's planning approach is to ensure that there is sufficient energy and capacity supplies available at all times to meet its firm load and reserve obligations. To the extent that Manitoba Hydro has surplus supplies available, these surpluses are scheduled for sale to the various external markets in a manner such that Manitoba Hydro's net revenues are maximized. In scheduling the production of electricity, Manitoba Hydro recognizes all the constraints of its generating, transmission and export systems including; safety, reliability, legal and licenses as well as the physical characteristics of the reservoirs, rivers and water control structures.

In drought years, Manitoba Hydro is faced with the uncertainty of the magnitude and duration of the drought as there is no guarantee that the historic flow record includes the worst drought possible. To maintain the highest level of supply security, Manitoba Hydro adopts a conservation strategy which preserves reservoir storages to the extent possible given the availability of alternate supplies. Specifically, reservoir releases are managed on the assumption that forecast inflows will be at the lower 90% confidence level in the current year, that 1940/41 inflows will occur in the second year, that winter weather and electricity demand will be at the upper 90% confidence level and that imports will be relied on only to the extent there is firm transmission available.

In non drought years, energy security is not an issue as Manitoba Hydro is not in an energy short situation and the power system can be operated normally.

2010-11 and 2011-12 GRA and Risk Review PUB/MH I-163

Subject: **Tab 12: Corporate Risk Management**

Reference: **ICF Report, Chapter 9.0 (Pages 118 to 120)**

b) Please provide a detailed process outline of MH operational modelling to define surplus energy at various times of the years, e.g.:

i. February (precipitation/energy in storage).
ii. April (precipitation/energy in storage).
iii. July (runoff/energy in storage).
iv. October (runoff/energy in storage).

ANSWER:

On a weekly basis, Manitoba Hydro prepares a production forecast for the generating system for a period as long as 16 months into the future. This forecast indicates the generation plans for each of Manitoba Hydro's facilities and any import and export transactions necessary to serve Manitoba Hydro's load obligations. Inputs into this forecast are Manitoba Hydro's reservoir storages plus its current water supply forecast for the planning period. Should Manitoba Hydro have surplus energy supplies available, these are scheduled for sale into the external markets in a manner that maximizes Manitoba Hydro's net export revenue. This process is updated weekly, adjusting on a continuous basis for current water, market and other conditions. The production plan also consists of a set of reservoir releases that reflect those necessary to accommodate Manitoba Hydro's various stakeholders, anticipated releases from upstream reservoir operators, and license requirements as well as those needed for economic power system operation.

2010-11 and 2011-12 GRA and Risk Review PUB/MH II-74

Subject: **Tab 8: Energy Supply**
Reference: **PUB/MH I-77(a), (b), (c), (d) - System Energy Storage Depletion**

Please provide a detailed explanation of MH's actual energy operational parameters and constraints (e.g., rule curve) used to determine surplus energy available for export in:

a) April-May period.
b) June-September period.
c) October-March period.

ANSWER:

As explained in PUB/MH I-77, with respect to rule curve, Manitoba Hydro plans its operations to ensure useable storage levels are, at minimum, sufficient to supply firm domestic and export load under the most severe single year historic drought of record inflow condition. This useable energy storage requirement is effectively a rule curve level.

Manitoba Hydro plans its operations to export surplus energy (i.e. energy in excess of the reserve requirement) in the highest valued periods to the extent possible subject to constraints and operational parameters. Of the periods listed in this information request, higher export prices generally occur in the June-September period. To account for uncertainty in key parameters such as future inflows and Manitoba Load, Manitoba Hydro uses conservative assumptions prior to committing to sell this surplus energy under contract.

As explained in PUB/MH I-91, in addition to inflows, the constraints and operational parameters that impact the operations planning process include, but are not limited to:

a. license, legal and citizenship obligations to all stakeholders affected by Manitoba Hydro's operations;
b. public safety, energy security and environmental stewardship considerations which all involve the use of professional judgment and experience; and
c. current storage levels, near term weather forecasts, equipment maintenance schedules, domestic load forecasts, ice conditions, availability of extraprovincial tie-line capacity and short term market trends and needs.

2010-11 and 2011-12 GRA and Risk Review PUB/MH II-76

Subject: **Tab 8: Energy Supply**
Reference: **PUB/MH I-77(a), (b), (c), (d) Actual Energy Operations**

Please define on a monthly basis for the 2002-03 and 2003/04 years, MH's decision process based on the then available specific data on:

- **Actual accumulated winter snow pack (inches).**
- **Actual accumulated spring and summer rainfall (inches).**
- **Lake Winnipeg partial inflows (cfs/GWh).**
- **Lake Winnipeg water levels.**
- **System energy-in-storage (GWh).**
- **Total hydraulic generation (GWh).**
- **Total imports and thermal generation (GWh).**
- **Total exports (GWh).**

ANSWER:

Manitoba Hydro's rationale for managing the 2003/04 drought was tested during the 2004 PUB rate hearing. Please refer to the transcripts of that hearing for the details. In addition, Manitoba Hydro had its operations reviewed by an independent consultant as requested by the PUB.

The Manitoba Hydro 2002-2004 Drought Risk Management Review was filed with the PUB on May 3, 2005 and re-filed as Appendix 43 of the 2008 GRA. The document can be found at: http://www.hydro.mb.ca/regulatory_affairs/electric/gra_08_09/information_requests/Appendix_43-Report_on_2002-2004_Drought.pdf

The review addresses Manitoba Hydro's energy portfolio management activities as they pertained to the drought experienced by Manitoba Hydro from 2002-2004. In both reviews, Manitoba Hydro's actions were deemed to be prudent and in the best interests of the Manitoba rate payer.

Please also refer to explanations of Manitoba Hydro's operations planning decision process provided in PUB/MH I-91 and PUB/MH I-163. Manitoba Hydro respectfully declines to provide a more detailed response to this question.

2010-11 and 2011-12 GRA and Risk Review PUB/MH II-136

Subject: **Tab 12: Corporate Risk Management**
Reference: **Tab 12, Sections 12.1 and 12.2, Pages 1/2/3 Drought Operations**

b) What parameters does MH employ to predict an impending drought? List and explain.

ANSWER:

Droughts are not predictable and Manitoba Hydro does not rely on its predictive ability in protecting Manitoba Hydro from the risk of drought. Instead of operating based on predictive ability, Manitoba Hydro plans its operations considering the full range of possible future water supply conditions. Sufficient storage reserves are maintained such that firm demand and exports can be supplied during the most severe single-year drought of record. Relating specifically to water supply, Manitoba Hydro's operations planning process considers the following parameters:

a. historical record of inflow conditions – used to establish the severity of dry conditions that are possible in the future;
b. current usable energy in reservoir storage;
c. existing inflow conditions – tributary flows into the Churchill and Nelson River basins;
d. accumulated snowpack conditions – extreme snowpack conditions (high or low) correlate to spring runoff; and
e. accumulated rainfall - recent rainfall information is used qualitatively to monitor overall basin conditions.

