Generation Interconnection Combined Feasibility/System Impact Study Report

For

PJM Generation Interconnection Request Queue Position V4-017

Woodruffs Gap 34.5kV

April 2010

Preface

The intent of the Combined Feasibility/System Impact Study is to determine a plan, with approximate 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 (on PJM web site) 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, if any, is included in the System Impact Study.

The 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 associated with them will be addressed when seeking an Interconnection Agreement as outlined below. . Developer will also be responsible for providing and installing metering equipment in compliance with applicable PJM and Transmission Owner standards.

General

The Interconnection Customer (IC), has proposed a 3.5 MW 1.3 MW capacity) solar generating facility. The facility will be located adjacent to the Woodruffs Gap substation in Sparta, New Jersey (see Attachment 1).

Point of Interconnection

Based on a study performed by the Jersey Central Regional staff, it was determined that the proposed Woodruffs Gap (V4-017) Project will be connected to the Franklin - Newton (A703) 34.5 kV circuit near its exit from the Woodruffs Gap substation. As defined on Attachment 2, there are wetlands in the vicinity of the Woodruffs Gap 34.5 kV substation that could impact on the direct connection facilities. For this reason a connection of the Woodruffs Gap (V4-017) Project to the A703 line section between the Woodruffs Gap 34.5 kV substation to the Lime Crest Switch Point has been chosen for study.

Attachment 3 shows a conceptual one-line diagram of the Direct Connection facilities that will be required for the Woodruffs Gap (V4-017) Project. As indicated, it will be studied as a 3.5 MW injection between pole numbers NJ74ST and NJ75ST of the Franklin - Newton (A703) 34.5 kV line path. Both line and radial disconnect switches and a fuse will be needed at the point of attachment in addition to a circuit breaker and switch on the system side of the generator step-up

transformer. The Interconnection Customer will be responsible for constructing all of the facilities on its side of the point of interconnection including the attachment line. A summary of the FE facilities required for the Woodruffs Gap (V4-017) Project Direct Connection and their cost estimate is shown on Attachment 4.

Network Impacts

The queue V4-017 project was studied as a 3.5MW injection (1.3MW of which was capacity) into JCPL's system. The project was modeled by PJM as a tap point between the Woodruffs Gap A and Lime Crest 34.5kV substations. The project was studied on a combined feasibility-impact basis which utilizes an AC analysis, and incorporates all contingency types. Project V4-017 was evaluated for compliance with reliability criteria for summer peak conditions in 2014.

Potential network impacts were as follows:

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, Line with Failed Breaker and, Bus Fault contingencies for the Full energy output.

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.

Short Circuit

A short circuit analysis was conducted by the FE Protection staff. This analysis showed that no FE circuit breaker will exceed its interrupting capability with the implementation of the Woodruffs Gap (V4-017) Project.

No reinforcements will be required.

New System Reinforcements

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

None.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project.

None.

Stability Analysis

Stability studies will be conducted by the PJM staff should this project proceed to the Facilities Study stage

Potential Congestion due to Local Energy Deliverability

(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 below. There is no guarantee of full deliverability 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 identified overloaded element(s). . As a result of the aggregate energy resources in the area, the following violations were identified:

No problems identified.

System Protection Analysis

An analysis was conducted to assess the impact of the Woodruffs Gap (V4-017) Project on the system protection requirements in the area. The results of this review have identified the following:

Under the assumption that the Woodruffs Gap (V4-017) Project generation will not supply fault current to the Jersey Central transmission system, there will be no protection upgrades needed for the Franklin - Newton (A703) 34.5 kV line path. However, the Woodruffs Gap (V4-017) Project will be required to have two independent high-speed zones of protection to sense and clear faults on the interconnection transformer.

Fault current on the radial attachment line are listed below:

- Three phase: 7,467 amperes
- Line-to Ground: 3,744 amperes

Based on this information an S&C SMD-2C, 100E fuse, either standard or slow speed, will be required.

