

**PJM Generator Interconnection
Y2-099 Warrenton 34.5 kV
2 MW Capacity / 2 MW Energy
Combined Feasibility
& System Impact Study
Report**

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Introduction

This combined Feasibility & System Impact Study report has been prepared in accordance with the PJM Open Access Transmission Tariff, §110, as well as the study agreement between Fauquier County Landfill Gas LLC, 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 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 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 Y2-099 was studied as a 2 MW (Capacity 2 MW) injection at the Warrenton 230 kV substation in the ITO area. Project Y2-099 was evaluated for compliance with reliability criteria for summer peak conditions in 2016. Potential network impacts were as follows:

Network Impacts:

Impactful Contingencies

(The following contingencies resulted in overloads identified below)

None.

Generator Deliverability

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

None.

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)

None.

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.)

None.

Short Circuit

(Report Overdutied breakers here)

There is no impact to breaker interrupting capabilities.

ITO Analysis

ITO assessed the impact of the proposed queue Y2-099 interconnection as a 2 MW injection into the ITO transmission system. The system was assessed using the summer 2016 RTEP case provided to ITO by PJM, where the proposed generation capacity was injected on the 230kV transmission bus at Warrenton 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 criteria consider 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>.

The results of these studies evaluate the system under a limited set of operating conditions and do not guarantee the full delivery of the capacity and associated energy of this proposed generation facility under all operating conditions. NERC planning and operating reliability criteria allow for the re-dispatch of generating units to resolve projected and actual deficiencies in real time and planning studies. Specifically NERC Category C contingency conditions: bus fault, tower line, n-1-1, and stuck breaker scenarios, allow for re-dispatch of generating units to resolve potential reliability deficiencies. For ITO planning criteria the re-dispatch of generating units for these contingency conditions is allowed as long as the projected loading does not exceed 100% of a facility load dump rating.

As part of its generation impact analysis ITO routinely evaluates the impact that a proposed new generation resource will have under maximum generation conditions, stress system conditions and import & export system conditions. The results of these studies are discussed in more detail below.

1. The first being when local generation including the proposed Y2-099 Facility is operated at their maximum capability. The result of this study is shown below.

No Problems Identified.

2. The second being a stressed system condition where the largest generator in the area is unavailable. With the Y2-099 generator geographically located in Northern Virginia, Possum Point Unit #5 is considered the most critical generating unit in the area. The impact of Y2-099 was studied with the outage of Possum Point Unit #5. The result of this study is shown below.

No Problems Identified.

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 FCITC between utilities. The results of these studies can be found in Tables A and B.

Table A: Import Study Results			
Area	Summer 2016	Summer 2016 with Y2-099	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

Table B: Export Study Results			
Area	Summer 2016	Summer 2016 with Y2-099	Limiting Element
AEP	2000+	2000+	None
APS	2000+	2000+	None
CPL	2000+	2000+	None
PJM	2000+	2000+	None

ITO's planning criteria indicate a need to have approximately 2000 MW of import and export capability. The results of these import and export studies are indicate that the proposed generation facility will not impact ITO's import or export capability.

Distribution Company Analysis

IC requested interconnection of 2.2 MW from two existing 1100 kW units for parallel generation. The project, PJM queue Y2-099, requests participation in the PJM wholesale market. The IC generating units are located at Fauquier County Landfill facility located at 8499 Bingham Road in Warrenton, Virginia 20187. Refer to the one-line diagram.

New Attachment Facilities Required:

ITO modifications are required to existing metering to accommodate sells into the wholesale market. Modifications include the following:

1. replace existing metering to accommodate real time data; and
2. provide conduit and cable for communication of metering data.

The total estimated cost of the metering modification work is \$10,095.

Existing Attachment Facilities Required:

The existing facilities required to provide the interconnection will include:

1. metering;
2. generator transfer trip equipment; and
3. two phases of underground primary.