2010-11 and 2011-12 GRA and Risk Review PUB/MH II-136

Subject: **Tab 12: Corporate Risk Management**
Reference: **Tab 12, Sections 12.1 and 12.2, Pages 1/2/3 Drought Operations**

g) What specific actions would MH undertake if October energy-in-storage fell below average? Explain.

ANSWER:

The response to this question is dependent on numerous factors including, but not limited to what is the useable energy in storage (*i.e.,* how much below average), inflow conditions, forecast Manitoba load, export contract commitments, thermal generation availability, import capability, etc.

If energy in storage is below average in October but not well below average, Manitoba Hydro may still be exporting power in the off-peak period depending on inflow conditions.

Regardless of the water supply condition, Manitoba hydro will operate in accordance with the System Operations Priorities as provided in the response to PUB/MH I-147(a)(ii), where Priority 1 is to maintain firm energy supply. Depending on the severity of the water supply conditions, including current storage and inflows, Manitoba Hydro continuously evaluates the need to, and merit of, taking the following actions:

- decreased off-peak exports;
- increased off-peak imports;
- financial settlement of existing on-peak export contracts;
- hedging to mitigate price risk for imports and/or gas costs;
- increased on-peak imports;
- operation of gas-fired generation; and
- operation of coal-fired generation (as permitted under *The Climate Change and Emissions Reductions Act*).

Some or all of the above actions could be invoked at any point in the year if deemed necessary to protect firm energy supply.

2010-11 and 2011-12 GRA and Risk Review PUB/MH/RISK-31

Reference: PUB/MH II-75; PUB/MH II-90

Risk Issue: Energy from Storage

a) Please confirm that in defining dependable energy MH typically assumes every drought year will commence with an April 1st average energy-in-storage of 8,000 GWh; and therefore, MH is targeting to retain at least average energy-in-storage at the end of March.

ANSWER:

Manitoba Hydro cannot confirm that it is targeting to retain 8,000 GW.h of energy in storage. Given that the annual energy from inflow in the most severe drought is approximately 15,500 GW.h and that dependable hydraulic energy is 21,000 GW.h, it could be concluded that Manitoba Hydro requires about 5,500 GW.h in storage at the end on March that can be utilized over the next year of low flows assuming financial settlements and additional market supplied energy are ignored as supply sources.

For operational planning purposes, Manitoba Hydro assumes that a portion of its long term export contracts will be financially settled and that some market supplied energy will be available in determining its energy reserve requirements.

2010-11 and 2011-12 GRA and Risk Review PUB/MH/RISK-31

Reference: PUB/MH II-75; PUB/MH II-90
Risk Issue: Energy from Storage

b) Please confirm that in above average flow years, it should be almost always possible to sustain an outflow from energy-in-storage of 8,000 GWh over an eight-month (August to March) period.

ANSWER:

Manitoba Hydro cannot confirm that it is able to sustain an 8,000 GWh draw from energy-in-storage in above average flow years from August to March.

In above average inflow years the outflow capability from Lake Winnipeg is insufficient to achieve a significant draw (if any) from storage for power purposes. 2010/11 is a good example of this situation when the draw for power purposes (in spite of maximum outflows at Jenpeg) will be limited to 225 GWh by March 31, 2011 due to ice restrictions in the Lake Winnipeg outlet channels. When storage draws from Cedar Lake and Southern Indian Lake of 2,000 GWh are included the total storage draw is 2,225 GWh.

Manitoba Hydro does not control the storage draw on all the other major reservoirs in the Nelson-Churchill watershed.

2010-11 and 2011-12 GRA and Risk Review CAC/MSOS/MH/RISK-13

Reference: KPMG Report, pages 42 - 43

a) Please explain further the basis for the D.R.S. Is it based on a one-year drought (i.e. the inflow for 1940/41)? Exactly at what point in time – looking forward – is the low flow assumed to start?

ANSWER:

The Drought Reserve Storage requirement is based on 1940/41 inflow condition which is assumed to start on April 1st of the fiscal year following the "operating horizon." Manitoba Hydro plans its operations through the operating horizon such that the energy in reservoir storage at the end of the horizon exceeds the DRS. The operating horizon ends on March 31st and is extended in the fall to include the second year; hence the operating horizon is generally between 5 and 17 months in duration.

2010-11 and 2011-12 GRA and Risk Review CAC/MSOS/MH/RISK-83

Reference: KPMG Report, pages (viii) and 42

a) The Report states that following a draw down, water storage levels will be replenished at the first opportunity, including from opportunity sales and other non-firm sources. Please describe more fully Manitoba Hydro' practices in the this regard and, particular, whether Manitoba Hydro's approach to weighing the cost of replenishing water storage levels relative to the future risk of inadequate supply.

ANSWER:

Maintaining energy security is one of Manitoba Hydro's highest operating priorities. In order to ensure adequate energy supplies for drought as well as other contingencies Manitoba Hydro maintains hydraulic energy reserves in its storage reservoirs adequate to meet its projected needs during severe conditions, consistent with its energy security operating criteria. If in planning its operations it is necessary to draw into its hydraulic reserves projected at the end of the planning period, rather than curtail supply before that time, Manitoba Hydro will draw from those reserves first. Should conditions subsequently improve, Manitoba Hydro will re-establish these planning reserves first prior to reducing other supply plans.

Please also refer to Manitoba Hydro's operating priorities in Attachment 1 to PUB/MH I-147(a)(ii).

2010-11 and 2011-12 GRA and Risk Review MIPUG/MH/RISK-2

KPMG April 2010 Report and Appendices: Forecasting Models

d) Please provide additional discuss on MH's perspectives with respect to the comments on page 114 of the KPMG report – specifically:

i. Does MH agree with KPMG's observation that management's tendency to maintain higher water levels will result in somewhat greater risk of the "spill" of water in subsequent periods? Please discuss.

ANSWER:

Manitoba Hydro's priorities place energy supply security above economics. Therefore Manitoba Hydro accepts the increased risk of future spill and potential costs that result from maintaining higher storage levels, if this incremental storage is required to ensure a secure supply of energy for its customers under pessimistic inflow and weather conditions. Please see Manitoba Hydro's operating priorities in Attachment 1 to PUB/MH I-147(a)(ii). Therefore Manitoba Hydro agrees with KPMG's observation.

2012 GRA MIPUG/MH I-43

Subject: Appendix 4.2-Consolidated Integrated Financial Forecast IFF11-2

d) Please provide a detailed explanation of the approach to determining the "expected" conditions.

ANSWER:

The expected inflow conditions for the beginning of the second year of the IFF11-2 (2012/13) were based on a regression relationship between antecedent precipitation conditions (explanatory variable) versus future spring Hydraulic Energy from Inflows (HEFI) as the dependent variable. The observed precipitation (% of normal) from September 2011 to March 2012 (the antecedent condition) was applied to the regression relationship to determine the expected April to June 2012 HEFI. The remaining fiscal year volume from July 2012 to March 2013 was defined using a second regression relationship between June HEFI (as the explanatory variable) predicting July to March HEFI (as the dependent variable).