The cost estimate for the required FE system protection facilities is included on Attachment 4.

Metering

The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are detailed on Attachment 5 to this report.

Compliance Issues

The Interconnection Customer will be responsible for meeting all FE criteria as defined in the FE Requirements for Transmission Connected Facilities document. This includes the provision of a reactive power capability sufficient to maintain a composite power delivery for the facility at the interconnection point at a power factor between .95 leading (absorbing MVARs) and .90 lagging (producing MVARs). If this capability cannot be provided, a 1.5 MVAR capacitor must be installed at the Woodruffs Gap (V4-017) Project substation at the Interconnection Customer's cost.

The Interconnection Customer will also be required to meet all PJM, Reliability*First* and NERC reliability criteria and operating procedures for standards compliance. For example, the Developer will need to properly locate and report the over and under-voltage and over and under-frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and Reliability*First* audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

FE Facility Upgrades and Costs

The results of the FE analysis shows that no planning criteria violations are attributable to the addition of the Woodruffs Gap (V4-017) Project for the conditions studied. Therefore the conclusion is that no transmission or distribution reinforcements will be required to provide the requested service.

Interconnection Customer Requirements

In addition to the FE facilities, the Interconnection Customer will also be responsible for meeting all criteria as specified in the applicable sections of the "FE Requirements for Transmission Connected Facilities" document including:

1. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

2. The purchase and installation of a 34.5 kV interconnection metering instrument transformer. FE will provide the ratio and accuracy specifications based on the customer load and generation levels.

3. The purchase and installation of a revenue class meter for the Woodruffs Gap (V4-017) Project interconnection to measure the power delivered in compliance with the FE standards.

4. A compliance with the FE and PJM generator power factor and voltage control requirements.

5. The execution of a back-up service agreement to serve the customer load supplied from the attachment substation when the units are out-of-service. This assumes the intent of the Interconnection Customer is to net the generation with the load.

6. Any complaints from other customers (e.g. flicker complaints) will have to be corrected by the Interconnection Customer. Correction may include changing operation, reducing generation, disconnecting the generators from the Jersey Central system, or other measures.

7. The purchase and installation of supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FE Transmission System Control Center. The RTU, the communications channel and all related equipment will be furnished and maintained by the Interconnection Customer. The RTU must communicate with the FirstEnergy EMS via DNP 3.0 protocol.

8. The following status and metering points will be required:

    a. Interconnection breaker position.

    b. Generator real and reactive power output measured at the high-side of the generator step-up transformer.

    c. Generator voltage at the point of interconnection.

9. An installation of two independent high-speed zones of protection to sense and clear faults on the interconnection transformer.

The above requirements are in addition to any metering or other requirements imposed by PJM.

Summary

The connection of the Woodruffs Gap (V4-017) Project to the FE transmission system will require no network upgrades. Therefore the Interconnection Customer will only have a cost responsibility for the Direct Connection of the Woodruffs Gap (V4-017) Project to the Jersey Central transmission system. As shown on Attachment 4, the estimated cost of these facilities is $160,000.

Based on the extent of the FE Direct Connection and system upgrades required to support this project, it is estimated that it will take one (1) year from the date of a fully executed Interconnection Construction Service Agreement to complete the upgrades required for the Woodruffs Gap (V4-017) Project. This includes the requirement for the Interconnection Customer to make a preliminary payment to FE that funds the first three months of engineering design that is related to the construction of the Direct Connection facilities. It further assumes that the Interconnection Customer will provide the property for the attachment facilities needed and any right-of-way properties needed. A further assumption is that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined direct connection and network upgrades, and that PJM will allow all transmission system outages when requested.

