

**PJM Generator Interconnection
W3-054 Mackeys-Riders Creek 115 kV
20.8 MW Capacity / 160 MW Energy
Feasibility Study Report**

*January 2011
DMS #628914v1*

Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, §36.2, as well as the Feasibility Study Agreement between Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Virginia Electric and Power Company.

Preface

The intent of this Feasibility Study is to determine a plan, with preliminary cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by IC. As a requirement for interconnection, IC may be responsible for the cost of constructing Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM and the underlying system. All facilities required for interconnection of a generation interconnection project must be designed to meet ITO technical specifications.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. IC is responsible for its right of way, real estate, and construction permit issues.

General

Queue W3-054 is an IC 160 MW energy (20.8 MW Capacity) wind farm generation request. W3-054 will be located south of Columbia, NC in the ITO area. The requested in-service date is December September 30, 2013. The project was studied with its primary interconnection point at Riders Creek 115 kV substation. Project W3-054 was evaluated for compliance with reliability criteria for summer peak conditions in 2014.

Network Impacts: Primary Interconnection Point

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

No problems identified.

Multiple Facility Contingency

(Double Circuit Tower Line Contingencies only with full energy output. Stuck Breaker and Bus Fault contingencies will be applied during the Impact Study)

No problems identified.

Contribution to Previously Identified Overloads

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have % allocation of cost responsibility which will be calculated and reported for the Impact Study.)

No problems identified.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

None.

Short Circuit

(Report Overdutied breakers here)

No problems identified.

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

1. The Creswell 115 kV-Mackeys 115 kV line (from bus 314566 to bus 314586 ckt 1) loads from 16.51% to 107.52% (DC power flow) of its normal rating (129 MVA) for non

contingency condition. This project contributes approximately 160.00 MW to the thermal violation.

This overload will be resolved with Non-Direct Connection Network Upgrades in the ITO analysis. This will require recondutoring the 101 line between Mackeys and Riders Creek.

2. The Poplar Chapel 115 kV - Everetts 115 kV line (from bus 314596 to bus 314573 ckt 1) loads from 115.31% to 166.8% (DC power flow) of its emergency rating (159 MVA) for the operational contingency 'V 2034'. This project contributes approximately 81.86 MW to the thermal violation.

This overload will be resolved with project 99-2193 (RTEP b0325) which installs a 2nd 230-115kV Tx and 25 line upgrade at Everetts and project 99-2192 (RTEP b0342) which installed a 2nd 230-115kV Tx and 230kV breakers at Trowbridge. This overload also assumes energy output from a prior queue.

3. The Riders Creek 115 kV-Creswell 115 kV 115 kV line (from bus 314597 to bus 314566 ckt 1) loads from 7.16% to 116.88% (DC power flow) of its normal rating (129 MVA) for non contingency condition. This project contributes approximately 160.00 MW to the thermal violation.

This overload will be resolved with Non-Direct Connection Network Upgrades in the Dominion Analysis. This will require recondutoring the 101 line between Mackeys and Riders Creek.

4. The Trowbridge 115 kV 2-Poplar Chapel 115 kV 115 kV line (from bus 314614 to bus 314596 ckt 1) loads from 82.17% to 116.42% (DC power flow) of its emergency rating (239 MVA) for the operational contingency 'V 2034'. This project contributes approximately 81.86 MW to the thermal violation.

This overload was resolved with project 99-2192 (RTEP b0342) which installed a 2nd 230-115 kV transformer and 230 kV breakers at Trowbridge.