2012 GRA PUB/MH I-133

Reference: 2010 GRA – Risk Scenarios PUB/MH I-150/2011/12 Power Resource Plan Drought Risk Reserves

d) Please provide MH"s Drought Mitigation Plan or alternatively define the appropriate steps that MH intends to undertake to minimize the financial impacts of both a five year and seven year drought.

ANSWER:

Manitoba Hydro operates and dispatches its generation fleet and manages its export obligations on an ongoing and continuous basis in a manner that maximizes net revenue while maintaining a reliable and dependable supply for Manitobans. This practice is used under all water conditions, including during droughts. So to the extent that the cost of drought can be mitigated this goal will be achieved as a matter of course.

During lower flow and drought conditions when hydraulic supplies are insufficient to meet the provincial demand, Manitoba Hydro augments the hydraulic supply with more expensive thermal or purchased electricity, whether produced in province or in the extra-provincial markets. Under extremely low flow conditions Manitoba thermal generation may be dispatched in order to provide voltage or contingency support. Additional energy beyond these reliability needs is generally purchased in the external markets given that Manitoba thermal generation is generally much more expensive than energy purchased in the external markets.

Under drought conditions The Climate Change and Emissions Reduction Act permits Manitoba Hydro to operate the coal fired unit at Brandon G.S. The decision to operate the station during extreme drought conditions will be made at that time by the Executive of Manitoba Hydro having considered all the relevant factors. Should Manitoba Hydro elect to operate the coal fired unit, there may be some cost savings to the Corporation depending upon whether Brandon coal fired energy displaces higher priced market energy.

To the extent that Manitoba Hydro is exposed to additional financial risk during drought as a result of uncertain market and natural gas prices, Manitoba Hydro may choose to hedge that risk by purchasing electricity/natural gas forward contracts or options. The decision to hedge to manage Manitoba Hydro's financial risk will be made by the Executive of Manitoba Hydro having considered all the relevant factors at that time.

2012 GRA PUB/MH II-92

Reference: PUB/MH I-133 (d) Drought Management

a) Please confirm that MH does not have a formal drought mitigation plan and does not intend to put one in place.

ANSWER:

As a predominantly hydraulic utility MH plans all of its operations to in effect act as a Drought Plan. It should be recognized however that once a drought has commenced that it cannot be mitigated. They are naturally occurring events, their timing and magnitude cannot be predicted and Manitoba Hydro cannot change the volume of water available at any time including during drought periods. Given those realities, Manitoba Hydro builds new generating plant, maintains the readiness of its existing generation fleet and operates its reservoir storages at all times so that under a repeat of historic worst drought conditions it has or will have adequate energy supplies to meet its firm load obligations without having to declare an energy emergency.

To the extent that the cost of drought can be mitigated Manitoba Hydro does so through its normal operating practices of managing reservoir storages, dispatching its generation fleet and managing its export obligations and market activities in a manner that maximizes net revenue while maintaining a reliable and dependable supply for Manitobans. This practice is continuous, ongoing and is used under all water conditions, not just during droughts.

2012 GRA PUB/MH II-92

Reference: PUB/MH I-133 (d) Drought Management

b) Please confirm that MH does not employ a precipitation-runoff prediction process in order to anticipate a pending drought, but rather employs actual flows and reservoir at specific times in the year to confirm the existence of a drought.

ANSWER:

Manitoba Hydro does not rely on its predictive ability, whether based upon precipitation or stream flow forecasting, to anticipate droughts.

Manitoba Hydro can confirm that its operational planning process relies on measured river flows and reservoir inflows as the basis for its decision making process.

2012 GRA PUB/MH II-92

Reference: PUB/MH I-133 (d) Drought Management

c) Please provide the specific processes and parameters (e.g. in April and September) that MH employs to determine the existence of a drought situation.

ANSWER:

Manitoba Hydro monitors basin wide precipitation (seasonal, last 60 days, last week, daily), river flows, and reservoir inflows throughout the year. This information provides input into Manitoba Hydro's antecedent forecasting procedures which produces water supply forecasts for the balance of the year. These forecasts, as well as forecasts of other key inputs such as water storage levels, reserve targets, committed load, market, and generator and transmission outages are inputs to the HERMES model. Results from the HERMES model include revenue and cost inputs to the IFF.

The existence of a drought can be indicated by:

a) Cumulative and current water supply conditions relative to long term normals, and
b) Net export revenues variance compared to those forecast in the IFF. Significant financial variations associated with below average water conditions are indicative of drought.

Manitoba Hydro reviews current conditions, updates forecasts and prepares operating plan updates on a weekly basis. The Manitoba Hydro executive is provided water supply condition update reports on a weekly basis. The Export Power Risk Management Committee meets quarterly to review current water conditions and updated net export revenue projections for the balance of the year under a range of scenarios. During periods of significant drought the EPRMC reviews the situation more frequently.

For additional information on Manitoba Hydro's antecedent forecasting procedures and the HERMES model please review Chapter 3 of the Manitoba Hydro External Quality Review, "Forecasting Models", dated April 15, 2010.

2012 GRA PUB/MH II-92

Reference: PUB/MH I-133 (d) Drought Management

d) Please confirm that because MH does not attempt to predict drought situations there is only minimal opportunity to mitigate the cost of an imminent drought.

ANSWER:

Not confirmed.

Manitoba Hydro is well-prepared to recognize the onset of drought and to take actions appropriate to address current and potential water supply conditions. As explained in part c) of this question, Manitoba Hydro continually monitors conditions as a normal course of business and responds weekly through appropriate revisions to its operating plans.

However, because precipitation and river flows are mean reverting and because Manitoba Hydro protects against worst case drought conditions, in most circumstances Manitoba Hydro's actions, although justified, are conservative with resultant additional costs or lost opportunity costs. This is because on average water conditions do improve and in some cases, such as in the spring-fall 2010 period, to such an extent that water held back in storage due to concern about low inflows, is subsequently spilled as the result of flood inflows.

SUBJECT: Drought Impact, MISO

QUESTION:

Please describe how Manitoba Hydro could use the MISO market to mitigate the financial impact from a drought.

RESPONSE:

Manitoba Hydro relies on its gas fired thermal generation at Brandon and Selkirk for dependable energy during droughts.

Compared to energy purchased in the MISO market this Manitoba supply is relatively expensive. For example, the heat rate at both stations under base load operations is at least 12.5 Dth/MWh plus start up costs. Assuming a gas cost of $4/Dth, the pure energy cost from these facilities is $50/MWh. The average implied heat rate in the MISO market is about 8 Dth/MWh which with the same cost of gas would result in a cost of $32/MWh for a market purchase. So on the average, burning gas in Manitoba for energy purposes is at least 56% more expensive than purchased energy. This is a result of the difference in heat rates, and is true regardless of the cost of natural gas.

