Request IR-42:

Please provide Annual GWh and MW Load Projections in high and low load cases with and without DSM in excel spreadsheet format, as initially provided in NSUARB IR-61, Attachment 1.

Response IR-42:

Please refer to Attachment 1, filed electronically.

GWh

	NSPML Base						
Year	Residential	Commercial	Industrial	Losses	DSM	PHP	NSPML Base
2015	4,543	3,500	1,641	752	-621	1,139	10,952
2016	4,609	3,553	1,659	761	-770	1,139	10,950
2017	4,672	3,605	1,678	774	-909	1,139	10,959
2018	4,720	3,658	1,697	783	-1,053	1,139	10,944
2019	4,787	3,712	1,718	794	-1,197	1,139	10,954
2020	4,853	3,767	1,740	806	-1,356	1,139	10,950
2021	4,919	3,823	1,764	818	-1,505	1,139	10,958
2022	4,985	3,880	1,789	830	-1,649	1,139	10,972
2023	5,063	3,937	1,814	842	-1,793	1,139	11,002
2024	5,130	3,996	1,841	854	-1,938	1,139	11,022
2025	5,184	4,056	1,868	865	-2,073	1,139	11,039
2026	5,239	4,117	1,896	876	-2,203	1,139	11,064
2027	5,294	4,179	1,925	887	-2,333	1,139	11,091
2028	5,350	4,241	1,954	899	-2,468	1,139	11,114
2029	5,407	4,305	1,983	910	-2,593	1,139	11,150
2030	5,463	4,370	2,013	922	-2,713	1,139	11,193
2031	5,521	4,435	2,043	934	-2,833	1,139	11,239
2032	5,579	4,502	2,073	946	-2,958	1,139	11,281
2033	5,638	4,569	2,105	958	-3,022	1,139	11,387
2034	5,697	4,638	2,136	971	-3,087	1,139	11,494
2035	5,757	4,707	2,168	983	-3,152	1,139	11,603
2036	5,818	4,778	2,201	996	-3,217	1,139	11,714
2037	5,879	4,850	2,234	1,009	-3,283	1,139	11,828
2038	5,941	4,922	2,267	1,020	-3,349	1,139	11,941
2039	6,004	4,996	2,301	1,032	-3,415	1,139	12,057
2040	6,067	5,071	2,336	1,044	-3,482	1,139	12,174

Demand forecast (MW) by sector, base case

NSPML Base								
Year	Residential	Commercial	Industrial	Losses	Total Peak	DSM MW	System Peak MW	Firm MW
2015	1,051	539	335	217	2,142	-100	2,042	1,891
2016	1,066	546	337	220	2,169	-129	2,041	1,890
2017	1,079	554	340	223	2,197	-155	2,042	1,892
2018	1,090	562	343	226	2,221	-182	2,039	1,888
2019	1,105	570	346	229	2,250	-210	2,040	1,890
2020	1,119	578	350	232	2,279	-240	2,039	1,889
2021	1,134	586	353	235	2,308	-268	2,040	1,890
2022	1,147	594	357	239	2,337	-296	2,041	1,891
2023	1,164	602	361	242	2,368	-323	2,045	1,895
2024	1,178	610	365	245	2,398	-351	2,047	1,897
2025	1,189	619	369	248	2,425	-376	2,049	1,898
2026	1,201	627	373	251	2,452	-401	2,051	1,901
2027	1,212	636	378	254	2,480	-426	2,054	1,904
2028	1,224	645	382	257	2,508	-451	2,057	1,906
2029	1,236	654	387	260	2,536	-475	2,061	1,911
2030	1,248	664	391	263	2,565	-498	2,067	1,917
2031	1,260	673	396	266	2,594	-521	2,074	1,924
2032	1,272	682	400	269	2,624	-544	2,080	1,930
2033	1,285	692	405	273	2,655	-556	2,099	1,948
2034	1,298	702	410	276	2,687	-569	2,118	1,968
2035	1,311	713	415	280	2,718	-581	2,138	1,987
2036	1,324	723	420	283	2,751	-593	2,158	2,007
2037	1,337	734	426	287	2,783	-605	2,178	2,028
2038	1,351	744	431	290	2,816	-618	2,198	2,048
2039	1,365	755	436	293	2,849	-630	2,219	2,069
2040	1,379	766	442	296	2,883	-643	2,240	2,090

