NEEDS FOR AND ALTERNATIVES TO (NFAT)

Manitoba Hydro Undertaking #41

Manitoba Hydro to refile Tab1 of Excel Spreadsheet (Keeyask) and Tab 2 of Excel Spreadsheet (Conawapa) of MH/LCA 308 using the current capital cost information that has been provided.

Response:

The Levelized Cost of Energy (LCOE) for Tab 1 and Tab 2 of Excel Spreadsheet, "LCA_MH I-308 Att1.xlsx" attached to LCA/MH I-308 have been recalculated with the March 2014 updated capital costs. The information is provided in the attached Excel Workbook file named "Undertaking 41 - Refiling of Tab 1 and 2 Update of LCOE with March 2014 Estimates.xlsx".

The updated levelized cost is $62.05 for Keeyask 2019 in-service date and $66.17 for Conawapa 2026 in-service date including transmission and expressed in 2014 dollars at a 5.05% real WACC.

Levelized Cost of Energy

Keeyask Generating Station

Undertaking #41

Current Dollar Year:	2013	
Discount Rate:	5.05	%
Service Life:	67	yrs
Time to First Power:	7	yrs
Nominal Capacity:	695	MW
Net Summer Capacity:	630	MW
Net Winter Capacity:	630	MW
Capacity Factor:	60	%
Auxiliary Power:	0	%
N to S Trans. Adjustment:	10	%
Capital Tax:	0.5	%
Water Rental Rate:	3.3426	$/MW.h
Heat Rate:	N/A	Btu/kW.h

With Transmission	2013$	2014$	
Base Estimate:	3699	3769	$Million
Overnight Capital Cost:	5322	5423	$/kW
LCOE@Gen.:	60.89	62.05	$/MW.h
LCOE@Load:	66.98	68.26	$/MW.h

Without Transmission	2013$	2014$	
Base Estimate:	3553	3620	$Million
Overnight Capital Cost:	5112	5209	$/kW
LCOE@Gen.:	58.68	59.79	$/MW.h
LCOE@Load:	64.54	65.77	$/MW.h