Recognizing this situation, Manitoba Hydro can mitigate the financial impact of the drought by purchasing energy from MISO either to serve Manitoba load or to meet its export contract obligations. In order to achieve this, following the opening of the MISO standard market in 2005, Manitoba Hydro negotiated amendments to most existing export agreements giving Manitoba Hydro the flexibility to make an economic choice to supply energy from its own resources or to purchase lower priced energy from the MISO market. Provisions to financially settle obligations have been included in all new agreements negotiated after 2005.

Further, since the drought, Manitoba Hydro has purchased all available MISO northbound transmission service between MISO and Manitoba. Previously this service was owned by Manitoba Hydro export counterparties which meant Manitoba Hydro had to involve them in any purchases that used this transmission service. With the ownership of these transmission positions, Manitoba Hydro can now purchase energy on an as-needed hourly basis directly from the MISO market without involving a third party. As a result Manitoba Hydro no longer has to rely on fixed price multi-hour arrangements traditionally only available on a bilateral basis.

SUBJECT: Drought Impact, MISO

QUESTION:

How would the 2003 drought have been managed differently if Manitoba Hydro had the MISO market available to it.

RESPONSE:

During the 2003 drought Manitoba Hydro did not own the MISO northbound transmission service reservations, the MISO market did not exist and Manitoba Hydro's bilateral export contracts had to be served at the border. Therefore the full benefits of the current situation described in the response to LCA/MH II-462 were not available. It should be noted that even without having these options, Manitoba Hydro was still able to achieve significant savings through bilateral arrangements to purchase energy which avoided base load operations of its natural gas fired generators.

SUBJECT: Reservoir Operation

QUESTION:

Please provide the references to the risk review proceeding discussed on the November 13, 2013 call with La Capra Associates.

RESPONSE:

Please refer to the following links and linked documents from the 2010-11 & 2011-12 GRA and Risk Review hearing:

References

2010/11 and 2011/12 Rates and Risk Review Hearing:

http://www.pub.gov.mb.ca/mhgra-index.html

Exhibit #MH-4-7 KPMG's April 2010 Report and Appendices:

http://www.pub.gov.mb.ca/exhibits/mh-4-7.pdf

Exhibit #MH-61 KPMG Direct Evidence:

http://www.pub.gov.mb.ca/exhibits/mh-61.pdf

Exhibit #MH-55 ICF Direct Testimony:

http://www.pub.gov.mb.ca/exhibits/mh-55.pdf

SUBJECT: Reservoir Operation; opportunity sales

PREAMBLE: Please provide the following monthly historical data from the year 2000 through the time with the latest available data. Please provide the data in electronic spreadsheet format.

QUESTION:

Opportunity imports in MWh, separately for off-peak and peak periods.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Reservoir Operation; opportunity sales

PREAMBLE: Please provide the following monthly historical data from the year 2000 through the time with the latest available data. Please provide the data in electronic spreadsheet format.

QUESTION:

Opportunity import costs in dollars, separately for off-peak and peak periods.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Reservoir Operation; opportunity sales

PREAMBLE: Please provide the following monthly historical data from the year 2000 through the time with the latest available data. Please provide the data in electronic spreadsheet format.

QUESTION:

Opportunity exports in MWh, separately for off-peak and peak periods.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Reservoir Operation; opportunity sales

PREAMBLE: Please provide the following monthly historical data from the year 2000 through the time with the latest available data. Please provide the data in electronic spreadsheet format.

QUESTION:

Opportunity export revenues in dollars, separately for off-peak and peak periods.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: SPLASH; export Market prices

REFERENCE: Potomac Dependable Sales October 24 presentation provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information. Please refer to slide 5 of the referenced presentation.

QUESTION:

Please provide the assumed on-peak energy price plus 50% of capacity price used for the SPLASH modeling runs in the NFAT submission in an electronic spreadsheet.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: SPLASH; export Market prices

REFERENCE: Potomac Dependable Sales October 24 presentation provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information. Please refer to slide 5 of the referenced presentation.

QUESTION:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: SPLASH; export Market prices

REFERENCE: Potomac Dependable Sales October 24 presentation provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information. Please refer to slide 5 of the referenced presentation.

QUESTION:

Are there any circumstances where on-peak opportunity sales do not include any capacity portion but are instead only based on energy prices? If so, please describe these circumstances.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Natural Gas price; Carbon price

REFERENCE: Moment Matching and Probability Distribution Explanation pdf provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information. Please refer to the Natural Gas and Carbon price forecasts listed in Table 2.

QUESTION:

Are these values in constant or nominal dollars? If constant dollars, from what year?

RESPONSE:

The values shown in Table 2 are in constant 2012 dollars.

SUBJECT: Natural Gas price; Carbon price

REFERENCE: Moment Matching and Probability Distribution Explanation pdf provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information. Please refer to the Natural Gas and Carbon price forecasts listed in Table 2.

QUESTION:

Does the natural gas price forecast reflect a forecast of Henry Hub prices or a delivered price? If a delivered price please define the delivery point.

RESPONSE:

The natural gas price forecast in Table 2 reflects a forecast of Henry Hub prices.

SUBJECT: Natural Gas price; Carbon price

REFERENCE: Moment Matching and Probability Distribution Explanation pdf provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information. Please refer to the Natural Gas and Carbon price forecasts listed in Table 2.

QUESTION:

What Energy Price Outlook was relied upon to create the natural gas price forecast shown in the table, if any?

RESPONSE:

The 2012 Energy Price Outlook was used to create the natural gas price forecast shown in Table 2. The Henry Hub forecasted values provided in the 2012 Energy Price Outlook were escalated from 2011 constant dollars to 2012 constant dollars using the US GDP Deflator for the reference scenario documented in Appendix 11.2 of the NFAT submission.

SUBJECT: Natural Gas Price

REFERENCE: Appendix 9.3, Section 1.5.2

QUESTION:

Does the natural gas price entered into SPLASH for use in estimating the production costs of new CCGT or CT units reflect only Henry Hub prices? If there are any adjustments made to the Henry Hub forecast, such as a basis differential, please provide the adjustments used for the natural gas price forecasts relied upon for the NFAT submission with any supporting work papers in electronic spreadsheet format. Please provide the information separately for the 2012/13 forecast and 2013/14 forecast.

RESPONSE:

The natural gas prices used in the SPLASH model to estimate the production cost of a new CCGT or SCGT in Manitoba is based on forecasted AECO Hub prices deliverd from Alberta to Manitoba and is the same as that used to estimate the production cost of Manitoba Hydro's existing natural gas-fired units. Please see Manitoba Hydro's response to LCA/MH II-475.

SUBJECT: Natural Gas Price

REFERENCE: Appendix 9.3, Section 1.5.2

QUESTION:

Does Manitoba Hydro prepare any delivered natural gas price forecasts for the MISO market? If so please supply these forecasts from the past two years along with any supporting workpapers in electronic spreadsheet format. Please identify any relied upon for the NFAT submission.

