Generation Interconnection Feasibility Study Report

PJM Generation Interconnection Request Queue Position #T153 Medford 34.5kV 1.1MW

October 2008

34.5 kV Transmission Connection

for

Warren Glenn Estates

Hydro Generation Project (T153)

October, 2008

FirstEnergy

Transmission Group

FirstEnergy Feasibility / Impact Study
Warren Glen (T153) Generation Project

Introduction

This Feasibility/Impact Study report provides the documentation of an assessment which has been performed by FirstEnergy (FE) in response to a request made by Warren Glenn Estates for the interconnection of a 1.1 MW hydro generation project (Warren Glen - T153) to the Jersey Central Transmission System. This assessment was accomplished by: 1. An Evaluation of the reliability impact of the proposed facilities and connection on the interconnected transmission system by the performance of a power flow study to test compliance with the FE "Requirements for Transmission Connected Facilities" document; 2. Ensuring a compliance with the NERC, ReliabilityFirst, PJM and FE Reliability Standards by identifying the system reinforcements that will need to be installed for an interconnection of the proposed project; 3. Coordinating and cooperating with the PJM staff and Warren Glenn Estates by conducting meetings and issuing this report as a part of the RTEP study process; 4. Performing a Steady State, Short-Circuit and Dynamics Study as necessary; 5. Conducting this study in accordance with the PJM Manuals, the FE Requirements for Transmission Connected Facilities document and the FE Study Guide.

Connection Facilities

Warren Glenn Estates has submitted a "Form of Generation Interconnection Feasibility Study Agreement" to PJM that identifies its plan to refurbish and return to service four small hydro generating units that were retired by a previous owner. These units will be attached to the customer owned Warren Glen substation and not directly to the FE transmission system. As shown on Figure 1 & 2, this substation is currently served from a tapped connection of the Gilbert - Morris Park (A27 and X24) 34.5 kV lines. The proposed plan is to refurbish a 320 kW and 400 kW unit at the Warren Power House and another two 200 kW units at the Hughesville Power House. Since the project is beyond the current Point of Interconnection, Warren Glenn Estates will be responsible for all contracts and agreements with the current customer and the facilities and modifications at the Warren Glen substation that will be required for this project. In addition, a site visit has revealed that both the Warren and Hughesville Power Houses have been abandoned for years and have suffered significant physical damage from exposure to the elements. For this reason a compliance and safety inspection of the site will be required before any connection will be permitted.

Power Flow Analysis

A Power Flow study was conducted to determine the reliability impact of the proposed Warren Glenn Project on the FE Transmission System. This included the performance of a contingency analysis to identify any thermal overload or voltage condition that violates the FE Planning Criteria that is either directly attributable to this project or for which it will have a shared responsibility. A least cost mitigation plan will then be developed to resolve any violation found and ensure compliance.

Note that the Warren Glenn Project Power Flow Analysis was completed using a 2012 summer peak load base case power flow that was provided by the PJM staff. This case included a detailed representation of the Jersey Central 34.5 kV system in the area near the Warren Glen substation. A simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the Warren Glenn Project was conducted to test for criteria compliance.

The results of the FE analysis shows that no FE planning criteria violations are attributable to the addition of the Warren Glenn project for the conditions studied. Therefore the conclusion is that no transmission reinforcements will be required to provide the requested service.

Short Circuit and Dynamics Analysis

A short circuit analysis was conducted and showed that no FE circuit breaker will exceed its interrupting capability with the implementation of the Warren Glenn project. Therefore no reinforcements will be required.

Note that stability studies were not conducted by FE or PJM due to the size of the unit for this project.

System Protection Analysis

An analysis was conducted to assess the impact of the Warren Glenn Project on the system protection requirements in the area. The results of this review show that Warren Glenn Estates will need to install the following equipment at the Warren Glen Switching Station in addition to the existing line protective relays: over/under voltage protection, over/under frequency protection, zero sequence voltage protection. In addition, if the Warren Glen generation is capable of operating in an islanded mode with the loss of the tie to the FE system, then transfer trip receivers at the Warren Glen substation and transfer trip transmitters at the Gilbert and Morris Park substations will be required. The transfer trip system is needed to insure that the generation is removed from the FE system in the event that all remote substation breakers feeding the Warren Glen substation are open. Warren Glenn Estates will be responsible for all leasing costs for the communication circuits that will be associated with this protection system if implemented.