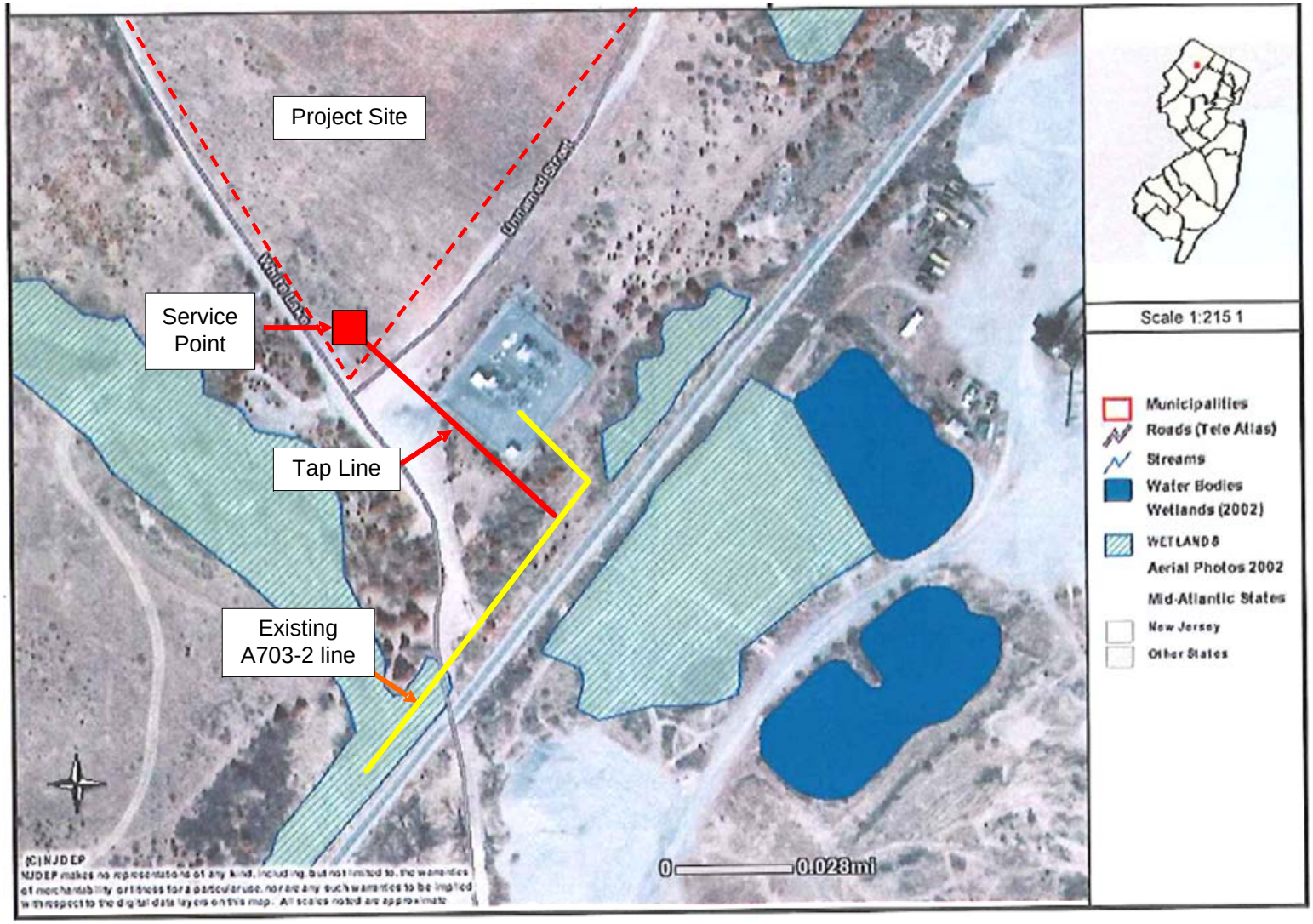
Note that the FE findings were made from a conceptual review of this project. A more detailed review of the connection facilities and their cost will be identified in the Facilities Study. Further note that the cost estimate data contained in this document should be considered as only ballpark since it was produced without a detailed engineering review. The applicant will be responsible for the actual cost of construction. FE herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any connections to the transmission system.