ITO Analyses

ITO assessed the impact of the proposed queue project, W3-054, interconnection of 20.8 MW of capacity and 160 MW of energy on the ITO transmission system. The system was assessed using the summer 2014 RTEP case provided to ITO by PJM, where the proposed generation capacity was injected at ITO’s Riders Creek Substation. This analysis did include the impacts of the generation capacity for all higher order queue generators within the ITO transmission system. When performing a generation analysis, ITO’s main analysis will be load flow study results under single contingency (both normal and stressed system conditions) and import/export system conditions. ITO criterion considers a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. For import/export studies ITO considers a transmission facility overloaded if it exceeded 100% of its emergency rating. A full listing of ITO’s planning criteria and interconnection requirements can be found in the ITO *Facility Connection Requirements* which are publicly available at: <http://www.dom.com>.

As part of its generation impact analysis ITO routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions and stressed system conditions. For the W3-054 evaluation three different assessments were conducted.

- 1) The first being when local generation including the proposed W3-054 Facility is operated at their maximum capability. The result of this study is shown below.

No problems indentified for 20.8MW capacity from W3-054.

The results of 160MW energy from W3-054 are shown below in Table A.

Table A: Pmax System Conditions for W3-054 Energy

Overloaded Element	Cont Loading (MVA)	Rating	Cont Loading (%)	Contingency Label
314566 3CRESWEL 115 314597 3RIDERS 115 1	142.7	142.0	100.5	** Base Case **
314566 3CRESWEL 115 314586 3MACKEYS 115 1	133.6	142.0	94.1	314586 3MACKEYS 115 314831 3MACKE_1 115 1

As shown above in Table A, the impact of the W3-054 generator energy under base case and single contingency conditions results in the thermal overload of two 115 kV line sections.

- 2) The second being a stressed system condition where the largest generator in the area is unavailable. With the W3-054 generator geographically located in Eastern Virginia, Surry Unit #2 is considered the most critical generating unit in the area. The impact of W3-054 was studied with the outage of Surry Unit #2. The result of this study is shown below.

No problems indentified for 20.8MW capacity from W3-054.

The results of 160MW energy from W3-054 are shown below in Table B.

Table B: Stressed System Conditions for W3-054 Energy

Overloaded Element	Cont Loading (MVA)	Rating	Cont Loading (%)	Contingency Label
314137 6FREDBRG 230 314138 6MINE RD 230 1	742.1	797.0	93.1	314212 6FRRIVER 230 314222 6HANOVER 230 1
314566 3CRESWEL 115 314597 3RIDERS 115 1	142.5	142.0	100.4	** Base Case **
314566 3CRESWEL 115 314586 3MACKEYS 115 1	133.3	142.0	93.8	314586 3MACKEYS 115 314831 3MACKE_1 115 1

As shown above in Table B, the impact of the W3-054 generator energy under single contingency conditions results in the thermal overload of of 115 kV line section and almost overloads a 115 kV and a 230 kV line section. The almost overloaded lines were listed because they may show up in the System Impact Study.

- 3) The third being import and export conditions into and out of the ITO system. Any new facility that is interconnected with the ITO system should not significantly decrement First Contingency Incremental Transfer Capability between utilities. This analysis will be performed during the System Impact Study.

Light load analysis will be necessary during the System Impact Study to determine the effects of energy level

generation on the ITO system during light load conditions. System upgrades may be necessary to resolve problems identified in this analysis.

Optional Merchant Network Upgrades

The results of these studies, as indicated above in Tables A and B, show an overload on one 230 kV line section and two 115 kV line sections. In order to resolve these thermal violations, IC must submit a Merchant Transmission queue request for the following work to be completed prior to adding the generation energy of W3-054 at the Riders Creek Substation location.

Upgrade the existing 230 kV, 2090 line between Fredericksburg and Mine Rd by replacing two 230 kV line switches at Mine Rd Substation. The cost of this upgrade is estimated to be \$50 thousand dollars (2011 dollars) and is expected to take 12 months to complete.

Reconductor 21 miles of the existing 115 kV, 101 line between Riders Creek and Mackeys Substations. The cost of this upgrade is estimated to be \$23.0 million dollars (2011 dollars) and is expected to take 24 to 36 months to complete.