RESPONSE:

Manitoba does not prepare any delivered natural gas price forecasts for the MISO market.

SUBJECT: Natural Gas Price

REFERENCE: 2012-13 and 2013-14 Consultant Natural Gas Price Forecasts spreadsheet provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information. Please refer to the Natural Gas price forecasts.

QUESTION:

Please explain how the consultant forecasts, NYMEX or other data was used to calculate the numbers in the "Forecast-Henry Hub" column?

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Natural Gas Price

REFERENCE: 2012-13 and 2013-14 Consultant Natural Gas Price Forecasts spreadsheet provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information. Please refer to the Natural Gas price forecasts.

QUESTION:

Please provide the source and dates for the numbers in the NYMEX and EIA columns.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Natural Gas Price

REFERENCE: 2012-13 and 2013-14 Consultant Natural Gas Price Forecasts spreadsheet and Gas Turbine Operating Cost Inputs pdf both provided on SharePoint

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information. Please refer to the Natural Gas price forecasts in the spreadsheet and the Natural Gas Price forecasts on page 4 of the pdf.

QUESTION:

Please explain how the reference, high, and low natural gas price forecasts on page 4 of the referenced pdf relate to the forecasts in the spreadsheet?

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Export Contracts; Export Market Policies

REFERENCE: 2012 08 Wholesale Export Policy pdf provided on SharePoint, p. 1

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information.

QUESTION:

Please provide a copy of the "Import & Export of Power - Approval Authority for Wholesale Power Related Transactions".

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Export Contracts; Export Market Policies

REFERENCE: 2012 08 Wholesale Export Policy pdf provided on SharePoint, p. 2

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information.

QUESTION:

Please provide an example of the operational risk "arising from carrying out Manitoba Hydro's business functions with respect to wholesale power related transactions".

RESPONSE:

Manitoba Hydro defines operational risk as the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events.

An example of the operational risk “arising from carrying out Manitoba Hydro’s business functions with respect to the wholesale power related transactions” is described below:

Manitoba Hydro regularly sells energy on a forward bilateral basis. In order to minimize exposure to operational risk, Manitoba Hydro’s power trader must seek approval of sales quantities prior to execution. In this case the operational risk would be the risk of over committing Manitoba Hydro to energy sales.

SUBJECT: Export Contracts; Export Market Policies

REFERENCE: 2012 08 Wholesale Export Policy pdf provided on SharePoint, p. 2

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information.

QUESTION:

Please provide an example of how the export contracts that are part of the Preferred Development Plan were approved with "a risk governance and executive oversight structure". What controls, measurement and reporting were used?

RESPONSE:

The following risk governance and executive oversight process was used for the Minnesota Power 250 MW Power Sales Agreement .

In 2006 discussions with Minnesota Power and Manitoba Hydro commenced on the possibility of a long-term surplus energy and capacity sale. In February 2007, Minnesota Power (MP) issued a RFP for up to 200 MW for 30 years, to which Manitoba Hydro submitted a proposal. Based upon that proposal and subsequent discussions with MP a Term Sheet was prepared by the Export Power Marketing Department. The Term Sheet was drafted in accordance with Manitoba Hydro's Management Control Plan which had been approved by The Manitoba Hydro-Electric Board in 2007. An Executive Committee recommendation was presented and approved at the December 4, 2007 meeting.

In accordance with the Approved Signing Authority Table in place at the time, the Term Sheet was signed by the Division Manager of Power Sales and Operations on December 12, 2007.

With the signing of the Term Sheet, drafting of a Power Sales Agreement commenced. Manitoba Hydro's negotiating team included a lead negotiator, who reported directly to the Division Manager of Power Sales and Operations, contract administrative staff and analysts from the Export Power Marketing Department, and internal and external legal advisors.

The final agreements were locked down February 28, 2011 at which point internal reviews were completed by the following:

- Market Access and Regulatory Affairs, Export Power Marketing – Review contract provisions related to market access and regulatory requirements;
- Transmission Access, Export Power Marketing – Review provisions related to transmission requirements;
- Contract Administration and Credit - Review counterparty credit worthiness;
- Export Operations Department – Review provisions for operating requirements;
- Energy Policy Officer - Review provisions related to claims on environmental attributes (e.g. Renewable Energy Credits (RECs), Emissions);
- Resource Planning and Market Analysis conducted an independent review and analysis of the sale and provided a favourable recommendation to the Vice President of Power Supply.

A recommendation to execute the 250 MW MP Power Sale Agreement and 250 MW Energy Exchange Agreement was made to the Executive Committee and then to The Manitoba Hydro-Electric Board. Following Board approval the Agreement was signed by Manitoba Hydro.

SUBJECT: Export Contracts; Export Market Policies

REFERENCE: 2012 08 Wholesale Export Policy pdf provided on SharePoint, p. 2

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information.

QUESTION:

Please provide a recent example of the records of transactions in Manitoba Hydro's deal capture system.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Export Contracts; Export Market Policies

REFERENCE: 2012 08 Wholesale Export Policy pdf provided on SharePoint, p. 2

PREAMBLE: This question references documents Manitoba Hydro has labeled as commercially sensitive information.

QUESTION:

How frequently does the President and CEO of Manitoba Hydro report policy violations to the Chairman of the Board?

RESPONSE:

The President and CEO of Manitoba is required to notify the Chairman of the Board of any policy violations as soon as reasonably possible. A report summarizing the violation is provided for review at the next scheduled Board meeting. To date there have been very few policy violations reported.

Exceptions to policy are handled differently. Exceptions to policy are immediately reported to the Vice President of Generation Operations and are reported at and recorded in the minutes of the next EPRMC (Export Power Risk Management Committee) meeting. Should this exceptional circumstance be expected to become the norm, the Wholesale Export Power Policy is revised accordingly.

SUBJECT: Drought Impacts; Climate Change

REFERENCE: LCA/MH I-121

PREAMBLE: The climate change sensitivity offers no analysis of the potential change in likelihood of a drought worse than the worst drought on record because (a) only average change in streamflow was used from GCMs, without analyzing potential volatility in annual streamflow estimates; and (b) historic drought years in the long term flow data were assumed not to change.

QUESTION:

Has Manitoba Hydro analyzed the potential impact of climate change on the probability of experiencing a drought worse than the worst drought on record in the long term flow data? If so, please describe the results and conclusions. If not, please explain why such an analysis has not been conducted.

RESPONSE:

Manitoba Hydro has not specifically analyzed the potential impact of climate change on the probability of experiencing a drought worse than the worst drought on record in the long-term flow data. However, Manitoba Hydro has given consideration to the probability of drought. There are a number of references to the probability of the current drought on record which can be found in the Kubursi-Magee report, "*Manitoba Hydro Risks: An Independent Review" submitted to the Public Utilities Board in the 2010 Risk hearing.* A link to the redacted version of this report was provided to La Capra in November 2013 at http://www.pub.gov.mb.ca/exhibits-6.html .