			Generation (Millions of $CDN)							
Fiscal Year	Years to Earliest ISD	Average Net Energy (GW.h)	Generating Station	Trans. Station	Trans. Line	Capital Tax on GS	Capital Tax on TL & TS	Water Rentals	Fixed O&M	TOTAL COST
	Sunk									
2013/14	-6	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2014/15	-5	0	374.18	1.07	10.23	1.87	0.06	0.00	0.00	387.41
2015/16	-4	0	645.36	0.42	8.46	5.10	0.10	0.00	0.00	659.43
2016/17	-3	0	712.92	14.71	1.16	8.66	0.18	0.00	0.00	737.63
2017/18	-2	0	873.85	18.34	10.81	13.03	0.33	0.00	0.00	916.36
2018/19	-1	0	500.90	19.21	22.30	15.54	0.53	0.00	0.00	558.48
2019/20	0	1371	253.40	16.39	22.67	16.80	0.73	4.50	16.27	330.76
2020/21	1	3955	134.06	0.00	0.01	17.47	0.73	12.99	16.36	181.62
2021/22	2	4430	58.07	0.00		17.76	0.73	14.55	15.96	107.07
2022/23	3	4430		0.00		17.76	0.73	14.55	16.18	49.21
2023/24	4	4430		0.00		17.76	0.73	14.55	16.01	49.04
2024/25	5	4430		0.00		17.76	0.73	14.55	15.85	48.89
2025/26	6	4430		0.00		17.76	0.73	14.55	15.61	48.65
2026/27	7	4430		0.00		17.76	0.73	14.55	15.19	48.23
2027/28	8	4430		0.00		17.76	0.73	14.55	15.19	48.23
2028/29	9	4430		0.00		17.76	0.73	14.55	15.23	48.27
2029/30	10	4430		0.00		17.76	0.73	14.55	17.87	50.91
2030/31	11	4430		0.00		17.76	0.73	14.55	14.02	47.06
2031/32	12	4430		0.00		17.76	0.73	14.55	14.02	47.06
2032/33	13	4430		0.00		17.76	0.73	14.55	14.02	47.06
2033/34	14	4430		0.00		17.76	0.73	14.55	14.02	47.06
2034/35	15	4430		0.00		17.76	0.73	14.55	14.02	47.06
2035/36	16	4430		0.00		17.76	0.73	14.55	13.37	46.41
2036/37	17	4430		0.00		17.76	0.73	14.55	13.37	46.41
2037/38	18	4430		0.00		17.76	0.73	14.55	13.37	46.41
2038/39	19	4430		0.00		17.76	0.73	14.55	13.37	46.41
2039/40	20	4430		0.00		17.76	0.73	14.55	16.21	49.25
2040/41	21	4430		0.00		17.76	0.73	14.55	13.37	46.41
2041/42	22	4430		0.00		17.76	0.73	14.55	13.37	46.41
2042/43	23	4430		0.00		17.76	0.73	14.55	13.37	46.41
2043/44	24	4430		0.00		17.76	0.73	14.55	13.37	46.41
2044/45	25	4430		0.00		17.76	0.73	14.55	15.08	48.11
2045/46	26	4430		0.00		17.76	0.73	14.55	15.08	48.11
2046/47	27	4430		0.00		17.76	0.73	14.55	15.08	48.11
2047/48	28	4430		0.00		17.76	0.73	14.55	14.22	47.26
2048/49	29	4430		0.00		17.76	0.73	14.55	13.37	46.41
2049/50	30	4430		1.07		17.76	0.73	14.55	16.21	50.32
2050/51	31	4430		0.42		17.76	0.74	14.55	13.37	46.84
2051/52	32	4430		14.71		17.76	0.81	14.55	13.37	61.20
2052/53	33	4430		18.34		17.76	0.90	14.55	13.37	64.93
2053/54	34	4430		19.21		17.76	1.00	14.55	13.37	65.89
2054/55	35	4430		16.39		17.76	1.08	14.55	13.37	63.15
2055/56	36	4430				17.76	1.08	14.55	13.37	46.76
2056/57	37	4430				17.76	1.08	14.55	28.56	61.95
2057/58	38	4430				17.76	1.08	14.55	13.37	46.76
2058/59	39	4430				17.76	1.08	14.55	28.56	61.95
2059/60	40	4430				17.76	1.08	14.55	16.21	49.60
2060/61	41	4430				17.76	1.08	14.55	28.56	61.95
2061/62	42	4430				17.76	1.08	14.55	13.37	46.76
2062/63	43	4430				17.76	1.08	14.55	28.56	61.95
2063/64	44	4430				17.76	1.08	14.55	13.37	46.76
2064/65	45	4430				17.76	1.08	14.55	28.56	61.95
2065/66	46	4430				17.76	1.08	14.55	13.37	46.76
2066/67	47	4430				17.76	1.08	14.55	28.56	61.95
2067/68	48	4430				17.76	1.08	14.55	13.37	46.76
2068/69	49	4430				17.76	1.08	14.55	28.56	61.95
2069/70	50	4430				17.76	1.08	14.55	16.21	49.60
2070/71	51	4430				17.76	1.08	14.55	15.08	48.46
2071/72	52	4430				17.76	1.08	14.55	15.08	48.46
2072/73	53	4430				17.76	1.08	14.55	15.08	48.46
2073/74	54	4430				17.76	1.08	14.55	14.22	47.61
2074/75	55	4430				17.76	1.08	14.55	13.37	46.76
2075/76	56	4430				17.76	1.08	14.55	13.37	46.76
2076/77	57	4430				17.76	1.08	14.55	13.37	46.76
2077/78	58	4430				17.76	1.08	14.55	13.37	46.76
2078/79	59	4430				17.76	1.08	14.55	13.37	46.76
2079/80	60	4430				17.76	1.08	14.55	16.21	49.60
2080/81	61	4430				17.76	1.08	14.55	13.37	46.76
2081/82	62	4430				17.76	1.08	14.55	13.37	46.76
2082/83	63	4430				17.76	1.08	14.55	13.37	46.76
2083/84	64	4430				17.76	1.08	14.55	13.37	46.76
2084/85	65	4430				17.76	1.08	14.55	13.37	46.76
2085/86	66	4430				17.76	1.08	14.55	13.37	46.76
2086/87	67	3059						10.04		10.04
2087/88	68	475						1.56		1.56
2088/89	69									
2089/90	70									
2090/91	71									
2091/92	72									
2092/93	73									
2093/94	74									
2094/95	75									
PV =		63526	2987.71	66.40	61.59	300.62	12.70	208.59	230.64	3868.24
LCOE@Gen. ($/MW.h) =			47.03	1.05	0.97	4.73	0.20	3.28	3.63	60.89
LCOE@Load ($/MW.h) =			51.73	1.15	1.07	5.21	0.22	3.61	3.99	**66.98**