GWh

NSPML LOW							
Year	Residential	Commercial	Industrial	Losses	DSM	PHP	NSPML LOW case
2015	4,510	3,500	1,645	750	-621	1,139	10,922
2016	4,564	3,538	1,657	756	-770	1,139	10,884
2017	4,610	3,574	1,672	766	-909	1,139	10,852
2018	4,641	3,611	1,692	772	-1,053	1,139	10,802
2019	4,690	3,649	1,721	782	-1,197	1,139	10,783
2020	4,735	3,686	1,748	791	-1,356	-	9,605
2021	4,776	3,724	1,767	799	-1,505	-	9,560
2022	4,810	3,757	1,776	805	-1,649	-	9,499
2023	4,855	3,790	1,784	811	-1,793	-	9,448
2024	4,888	3,822	1,792	817	-1,938	-	9,380
2025	4,907	3,852	1,799	821	-2,073	-	9,306
2026	4,926	3,883	1,807	825	-2,203	-	9,237
2027	4,945	3,913	1,815	830	-2,333	-	9,169
2028	4,964	3,944	1,822	834	-2,468	-	9,096
2029	4,983	3,976	1,830	839	-2,593	-	9,034
2030	5,002	4,007	1,838	843	-2,713	-	8,977
2031	5,021	4,039	1,846	848	-2,833	-	8,920
2032	5,040	4,071	1,854	853	-2,958	-	8,859
2033	5,059	4,103	1,861	857	-3,022	-	8,859
2034	5,079	4,136	1,869	862	-3,087	-	8,859
2035	5,098	4,169	1,877	866	-3,152	-	8,859
2036	5,118	4,202	1,885	871	-3,217	-	8,859
2037	5,137	4,235	1,893	876	-3,283	-	8,859
2038	5,157	4,269	1,901	881	-3,349	-	8,859
2039	5,177	4,303	1,910	885	-3,415	-	8,859
2040	5,196	4,337	1,918	890	-3,482	-	8,859

Demand forecast (MW) by sector,low load case

NSPML LOW								
Year	Residential	Commercial	Industrial	Losses	Total	DSM MW	System Peak MW	Firm MW
2015	1,079	557	213	222	2,070	-100	1,970	1,885
2016	1,091	562	214	224	2,091	-129	1,962	1,877
2017	1,101	568	216	227	2,111	-155	1,956	1,870
2018	1,108	573	218	229	2,128	-182	1,946	1,860
2019	1,119	579	222	231	2,152	-210	1,942	1,857
2020	1,130	585	225	234	2,174	-240	1,934	1,849
2021	1,139	591	228	236	2,193	-268	1,925	1,840
2022	1,146	596	229	238	2,208	-296	1,913	1,827
2023	1,156	600	230	239	2,225	-323	1,902	1,817
2024	1,163	605	230	241	2,239	-351	1,889	1,803
2025	1,167	609	231	242	2,250	-376	1,874	1,788
2026	1,171	614	232	243	2,261	-401	1,860	1,775
2027	1,175	619	233	244	2,272	-426	1,846	1,761
2028	1,180	623	234	246	2,283	-451	1,832	1,746
2029	1,184	628	235	247	2,294	-475	1,819	1,734
2030	1,188	633	236	248	2,305	-498	1,807	1,722
2031	1,192	638	237	250	2,317	-521	1,796	1,711
2032	1,197	643	238	251	2,328	-544	1,784	1,698
2033	1,201	648	239	252	2,340	-556	1,784	1,698
2034	1,206	653	240	254	2,352	-569	1,784	1,698
2035	1,210	658	241	255	2,364	-581	1,784	1,698
2036	1,215	664	242	256	2,377	-593	1,784	1,698
2037	1,220	669	243	258	2,389	-605	1,784	1,698
2038	1,224	674	244	259	2,401	-618	1,784	1,698
2039	1,229	679	245	261	2,414	-630	1,784	1,698
2040	1,234	685	246	262	2,427	-643	1,784	1,698

NON-CONFIDENTIAL

Request IR-43:

The EAC maintains its position that this process should consider stricter regulatory scenarios for the integration of variable (i.e. non-hydro import) renewable energy and GHG emissions in the post-2020 period. We suggest demonstrating the value proposition of the scenarios provided in a post-2020 world where:

(a) Nova Scotia's electricity was required to meet a 100% renewable energy target, of which at least 50% is variable renewables by 2050 or before,

(b) Nova Scotia's electricity system was required to produce zero-GHG emissions by 2050.

