PJM Generator Interconnection Request
Queue # X1-035
Piney I
Feasibility/Impact Study Report

March 2012

X1-035 Piney I Feasibility/Impact Study Report

Introduction

This System Impact Study report provides the documentation of an assessment that has been performed by PJM Interconnection and FirstEnergy (FE) in response to a request made by the customer McClellan Power & Energy for the connection of a 2.0 MW (0.76 MW Capacity) Piney I (X1-035) Solar Generation Project to the Penelec Distribution System.

Connection Facilities

In compliance with the PJM Generation Interconnection Procedures, McClellan Power & Energy has submitted a "Generation Interconnection Feasibility Study agreement" to PJM that identifies its plan to construct numerous arrays of solar panels connected to four 0.5 MW inverters with a total capability of 2.0 MW (0.76 MW Capacity) on a property that is approximately 14.8 miles southeast of Franklin, PA, off Rt 322 (see Attachments 1).

McClellan Power & Energy has requested a 34.5kV interconnection. The project was studied as an interconnection into the First Energy distribution system at Piney Substation 34.5kV bus via the 34.5kV PE line. The proposed generation is to be interconnected to the First Energy distribution system at pole # PE-51-2 by way of the Central REC facilities (Beaver REC delivery point). A summary of the Piney I (X1-035) Project direct connection facilities that will be required and their estimated cost are shown on Attachment 3.

PJM Transmission System Analysis

The following analysis was performed by PJM on the transmission level voltage system. No problems were found on that system as a result of this project's interconnection.

Network Impacts

Queue project X1-035 was studied as a 2.0 MW (0.76 MW of which was Capacity) injection into PENELEC's system at the PINEY 34.5 kV substation. Project X1-035 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Potential transmission network impacts are as follows:

Generator Deliverability

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

No violations 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 violations 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 violations identified.

New System Reinforcements

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

None required.

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 required.

Short Circuit

Not required.

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 violations identified.

FirstEnergy Analysis

The following analysis was performed by the Transmission Owner on the underlying distribution level voltage network.

Power Flow Analysis (New Project Upgrades and Contributions)

A Power Flow study was conducted to determine the reliability impact of the proposed Piney I (X1-035) Project on the FE Bulk Transmission System (greater than 100 kV). This included the performance of a contingency analysis to identify any facility overload or voltage condition that violates the FE Planning Criteria. Any such violation that is either directly attributable to this project or for which it will have a shared responsibility is included in this report with a least cost plan identified to mitigate them. The Piney I (X1-035) Project Power Flow Analysis was completed using a 2015 summer peak load base case power flow provided by the PJM staff. This base case included an equivalent representation of the Penelec 34.5kV distribution system modeled as lumped equivalent load at the Piney 115 kV substation. The Piney I (X1-035) Project was modeled as an injection into the Piney 115 kV substation. A simulation of all possible contingencies within the NERC and FE Planning Standards that are impacted by the Piney I (X1-035) Project was conducted to test for criteria compliance. The results from the study Power Flow Analysis showing a comparison of the FE and PJM contingency study results is detailed on Attachment 4. As shown, the FE conclusion from this analysis is that there are no new bulk electric system network upgrades required for the Piney I (X1-035) Project. Furthermore, there are no findings of previously identified criteria violations from other generation or transmission interconnection projects in which the Piney I (X1-035) Project contributes.

Power Flow Analysis (Detailed 34.5kV)

In order to identify any overloads or voltage conditions on the 34.5kV system near the Piney I (X1-035) Project, FirstEnergy studied its own detailed model for the 2015 Penelec Summer Peak case. The Piney I (X1-035) Project was modeled at both 0.76 MW and 2.0 MW output, and with the generator at unity power factor (see Attachment 4).

0.76 MW Capacity Output
No overload/voltage issues identified

2.0 MW Energy Output
No overload/voltage issues identified

Short Circuit and Dynamics Analysis

Since the Piney I (X1-035) Project is solar, the inverter should not contribute to the fault duty of the 34.5kV breakers on the FE system. "Inverters are generally designed to limit fault currents to 130% or less of rated current. Thus they can usually be disregarded when conducting fault studies." Therefore no FE short circuit analysis was done and no circuit breaker reinforcements will be required.

Note that stability studies will be conducted by the PJM staff should this project proceed to the Facilities Study stage of the Generation Interconnection process.

