Staff Exhibit 212

Company Name: Gran Belt Express Clean Line LLC
Case Description: Application for Certificate of Convenience and Necessity
Case: EA-2014-0207

Response to Staff's First Set of Data Requests:
Date of Response: April 28, 2014

Data Request No. 04: Did Robert M. Zavadil's Loss of Load Expectation (LOLE) study address the impacts of the variable renewable energy resource, such as a rapid change in energy, injection, on other energy resources? If so, please provide details, including identification of which balancing area will provide ancillary services including regulation up and regulation down to support the injection of the variable renewable energy resource.

RESPONSE:

Nature of Mr. Zavadil's LOLE Study

Mr. Zavadil's analysis explicitly models wind generation as typically producing less than 100% of its output due to meteorological conditions, and therefore the results of his model reflect wind generation's variability. In his calculations, Mr. Zavadil uses an hourly wind generation profile, which is based on mesoscale modeling of weather systems by the National Renewable Energy Laboratory. The profile is described in Mr. Zavadil's testimony at page 7, lines 9-15. To the extent that wind conditions limited output, the wind generation does not contribute to a reduced LOLE or the Expected Load Carrying Capability (ELCC) of the Project over the time period of limited output. Accordingly, if wind generation declines from one hour to the next, then, all other things being equal, the contribution of wind generation to resource adequacy in Mr. Zavadil's model also declines in the second hour. In an LOLE model, wind turbines actually contribute to reliability only when they generate.

Mr. Zavadil's LOLE analysis did not consider the impact of the Grain Belt Express Project's wind energy injection on other generators or any potential need for additional ancillary services. Both of these topics are beyond the scope of a traditional LOLE analysis, which is limited to the frequency of generation not being available to meet load. However, Grain Belt Express does possess relevant information with respect to these topics, as discussed below.

Impacts on Other Generators

Mr. Moland's production cost modeling, as presented in his direct testimony, does address the impact of the wind energy injection on other energy resources. On an hourly basis, the PROMOD tool used by Mr. Moland dispatches all generation resources based on their economic merit and subject to technical constraints. When low-cost wind energy is injected into Missouri, other, more expensive generators must ramp down their output to accommodate it.

Each generator in the PROMOD model has a modeled minimum generation level as well as a maximum ramp rate. The PROMOD model incorporates the limited ability of thermal generators to generate below a minimum output and, for coal plants, to ramp up and down quickly. Further,

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PROMOD designates nuclear generators as "must run" resources (and therefore unavailable for redispatch).

Because the changed dispatch levels of other generators are incorporated into the PROMOD model's algorithms, they are also reflected in the variable production cost and wholesale market price metrics reported by Mr. Moland. Mr. Moland's analysis establishes that the wind energy injection from the Project decreases variable production cost and decreases wholesale market prices taking into account the impacts from other generators adjusting their output to accommodate wind energy.

Potential Need for Additional Ancillary Services

There is no basis to believe that the addition of 500 MW of wind energy in the Missouri electric grid will drive a substantial need for additional ancillary services. In reaching this conclusion, it is useful to distinguish between short-term (one minute) and longer-term (one hour or more) impacts.

The variability of wind power over time intervals of one minute or less, the traditional unit of time for regulation and operating reserves, is very low. One recent paper examined a 300 MW wind plant in Colorado and found that the standard deviation of output over one minute was only 2 MW. The same study found that one minute ramps across individual wind turbines, even at the same wind farm were almost entirely uncorrelated, with a correlation coefficient of 0.05. See B. Hodge, S. Shedd, and A. Florita Examining the Variability of Wind Power Output in the Regulation Time Frame (2012), available at http://www.nrel.gov/docs/fy12osti/55967.pdf. Because of this lack of correlation, short-term output ramps of individual turbines are smoothed across one or more wind farms, and therefore aggregate one minute ramps are not significant.