We note that these scenarios could be modified after collaborative discussions with NSPI, Board staff, and other stakeholders.

Response IR-43:

(a-b) With respect to the EAC position and suggestion above, please see the Board's letter of March 21, 2013.

NON-CONFIDENTIAL

Request IR-44:

Please provide a narrative description of how each scenario presented by NSP either blocks or enables the achievement of more stringent requirements in terms of GHG emissions and the development of variable renewable energy in a post-2020 period.

Response IR-44:

The Maritime Link enables access to a substantial new market of non-GHG-emitting energy. This includes the renewable energy from Muskrat Falls and potential large and small scale hydro and potential new variable sources in Newfoundland and Labrador. The inherent storage available in hydro assets assists in the integration of variable renewable energy.

While the Other Import enables increased access to current sources of GHG-emitting and non-GHG-emitting energy in Eastern Canada and New England there is no development of incremental renewable energy in the Other Import, rather the energy is being taken from existing sources. To the extent that new renewable energy is developed and available for export from a source in that market, it may be possible to contract for some of that energy.

Indigenous Wind requires GHG-emitting back-up sources or other dispatchable renewable sources such as stored hydro, due to the variable nature of the wind energy. It does not enable increased access to new or exisiting markets. System stability limits are challenged at the current level proposed in the Indigenous Wind Alternative.

NON-CONFIDENTIAL

Request IR-45:

In the application, p 24, Figure 1-5, the NSPML asserts that the link will provide access to future wind and hydro development in Newfoundland. It is widely acknowledged that a wider geographic catchment area for wind energy increases both its availability and effective firm generation capacity. Please compare how the link and alternates considered (Other Import and Indigenous Wind) would increase the ability to gather wind energy over a wide geographic region.

Response IR-45:

The Maritime Link transmission connection between Nova Scotia and Newfoundland and Labrador substantially extends the interconnected geographic wind catchment area. As indicated in Figure 1-5 of the Application, the Newfoundland wind regime is considerable. The Other Import option offers enhanced interconnection transfer capability within the Maritimes region offering possible new opportunities for collaborative balancing, but accesses the same market that is accessed today. The Maritime Link accesses a new wind regime. Transmission developments in the Indigenous Wind case are largely committed to reliability and not available for incremental transfer capability. Similar to Other Import, Indigenous Wind transmission developments would provide access to the same wind regime that is available today.

NON-CONFIDENTIAL

Request IR-46:

In the application, p 25, line 13 – 16 , NSPML asserts that the proposed link will support additional wind energy development. Please compare how the link and alternates considered (Other Import and Indigenous Wind) would enable system operators to responsed to the following two events:

(a) Transition from high early morning wind to calm conditions aligned with morning demand increase,

(b) Transition from high late evening generation and no wind generation to high overnight wind conditionsn aligned with late evening demand decrease.

Response IR-46:

(a-b) Please refer to the NSP Whitepaper on Wind Integration, Figure 3.3 which demonstrates actual events on the NS Power system consistent with the two scenarios mentioned, from left to right demonstrating wind production increase while load is decreasing, then periods with wind generation declining while load grows.

The power system arising from each of the alternatives must be equipped with the tools to allow the system operator to reliably respond to the conditions presented in parts a) and b). Clearly, the challenges faced in the conditions described are less in the Maritime Link and the Other Import alternatives than the Indigenous Wind because the installed wind capacity is considerably less in those cases. For the Indigenous Wind case, NSPML has estimated the expenditures necessary to cope with these conditions and has reflected these in the financial analysis. These include the development of combustion turbines and combined cycle units. In some cases these developments are provoked by reductions in air emission limits, but they will serve equally well in response to the conditions described. Transmission reinforcements and storage of load control investments were also identified as necessary to varying degrees in the Indigenous Wind cases.