System Protection Analysis

An analysis was conducted to assess the impact of the Piney I (X1-035) Project on the system protection requirements in the area. The results of this review show that no relay additions will be required.

Metering

McClellan Power & Energy will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. These FE requirements are detailed on Attachment 7 of this report.

Compliance Issues

McClellan Power & Energy must also meet all PJM, ReliabilityFirst and NERC reliability criteria and operating procedures required 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 results from the FE power flow analysis (Attachment 4) show that there are no FE criteria violations that are directly attributable to the capacity of the Piney I (X1-035) Project. Furthermore, there are no violations affecting thermal overload on network branches in which the capacity of the Piney I (X1-035) Project is a contributor. In accordance with the Generation Interconnection procedures defined in the PJM Open Access Transmission Tariff and PJM Manuals, McClellan Power & Energy is not responsible for network upgrades, and hence Attachment 5 has been omitted. The direct connection costs however are detailed in Attachment 3.

Note that all cost estimates contained in this document were produced without a detailed engineering review and are therefore subject to error. The McClellan Power & Energy will be responsible for the actual cost of the direct connection that is implemented. FE herein reserves the right to return to any issues in this document and, upon appropriate justification, request additional monies to complete any reinforcements to the distribution system.

Generation Connection Requirements

The proposed interconnection facilities must be designed in accordance with Attachment 8, FirstEnergy's "Technical Requirements for the Interconnection of Parallel-Operated Generation to the FirstEnergy Distribution System" and must also meet IEEE 1547.

The Interconnection Customer will also be responsible for following the requirements of the "FirstEnergy Wholesale Generation Interconnection (WGI) Manual" and the "FE Approved Vendors and Contractors" documents which are also located at the above link.

McClellan Power & Energy Requirements

In addition to the FE facilities, McClellan Power & Energy 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 supervisory control and data acquisition (SCADA) equipment to provide information in a compatible format to the FE Transmission System Control Center.

3. The establishment of dedicated communication circuits for SCADA report to the FE Transmission System Control Center.

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

5. The above requirements are in addition to any metering and telecommunications required by PJM as specified in PJM Manuals M-01 and M-14D