Metering

In compliance with the FE standards, Warren Glenn Estates will install, own, operate and maintain the necessary revenue 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 FE connection documents, PJM Tariff, and PJM Manuals.

The revenue metering equipment shall be located at the generation facility. Power flows to and from the facility shall be compensated to the Point of Interconnection unless otherwise agreed to by FE, the RTO, and the generation facility owner. The

preferred point of revenue metering is on the high voltage side of the generator step-up transformers and/or station service power transformers. Any alternative metering methods must be approved by FE and the RTO.

FE will provide revenue metering equipment for a station service power supply at a generation facility if the supply is from the local FE distribution system and is specified in an agreement between the local FE operating company and the generation owner.

The revenue meters shall be capable of collecting and storing bidirectional billing data. The billing data shall be stored in intervals specified by FE, typically fifteen minutes or thirty minutes. Warren Glenn Estates must provide FE with remote access to the billing data in the meters via a dedicated voice-grade analog telephone circuit. Warren Glenn Estates shall also provide FE with contact information for the person or persons responsible for meter programming and metering equipment maintenance.

Warren Glenn Estates shall consult with FE regarding the revenue 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 FE billing data collection system (MV-90)
- Revenue meter telephone number
- Revenue meter loss compensation data (if applicable)

Warren Glenn Estates shall provide FE 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 Warren Glenn Estates once every two years. Warren Glenn Estates shall give reasonable notice to FE of the time when the testing is scheduled so that FE may have representatives present. FE and PJM shall have the right to audit the revenue metering equipment and/or related documents. Warren Glenn Estates shall be given a reasonable period of time to comply with any requests associated with an audit.

Compliance Issues

Warren Glenn Estates 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).

Warren Glenn Estates will also be required to meet all PJM, ReliabilityFirst 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 ReliabilityFirst 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 following is a summary of the FE facilities that will be required for the Warren Glenn Generation Project:

1. Review of design drawings, equipment specifications and oversight of substation and connection facility modifications. ($10,000)

2. Metering, SCADA, Substation and System Protection checkout. ($15,000)

3. Installation of a direct transfer relay scheme at the Warren Glen substation to disconnect each generator and/or open the 34.5 kV connection breaker when both the Gilbert and Morris Park 34.5 kV breakers open. ($120,000 if required)

All cost data contained in this document should be considered estimated. The applicant will be responsible for the actual cost of construction. FirstEnergy 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.

Warren Glenn Estates Requirements

In addition to the FE facilities, Warren Glenn Estates 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 to trip and lock out the A27 breaker at the Warren Glen 34.5 kV substation.

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 each unit and bi-directional meter at the Warren Glen substation to measure the power delivered in compliance with the FE standards.

4. 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.

5. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center and for dialup access to revenue metering.

6. A compliance with the FE and PJM generator power factor and voltage control requirements. This may include the installation of a switched shunt capacitor bank if the units do not meet the established design criteria.

7. The execution of a back-up service agreement to serve the customer load supplied from the Warren Glen substation when the units are out-of-service. This assumes the intent of Warren Glenn Estates is to net the generation with the load.

The above requirements are in addition to any metering required by PJM.

Summary

The connection of the Warren Glenn generation project to the customer owned substation will require no FE transmission system upgrades. However, Warren Glenn Estates will need to install system protection, metering and SCADA upgrades required for compliance with the FE connection standards in support of the proposed new units. In summary, the total cost estimate of the FE facilities required for the Warren Glenn Estates (T153) project is $25,000 if no direct transfer trip facilities are required and $145,000 if the units are capable of operating in an islanded mode. It is estimated that it will take 1 year to design and install the required FE direct transfer trip facilities from the execution of a Construction Service Agreement if needed. 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.

