

**NCUC DOCKET NO. EMP-108, SUB 0**

**SUPPLEMENTAL PRE-FILED DIRECT TESTIMONY OF  
WHITNEY RUBIN  
ON BEHALF OF AMERICAN BEECH SOLAR LLC**

**ATTACHMENT J**

# **Generator Interconnection Affected System Study Report**

**PJM Interconnection Cluster AB2**



**December 22, 2016  
Duke Energy Progress  
Transmission Department**

## PURPOSE

The purpose of this study was to determine under what conditions the DEP transmission system can accommodate PJM's interconnection cluster AB2. Cluster AB2 includes generation throughout the PJM interconnection, but only those with an impact on the DEP system were included in this study. The size and in-service dates of the projects varies. The projects identified by PJM as potentially affecting DEP's CPLE control area are as follows:

- AB2-005 is a 148 MW Network Long Term Firm request from the Choctaw plant in TVA to PJM
- AB2-015 is a solar facility connected at the Franklin 115kV substation in DVP; 107 MW total facility capability, 62 MW capacity, 107 MW energy
- AB2-022 is a solar facility connected at the Elizabeth City 230kV substation in DVP; 20 MW total facility capability, 13 MW capacity, 20 MW energy
- AB2-025 is a solar facility connected at the Sapony 230kV substation in DVP; 20 MW total facility capability, 13.8 MW capacity, 20 MW energy
- AB2-031 is a solar facility connected as a tap of the Brink-Trego 115kV line in DVP; 20 MW total facility capability, 13.4 MW capacity, 20 MW energy
- AB2-035 is a solar facility connected at the Bethel Carolina 115kV substation in DVP; 3 MW total facility capability, 2.1 MW capacity, 3 MW energy
- AB2-039 is a solar facility connected as a tap of the Bakers Pond-Ivor 115kV line in DVP; 100 MW total facility capability, 55 MW capacity, 100 MW energy
- AB2-040 is a solar facility connected at the Brink 115kV substation in DVP; 80 MW total facility capability, 45.6 MW capacity, 80 MW energy
- AB2-042 is a solar facility connected as a tap of the Surry-Smithfield 230kV line in DVP; 160 MW total facility capability, 89 MW capacity, 160 MW energy
- AB2-043 is a solar facility connected at the Buckingham 230kV substation in DVP; 49.9 MW total facility capability, 18.9 MW capacity, 49.9 MW energy
- AB2-051 is a natural gas facility connected at the Chesapeake 230kV substation in DVP; 884.5 MW total facility capability, 765.5 MW capacity, 884.5 MW energy
- AB2-059 is a solar facility connected at the Benson 115kV substation in DVP; 100 MW total facility capability, 66 MW capacity, 100 MW energy
- AB2-060 is a solar facility connected at the Gary Tap 115kV substation in DVP; 80 MW total facility capability, 54.4 MW capacity, 80 MW energy
- AB2-069 is a solar facility connected as a tap of the Kerr-Boydton 115kV line in DVP; 80 MW total facility capability, 54.4 MW capacity, 80 MW energy
- AB2-075 is a 42 MW Network Long Term Firm request from the Santeeelah plant in TVA to PJM
- AB2-076 is a 51 MW Network Long Term Firm request from the Chilhowee plant in TVA to PJM
- AB2-077 is a solar facility connected at the Black Branch 115kV substation in DVP; 20 MW total facility capability, 12 MW capacity, 20 MW energy
- AB2-078 is a solar facility connected at the Black Branch 115kV substation in DVP; 20 MW total facility capability, 12 MW capacity, 20 MW energy
- AB2-079 is a solar facility connected at the Black Branch 115kV substation in DVP; 20 MW total facility capability, 12 MW capacity, 20 MW energy

- AB2-087 is a solar facility connected at the Earleys 115kV substation in DVP; 5 MW total facility capability, 3.4 MW capacity, 5 MW energy
- AB2-088 is a solar facility connected at the Tarboro 115kV substation in DVP; 4 MW total facility capability, 2.7 MW capacity, 4 MW energy
- AB2-089 is a solar facility connected at the Beechwood 115kV substation in DVP; 20 MW total facility capability, 13.2 MW capacity, 20 MW energy
- AB2-090 is a solar facility connected at the Chase City 115kV substation in DVP; 36 MW total facility capability, 23.8 MW capacity, 36 MW energy
- AB2-098 is a solar facility connected at the Everetts 230kV substation in DVP; 5 MW total facility capability, 3.5 MW capacity, 5 MW energy
- AB2-099 is a solar facility connected at the Ahoskie 115kV substation in DVP; 5 MW total facility capability, 3.5 MW capacity, 5 MW energy
- AB2-100 is a solar facility connected as a tap of the Clubhouse-Lakeview 230kV line in DVP; 100 MW total facility capability, 67 MW capacity, 100 MW energy
- AB2-128 is a solar facility connected as a tap of the Clubhouse-Lakeview 230kV line in DVP; 100 MW total facility capability, 67 MW capacity, 100 MW energy
- AB2-145 is a natural gas facility connected at the Axton 765kV substation in AEP; 572 MW total facility capability, 572 MW capacity, 572 MW energy
- AB2-146 is a natural gas facility connected at the Axton 138kV substation in AEP; 382 MW total facility capability, 382 MW capacity, 382 MW energy
- AB2-147 is a solar facility connected as a tap of the Clubhouse-Freeman 115kV line in DVP; 40 MW total facility capability, 15.2 MW capacity, 40 MW energy
- AB2-149 is a solar facility connected as a tap of the Oak Ridge-Ivor 115kV line in DVP; 50 MW total facility capability, 19 MW capacity, 50 MW energy
- AB2-150 is a solar facility connected as a tap of the Clubhouse-Freeman 115kV line in DVP; 40 MW total facility capability, 15.2 MW capacity, 40 MW energy
- AB2-161 is a solar facility connected as a tap of the Bakers Pond-Ivor 115kV line in DVP; 50 MW total facility capability, 19 MW capacity, 50 MW energy
- AB2-169 is a solar facility connected at the Pantego 115kV substation in DVP; 74 MW total facility capability, 39 MW capacity, 74MW energy
- AB2-171 is a solar facility connected at the South Hampton 115kV substation in DVP; 75 MW total facility capability, 28.5 MW capacity, 75MW energy
- AB2-174 is a solar facility connected as a tap of the Trego-Emporia 115kV line in DVP; 80 MW total facility capability, 42 MW capacity, 80MW energy
- AB2-176 is a solar facility connected at the Chase City 115kV substation in DVP; 14 MW total facility capability, 9.8 MW capacity, 14MW energy
- AB2-186 is a solar facility connected at the Edenton 230kV substation in DVP; 5 MW total facility capability, 3.5 MW capacity, 5MW energy
- AB2-188 is a solar facility connected at the Creswell 115kV substation in DVP; 20 MW total facility capability, 13.8 MW capacity, 20MW energy