The existing facilities were installed under a Generator Interconnection and Operating Agreement (GIOA) August 12, 2003, as amended on June 17, 2005 and January 9, 2009 by Virginia Electric and Power Company at a cost of \$119,404.

The Interconnect Customer will be responsible for the upfront cost of the new metering of \$10,095 on this ISA.

Facility Charges to be included in the ISA will be the existing \$119,404 plus the metering cost of \$10,095 for a total of \$129,499. The IC will pay a monthly facility charge of 0.054% x 129,499 for a total of \$699.29 a month.

The IC will also be responsible for providing and maintaining telephone lines to the ITO's metering equipment at the Point of Interconnection and provide all communication lines necessary to

transmit data from the metering to PJM. The IC must continue to maintain the existing communications from generator to ITO's protection equipment for transfer trip.

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

Operating Restrictions

Based on the information provided, the IC site will be interfacing with the ITO source in the following manner:

- The IC facility is fed by Warrenton Substation transformers #1, sourced from the 230 kilovolt (kV) line 2086, Remington CT to Warrenton;
- The IC generation facility is connected to Warrenton circuit 493 through a IC owned transformer, 2500 kVA OA, 34.5/0.48 kV, which connects two of the identical IC generators to ITO 34.5 kV distribution system. The transformer is connected delta at 34.5 kV and grounded wye at 0.48KV;
- On Warrenton circuit 493, the immediate up-line utility sectionalizing device is a Cooper WVE form 4C recloser, 493 R3, with reclosing intervals of 20 seconds and 35 seconds. The next up-line sectionalizing device from 493R3 is the circuit's main feeder breaker, 49352, with reclosing times at 10 seconds and 45 seconds after the first trip;
- The load data for the pertinent sectionalizing devices are as follows:
 - Warrenton circuit 493, CB 49352, has a typical "light" loading of 4.84 MVA;
 - Warrenton 493 R3 has a typical "light" loading of 1.0 MVA;
- The light load data for the lines serving the White Oak substation are as follows:
 - Line 2086 has a typical "light" loading of 22.5 MVA;
- IC parallel operation will not be limited to any particular time or ITO circuit-loading condition; and
- IC will export power into the ITO system.

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

<i>ITO Device</i>	<i>Minimum Ratio</i>
CB 49352	1.76
493 R3	0.36
Line 2086	8.18

These minimum ratios applicable for this installation will require the IC to have direct pilot wire tripping, or transfer trip, to be installed from the ITO devices CB 49352 and 493 R3 to the IC main (52-M). The direct trip control features are meant to ensure that a "prolonged," or "permanent", islanding condition, where the IC generation supplying ITO load in the absence of the ITO source, will not be set-up. In addition, the direct tripping function would aid in protecting the IC generation equipment from an out-of-step reclosure of the ITO source.

In its current design, the protection scheme on Warrenton circuit 493 is set up to initiate a transfer trip to the IC main (52-M) anytime CB 49352 or 493 R3 operates during a system disturbance through basic over current or breaker failure scheme for disturbances at the local level. Consequently the protection currently in place is adequate and therefore no additional requirements for interconnection will be necessary other than the base protection package described below.

Moreover, a zero sequence over-voltage ground fault tripping function (59N), monitoring at the high-side of the generator step up transformer, delta-grounded wye, 34.5-0.48 kV, would normally be required. This function is meant for detecting ground faults on the ungrounded 34.5 kV circuit, existing when the IC facility energizes with a ITO device opened. Since direct pilot wire tripping function is already installed, the requirement of this function will be waived.

The required relay functions, each sectionalizing all of the IC generation, and the corresponding setting ranges, applying for each of the designated utility feeds, are listed in the following tables:

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

For ITO records, provide ITO with an updated operating one-line of the IC installation in addition to relay settings, including the operating times, applied for the protective functions at the Point of Interconnection, IC main 52-M, prior to making wholesale sales.

One-Line Diagram

PJM QUEUE Y2-099 Fauquier Co, VA Landfill