Figure 1 : Warren Power House

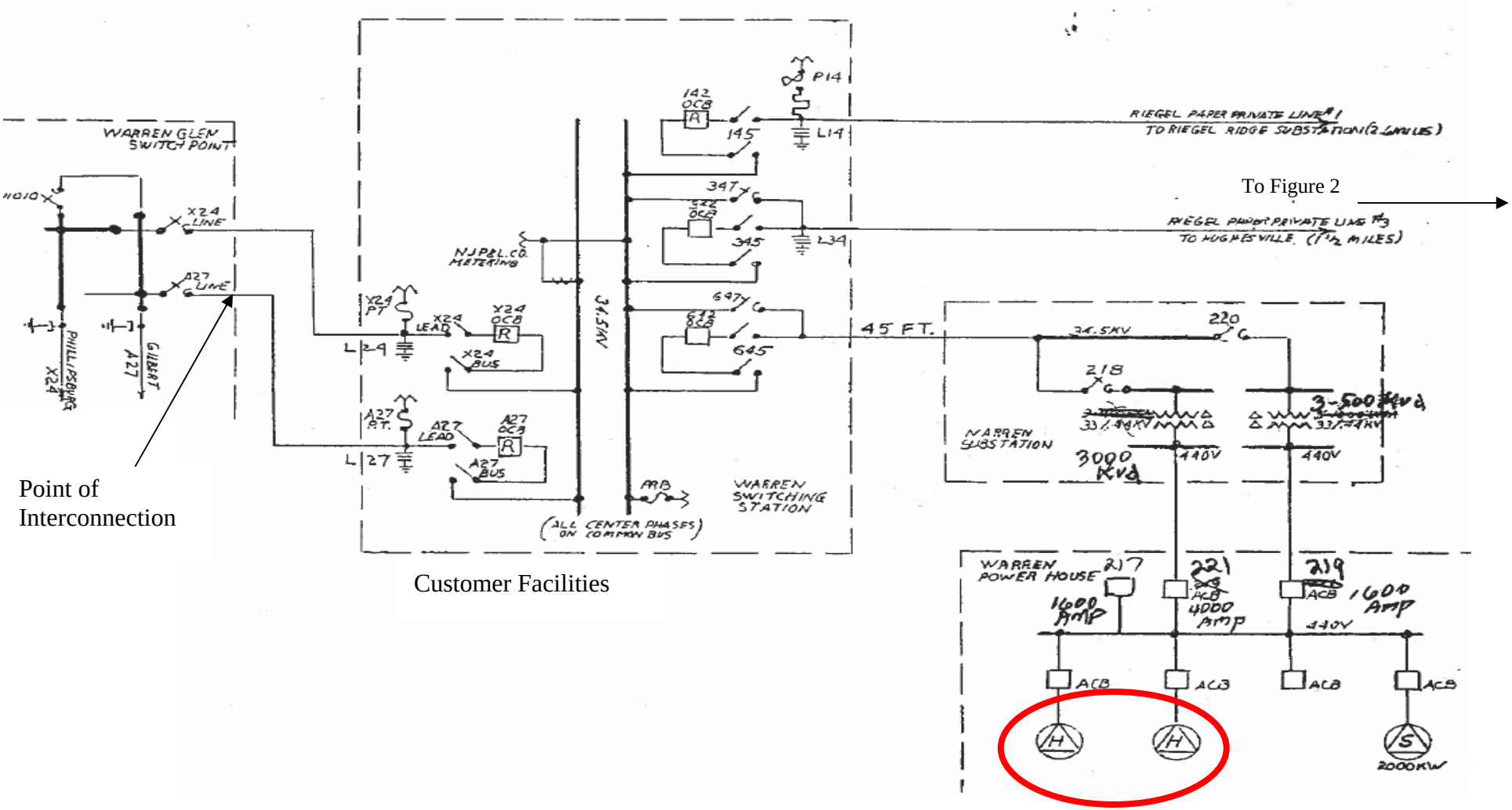

Figure 2: Hughesville Power House