Attachment Facilities

The proposed layout and attachment facilities are illustrated below in Figure A. The interconnection arrangement shown assumes the proposed W3-054 facility is 5 miles from Riders Creek Substation. The Direct Assigned interconnection costs are estimated to be \$15 Million dollars (2011 dollars). This cost includes metering, protection equipment and 115 kV line work to directly connect the proposed facility with the 115 kV at Riders Creek Substation. This work will take an estimated time of 36 to 48 months to engineer and construct. This includes obtaining all necessary NCPUC permits.

Direct Connection Network Upgrades

To reliably interconnect the proposed generation with the ITO Transmission System it will be necessary to create a two breaker 115 kV straight bus at Riders Creek Substation. At

Riders Creek Substation, two 115 kV breakers and associated equipment will be installed. The estimated cost of this work is \$2.0 Million dollars (2011 dollars) and is estimated to take 24 to 30 months to engineer and construct. This substation may also need to be expanded to accommodate the additional equipment and additional land and permitting may be required.

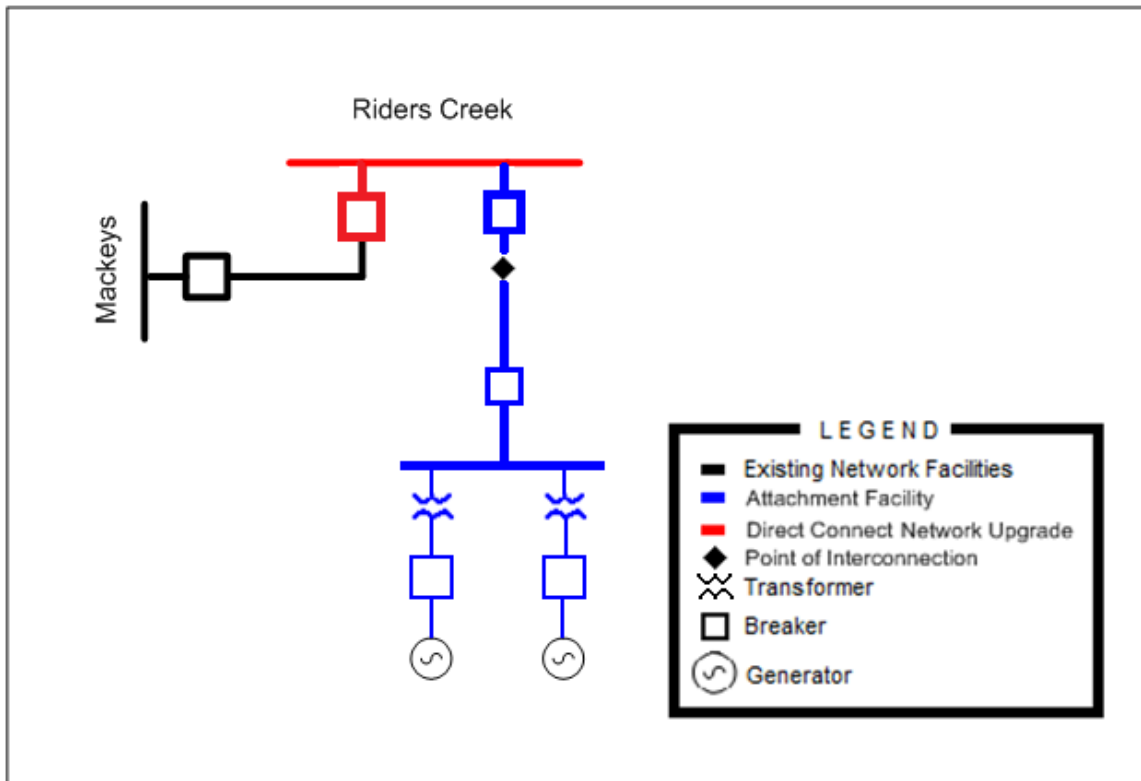


Figure A: W3-054 Layout