In Chapter 4 of the Kubursi-Magee report (*Water Flows: Statistical Modeling, Prediction of Droughts, and other Issues*) and Chapter 7 (*Conclusions*), reference is made to statistical analysis that was done independently and concluded that the worst drought on record (actual

minimum) fell within the expected range of the probability distribution, as noted in the reference extracted from Chapter 4.7, page 162:

"We find that the actual minimum lies roughly in the middle of our 95% intervals, and the means and medians of our simulated minima are greater than the actual minimum. On the one hand, this reassures us that the use of the actual minimum as a kind of benchmark worst-possible-case scenario is not unduly optimistic or pessimistic. On the other hand, because we find that the 95% intervals are fairly wide, we wish to caution that an over-reliance on the actual minimum could result in a mind-set in which it is not necessary to consider the possibility of even worse outcomes, or indeed more beneficial water flow conditions".

Due to the rare occurrence of extreme events, the limited record of historic climate and climate model biases, it is difficult to assess the performance of the climate model's ability to simulate past extreme events. These limitations are particularly relevant to extreme drought events, which can be influenced by decadal and multi-decadal signals in hydroclimatic variability. Global Climate Models (GCMs) are more adept at reproducing average climatic conditions and less adept in simulating extreme events. The ability of GCMs to simulate average climatic conditions better than extremes is not surprising, since GCMs operate on a coarse spatial resolution and do not capture smaller-scale features that can influence extremes. Currently there is a high level of uncertainty on the magnitude of impacts to future extremes. As stated in Chapter 10 page 43 of the NFAT Business Case, "Manitoba Hydro is working with Ouranos, several universities and other utilities to investigate downscaling and post-treatment methods to quantify local impacts to extreme events and climatic variability. These studies are currently on-going."

As a result, Manitoba Hydro has not conducted a probabilistic analysis of climate change impacts on more extreme drought events. Manitoba Hydro recognizes that there are views that more extreme floods and droughts could occur in a changing climate; however, at this point there is no quantitative evidence to support these views.

Please see Manitoba Hydro's response to MNP/MH I-072 for additional discussion related to the risks of extreme events.

SUBJECT: Transmission Economics

REFERENCE: Integrated Transmission Plan for Keeyask and Conawapa Generation SPD 2011/11

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

Is the north/south project included in the NFAT the same as option 2A described in the Integrated Transmission Plan for Keeyask and Conawapa generation report? If yes, confirm that up to 122 MW of non-firm transmission has been included in the economic cash flows/SPLASH runs?

RESPONSE:

The incremental north/south transmission that is included in the NFAT for development plans that include both Keeyask and Conawapa is as described in option 2A. It is assumed that normal operating conditions would have 2 of the 3 switchable Kettle units placed on NCS1 and 1 unit would be placed on NCS2, resulting in only 105 MW of non-firm transmission. The configuration of the switchable units would be varied to accommodate equipment maintenance conditions.

It is not confirmed that up to 122 MW of non-firm transmission has been included in the economic cash flows/SPLASH runs, however 105 MW of non-firm transmission was included. The cost of the Option 2A was included in the economic analysis. It is expected that opportunity sales can be made using non-firm transmission.

SUBJECT: Transmission Economics

REFERENCE: Integrated Transmission Plan for Keeyask and Conawapa Generation SPD 2011/12

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

Please provide detailed cost estimates for the capital costs of Option 2A (Table 12 in the document). Provide all assumptions, workpapers, and data sources used. Where possible, please provide workpapers and data in electronic spreadsheet format with all formulas intact and readable.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Transmission Economics

REFERENCE: Integrated Transmission Plan for Keeyask and Conawapa Generation SPD 2011/13

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

Please provide detailed costs estimates for capital costs of Option 1 (Table 2 in the document) Provide all assumptions, workpapers, and data sources used. Where possible, please provide workpapers and data in electronic spreadsheet format with all formulas intact and readable.

RESPONSE:

The response to this Information Request includes Commercially Sensitive Information and has been filed in confidence with the Public Utilities Board.

SUBJECT: Transmission Economics

REFERENCE: Final Interconnection Evaluation Study Report for Keeyask Hydropower Limited Partnership NRIS for Keeyask Generating Station (650, 695 or, 800 MW June 2012)

PREAMBLE: This question references documents Manitoba Hydro has labled as confidential.

QUESTION:

Is Option 2- Keeyask 695 MW NRIS included in the NFAT? If yes, is the assumption that requires Kettle to relinquish 65 MW factored in the SPLASH runs/economic cash flows?

RESPONSE:

The effect of the Keeyask G.S. rating on the Kettle G.S. is factored into the SPLASH runs and economic analysis. The assumptions for the net system firm capacity addition in the NFAT analysis at Keeyask is 630 MW. It is noted in the Manitoba Hydro 2011/12 Power Resource Plan (Section 5, page 21) included as Appendix B of the NFAT Business Case, that the winter peak prating for Keeyask is 630 MW and at this output level the capacity at other plants is not affected.

The energy levels assumed in the SPLASH runs are consistent with a 630 MW capacity assumption at Keeyask[i]. The SPLASH model assumes that Stephens Lake is at the average elevation for each month, and that the capacity of both Keeyask and Kettle is adjusted to reflect the assumed Stephens Lake elevation. The combined capacity of Kettle and Keeyask is equal to or less than 1854 MW (ranging from about 1840 MW to 1854 MW).

The Interconnection Facilities Study request for Keeyask identifies 630 MW of Network Resource Interconnection Service, and 65 MW of Energy Resource Interconnection Service. This request is published on the Manitoba Hydro Open Access site as part the Transmission Tarrif, and can be found at:

(http://www.oasis.oati.com/woa/docs/MHEB/MHEBdocs/MHEB_Gen_Q_Status_Report_Oct_31_2013.pdf)

[i] The rating of Keeyask is noted in Table 2.1 of Chapter 2 of the NFAT Business Case. Assuming Stephens Lake is 141.12 m, the rated output of Keeyask is 630 MW and Kettle is 1224 MW. If Stephens Lake is at a low level of 139.60 m the output of Keeyask increases to 695 MW, while the output of Kettle reduces to 1150 MW.

SUBJECT: Transmission Economics

REFERENCE: Final Interconnection Evaluation Study Report for Keeyask Hydropower Limited Partnership NRIS for Keeyask Generating Station (650, 695 or, 800 MW June 8 2012)

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

Is Option 2- Keeyask 695 MW NRIS included in the NFAT? If yes, is the assumption that requires Kettle to relinquish 65 MW factored in the SPLASH runs/economic cash flows?