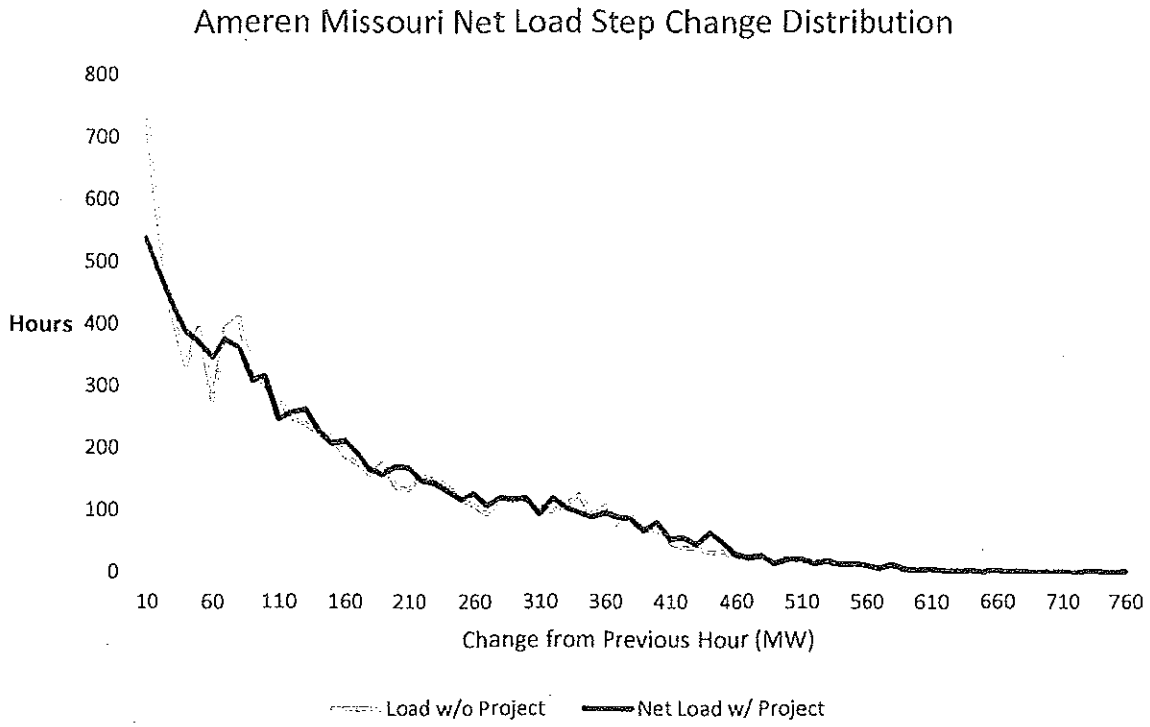
The variability of wind power increases over intervals of one hour. To quantify this hourly variability, Grain Belt Express performed a net load analysis. The analysis examines both the Ameren Missouri system individually and the overall Missouri electric system.

