PJM Generator Interconnection

X1-053 Suffolk 34.5 kV

20 MW Capacity / 20 MW Energy

Feasibility Study Report

July 2011
DMS #656463v1

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 project X1-053 was studied as a(n) 20.0 MW (20.0 MW of which was Capacity) injection into Dominion's system at the Suffolk 34.5 kV substation. Project X1-053 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Network Impacts:

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.

No problems identified.

ITO Analyses

IC has requested a Feasibility Study of a 20 MW interconnection for its proposed Suffolk, VA facility onto ITO's 34.5 kV Distribution System. IC has requested that any modifications to existing facilities and any facilities built new to accommodate the 20 MW interconnection requests be constructed for a potential final build out capacity of 20 MW. The requested site has ITO's existing 34.5 kV Suffolk Substation circuit 342 source.

Modifications Required:

Modifications are required to existing Suffolk circuit 342 to accommodate proposed interconnection. Modifications will include:

1. Relocate existing 342T455 recloser 800 to 1000 ft north of present location, just past the new tap into the IC generator.
2. Remove existing loop scheme components from 342T455 recloser, 342R8, and 342R6.
3. Install new 38 kV ABB with loop control module recloser and PT rack on the eastern branch of Suffolk 342 circuit at the 342TB455 tie location.
4. Replace the RV unit at 342R5 with a new 38kV ABB with loop control module recloser to make a midpoint loop scheme recloser
5. Reprogram existing 342R1 ABB recloser (add LOOP CONTROL MODULE if necessary) to make the sectionalizer LOOP SCHEME recloser, done by Reliability personnel.

The total estimated cost of rearrangement work is $300,000.

New Facilities Required:

The new facilities required to provide the interconnection will include:

1. Installation of transfer trip protection on the existing reclosers.
2. Installation of transfer trip protection on the existing transformer #4, bus #6, bus #4
3. Installation of transfer trip protection on IC generator breaker.

4. Install line tension disconnects on this new tap plus ~600 ft of 477 Al primary w/ 246.9 Al neutral.
5. Installation of three phase overhead line tension disconnects
6. Installation of pole mounted bi-directional metering.

The Feasibility Study estimated cost for the installation of new facilities to provide the interconnection is $260,000. The grand total for Modification and New Facilities to provide interconnection is $560,000.

In addition to the ITO facilities indicated above, to provide a transfer trip circuit protection scheme, the IC will be responsible for providing and maintaining communication lines between the IC's main generator breaker, its up-line reclosers and the ITO's Suffolk Substation. The IC will also be responsible for providing and maintaining telephone lines to the ITO's metering equipment at the Point of Interconnection. The IC provided 34.5 kV 3-phase circuit will interconnect overhead at the Point of Interconnection which will be the load side terminals of the ITO provided pole mounted bi-directional meter. It will be the IC's responsibility to obtain any required right-of-way between the ITO's existing facilities and the Point of Interconnection.

The estimated time for engineering, material acquisition and construction of this interconnection is approximately eight months. Detailed engineering, costs, material lead times and construction time requirements will be determined as part of the System Impact Study.

Technical Requirements

ITO has reviewed the 20 MW Interconnection (PJM Queue X1-053) request for installation of parallel generation (20 MW) natural gas and/or landfill gas (methane) units located on Wilroy Rd, Suffolk, Virginia 23434. IC desires to export power into the ITO source. IC generation typically consists of three

(3) 5,200 kW and one (1) 7,500 kW generators with an operating voltage of 4.16 kV. The power generated is stepped up to 34.5 kV level by a IC owned transformer (GSU-1) rated 34.5 kV – 4.16 kV (delta - wye). The resulting protection requirements are based on the following information:

- No more than 20 MW of total generation will be in parallel with the ITO system at any one time.
- IC generation will be paralleled with the ITO system by the following connections:

    - IC facility is fed by Suffolk Substation 34.5 kV Circuit 342 through 34.5 kV – 480 (delta - wye) GSU-2
    - IC generation interfaces with ITO utility feed through GSU-1 and is located down-line from utility devices 342R8, 342R6 and circuit breaker (CB) 34242 respectively.

- Suffolk 342R8 and 342R6 have reclosing time of 20 seconds and 35 seconds.
- Suffolk CB 34242 has reclosing time at 2.5 seconds and 15 seconds after the first trip.
- IC parallel operation will not be limited to any particular time or utility circuit-loading condition.
- IC will be contracting to export power into the ITO distribution system.
- The load data for the pertinent sectionalizing devices are as follows:

    - Suffolk Circuit 342 has a typical "light" loading of 5.86 MVA
    - Suffolk 342R6 has a typical "light" loading of 2.51 MVA
    - Suffolk 342R8 has a typical “light” loading of 2.09 MVA

Based on the minimum loads given for the ITO sectionalizing devices, the following minimum "Local Load to Customer Generation Capacity" ratios will apply for this installation:

ITO Transmission Line	Minimum Ratio
CB 34242	0.25
342 R6	0.11
342 R8	0.09

The minimum ratios applicable for this installation will require the IC to have the Direct Pilot Wire Tripping (or Transfer Trip) function installed from the following utility protection zones or devices: transformer #4, bus #6, bus #4, circuit breaker 34242, 342R6, 342R8 to the generation site's lockout (main or interconnection breaker). Such direct tripping functions should sectionalize the IC generation for any opening of the respective device. The direct trip control feature is meant to ensure that a "prolonged" (or "permanent") islanding condition (with the IC generation supplying ITO load in the absence of the ITO source) will not be set-up. In addition, the direct tripping function will aid in protecting the IC generator from an out-of-step reclosure of the ITO source.

The closing conditions for the IC interconnection or main breaker (IC relays monitoring all three phases of the incoming line [all three "hot"] to establish a "hot" condition) shall be limited to no more than hot line-dead bus (generator) or hot line-hot bus (generator) under supervision of the IC synchronization system.

The required relay functions (each sectionalizing all of the IC generation) and the corresponding setting ranges, applying for each of the designated ITO feed, are listed in the following table:

Function		Set Point	Duration To Disconnection (seconds)	
			Preferred	Maximum
27	Undervoltage	90% of nominal operating voltage	Less than 2.0	2.0
59	Overvoltage	106 to 110% of nominal operating voltage	Less than 2.0	2.0
81U	Underfrequency	59.0 to 59.5 Hz	Less than 2.0	2.0
81O	Overfrequency	60.5 to 61.0 Hz	Less than 2.0	2.0
51	Phase Time-delay Overcurrent	Set for minimum, with adequate load allowance	Maintain proper coordination	
51N	Ground Time-delay Overcurrent	Set for minimum, with adequate imbalance allowance	Maintain proper coordination	

Since the application of Pilot Wire Tripping is provided at IC expense and have associated engineering, equipment acquisition and installation lead-time, these details must be coordinated with IC planned interconnection date.