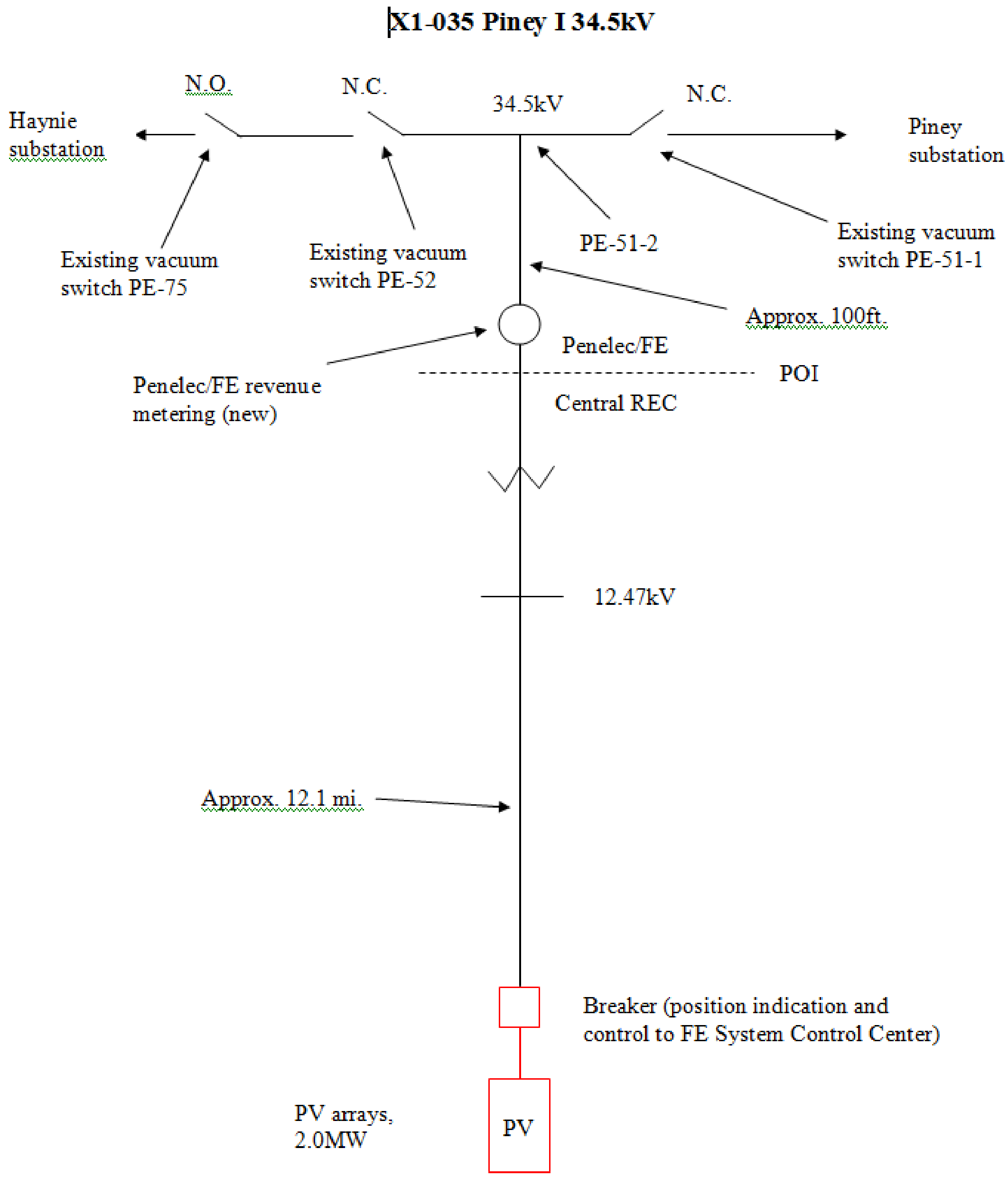
Summary

The Piney I (X1-035) Project direct connection will require the facility upgrades defined in Attachment 3. As shown, the total estimated cost of the 34.5kV interconnection is $40,000. The Piney I (X1-035) Project does not have any network upgrades.

Based on the scope of the FE direct connection, it is expected to take approximately one half (0.5) year from the signing of a Connection Service Agreement to complete the installation required for the Piney I (X1-035) Project. This includes a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the installation of new interconnecting metering and the associated work to connect this site. 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 FE will allow all distribution system outages when requested.

Attachment 1
Piney I (X1-035) Project
Project Location

Attachment 2
Piney I (X1-035) Project
Conceptual 34.5 kV Interconnection



Attachment 3		
Piney I (X1-035) Project		
Direct Connection Requirements		
Network Upgrade	Description	Cost
	Replace the 12.47kV revenue metering with 34.5kV metering at the Beaver REC delivery point. Note: This metering replacement cost is also included in Project X1-036. If both projects go forward this replacement cost only has to be paid once.	$30,000
	RTU programming for connection to the First Energy SCADA and relay support for the generation installation.	$10,000
Total		$40,000

PJM Network Upgrade numbers for the above Direct Connection Items:
Replacement of the 12.47 kV meter with the 34.5 kV meter as Beaver: n3040
RTU Programming: n 3041

Attachment 4						
Piney I (X1-035) Project						
FE Contingency Analysis Results						
New Project Upgrades and Contributions						
			FirstEnergy Results		PJM Results	
Outage Description	Overloaded Element	N/4 Hr - Rating	MVA Flow	% Rating	MVA Flow	% Rating
	No Problems					
Detailed 34.5kV analysis						
			FirstEnergy Results		PJM Results	
Outage Description	Overloaded Element	N/4 Hr - Rating	MVA Flow	% Rating	MVA Flow	% Rating
	No Problems					

Attachment 5
Piney I (X1-035) Project
FE Network Facility Reinforcement Conceptual Cost Estimates

None Required

Attachment 6
Piney I (X1-035) Project
FE Network Facility Reinforcement Conceptual One Line Diagrams

None Required

Attachment 7

FirstEnergy Revenue Metering Requirements for Generation Interconnection Customer

The FE operating company (Penelec) shall provide, own, operate, test, and maintain the revenue metering equipment at the Interconnection Customer's (IC) expense. The revenue metering equipment includes, but is not limited to, current transformers, voltage transformers, secondary wires, meter socket, bidirectional revenue meter, and associated devices. The IC shall mount the instrument transformers unless otherwise agreed to by Penelec. The instrument transformers and meter socket shall be installed in a location that is readily accessible to authorized Penelec representatives. Penelec will provide the IC access to bidirectional kWh and kVARh pulses from the Penelec meter at the IC's expense if requested. The IC shall, at its expense, install, own, operate, test, and maintain any metering and telemetry equipment that may be required to provide real-time meter data to FE or PJM.