RESPONSE:

The rating of Keeyask is noted in Table 2.1 of Chapter 2. Assuming Stephens Lake is 141.12 m, the rated output is 630 MW and if Stephens Lake is at a low level of 139.6 m the rated output of Keeyask is 695 MW. The assumptions for net system firm capacity addition in NFAT at Keeyask is 630 MW. Chapter 5 of the Manitoba Power Resource Plan (Appendix B) also notes that winter peak rating for Keeyask is 630 MW and at this output level the capacity at other plants is not affected. The energy levels assumed in the Splash runs are consistent with a 630 MW capacity assumption at Keeyask. The SPLASH model assumes that Stephens Lake is at the average elevation for each month, and both Keeyask and Kettle capacity is adjusted to reflect the assumed Stephens Lake elevation. The combined Kettle and Keeyask capacity is equal to or less than 1854 MW (ranging from about 1820 to 1854 MW), so the effect of Keeyask rating on Kettle is factored on the SPLASH runs.

SUBJECT: Transmission Economics

REFERENCE: Final Interconnection Evaluation Study Report for Keeyask Hydropower Limited Partnership NRIS for Keeyask Generating Station (650, 695 or, 800 MW June 8 2012)

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

Is the estimated cost for Option 2 network upgrades included in the economic cash flows for all the plans that include Keeyask?

RESPONSE:

Yes, the estimated cost for Option 2 network upgrades to interconnect Keeyask to the northern collector system, were included in the economic cash flows for all plans that include Keeyask. It is noted that the cost for Option 1 (650 MW) is the same as the cost for Option 2 (695 MW).

SUBJECT: Transmission Economics

REFERENCE: MHEM 1100/750/250 MW Export/Import Firm Point to Point Group Transmission service requests

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

Is the Y500 option similar to the option utilized in the preferred plan? If not, describe any differences.

RESPONSE:

Option Y500 in the referenced report "Group Facilities Study MHEM 1100/750/250 MW Export/Import Firm Group TSR" is virtually identical to the 500 kV 750 MW tie line referenced in the preferred plan in the NFAT submission. The only minor difference is that an additional series phase shifter at Glenboro is recommended to be included with Y500 in the latest report compared with the preferred plan submission assumptions. The cost difference is roughly $12 million.

SUBJECT: Transmission Economics

REFERENCE: MHEM 1100/750/250 MW Export/Import Firm Point to Point Group Transmission service requests

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

Table ES1 shows a summary of all the network upgrades needed for the Y500 option. Are the network upgrade costs included in the NFAT analysis?

RESPONSE:

Table ES1 in the referenced report included a summary of both additional Network Upgrades needed in Manitoba on top of the new tie line Network Upgrade as well as third party impacts. The first two items in the list: G82R phase shifting transformer and HVdc reduction scheme are Manitoba Network Upgrades. The phase shifter cost was included in the estimate. The dc reduction scheme additions were not included as the complete scope of work was not defined at the time the report was issued. It is expected that the dc reduction scheme cost would be of an amount which could be assumed to be included in the estimate contingency.

The remainder of the items are third party impacts in the MISO network and the no estimate was determined. . Manitoba Hydro is in the process of coordinating with MISO to determine if the identified third party upgrades are valid and should be included in MISO's report and final Facility Construction Agreement.

SUBJECT: Transmission Economics

REFERENCE: MHEM 1100/750/250 MW Export/Import Firm Point to Point Group Transmission service requests

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

The report states "North Dakota export and Minnesota- Wisconsin export increases negatively affect the flow on the new 500 kV line". How is Manitoba Hydro accounting for this finding in its NFAT analysis?

RESPONSE:

The reference is found on Page 6 of the referenced report, “Increase in North Dakota Export (NDEX) and Minnesota-Wisconsin Export (MWEX) negatively affects the flow on the Riel – Forbes 500 kV for the Fargo injection. At the maximum simultaneous transfer simulated in this study (NDEX=2200 MW, MWEX=1600 MW), the North Dakota-Manitoba loop flow issue results in approximately 105% pre-contingency overload on the Riel – Forbes 500 kV line. This pre-contingency overload can be mitigated by controlling the power flow distributions on the US-MH interface through a phase shifting transformer added on to 230 kV line G82R.” The issue identified in the report was mitigated by controlling the setpoint on the proposed phase shifter on G82R to 200-250 MW south.

However, the issue was identified for the competing plan terminating in the Fargo area. This issue did not arise in the preferred plan where the tie line terminates at Blackberry. The phase shifter at Glenboro could be used for controlling congestion in the export direction if needed, however it was justified in the preferred plan because it eliminated overloads on the 230 kV

line G82R during import conditions. The preferred plan in NFAT includes the cost of a phase shifting transformer at Glenboro.

SUBJECT: Transmission Economics

REFERENCE: MHEM 1100/750/250 MW Export/Import Firm Point to Point Group Transmission service requests

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

One of the upgrades needed for the Y500 option is a new HVDC power order reduction scheme. Please provide documentation of this and estimated cost. (See Table 12 Comments section for the new 500 kV tie line contingency.)

RESPONSE:

Manitoba Hydro has an existing HVdc power order reduction scheme that includes inputs from all of its tie lines. The assumption is the new tie line would add new inputs into the existing HVdc reduction scheme. The referenced report has identified a minimum of two new inputs would be required: loss of the new 500 kV line between Dorsey and Blackberry as well as the Blackberry 500/230 kV transformer. It is likely that bypassing of the new series capacitor bank at Blackberry will also require detection and a dc reduction but this was not verified.

An estimate for the additional dc reduction input signals was not prepared or included in the cost of upgrades. Based on past experience, it is expected that these upgrades will be relatively modest depending on available communication capacity and controller capacity at Dorsey. An estimate is being prepared and will be included in the final version of the Group Facility Study report.

SUBJECT: Transmission Economics

REFERENCE: MHEM 1100/750/250 MW Export/Import Firm Point to Point Group Transmission service requests

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

The incremental impact of the TSRs included in this report is evaluated with the VSAT application. How does VSAT determine the output of different generators (Manitoba and U.S.) in the study?

RESPONSE:

VSAT is a tool developed by PowerTech that is similar to Siemen's PSS/E in terms of the network solution calculation method. With VSAT, transactions (e.g. Manitoba to U.S.) can be programmed to occur automatically in steps. The activity identifies a study system in which generation is increased (or load is decreased) and an opposing system in which generation is decreased (or load is increased). Manitoba Hydro used the same POR and POD sources and sinks as MISO did in their studies. For each 50 MW step in transfer level, appropriate generation is adjusted in each control area based on the aggregate of the 1100 MW in TSRs. For example, 250/1100 or 22.7% of the 50 MW step will result in generation in the MP control area being adjusted.

SUBJECT: Transmission Economics

REFERENCE: LCA/MH I-152, LCA/MH I-153, LCA/MH I-154, LCA/MH I-155, LCA/MH I-156

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

Provide all assumptions, workpapers, and data sources used in forming the referenced responses. In the reports provided by Manitoba Hydro, it is mentioned that the costs are estimated (+/- 50%). How is this calculated? Where possible, please provide workpapers and data in electronic spreadsheet format with all formulas intact and readable.

