Responses to Industrial Group Requests – received via letter May 7, 2014

<u>Comment/Request:</u>

The graphs on pages 4 and 11 show operational wind integration costs versus installed wind capacity with the costs expressed in dollars/MWh. The graph shows a sharp increase in the average cost as wind capacity increases. If $14/MWh is the average cost at 550 MW and $28/MWh is the average cost at 650 MW, please confirm that the incremental cost of integration to go from 550 MW to 650 MW is $105/MWh, (derived as follows):

1. We assume that the $/MWh cost shown in the graph on page 4 is the average cost for the level of installed wind generation (not the incremental cost at each level of installed wind generation).

2. The total wind integration costs with 550 MW of installed wind generation appear to be about $24 million per year [550 MW x 8760 hours/year x 35% CF1 x $14/MWh (from graph) = $23.6 million/year].

3. Total wind integration costs with 650 MW of installed wind generation appear to be about $56 million per year [650 MW x 8760 hours/year x 35% CF x $28/MWh (from graph) = $55.8 million/year].

4. The difference in total wind integration costs between 550 MW and 650 MW is therefore $105/MWh [($55.8 million - $23.6 million]/((650 MW - 550 MW) x 8760 hours/year x 35% CF) = $105/MWh].

If this calculation and interpretation of the graph is incorrect, please explain. Alternatively, if the cost of accommodating additional wind above 550 MW is this high (higher than the cost of wind generation itself), why would it be considered as a resource in the IRP?

<u>Response:</u>

The graphs on pages 4 and 11 of the Wind Integration Costs document illustrate the sharply increasing cost of wind integration associated with reaching the limit of the amount of variable intermittent generation that can be integrated on the existing system without any additional resources.

Some Candidate Resource Plans in the IRP exercise may specify additional quantity of wind generation to be studied as a valid resource option. Once the quantity, location and type of the proposed variable resource are known, specific capital investments required to integrate the additional variable generation can be specified.

Once additional capital investments required to integrate variable energy are specified in the system model, we expect the operating portion of the wind integration costs will decrease. The capital and operating portions of variable energy integration costs will be calculated on a case by case basis.

<u>Comment/Request:</u>

With respect to the study methodology - operational dispatch costs (page 8) the Industrial Group suggests that estimates or calculations of the incremental emissions associated with heat rate degradation and additional unit starts resulting from variable generation would be useful in assessing the actual (net) emissions reductions associated with mandatory RES or other policies and should be included.

<u>Response:</u>

Opportunities to assess the costs associated with incremental emissions, heat rate degradation and additional start/shut down will be reviewed through the IRP process.

<u>Comment/Request:</u>

At p.12 NSPI indicates "GE Energy estimates that NSPI will have to carry additional 32 MW of non-synchronous 10-minute reserve...". Is this value reported in the Renewable Energy Integration Strategy? If so, where? If not and it was derived, please explain the derivation.

<u>Response:</u>

Please refer to GE Energy Renewable Energy Integration Study page 67 for the source of incremental reserve requirements for given wind penetration levels.

<u>Comment/Request:</u>

Please provide the back-up data and documentation on how the numbers in the tables on pages 4 and 11 were calculated.

<u>Response:</u>

The figures presented here are indicative of the sharp increase in operating portion of wind integration costs if the system were to stay in its present configuration, and as such they may not be consistent with Candidate Resource Plans and related capital additions to the power systems. Relevant data and documentation from case specific variable integration costs calculations will be provided for stakeholders and the board consultant analysis.

Comment/Request:

There is little in the document to indicate what NSPI is doing to control operational dispatch costs and additional reserve requirements. In other areas where wind is being aggressively integrated, ego ERCOT (Texas) and Alberta, wind is being made dispatchable (contracts limit this to about 10% of total hours per year in order to still make the wind project financeable). Under existing 100% take-or-pay contracts, it would seem to make sense in light of the "incremental operating integration costs" to sometimes simply pay the wind farm operator. The Industrial Group suggests that appropriate consideration be given to this option in evaluating the plans.

Response:

Nova Scotia Power considers wind generation curtailment due to system security or transmission system congestion issues. Economic curtailment of wind generation is also considered in the system simulation where, for example, the cost of shutting down and restarting of a steam generating unit is evaluated against the cost of wind energy curtailment.

Comment/Request:

Going forward, the Industrial Group submits there should be a requirement for all additional wind farms that they be dispatchable and provide certain system services such as reactive power.

Response:

The IRP will provide insight to these issues. Operational matters such as future wind turbine specifications will be assessed as part of future wind solicitations.

Comment/Request:

It is further noted that wind in Ontario and Quebec carries approximately 30% capacity values. The lower values indicated by NSPI appear to be elsewhere in North America where the system peaks in summer - a low production period for wind. We are different in Nova Scotia as our system peaks when wind production is highest, suggesting a higher value more comparable to Ontario and Quebec."