Levelized Cost of Energy
Conawapa Generating Station

Undertaking #41

Current Dollar Year:	2013	
Discount Rate:	5.05	%
Service Life:	67	yrs
Time to First Power:	13	yrs
Nominal Capacity:	1485	MW
Net Summer Capacity:	1395	MW
Net Winter Capacity:	1300	MW
Capacity Factor:	57	%
Auxiliary Power:	0	%
N to S Trans. Adjustment:	10	%
Capital Tax:	0.5	%
Water Rental Rate:	3.3426	$/MW.h
Heat Rate:	N/A	Btu/kW.h

With Transmission	2013$	2014$	
Base Estimate:	6011	6125	$Million
Overnight Capital Cost:	4048	4125	$/kW
LCOE@Gen.:	64.94	66.17	$/MW.h
LCOE@Load:	71.43	72.79	$/MW.h

Without Transmission	2013$	2014$	
Base Estimate:	6000	6115	$Million
Overnight Capital Cost:	4041	4118	$/kW
LCOE@Gen.:	64.85	66.08	$/MW.h
LCOE@Load:	71.33	72.69	$/MW.h

			Generation (Millions of $CDN)							
Fiscal Year	Years to Earliest ISD	Average Net Energy (GW.h)	Generating Station	Trans. Station	Trans. Line	Capital Tax on GS	Capital Tax on TL & TS	Water Rentals	Fixed O&M	TOTAL COST
	Sunk									0.00
2013/14	-13	0	0.00		0.00	0.00	0.00	0.00	0.00	0.00
2014/15	-12	0	27.32		0.00	0.14	0.00	0.00	0.00	27.45
2015/16	-11	0	30.64		0.00	0.29	0.00	0.00	0.00	30.93
2016/17	-10	0	82.68		0.00	0.70	0.00	0.00	0.00	83.38
2017/18	-9	0	100.89		0.00	1.21	0.00	0.00	0.00	102.10
2018/19	-8	0	480.57		0.00	3.61	0.00	0.00	0.00	484.18
2019/20	-7	0	792.67		0.00	7.57	0.00	0.00	0.00	800.24
2020/21	-6	0	503.25		0.00	10.09	0.00	0.00	0.00	513.34
2021/22	-5	0	897.60		0.00	14.58	0.00	0.00	0.00	912.18
2022/23	-4	0	679.55		0.52	17.98	0.00	0.00	0.00	698.05
2023/24	-3	0	613.72		1.05	21.04	0.01	0.00	0.00	635.81
2024/25	-2	0	491.13		2.09	23.50	0.02	0.00	0.00	516.75
2025/26	-1	0	863.61		4.71	27.82	0.04	0.00	0.00	896.18
2026/27	0	2200	386.46		2.09	29.75	0.05	5.63	13.98	437.97
2027/28	1	6600	50.76			30.00	0.05	16.59	14.20	111.61
2028/29	2	7000	-0.37			30.00	0.05	17.26	13.92	60.86
2029/30	3	7000				30.00	0.05	16.94	14.13	61.13
2030/31	4	7000				30.00	0.05	16.63	13.96	60.64
2031/32	5	7000				30.00	0.05	16.32	13.92	60.29
2032/33	6	7000				30.00	0.05	16.01	13.69	59.76
2033/34	7	7000				30.00	0.05	15.71	13.27	59.04
2034/35	8	7000				30.00	0.05	15.42	13.28	58.75
2035/36	9	7000				30.00	0.05	15.13	13.32	58.51
2036/37	10	7000				30.00	0.05	14.85	15.98	60.89
2037/38	11	7000				30.00	0.05	14.57	13.15	57.78
2038/39	12	7000				30.00	0.05	14.30	13.15	57.51
2039/40	13	7000				30.00	0.05	14.03	13.15	57.24
2040/41	14	7000				30.00	0.05	13.77	13.15	56.98
2041/42	15	7000				30.00	0.05	13.52	13.15	56.72
2042/43	16	7000				30.00	0.05	13.26	12.51	55.83
2043/44	17	7000				30.00	0.05	13.02	12.51	55.58
