

***Generation Interconnection Feasibility Study
Report***

***PJM Generation Interconnection Request
Queue Position #U2-049
Monmouth
640 MW
(640 MW capacity)***

May 2009

Preface

The intent of the Generation Interconnection Feasibility Study is to determine a plan, with ballpark 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.

The proposed Interconnection Facilities must be designed in accordance with the FirstEnergy “Requirements for Transmission Connected Facilities” document. Procedures for gaining access to these standards can be found at the link below.

<http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx>

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 Generation Interconnection Feasibility Study, but the actual allocation will be deferred until the System Impact Study is performed.

The Generation Interconnection Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities unless noted in the report. The interconnection Customer is responsible for acquiring any necessary right of way and real estate, as well as applying for and obtaining any and all permits unless prior agreement by interested parties allows for other arrangements. For properties currently owned by Transmission Owners, some permitting and real estate costs may be included in the study.

Cost and Timing Estimates

The estimates in this report do not include tax gross-up.

While the information in this transmittal is reasonable for the scope of work defined, it should, however, be noted that the cost figures and time estimates are conceptual in nature at this stage, as an engineering team has not been assigned to the project. Any change to the scope of work will require that the estimates be revisited. The costs are a best estimate, but the developer will be charged for actual costs. Any under-runs or over-runs will be reconciled at the conclusion of the project.

General

The Interconnection Customer has submitted an Interconnection Request which identifies its plan to construct a 2 x 1 Combined Cycle Generation Project with a total capability of 640 MW on an adjacent property to the existing Larrabee 230 kV substation (see attachment 2). A new Randolph Road 230 kV substation will be constructed for the direct connection of this project. Both the New Prospect - Atlantic (G1021) and Larrabee - Atlantic 230 kV lines will be looped into this new substation to provide for the delivery of the project capability to the transmission system. In addition, the Interconnection Customer has requested a separate attachment for each of its three units. As shown on Attachment 1, this will require the new Randolph Road substation to be configured as a seven (7) breaker 230 kV ring bus. The Interconnection Customer will be responsible for acquiring all easements, properties and permits that may be required to construct the project connection substation and connection facilities. The Interconnection Customer will also be responsible for the rough grade of the property and an access road to the proposed Randolph Road substation site.

Metering

The Interconnection Customer will be required to install and maintain metering and telemetry equipment to provide revenue metering and real-time telemetry data to PJM and the Transmission Owner. The PJM requirements for this equipment are listed in Appendix 2, section 8 of Attachment O to the PJM Tariff, as well as PJM Manuals 01 and 14D. The Transmission Owner requirements for Metering Equipment are discussed in Attachment 1.

Design Requirements

The generation owner is responsible for specifying appropriate equipment and facilities such that the parallel generation is compatible with the FirstEnergy Transmission System. The generation owner is also responsible for meeting any applicable federal, state, and local codes. It is also the developer's responsibility to obtain any needed right-of-way between the plant site and FirstEnergy's facilities.

FirstEnergy will complete detailed relay coordination studies to identify off-site relay setting changes required due to this generation interconnection during the Facilities Study phase of this project. This may result in additional individual relay replacements being required. These relay replacements will be done at the cost of the developer.

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).

Reactive Power

The Generation Interconnection Customer shall design its Customer Facility to maintain a composite power delivery at continuous rated power output at a power factor of at least 0.95 leading (absorbing MVARs) to 0.90 lagging (producing MVARs).

Cost and Timing Estimates

While the information in this transmittal is reasonable for the scope of work defined, it should, however, be noted that the cost figures and time estimates are conceptual in nature at this stage, as an engineering team has not been assigned to the project. Any change to the scope of work will require that the estimates be revisited. The costs are a best estimate, but the Interconnection Customer will be charged for actual costs. Any under-runs or over-runs will be reconciled at the conclusion of the project.

