Q. On pg. 17 and pg. 18 of the Report referred to in PUB-Nalcor-151, it is stated that *"No additional generation would be installed east of Bay d'Espoir in a continued Isolated Island scenario until the 2022 timeframe when a 170 MW combined-cycle combustion turbine (CCCT) would be installed on the Avalon Peninsula. Transmission upgrades are therefore required."* Have any alternatives employing earlier generation additions to the Avalon Peninsula such as simple cycle gas turbines or CCCTs been considered from a cost benefit perspective under either of the two generation expansion scenarios? In responding please address how these could potentially: i) alleviate or resolve the transmission issue; ii) reduce the requirements for starting units at Holyrood early in the load forecast cycle and then operating them at a more fuel efficient, higher capacity, and iii) improving the reliability of supply to the Avalon by having generation available directly at the load center.

A. As noted above, this quote refers to the Isolated Island alternative. In the Interconnected Island alternative, transmission upgrades are required for reliable operation of the system.[1] Therefore, alternatives employing earlier generation additions to the Avalon Peninsula such as CTs or CCCTs have not been considered in the Island Interconnected Alternative.

In the Island Isolated alternative, scenarios employing earlier generation additions on the Avalon Peninsula such as CTs or CCCTs have been considered from a cost benefit perspective. Without additional transfer capability from Bay d'Espoir to the Avalon Peninsula, additional renewable capacity located off the Avalon cannot be added to the system.

[1] Transmission upgrades for the Interconnected Island alternative are discussed in Exhibit 114 and PUB-Nalcor-154.

A sensitivity analysis was completed with Portland Creek, Island Pond, and Round Pond excluded because of transmission capacity constraints to the Avalon Peninsula. The CPW of this generation expansion plan, which sees increased reliance on thermal generation to meet load, is $9,619 million in 2010$.

With an in-service capital cost of $210 million in 2016, the CPW of the new transmission line is $132 million in 2010$, so the total CPW of the Isolated Island alternative and the new transmission line is $8,810 million + $132 million, or $8,942 million in 2010$.

The economic preference for the Isolated Island alternative and the new transmission line over increased reliance on thermal generation is therefore $677 million in 2010$.

These early thermal generation additions on the Avalon would not alleviate or resolve the transmission issue, as they do not increase the transfer limit from Bay d'Espoir to the Avalon Peninsula.

New CTs or CCCTs are both more expensive on a per MWh basis than Holyrood, so there is no justification to operate them instead of Holyrood. Referring to Exhibit 9, the best and worst heat rates for Holyrood and CT/CCCT thermal units are as follows:

Worst Heat Rate for Holyrood	10.39 MMBTU/MWh
Best Heat Rate for CT	9.43 MMBTU/MWh
Best Heat Rate for CCCT	7.64 MMBTU/MWh

Based on thermal efficiency, the per BTU cost of #2 fuel can be no greater than 10% over the per BTU cost of #6 fuel in order to economically justify dispatching a CT over Holyrood. Similarly, the maximum economically justifiable premium for a CCCT unit over Holyrood is 36%. Using data from Exhibit 4, per BTU costs of #2 and #6 fuels were compared, and these conditions are never forecasted to be met. This is demonstrated in the table on the following page.

As indicated in Exhibit 106, the reliability of the Isolated Island alternative is already acceptable so the additional investment in thermal generation in an isolated case cannot be justified on reliability grounds.

The $132 million 2010$ CPW of the third transmission line is therefore preferable to the $677 million (2010$) CPW penalty to the Isolated Island alternative.

	Diesel ($Cdn/l)	Diesel ($Cdn/bbl)	Diesel ($Cdn/MMBTU)		#6 2.2%s ($Cdn/bbl)	#6 2.2%s ($Cdn/MMBTU)		Ratio of #2 to #6 Cost per BTU
2010	0.674	107.12	18.39		79.60	12.66		1.45
2011	0.700	111.29	19.11		80.50	12.80		1.49
2012	0.760	120.83	20.74		88.00	14.00		1.48
2013	0.815	129.57	22.24		95.50	15.19		1.46
2014	0.850	135.14	23.20		99.00	15.75		1.47
2015	0.905	143.88	24.70		103.00	16.38		1.51
2016	0.945	150.24	25.79		107.00	17.02		1.52
2017	0.990	157.40	27.02		111.50	17.74		1.52
2018	1.030	163.76	28.11		115.60	18.39		1.53
2019	1.065	169.32	29.07		118.60	18.86		1.54
2020	1.100	174.89	30.02		120.30	19.13		1.57
2021	1.155	183.63	31.52		123.10	19.58		1.61
2022	1.195	189.99	32.62		125.80	20.01		1.63
2023	1.235	196.35	33.71		128.50	20.44		1.65
2024	1.275	202.71	34.80		131.10	20.85		1.67
2025	1.315	209.07	35.89		133.70	21.27		1.69
2026	1.340	213.04	36.57		136.40	21.70		1.69
2027	1.365	217.02	37.26		139.10	22.13		1.68
2028	1.395	221.79	38.07		141.90	22.57		1.69
2029	1.425	226.56	38.89		144.80	23.03		1.69
2030	1.450	230.53	39.58		147.70	23.49		1.68
2031	1.480	235.30	40.39		150.60	23.95		1.69
2032	1.510	240.07	41.21		153.60	24.43		1.69
2033	1.540	244.84	42.03		156.70	24.92		1.69
2034	1.570	249.61	42.85		159.80	25.42		1.69
2035	1.600	254.38	43.67		163.00	25.93		1.68
2036	1.635	259.94	44.63		166.30	26.45		1.69
2037	1.665	264.71	45.44		169.60	26.98		1.68
2038	1.700	270.28	46.40		173.00	27.52		1.69
2039	1.735	275.84	47.35		176.40	28.06		1.69
2040	1.770	281.41	48.31		180.00	28.63		1.69
2041	1.805	286.97	49.27		183.60	29.20		1.69
2042	1.840	292.54	50.22		187.20	29.78		1.69
2043	1.875	298.10	51.18		191.00	30.38		1.68
	Notes	(1)			Diesel is fuel source for CT and CCCT			
		(2)			158.987 litres / bbl			
		(3)			1 barrel of diesel equivalent to 5.825 MMBTU			
		(4)			1 barrel of #6 equivalent to 6.287 MMBTU			

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