Attachment 8

Applicability

1. This document defines the technical requirements for the interconnection of parallel-operated generation and related equipment to the FirstEnergy distribution system. For purposes of this document the term "generation" includes rotating and inverter-derived generating sources.

2. These requirements apply to customer-owned generation used to offset energy usage and to distributed generation exporting energy on a wholesale basis.

3. This document also applies to standby generator schemes with a make-before-break transition provided that the duration of parallel operation is 100 milliseconds or more.

4. These requirements apply to new generator interconnections as well as existing facilities being upgraded or expanded.

Purpose

The purpose of this document is to ensure the safety of FirstEnergy employees and the public, to protect FirstEnergy equipment from damage and to ensure the reliability of service to FirstEnergy customers.

Applicable Standards

5. Generator facilities must comply with all requirements of the latest version of the IEEE 1547, "Standard for Interconnecting Distributed Resources with Electric Power Systems[1]."

6. Inverter systems must comply with all requirements of the latest version of the UL1741, "Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources[2]."

7. Generator facilities and equipment must comply with all applicable national, state, and local construction codes and all operation and maintenance-related safety codes, such as the National Electrical Code (NEC), the National Electrical Safety Code (NESC), and the Occupational Safety and Health Administration (OSHA) regulations.

8. Generator interconnections are subject to applicable Federal or State interconnection rules and regulations depending upon interconnection type.

[1] IEEE Standard 1547-2003, "IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems," July 28, 2003.
[2] Underwriters Laboratory U.L. 1741, "Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources," May 7, 1999.

Relaying and Protection

9. The generator owner is responsible for providing adequate protection to FirstEnergy facilities for conditions arising from the operation of generation under all FirstEnergy distribution system operating conditions. The generator owner is also responsible for providing adequate protection to their facility under any distribution system operating condition whether or not their generator is in operation. Conditions may include but are not limited to:
    - Loss of a single phase of supply
    - Distribution system faults
    - Equipment failures
    - Abnormal voltage or frequency
    - Lightning and switching surges
    - Excessive harmonic voltages
    - Excessive negative sequence voltages
    - Separation from supply
    - Synchronizing generator to the distribution system
    - Re-synchronizing the generation after electric restoration of the supply.
10. The generator must connect to the FirstEnergy system through an interrupting device, which has adequate fault interruption, and withstand capability, and adequate continuous current and voltage rating in accordance with latest IEEE C37 standards. Three-phase generators shall use an interrupting device that interrupts all three phases simultaneously. The tripping control of the circuit interrupting device shall be powered independently of the utility AC source in order to permit operation upon loss of the FirstEnergy supply.

11. Non-certified inverters rated 300 kW or larger and rotating machines rated 300 kW or larger will require the use of utility grade relays at the point of interconnection. Utility-grade relays are also required where multiple generators are connected to the FirstEnergy system through a single point of interconnection and the aggregate generation is 2000 kW or larger. For purposes of this policy, utility-grade relays are defined as follows:
    - Relays comply with the latest IEEE Standard, C37.90, “Relays and Relay Systems Associated with Electric Power Apparatus.”
    - Relays have appropriate test plugs/switches for testing the operation of the relay without unwiring or disassembly.
    - Relays have targets to indicate relay operation.
    - Relays have ability to record and store fault events.
12. The generator protection and controls must be designed to coordinate with the reclosing practices of FirstEnergy line protective devices. The generator must

cease to energize the FirstEnergy circuit to which it is connected prior to re-closure of any automatic reclosing devices.

13. The generator shall cease to energize the FirstEnergy distribution system for faults on the circuit to which it is connected. The generator shall not reconnect to the FirstEnergy system following a trip from a system protection device, until the FirstEnergy system has been re-energized for a minimum of five minutes.

14. The generator protection and controls shall be designed to prevent the generator from being connected to a de-energized FirstEnergy circuit.

Voltage Control & Flicker

15. The generator shall be capable of paralleling with the FirstEnergy system without causing a voltage fluctuation at the point of common coupling (PCC) greater than 5% of the prevailing voltage level of the FirstEnergy system at the PCC.