Interconnection Customer Requirements

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

1. The purchase and installation of the minimum required FirstEnergy 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 230 kV interconnection metering instrument transformer. FirstEnergy 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 generator proposed for installation to measure the power delivered in compliance with the FirstEnergy standards.
4. The purchase and installation of supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FirstEnergy Transmission System Control Center.
5. The establishment of dedicated communication circuits for SCADA report to the FirstEnergy Transmission System Control Center.
6. A compliance with the FirstEnergy 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 Randolph Road 230 kV substation when the units are out-of-service. This assumes the intent of the Interconnection Customer is to net the generation with the load.
8. The rough grade of the property for the Randolph Road 230 kV substation and an access road for the delivery of equipment to this site.

The above requirements are in addition to any Metering Equipment and communications required by PJM.

Direct Connection Facilities

The proposed Interconnection Facilities must be designed in accordance with the FirstEnergy “Requirements for Transmission Connected Facilities” document. Procedures for gaining access to these standards can be found at the link below.

<http://www.pjm.com/planning/design-engineering/to-tech-standards.aspx>

Below are conceptual estimates for the engineering/construction associated with Direct Connection requirements based upon similar projects that have been designed and/or constructed.

| Item | Description | Conceptual Cost Estimate |
|------|---|--------------------------|
| 1 | Construct 230kV 7 breaker ring bus | \$12,5876,600 |
| 2 | Line loops and communications necessary to connect the new 7 breaker ring bus (item #1 above) to the existing FirstEnergy system on the New Prospect-Atlantic and Larrabee-Atlantic lines | \$1,729,200 |

Total estimated costs: \$14,305,800

Estimated Lead Time: 2 years from signed CSA

Notes:

- The above estimates do not include 1) tax gross-up, 2) property costs and site development up to rough grade which is to be provided by the developer, 3) interconnection metering and generation SCADA to be provided by the developer, and 4) engineering and field activities for design review and commissioning of the developer’s facilities

Network Impacts

The Queue Position# U2-049 project was studied as a 640MW(Capacity=640MW) injection at a new 230kV substation which shall loop both the New Prospect - Atlantic (G1021) and Larrabee - Atlantic 230 kV lines into the new substation (Randolph Road) in the JCPL area. Queue Position #U2-049 was evaluated for compliance with reliability criteria for summer peak conditions in 2012. Potential network impacts were as follows:

Generator Deliverability

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

1. The RED OAKB-RAR RVR 230kV line (from bus 2882 to bus 2872 ckt 1) loads from 94.3% to 105.4% (DC power flow) of its normal rating (650MVA) for non-contingency condition. This project contributes approximately 72.0MW to cause this thermal violation.
2. The RED OAKA-RAR RVR 230kV line (from bus 2881 to bus 2872 ckt 1) loads from 93.7% to 104.8% (DC power flow) of its normal rating (650MVA) for non-contingency condition. This project contributes approximately 72.1MW to cause this thermal violation.

Both items #1 & #2 require rebuilding 2.6 miles of 230kV double circuit tower line as well as replacing the droop loop/bus conductor at the Raritan River and Red Oak substations. The estimated cost to complete these upgrades is \$14,470,900.

Multiple Facility Contingency

(Double Circuit Tower Line for the full energy output. Stuck breaker and bus fault contingencies will be performed for the System Impact Study)

No problems were 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)

3. The N.MESH2PN-MESH2REA 230/115kV transformer (from bus 414 to bus 560 ckt 3) loads from 157.53% to 162.91% (DC power flow) of its emergency rating (157MVA) for the single line contingency outage (PN47B). This project contributes approximately 8.4MW to the thermal violation. To mitigate this overload requires the installation of two (2) 230kV circuit breakers and four (4) 230kV disconnect switches, estimated to cost approximately \$2,396,200.
4. The LACKAWNA-OXBOW 230kV line (from bus 3070 to bus 417 ckt 1) loads from 148.77% to 153.49% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 23.5MW to the thermal violation. To mitigate this overload would require reconductoring approximately 16.5 miles of 230kV conductor, replacing two (2) disconnect switches and drop loop/bus conductor at the

Oxbow substation, and replacement of terminal equipment at the Lackawanna substation. The estimated cost for this reinforcement is \$14,631,700.