Wind production forecasting is critical to the successful operation of power systems with high levels of wind penetration. The NS Power system does have intrinsic balancing and regulating capability but much of this will be consumed by the existing and committed wind power projects. Power systems are well served by future renewable energy sources that not only provide RES qualifying energy but also serve some of the power system reliability requirements, including firm capacity, load following or regulating reserve. Economy energy purchases on tie lines can also assist with load following or changes in wind or load forecasted behaviour. The Maritime Link project brings all of these capabilities to some degree. The Other Import alternative assumes a firm renewable energy block, but other ancillary services may or may not be made available through commercial negotiations. The Indigenous Wind case reflects a development plan perhaps better suited to low level wind penetration where firm capacity and other ancillary services must be sourced from other resources, effectively duplicating the installed capacity on the system and adding associated costs.

	ML	**OI**	**IW**
Wind up when load going down in p.m.	ML shut down at 11 pm and allows wind to produce off-peak	Depends upon provisions of other supply agreements, if there were any flexibility attained and at what cost, may require curtailment if no flexibility	Curtail wind or other generation
Wind reducing when load growing in a.m.	ML scheduled to maximum of NS Block and dispatch in ½-hour blocks to best match demand. ML start time aligned to best suit load-up within 90-minute window. Remainder purchased as needed from either ML or NB-NS	Depends upon provisions of other supply agreements; if no flexibility to increase base load then all extra energy would be at a cost if available	Back-up generation would be dispatched and incur operating costs

NON-CONFIDENTIAL

Request IR-47:

In the application, p 41, line 7 – 11 , NSPML identifies that the proposed link will be able to carry power in the opposite direction. Please confirm our understanding that the Maritime Link's capacity to reverse direction could theoretically provide up to 1000 MW of fast ramping response to falling or rising wind energy on the NS power system. If this is not the case, please detail the benefits of the technical capacity to carry power in both directions, especially with respect to adapting to increased levels of variable renewable generation on the connected transmission systems.

Response IR-47:

The capacity of the Maritime Link is limited to 500 MW in both directions. Fast acting full range reverse flow from +500 MW to -500 MW (1000 MW) is theoretically possible but cannot be done to that degree and still maintain system stability in the present configuration. Dynamic system constraints limit the optimum range of ramping response and change with the system status at any given time.

The benefit of being able to carry power in both directions relative to the addition of intermittent resources such as wind are that; hydro generation resources in Newfoundland can provide the benefit of fast acting response to follow wind resources in Nova Scotia and, resources in Nova Scotia could also deliver power to Newfoundland which would otherwise not be possible without the Maritime Link. However, as mentioned, large fluctuations in flows, particularly in transition from forward to reverse, must be designed to meet overall system stability requirements and would change depending upon the status of the combined systems at any given time.

Flow in both directions also provides the reliability benefits associated with supporting system disturbances both in Newfoundland and Nova Scotia.

Please refer to UARB IR-68 and Hingorani IR-5.

Request IR-48:

Do the other considered scenarios have greater or lesser capacity to accommodate falling or rising wind generation?

Response IR-48:

Please refer to EAC IR-46.

There are both physical and commercial considerations in the determination of the capability of the alternatives to accommodate system ramps brought on by swings in wind generation and load. Each of the alternatives have resource additions in the form of combustion turbines and combined cycle facilities, which have been added to replace other retiring generating capacity or reserve. These fast acting forms of generation can provide response to the conditions described if they are not being utilized for load serving at the time, however, in the case where they are being installed to replace coal plants, they would have limited ability to provide response to wind production declines. Strong transmission ties combined with the necessary commercial agreements can also provide balancing or regulation services with the necessary agreements.
Only the Maritime Link has balancing and regulation service described within the commercial agreements, and dispatch and shaping of the firm block (NS Block) as defined in the ECA. Incremental cost would need to be assigned to the Other Import and Indigenous Wind cases to account for any potential benefit to follow wind.

In this case, both the Other Import and Indigenous Wind would have lesser capability to follow wind without considering the cost and counterparty for the provision of those services.