PJM Generator Interconnection
U1-031 Earleys 230-kV (100 MW)
Feasibility Study

July 2008
DMS #491523

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).

Preface

The intent of the 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 the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer 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 system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications for the appropriate transmission owner.

In some instances an interconnection customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

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. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

Network Impacts

The queue project U1-031 was studied as a 100MW (Capacity) injection into the Dominion system. The project was studied as two separate interconnection point options: Option 1 was modeled as a direct connection to the Earleys 115kV substation, while Option 2 was modeled as a direct connection to the Earleys 230-kV substation. U1-031 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

Option 1: Earleys 115-kV

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 for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

No problems identified.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

No problems identified.

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation)

None.

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

There is no impact to breaker interrupting capabilities as a result of U1-031. These results are subject to change due to changing system conditions.

Option 2: Earleys 230-kV

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 for the full energy output. Stuck breaker and bus fault contingencies will be performed for the Impact Study)

No problems identified.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

No problems identified.

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. "Network Impacts", initially caused by the addition of this project generation)

None.

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

There is no impact to breaker interrupting capabilities as a result of U1-031. These results are subject to change due to changing system conditions.

Dominion Assessment Results

Dominion assessed the impact on the Dominion Transmission System that the proposed 100 MW injection of new generation capacity would have at the Earleys Substation 115-kV bus (option 1) and Earleys Substation 230-kV bus (option 2). The system was assessed using the Summer 2012 RTEP case provided to Dominion by PJM for this analysis. This analysis did include the impacts that higher order queue generators may have on the study results, specifically those generators located on the Dominion Transmission System which have a signed a PJM ISA or IISA and their associated network upgrades were also modeled. When performing a generation analysis Dominion's main analysis will be load flow study results under single contingency (both normal and stressed system conditions) and import/export system conditions. Dominion Criteria consider a transmission facility overloaded if it exceeds 94% of its emergency rating under normal and stressed system conditions. For import /export studies Dominion considers a transmission facility overloaded if it exceed 100% of its emergency rating. A full listing of Dominion's Planning Criteria and interconnection requirements can be found in the Company's Facility Connection Requirements which are publicly available at:

http://www.dom.com/about/elec-transmission/pdf/Facility_Connection_Requirements.pdf

As part of its generation impact analysis Dominion routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions and stressed system conditions. For the U1-031 evaluation the following maximum generation assessments were conducted.

a. When local generation, including the proposed U1-031 Facility, are operating at their maximum capability. The result of this study indicated no significant system deficiencies were found for Option 1.

b. When local generation, including the proposed U1-031 Facility, are operating at their maximum capability. The result of this study indicated no significant system deficiencies were found for Option 2.

Potential Danger Due to Proximity to Arc Furnace Plant

The customer will be connected into Earleys Substation. An arc furnace exists on the 230-kV system on the Earleys-Suffolk 246 line. The arc furnace is about 19 miles from the Earleys Substation. Arc furnaces have a highly variable load profile and can cause harmonic distortion of the normal 60-Hertz waveform. Arc furnaces have a number of potentially damaging effects on generators. Among these effects are the stress to turbine-generator shaft and excess heating of generator windings. The torsional stress can fatigue the shaft; leading to cracks and/or component failure. Additionally, harmonic currents may cause excess rotor/stator heating.

The arc furnace is required to conform to IEEE 519-1992 with regard to harmonics. Also, it must meet a flicker requirement of 1.0 or less for the PST99% and two hour PLT99% as measure by the IEC 6100-4-15 (1997-11), above any existing background flicker level. These levels do not necessarily protect the generator from problems. Moreover, there is always the potential that the arc furnace may fall out of the acceptable range from time to time. Neither the Transmission Provider nor the Transmission Owner makes any warranty as to the performance of the arc furnace.

It is recommended that the customer perform studies for both Options 1 and 2 to determine if the generating plant is impacted by the arc furnace. The customer is responsible for the mitigation of any problems found and for the protection of its turbine-generator and plant auxiliary equipment. Neither PJM nor Dominion assumes any responsibility for the effects of the arc furnace due to either normal/abnormal operation of the transmission system or due to normal/abnormal operation of the arc furnace.

Attachment & Direct Connection Network Facilities

The potential transmission solution for Option 1 will require a rearrangement of the existing Earleys Substation 115-kV bus (Figure A) to accommodate the proposed new generation. The proposed attachment facilities can be found in Figure B. The estimated cost of these facilities which also includes metering, protection equipment along with a 0.5 mile 115-kV line and associated equipment dollars is $500,000 dollars. The network attachment facilities include the installation of one 115-kV breaker and associated equipment and are estimated to cost $550,000. This work is estimated to take 12-18 months to complete.