Response:

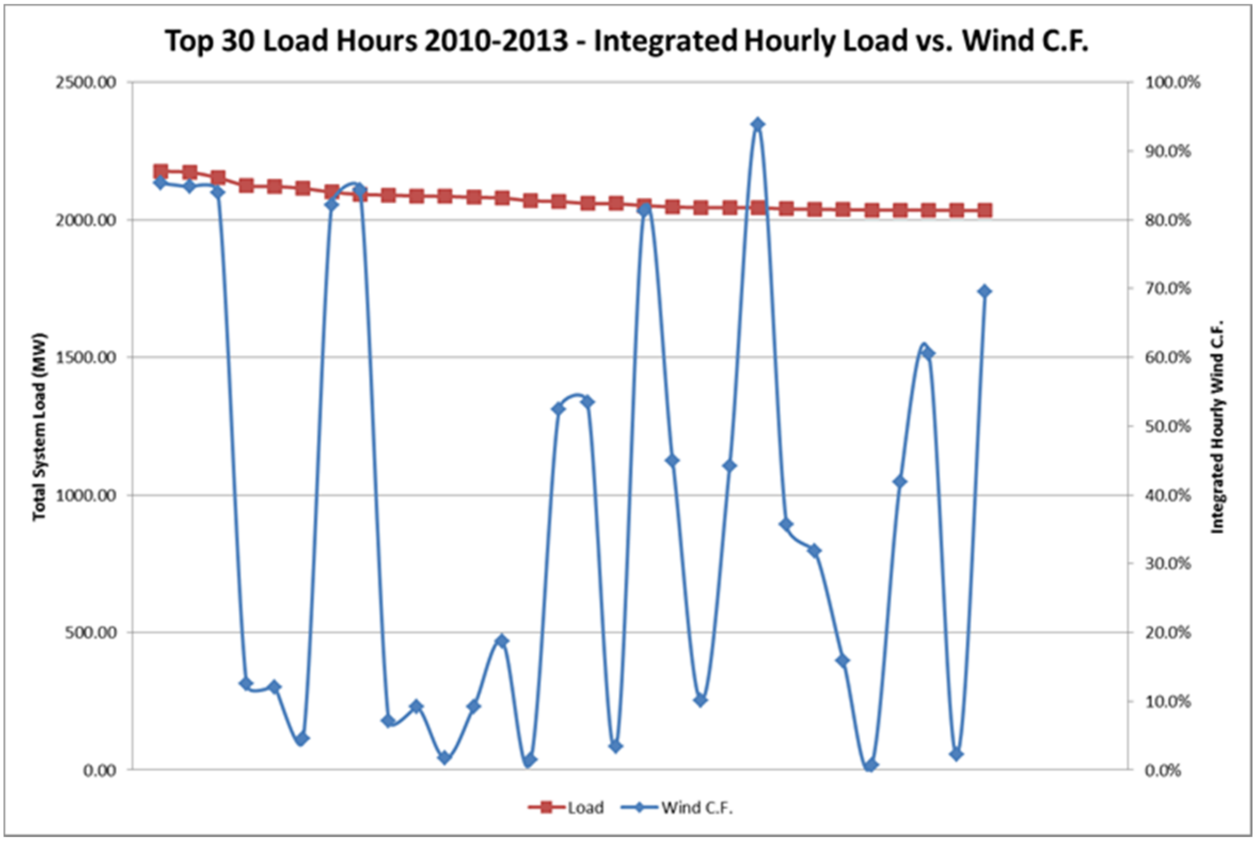
Each jurisdiction within NPCC determines its own methodology for calculation of capacity value of wind. Quebec and Ontario have relatively large systems compared to the level of wind penetration and their respective reserve margins. The impact of variable generation on such systems is not felt as severely as it is felt in Nova Scotia where wind penetration, compared to the size of the system, is very high.

The graph below was included in the Capacity Value of Wind document and it illustrates the issue with counting on wind generation to be available when capacity is needed.

Out of the 30 highest load hours from 2010-2013, we had several hours with wind generation at a very high capacity factor, but we also had several hours with very low or no wind generation. During those peak load hours where wind generation is not present, NS Power still needs to maintain enough dispatchable generation in order to serve customer demand.

In order to maintain system reliability consistent with LOLE specification of one day of load loss in 10 years, NS Power has to maintain ~20 percent planning reserve margin. If capacity value of wind is to be taken to be 30 percent, wind energy would count towards almost a half of the required planning reserve margin, which effectively reduces system reliability during peak system demand and little or no wind generation.

NS Power does not plan capacity to serve interruptible customers. In periods of heavy winter load, NS Power's interruptible customers may be served by capacity held in the planning reserve margin. While the planning reserve margin is developed to reduce the probable loss of firm load, it also serves to insulate non-firm customers from greater interruption frequency. Erosion of the reliability of the planning reserve margin will likely result in greater interruption frequency, a circumstance that could be compounded by non-traditional operation of previously base-loaded steam units.



Comment/Request:

At page 16, NSPI expresses concern that such technical features for wind turbines are "not available from all wind generation suppliers". The advice we have received is that if one goes out for a tender for wind today, one would normally include many of these technical requirements. The cost of wind turbines over the past five years has fallen significantly and the additional system integration features listed by NSPI have offset some of the cost decline for the "plain vanilla" wind turbines. The Industrial Group recommends that these alternatives be modelled.

Response:

NS Power agrees that we would include many of the additional technical requirements in any of the future wind generation tenders. We are aware of the fact that wind generators with additional system integration features come at higher cost than wind generators without the said features which were taken as the least cost alternatives in the building of the present wind generation portfolio.

Comment/Request:

With respect to the 10-minute reserve additions discussed on p.12, the Industrial Group presumes that

NSPI would tender for this before it incurs the high capital costs of building its own new generation and that alternatives to be considered in such a tender would include facilities on interconnected systems such as in New Brunswick.

<u>Response:</u>

NS Power is committed to providing lowest cost resources required for reliable and cost effective delivery of electricity. The procurement of these resources will not be determined through the IRP process.