Attachment 1

Aerial View

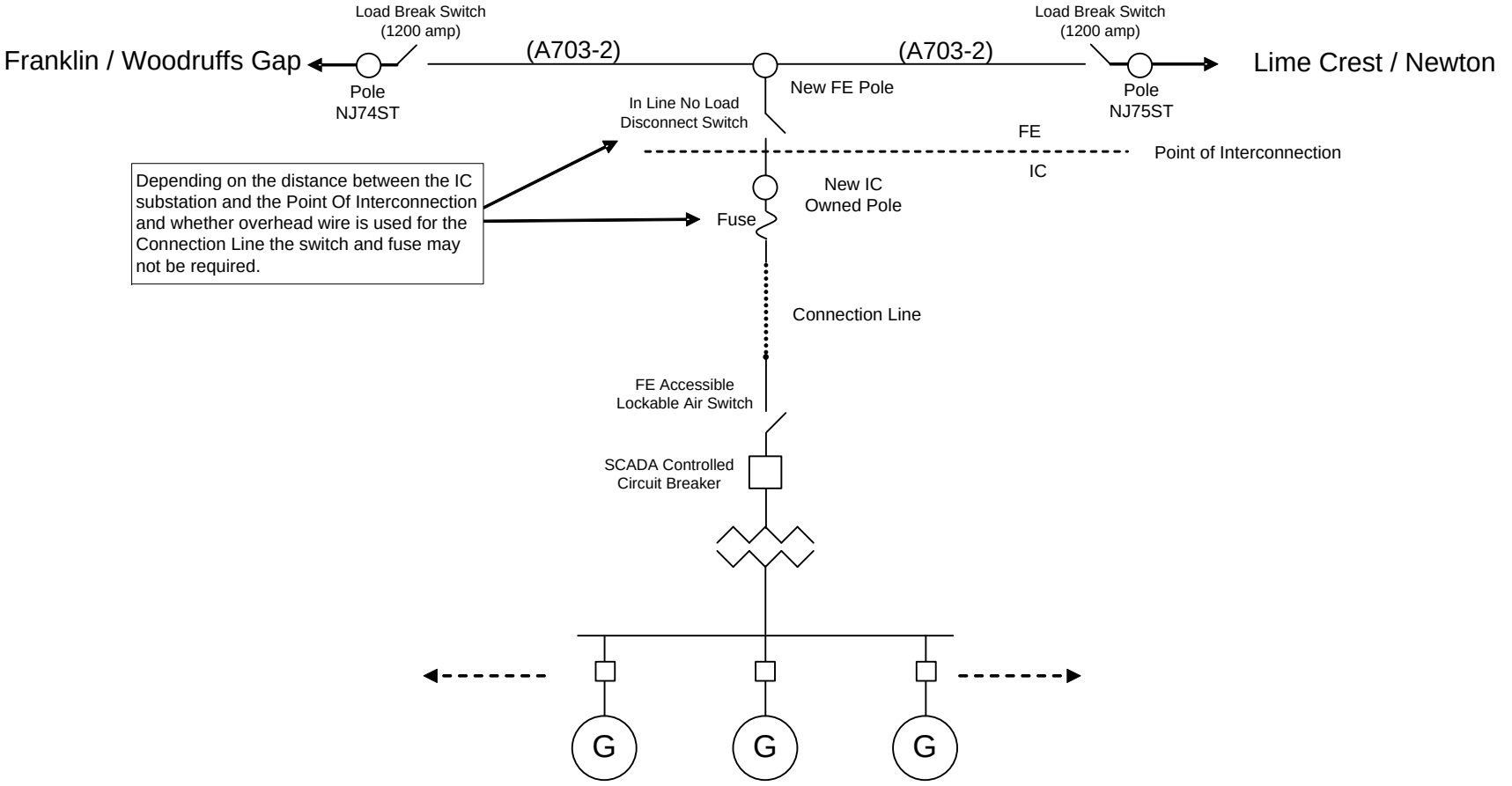
Attachment 2

Topographical Map Showing Wetlands



Attachment 3

Single Line Diagram of Interconnection



3.5 MW Total Solar Photo-Voltaic Generation

Attachment 4

Direct Connection Facilities

Item	Connection Facilities	Cost
1	Construct approximately 350 feet of new 34.5kV line from a point between poles NJ74ST & NJ75ST on the A703-2 34.5kV line (Woodruffs Gap-Woodruffs Gap Switch-Limecrest Switch).	
2	Construct a new tap pole, switch pole (single blade disconnects included in estimate), necessary guying, etc., and a span of wire to a customer-owned meter pole beyond the switch pole.	
3	Investigate environmental permitting as necessary due to wetland issues. Note that he Interconnection Customer will be responsible for acquiring permits needed.	
4	Install metering to be mounted on the customer owned pole.	
5	Miscellaneous Protection, Fuses, Metering, RTU, SCADA	
	Total Substation Costs:	**$160,000**

Attachment 5

FirstEnergy Revenue Metering Requirements for Generation Interconnection Customer

Interconnection Customer shall install, own, operate, test and maintain the necessary revenue quality Metering Equipment. This includes current transformers, voltage transformers, mounting structures, wiring, meters, communication circuits, and associated devices. The Metering Equipment must meet the specifications listed in the FirstEnergy and regional transmission organization (RTO) connection documents. The FirstEnergy "Requirements for Transmission Connected Facilities" are located at: http://www.firstenergycorp.com/feconnect

The Metering Equipment shall be located at the generation facility on the high voltage side of the generator step-up transformers or facility main step-up transformer and/or station service power transformers. Power flows to and from the facility shall be compensated to the Point of Interconnection.

FirstEnergy will provide revenue quality Metering Equipment for a station service power supply at a generation facility if the supply is from the local FirstEnergy distribution system.