5. The OXBOW-N.MESHPN 230kV line (from bus 417 to bus 414 ckt 1) loads from 142.92% to 147.55% (DC power flow) of its normal rating (499MVA) for non-contingency condition. This project contributes approximately 23.1MW to the thermal violation. To mitigate this overload would require reconductoring approximately 10.1 miles of 230kV conductor, replacing 2 disconnect switches and drop loop/bus conductor at the Oxbow substation, replacement of two (2) CT's and drop loop/bus conductor at the North Meshoppen substation.
6. The RED OAKB-RAR RVR 230kV line (from bus 2882 to bus 2872 ckt 1) loads from 154.90% to 172.12% (DC power flow) of its emergency rating (805MVA) for the single line contingency outage (JC30A_Q08OP1A). This project contributes approximately 138.6MW to the thermal violation. See items #1 & 2 above.
7. The RED OAKA-RAR RVR 230kV line (from bus 2881 to bus 2872 ckt 1) loads from 154.86% to 172.08% (DC power flow) of its emergency rating (805MVA) for the single line contingency outage (JC31A_Q08OP1A). This project contributes approximately 138.6MW to the thermal violation. See items #1 & 2 above.
8. The CNASTONE-N-NWEST 500kV line (from bus 4 to bus 119 ckt 2) loads from 146.40% to 151.30% (DC power flow) of its emergency rating (2901MVA) for the single line contingency outage (PJM13B_NNWEST_A). This project contributes approximately 142.1MW to the thermal violation. To mitigate this overload would require the following:
 - Install North-Northwest(NNW) substation with two (2) 500/230kV xfmrs, four (4) 500 kV bkrs, seven (7) 230 kV Bkrs and related substation equipment and land at a cost of \$70M. It also requires to reconductor Conastone to Northwest #2322 with 1,272kcmil ACSR 1,590kcmil ACSR with an estimated cost of \$8.21. This work would take 3-4 years to build the substation and 18-24 months for the line work.
 - 1 single circuit 500 kV line between Conastone to North-Northwest 500 kV line at an estimated cost of \$ 109 million and estimated time of 10 yrs.

Assumptions:

New 200 ft. wide R/W parallels existing Conastone to Northwest R/W

Total R/W length = 19.6 miles

3 - Bundle 1,590 kcm conductor

North Northwest located 4 miles north of Northwest substation

Substation Terminations (all in 2012 dollars):

Conastone - Install a 1 breaker bay \$3.2M

NNW - Install a 2 breaker bay \$6.4M

9. The CNASTONE-N-NWEST 500kV line (from bus 4 to bus 119 ckt 1) loads from 146.40% to 151.30% (DC power flow) of its emergency rating (2901MVA) for the single line contingency outage (U_queue_reinforcement_59). This project contributes approximately 142.1MW to the thermal violation. See item #8 above.

Short Circuit

A short circuit analysis was conducted by PJM and confirmed by the FIRSTENERGY Protection staff. This analysis showed that bus faults can cause four Smithburg 230 kV breakers and one Larrabee 230 kV breakers to exceed their rated current interrupting capability with the addition of the Randolph Road (U2-049) Project.

To mitigate the exceedances of the short circuit interrupting capability for these breakers requires the replacement of four (4) GIS breakers at Smithburg, and installation of a TRV capacitor for one breaker at Larrabee. The estimated cost for these upgrades is \$3,064,300.

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

To be determined during the System Impact Study phase of the study of this project.

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

To be determined during the System Impact Study phase of the study of this project.

System Protection Analysis

Due to the magnitude of this project, a detailed system protection analysis has been deferred to the Impact Study. However, the FirstEnergy direct connection and network upgrade costs identified in this report include an adder to reflect the typical system protection facilities that will be needed.