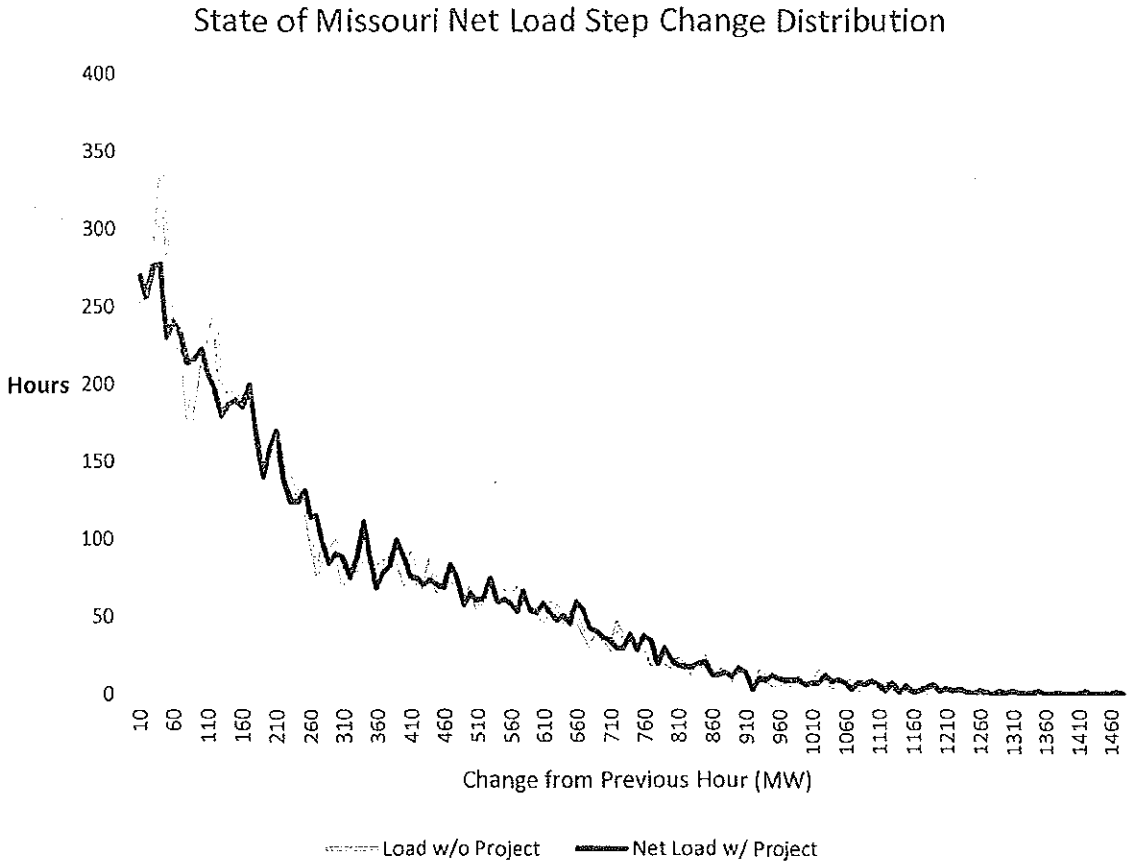
A net load analysis starts with the existing variability of system load. Electric load continually varies, and therefore dispatchable generation must respond to ensure generation equals load at all times. Load variability serves baseline for the amount of system flexibility required.

Load variability is then compared with "net load" variability. Net load is equal to load minus wind output." For this purpose, it is appropriate to treat wind power as a reduction in load because it reduces the amount of dispatchable generation needed to meet system demand. Like changes in load, changes in net load must be met by generators capable of ramping over the time interval of the change. Larger changes in net load mean more flexible capacity is needed. If there is no increase in net load variability from a wind energy injection, then there is no need for additional flexible resource or ancillary services.

The two graphs below show the comparisons of (1) load variability without the Project's injection and (2) net load variability with the Project's energy injection. The comparison is shown for Ameren Missouri and all of Missouri separately. The graph shows the frequency of one hour changes in load (in blue) or net load (in red). The y-axis represents the frequency of changes, while the x-axis represents the size of the change. The difference between the red (net

load w/ Project) and blue (load w/o Project) represents the increased or decreased frequency of a system ramp of a certain size due to the Grain Belt Project's wind energy injection. No major change is seen.





One way to measure the magnitude of increased system variability is the increase in 3-sigma changes in net load. This is the value of hourly step change (in MW) which is greater than or equal to the step changes in 99.7% of all hours. The 3-sigma change increases by 16 MW for just Ameren Missouri and 4 MW for the entire state. This represents potential additional system flexibility (in the form of fast-ramping generation or another technology) that may be needed to accommodate the wind generation injected by the Grain Belt Express Project.

However, even this small amount of added system flexibility may not be necessary. First, by predicting a wind ramp in advance of its occurrence, wind forecasting could allow existing generators more time to adjust their output and reduce the impacts of the wind injection. Second, one hour is a timeframe in which many natural gas plants can adjust their output, so sufficient flexibility may already be inherent in the system.

In summary, based on the very low variability of wind energy in one-minute time frames, and the modest increase in net load variability of an hour timeframe, Grain Belt Express does not foresee that the injection of 500 MW of wind in Missouri will drive any substantial need for additional ancillary services.

Source: Schedule RMZ-2 attached to the Direct Testimony of Robert M. Zavodil

Attachment: None

Response by: Robert Zavadil

VERIFICATION OF RESPONSE

The answers provided to this First Set of Data Requests have been collected from various sources at Clean Line Energy Partners LLC and Grain Belt Express Clean Line LLC, and are true and accurate to the best of my knowledge and belief.

Signed: _____

Position: EVP

Clean Line Energy Partners LLC

Date: 4/25/19