2044/45	18	7000				30.00	0.05	12.77	12.51	55.34
2045/46	19	7000				30.00	0.05	12.54	12.51	55.10
2046/47	20	7000				30.00	0.05	12.30	15.34	57.69
2047/48	21	7000				30.00	0.05	12.07	12.51	54.63
2048/49	22	7000				30.00	0.05	11.85	12.51	54.41
2049/50	23	7000				30.00	0.05	11.63	12.51	54.19
2050/51	24	7000				30.00	0.05	11.41	12.51	53.97
2051/52	25	7000				30.00	0.05	11.20	14.21	55.46
2052/53	26	7000				30.00	0.05	10.99	14.21	55.25
2053/54	27	7000				30.00	0.05	10.78	14.21	55.04
2054/55	28	7000				30.00	0.05	10.58	14.21	54.84
2055/56	29	7000				30.00	0.05	10.39	14.21	54.65
2056/57	30	7000				30.00	0.05	10.19	15.34	55.58
2057/58	31	7000				30.00	0.05	10.00	12.51	52.56
2058/59	32	7000				30.00	0.05	9.82	12.51	52.38
2059/60	33	7000				30.00	0.05	9.63	12.51	52.19
2060/61	34	7000				30.00	0.05	9.45	12.51	52.01
2061/62	35	7000				30.00	0.05	9.28	12.51	51.84
2062/63	36	7000				30.00	0.05	9.10	12.51	51.66
2063/64	37	7000				30.00	0.05	8.93	27.65	66.64
2064/65	38	7000				30.00	0.05	8.77	12.51	51.33
2065/66	39	7000				30.00	0.05	8.60	27.65	66.31
2066/67	40	7000				30.00	0.05	8.44	15.34	53.84
2067/68	41	7000				30.00	0.05	8.29	27.65	65.99
2068/69	42	7000				30.00	0.05	8.13	12.51	50.69
2069/70	43	7000				30.00	0.05	7.98	27.65	65.69
2070/71	44	7000				30.00	0.05	7.83	12.51	50.39
2071/72	45	7000				30.00	0.05	7.68	27.65	65.39
2072/73	46	7000				30.00	0.05	7.54	12.51	50.10
2073/74	47	7000				30.00	0.05	7.40	27.65	65.11
2074/75	48	7000				30.00	0.05	7.26	12.51	49.82
2075/76	49	7000				30.00	0.05	7.13	27.65	64.83
2076/77	50	7000				30.00	0.05	6.99	15.34	52.39
2077/78	51	7000				30.00	0.05	6.86	29.35	66.27
2078/79	52	7000				30.00	0.05	6.74	14.21	51.00
2079/80	53	7000				30.00	0.05	6.61	29.35	66.01
2080/81	54	7000				30.00	0.05	6.49	14.21	50.75
2081/82	55	7000				30.00	0.05	6.37	29.35	65.77
2082/83	56	7000				30.00	0.05	6.25	12.51	48.81
2083/84	57	7000				30.00	0.05	6.13	12.51	48.69
2084/85	58	7000				30.00	0.05	6.02	12.51	48.58
2085/86	59	7000				30.00	0.05	5.90	12.51	48.47
2086/87	60	7000				30.00	0.05	5.79	15.34	51.19
2087/88	61	7000				30.00	0.05	5.69	12.51	48.25
2088/89	62	7000				30.00	0.05	5.58	12.51	48.14
2089/90	63	7000				30.00	0.05	5.48	12.51	48.04
2090/91	64	7000				30.00	0.05	5.37	12.51	47.94
2091/92	65	7000				30.00	0.05	5.27	12.51	47.84
2092/93	66	7000				30.00	0.05	5.18	12.52	47.75
2093/94	67	4800						3.48		3.48
2094/95	68	400						0.28		0.28
PV =		71288	3939	0	6	398	1	135	151	4629
LCOE@Gen. ($/MW.h) =			55.26	0.00	0.08	5.58	0.01	1.90	2.12	64.94
LCOE@Load ($/MW.h) =			60.78	0.00	0.09	6.13	0.01	2.09	2.33	**71.43**