RESPONSE:

Ac Transmission lines and station estimates reflect a linear project and rely on Manitoba Hydro standard estimating approaches with cross-checks of recently completed projects. A different methodology applies to the HVdc component cost as they are non-standard custom designs and cost estimates have been developed based on a combination of equipment manufacturers' budgetary prices and Manitoba Hydro past experience.

Various estimate levels would occur for a project depending on the project stages. The costs provided for North-south transmission system upgrade project, Keeyask transmission project, Conawapa transmission project and the Manitoba Hydro-U.S. tie line projects refer to Manitoba Hydro level 1 estimate. This is a high-level base estimate in the Planning stage that typically relies on unit cost information based on the best information available on the project, historic numbers, evaluation of costs from comparable projects undertaken by other utilities, as well as consideration of market conditions. The estimate assumes +/-50% accuracy with no contingency . With the further refinement of project details and the progress of project, the accuracy of estimate levels will increase and falls into level 2 (+/-30%) or level 3 level (+/-10%).. A certain project may have mixed estimate levels for various

components depending on the different project stages for such component. In such a case, the lowest estimate level is used for the project.

The typical unit costs are summarized in the exploratory study, "Interconnection of 400 MW of Future Generation to the Northern AC System" completed in 2009 (filed as a reference report in response to LCA/MH-II-494). The unit cost of the 230kV line cost has been increased to 300k/km (> 10km) and the cost of the 500kV ac single circuit overhead line was estimated at 800k/km considering the cost increase experienced recently.

SUBJECT: Transmission Economics

REFERENCE: LCA/MH I-147

PREAMBLE: This question references documents Manitoba Hydro has labeled as confidential.

QUESTION:

In the answer provided for LCA-147, Manitoba Hydro states that the transfer limits may be different from the firm transfer capability limits provided in the NFAT. Provide the 5 lowest Manitoba Hydro-U.S. transfer limits and the reason for the reduction.

RESPONSE:

The long term firm transfer capability in the planning horizon during system intact conditions is 2175 MW south and 700 MW north. These limits include a 75 MW reliability margin and a 150 MW reserve sharing obligation to MISO in the southern direction. Therefore, long term firm transmission service requests would typically be limited to 625 MW in the north direction and 1950 MW in the southern direction.

Seasonal operating studies represent the transfer capability that can be specified during specific operating conditions expected for that season. The seasonal capability may be equal to or greater than the expected long term firm capability during system intact conditions. Long duration outages can impact shorter term transfer capability (eg. daily, weekly, monthly).

The top five outages and the associated Manitoba to US transfer limits are:

1. Dorsey to Forbes 500 kV line – 675 MW
2. Forbes to Chicago 500 kV line – 675 MW
3. Roseau series capacitors – 1875 MW

4. Dorsey 500/230 kV transformer – 1875 MW

5. Forbes SVC – 2080 MW

The real time performance of the interface has been very good. The export availability during the peak and off-peak summer hours (May-September) is typically better than 95%. Scheduled outages of the 500 kV line for maintenance occur in spring and fall for a few days or few weeks at most each year.

SUBJECT: MISO; Opportunity Exports

PREAMBLE: Regarding opportunity imports to the MISO market.

QUESTION:

Please describe how Manitoba Hydro uses MISO markets to import power.

RESPONSE:

Manitoba Hydro has the ability to purchase power from the MISO market to serve load in Manitoba on a day ahead and real time basis. Purchases are made when the price of purchased power is economic relative to Manitoba Hydro's alternative supply sources.

On a day-ahead basis, Manitoba Hydro is able to submit a bid to purchase power at a specified price signifying the maximum Manitoba Hydro is willing to pay for each hour of the following day. Manitoba Hydro's purchase price is determined based on its value of water in storage. Once the MISO market clears, Manitoba is notified of the energy quantity it has purchased and the Manitoba Hydro Electric Board market clearing price for each respective hour. On a real time basis, Manitoba Hydro is able to submit a bid to purchase power but is unable to indicate a maximum purchase price. MISO will charge the real time Manitoba Hydro Electric Board market clearing price to all power purchased in real time.

SUBJECT: MISO; Opportunity Exports

PREAMBLE: Regarding opportunity imports to the MISO market.

QUESTION:

As an external asynchronous resource, does Manitoba Hydro import using the DA and RT markets? Why or why not?

RESPONSE:

Currently MISO only allows external asynchronous resources to sell into the MISO market. Importing from MISO using an external asynchronous resource is not permitted at this time.

SUBJECT: MISO; Opportunity Exports

PREAMBLE: Regarding opportunity exports to the MISO market.

QUESTION:

Please describe how Manitoba Hydro uses MISO markets to export power.

RESPONSE:

Manitoba Hydro has the ability to sell energy to the MISO market on a day ahead and real time basis. On a day-ahead basis, Manitoba Hydro is able to submit an offer to sell power at a specified price signifying the minimum price Manitoba Hydro is willing to sell at for each hour of the following day. Manitoba Hydro's offer price is based on its value of water in storage plus a small risk premium. Once the MISO market clears, Manitoba is notified of the energy quantity it has sold and the MHEB market clearing price for each respective hour. On a real time basis, Manitoba Hydro is able to submit an offer to sell power but is unable to indicate a minimum sale price. MISO will pay the real time MHEB market clearing price for all power sold in real time.

SUBJECT: MISO; Opportunity Exports

PREAMBLE: Regarding opportunity exports to the MISO market.

QUESTION:

As an external asynchronous resource, does Manitoba Hydro export using the DA and RT markets? Why or why not?

RESPONSE:

Yes, Manitoba Hydro has the ability to export a portion of its surplus power to MISO on a DA and RT basis as an external asynchronous resource (EAR). Manitoba Hydro uses EAR to offer power as well as three ancillary service products (regulation, spinning reserves, and supplemental reserves) to the MISO market. An advantage to offering energy on the EAR in RT is that EAR provides a limited amount of RT price protection as Manitoba Hydro is permitted to submit a minimum offer price for power and ancillary services sold under the EAR. There is no price protection for energy offered to the RT market using MISO's standard export offer mechanisms.

SUBJECT: MISO; Opportunity Exports

PREAMBLE: Regarding opportunity exports to the MISO market.

QUESTION:

Does Manitoba Hydro offer power at cost or at zero price in MISO? If at cost, how does Manitoba Hydro bid non-zero amounts without market-based rate authority? If the conditions under which Manitoba Hydro makes non-zero offers varies, please explain the conditions Manitoba Hydro makes non-zero offers into MISO.

RESPONSE:

Manitoba Hydro offers its power to MISO based upon its marginal costs. Manitoba Hydro does not require U.S. Federal Energy Regulatory Commission market based rate authority to sell energy to the MISO market as the sale does not occur in the U.S. but rather title to the energy transfers to MISO at the Canada-U.S. border.