## ASSUMPTIONS

The following affected system study results are from a PJM power-flow model that reflects specific conditions of the system at points in time consistent with the generator interconnection requests being evaluated. The cases include the most recent information for load, generation additions, transmission additions, interchange, and other pertinent data necessary for analysis. Future years may include transmission, generation, and interchange modifications that are not budgeted for and for which no firm commitments have been made. Further, DEP retains the right to make modifications to power-flow cases as needed if additional information is available or if specific scenarios necessitate changes. For the systems surrounding the study area, data is based on the ERAG MMWG model. The suitability of the model for use by others is the sole responsibility of the user. Prior queued generator interconnection requests were considered in this analysis.

The results of this analysis are based on the Interconnection Customer's queue requests including generation equipment data provided. If the facilities' technical data or interconnection points to the transmission system change, the results of this analysis may need to be reevaluated.

## RESULTS

### Power Flow Analysis Results

Facilities that may require upgrade within the first three to five years following the in-service date are identified. Based on projected load growth on the DEP transmission system, facilities of concern are those with post-contingency loadings of 95% or greater of their thermal rating and low voltage of 0.92 pu and below, for the requested in-service year. The identification of these facilities is crucial due to the construction lead times necessary for certain system upgrades. This process will ensure that appropriate focus is given to these problem areas to investigate whether construction of upgrade projects is achievable to accommodate the requested interconnection service.

Contingency analysis study results show that interconnection of these generation facilities result in the following thermal issue on the DEP system. Based on study results for 2018 summer, Table 1 shows thermal facility loadings for this request:

**Table 1: Power Flow Thermal Results**

<b>Transmission Facility</b>	<b>Loading %</b>	<b>Contingency</b>
Rocky Mount – Battleboro (DVP) 115 kV Line	120.1*	Rocky Mount-Hathaway (DVP) Double Circuit 230 kV Lines

The impact of each AB2 project on the limiting line has not yet been determined.

\*The percentage loading is based on the new rating for this line that is planned to be in effect by 12/15/2017.

### **Estimate of Resolutions for Power Flow Impacts**

The DEP Rocky Mount-Battleboro 115 kV Line will need to be reconducted with 1590 ACSR conductor or equivalent. All ancillary equipment, including any breakers, wave traps, and CT ratios at both ends of the line will need to be updated to 2000A or greater.

#### **Reconductor**

*Description:* Reconductor/rebuild 8.5 miles of the DEP Rocky Mount-Battleboro 115 kV Line to 1590 ACSR or equivalent  
*Estimated Cost:* \$13,000,000 (DEP cost only)

#### **Line Equipment upgrades**

*Description:* Upgrade any ancillary line equipment at both the DEP and DVP ends of the line to 2000A or greater to enable the full conductor rating.  
*Estimated Cost:* \$2,000,000 (DEP cost only)

Total Power-flow Cost Estimate: **\$15,000,000 (DEP cost only)**

*Estimated Schedule:* 6/1/2020

### **Short Circuit Analysis**

Short circuit analysis was not performed, but it may need to be performed at a later date.

## SUMMARY

This Generator Interconnection Affected Study assesses the impact of interconnecting new Dominion generation facilities on the Duke Energy Progress system. Power flow analysis found an overloading issue that must be mitigated. A full reconductor/rebuild of the Rocky Mount-Battleboro 115 kV Line will be necessary, requiring cooperation with DVP. Estimates are that the Rocky Mount-Battleboro 115 kV Line can be upgraded by June 1, 2020 if a written agreement to proceed is obtained in the spring of 2017.

Power-flow	\$15,000,000
Stability	\$0
Short Circuit	\$0
<u>Interconnection</u>	<u>\$0</u>
Total Estimate	\$15,000,000

Study Completed by:



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Reviewed by:



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