The revenue quality Metering Equipment shall be capable of collecting and storing bidirectional billing data. The billing data shall be stored in intervals specified by FirstEnergy, typically fifteen minutes or thirty minutes. The Interconnection Customer must provide FirstEnergy with remote access to the billing data in the Metering Equipment via a dedicated voice-grade analog telephone circuit. The Interconnection Customer shall provide FirstEnergy with contact information for the person or persons responsible for meter programming and Metering Equipment maintenance.

The Interconnection Customer shall consult with FirstEnergy regarding the revenue quality metering system design and provide the following information:

- Facility one line and revenue metering installation drawings (schematics, wiring diagrams, etc.)
- Estimated power flows to and from the facility at all revenue metering points
- Current transformer and voltage transformer specifications, including manufacturer, type, nameplate drawings, and certified accuracy test reports
- Revenue meter specifications including manufacturer, type, model number, and accuracy
- Revenue meter program information including but not limited to billing data recorder channel assignments, recorder pulse weights (Ke), and read-only password for access to interval data by the FirstEnergy billing data collection system (MV-90)
- Revenue meter telephone number
- Revenue meter loss compensation data (if applicable)

The Interconnection Customer shall provide FirstEnergy with prior notification of any modifications at the facility that will affect the revenue meter measurements, including substation reconfigurations and meter program changes.

The revenue metering system at each location shall be tested for accuracy by the Interconnection Customer once every two years. The Interconnection Customer shall give reasonable notice to FirstEnergy of the time when the testing is scheduled so that FirstEnergy may have representatives present. FirstEnergy and the RTO shall have the right to audit the revenue metering equipment and/or related documents. The Interconnection Customer shall be given a reasonable period of time to comply with any requests associated with an audit.