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March 21, 2011

Mr. Len Johnson
Independent Electricity System Operator (IESO)
655 Bay Street, Suite 410
Toronto, Ontario
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RE: Comments on Proposed IESO Wind and Solar PV Generation Data Requirements as Inputs to Future IESO Centralized Energy Production Forecasts

Power Advisory LLC represents a consortium (the "Consortium") of the following renewable energy generation developers: International Power Canada Inc.; NextEra Energy Canada ULC; Pattern Renewable Holdings Canada ULC; and Samsung Renewable Energy Inc.

On March 3, 2011, the IESO proposed draft data requirements for wind and solar PV generation facilities greater than 5 MW to be submitted to the IESO for purposes of being used as inputs in the to be developed IESO energy production centralized forecasting tool. The IESO made revisions to the proposed data requirements and presented these to the Visibility Technical Working Group on March 16.

The Consortium supports the IESO's leadership towards addressing successful integration of variable generation facilities and thanks the IESO for requesting comments from stakeholders. The Consortium supports the proposed data requirements for wind and solar PV generation and note that the requirements are consistent with 'best practices' in other North American jurisdictions. The Consortium is particularly pleased with the IESO's revised proposal redefining the requirements for meteorological towers.

The Consortium does want to raise a key point regarding selection of a centralized forecasting tool. Based on the tool's forecasting methodology, the amount of dynamic data may very. Therefore, this should drive the final dynamic data requirements for wind generation facilities. These points are presented in Appendix A prepared by WindLogics Inc. (a NextEra Energy Inc. company). Mark Ahlstrom of WindLogics Inc. was the Team Leader of the North American Electric Reliability Corporation's IVGTF Task 2.1 Report: Variable Generation Power Forecasting for Operations (May 2010).

Sincerely,

Jason Chee-Aloy
Managing Director
Power Advisory LLC

cc: Darren Finkbeiner, IESO
stakeholder.engagement@ieso.ca
Colin Edwards, Pattern Renewable Energy Holdings ULC
JT Lee, Samsung Renewable Energy Inc.
David Timm, International Power Canada Inc.
Jennifer Tuck, NextEra Energy Resources Canada ULC

APPENDIX A

March 15, 2011

Jason Chee-Aloy

Managing Director

Power Advisory LLC

55 University Avenue, Suite 600

Toronto, Ontario, Canada

Via email attachment

Dear Jason:

I read the additional materials with interest, and I was glad to see a very healthy discussion taking place at the March 3rd meeting. I'm writing to add a few higher-level points regarding the data requirements for wind and solar forecasting.

When looking at the data requirements from other system operators that are doing centralized forecasting systems, you may have noticed that some of them require a great deal of meteorological data while others require very little. What you may not have noticed is that those that require a lot of data use AWS Truepower as their forecasting vendor, while those that require little meteorological data are using other forecasting vendors. Some understanding of why this is so may be useful in guiding IESO toward a reasonable requirement.

At first glance, most people may consider wind forecasting vendors to be quite similar. All advanced wind forecasting vendors will use weather models (usually several of them) in producing a forecast. They will also use the historical power data to train some sort of learning system or statistical step in the forecast. Ideally, curtailment and availability data is also available and can be used as a final step in producing the power forecast. But there are actually two different "schools of thought" when you look at the details more closely, and these two different approaches to the wind power forecasting problem tend to lead to dramatically different data requirements.

Let's call the first approach the "wind speed based" approach. Intuitively, most people assume that

you first need a good wind speed forecast at the wind power plant, then you can convert from the wind speed value to the power value. This approach seems obvious and easy to understand, but it has some shortcomings. The conversion from wind speed to power is far more complex that most people believe, and even if you could have a perfect wind speed forecast (which you do not have), you will still have significant errors in the power stage. And because there is both a wind speed stage and a power stage, with errors and uncertainties in each stage, the errors can interact and multiply. But the thing to note for our discussion here is that this approach has a natural tendency to want lots of wind speed and wind direction data at the wind plant for verifying the wind speed forecasting stage, so it often leads to very extensive data requirements.

In the second approach that we'll call the "power based" approach, many vendors have learned that they can reduce errors by directly finding the multidimensional, non-linear relationships between the multiple weather models and the power at the revenue meter. While perhaps less obvious, this approach bypasses the wind speed step, and it therefore has little need for real-time wind speed and wind direction values. Some of this data is still nice to have, such as for inferring curtailment when historical curtailment information is not available, but it is not required and the forecast continues to be robust even when wind speed data is not available. And in our experience, this approach works better and provides lower power forecast error rates.

So which wind forecasting vendors are in which school of thought? To my knowledge, of the leading wind forecasting firms, only AWS Truepower is still using the wind speed based approach. The other leading firms are using some form of a power based approach, including Energy & Meteo (Germany, PJM, MISO), Meteologica (Spain) and WindLogics (forecasting provider to market participants, utilities and Telvent).

AWS Truepower is currently the forecast provider to CAISO, NYISO and ERCOT. These system operators have been heavy influenced by AWS and it is reflected in the onerous requirements for dynamic data in these regions. However, there is no evidence that all this data actually results in a better wind power forecast. In fact, there appears to be growing evidence that the power based approach works better even when it has access to no wind speed and wind direction data whatsoever.

We therefore feel quite strongly that only a modest amount of dynamic meteorological data, such as one met tower per wind power plant providing ten-minute average values, is quite sufficient. This data can be used both to check curtailment and calculate lost energy in the event of curtailment (although even there, a good wind power forecast may prove to be just as good as a met tower-to-power conversion). In our view, this data is actually more valuable for historical purposes than for real-time purposes.

The true "all in" cost of the forecasting system includes not just the payments to the forecast vendor, but the incremental costs for additional data that a vendor may require. Costs for installing and maintaining addition weather instruments are very substantial, and the cost/benefit of these additional costs should be taken into account both when selecting a forecast vendor and establishing the dynamic data requirements. To do otherwise effectively increases the cost of wind energy without providing a true benefit.

IESO would be well served by looking at the centralized forecasting systems being done by MISO. For example, MISO has implemented a wind forecasting system that does not require any site specific weather data, and there is no evidence to show that the forecasting results are inferior to those in other areas that require extensive and expensive weather data. Similarly, our own experience in ERCOT has proven to us that superior results can be obtained with a power based approach, even when compared with a centralized wind speed based approach that has full access to extensive met data throughout the region, and we would be happy to discuss the details of these results directly with IESO in a private meeting if they wish to do so.

On a different topic, and as already pointed out by others at the March 3rd meeting, the dynamic data requirement for ice conditions is problematic. Automatic instruments to detect icing are notoriously inaccurate, and trying to include manual entries in the dynamic data is both onerous and prone to error.

For the dynamic solar data, we typically use an instrument called a shadow-band radiometer (often know by their model numbers from various vendors - RSR2, SPN1 etc.). These all-in-one irradiance instruments provide values for GHI, DHI and DNI at a reasonable price. Provided that IESO will agree that such an instrument is sufficient, the dynamic solar data requirements seem generally reasonable, although we do have sympathy with some of the points raised by other participants in the minutes of the March 3rd meeting. Specifically, we agree that expensive instruments such as a tracking pyrheliometer or sun-shaded pyranometer are overkill (and much more difficult to properly maintain), so requiring anything more than a RSR2-type instrument would not be justified.

Thanks and best regards,

Mark Ahlstrom

CEO, WindLogics Inc.