The potential transmission solution for Option 2 will require a rearrangement of the existing Earleys Substation 230-kV bus (Figure C) to accommodate the proposed new generation. The proposed attachment facilities can be found in Figure D. The estimated cost of these facilities which also includes metering, protection equipment along with a 0.5 mile 230-kV line and associated equipment dollars is $700,000 dollars. The network attachment facilities include the installation of one 230-kV breaker and associated equipment and are estimated to cost $800,000. This work is estimated to take 12-18 months to complete.

Figure A
Existing Arrangement

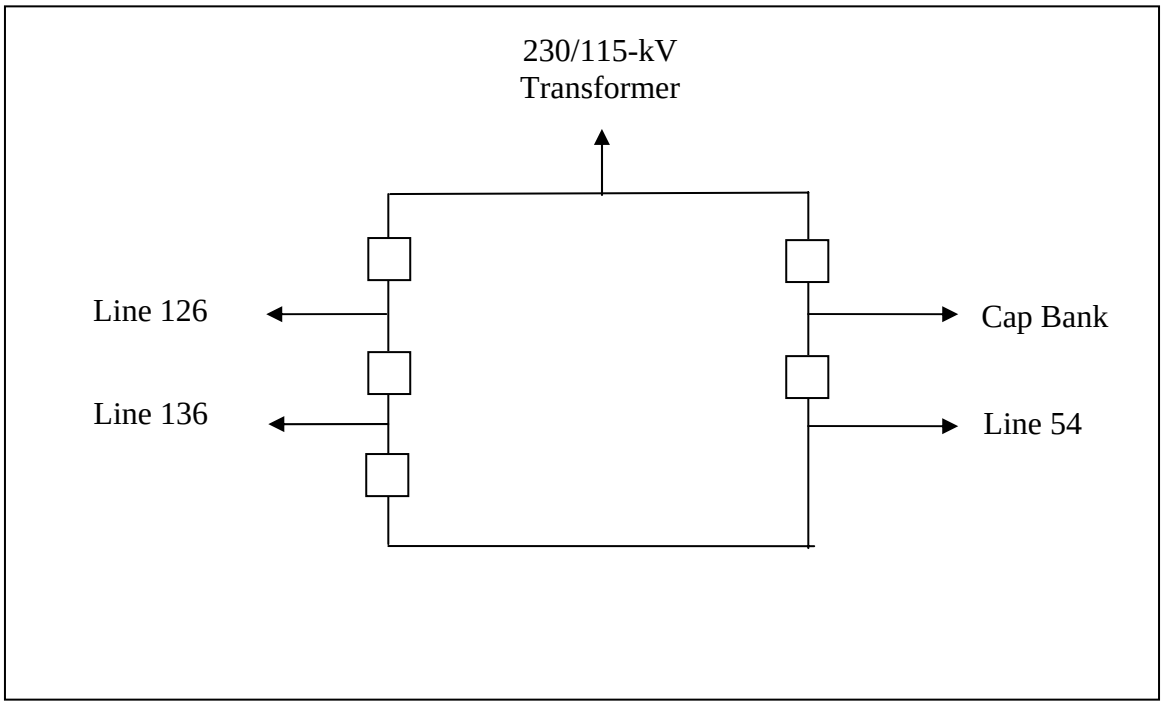

Figure B
Proposed Arrangement

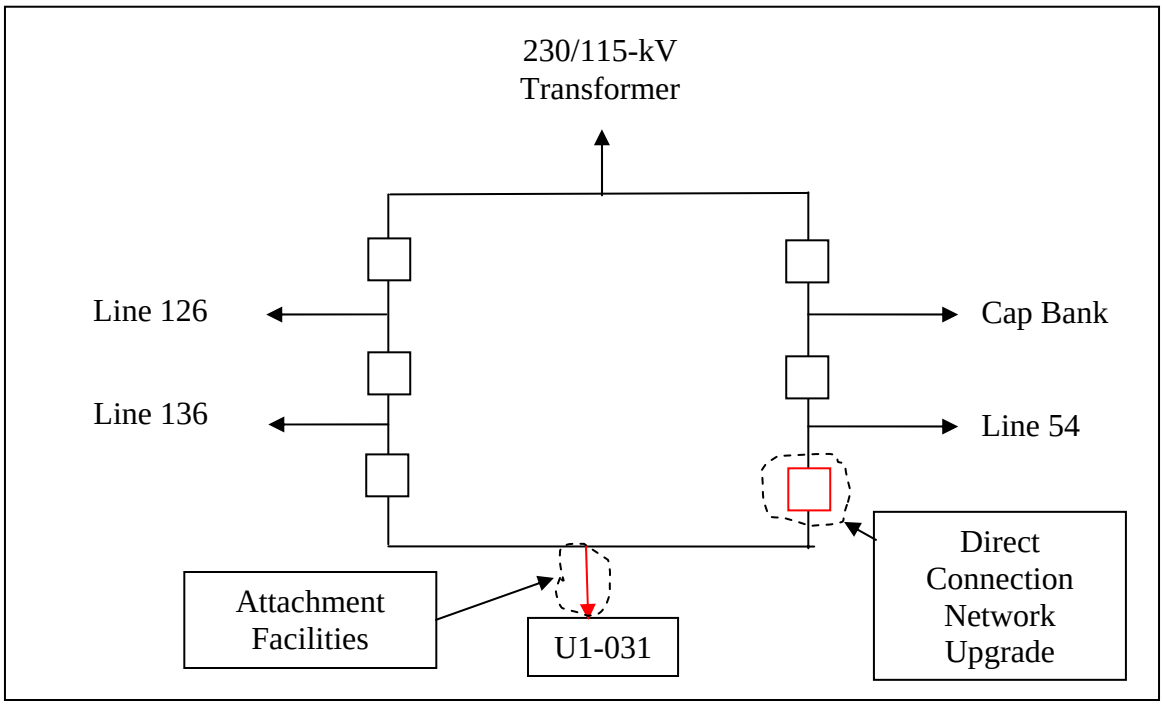

Figure C
Existing Arrangement

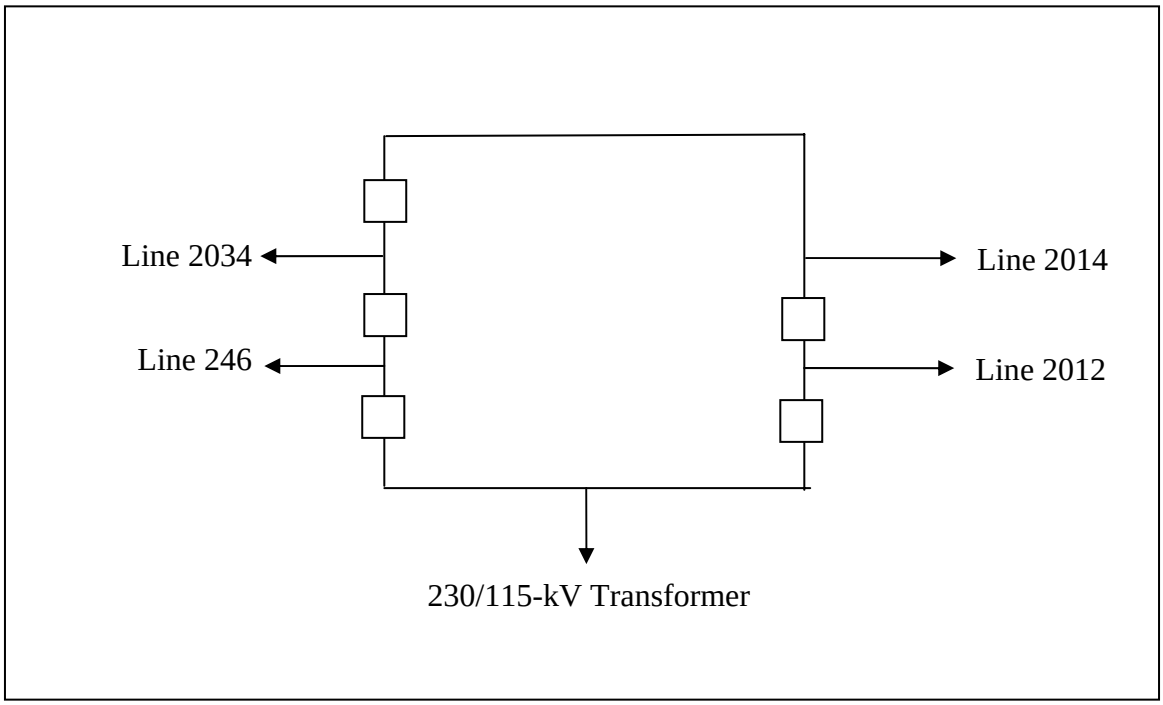

Figure D
Proposed Arrangement