Figure #1

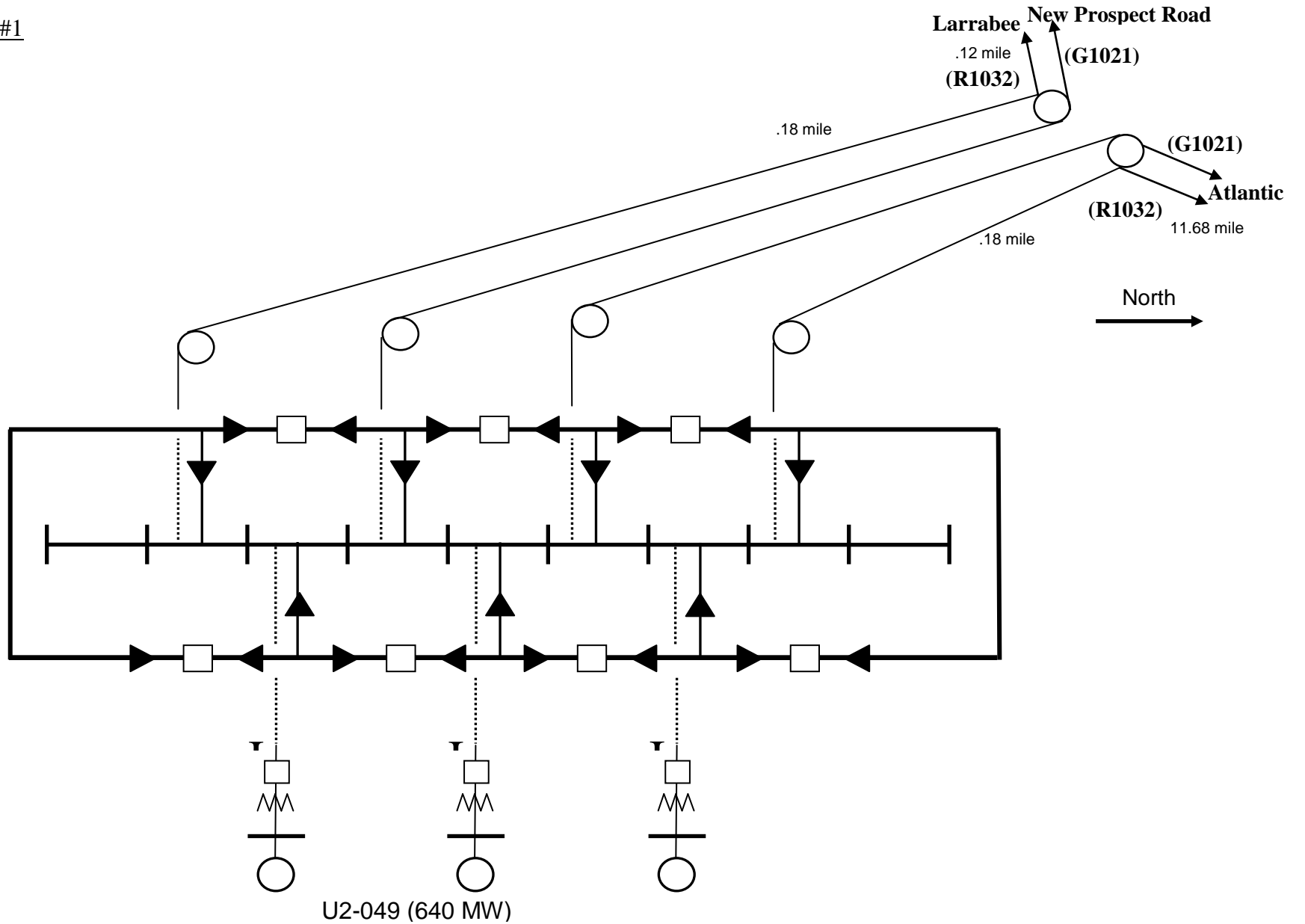


Figure 2

Nearest Tower for Loop



Attachment 1

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.