16. The generator must have adequate protection and controls to ensure the requirements for frequency, voltage, and phase angle shown in Table 1 are met prior to paralleling with the FirstEnergy system.

Table 1: Paralleling requirements for generators connecting to the distribution system.

Rating of Generator (kVA)	Frequency Difference (Hz)	Voltage Difference (%V)	Phase angle Difference (degrees)
0 - 500	0.3	10	20
500 - 1500	0.2	5	15
> 1500	0.1	3	10

17. The generator shall not be a source of excessive harmonic voltage and current distortion and/or voltage flicker. Limits for harmonic distortion (including inductive telephone influence factors) will be as published in the latest issues of IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems[3]." Flicker occurring at the point of common coupling serving other FirstEnergy customers shall remain below the Border Line of Visibility curve shown in fig. 10-3 of the IEEE 519 Standard. (A.k.a. the GE Flicker Curve). Flicker occurring at the secondary of a service transformer serving a sole DG customer shall remain below the Borderline of Irritability curve.

18. When there is reasonable cause for concern due to the nature of the generation and its location, FirstEnergy may require the installation of a monitoring system to permit ongoing assessment of compliance with these criteria. The

[3] IEEE Standard 519-1992, "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems," Second printing June 15, 2004

monitoring system, if required, will be installed at the generator owner's expense. Situations where high harmonic voltages and/or currents originate from the distribution system are to be addressed in the Interconnection Agreement.

19. If high voltage, low voltage, or objectionable voltage flicker arises due to the operation, frequent tripping, and/or frequent starting and stopping of the generator, the generator owner may be required to disconnect its generation equipment from the FirstEnergy system until the problem has been fully investigated and resolved.

20. The operation of the generator equipment must not result in harmonic currents or voltages at the point of common coupling that will interfere with FirstEnergy's metering accuracy and/or proper operation of facilities and/or with the loads of other FirstEnergy customers. Such adverse effects may include, but are not limited to heating of wiring and equipment, overvoltage, communication interference, harmonic resonance, etc.

21. DC injection from inverters shall be maintained at or below 0.5% of full rated inverter output current into the point of common coupling.

22. The generated voltage shall follow, not attempt to oppose or regulate, changes in the prevailing voltage level provided by FirstEnergy at the point of common coupling, unless otherwise mutually agreed to by the generator owner and FirstEnergy.

23. The generator must not interfere with the operation of FirstEnergy voltage regulating equipment including voltage regulators and line capacitors such that the service voltage to other FirstEnergy customers falls outside the limits specified in ANSI C84.1[4], Range A.

24. Voltage unbalance at the point of common coupling caused by the generator equipment under any condition shall not exceed 3% (ratio of maximum deviation from average voltage to the average voltage).[5]

25. A generator connected to an area network system shall not cause tripping of network protectors due to reversal of power flow.

Response to abnormal voltage

26. The protection functions of the interconnection system shall detect the effective (RMS) or fundamental frequency value of each phase-to-phase voltage, except where the transformer connecting the generator to the FirstEnergy system is a grounded wye-wye configuration, or single-phase

[4] ANSI C84.1-2006, American National Standard for Electrical Power Systems and Equipment—Voltage Ratings (60 Hertz)

[5] ANSI C84.1-2006, Annex C, Polyphase Voltage Unbalance, Paragraph C.2

installation, the phase-to-neutral voltage shall be detected.

27. When any voltage is in a range given in Table 2 the generator shall cease to energize the FirstEnergy system within the clearing time as indicated. Clearing time is the time between the start of the abnormal condition and the generator ceasing to energize the utility system.

28. For generators 30 kW or larger, different settings may be used for the under/over voltage trip levels or time delays if approved by FirstEnergy. Field-adjustable set points shall be protected against unauthorized adjustment.

Table 2: Interconnection System Response to Abnormal Voltages

Voltage Range (% of Base Voltage) [1]	Clearing time [2]
V < 50 %	0.16 Seconds
50 % ≤ V < 88 %	2.00 Seconds
110% < V < 120 %	1.00 Seconds
V ≥ 120 %	0.16 Seconds

[1] Base voltages are the nominal system voltages stated in ANSI C84.1-1995.
[2] For generators ≥ 30 kW times may be extended if approved by FirstEnergy.

29. Voltages shall normally be detected at the PCC to eliminate the effects of voltage drop or transformer connections between the PCC and the point of generator interconnection. However, under any of the following conditions the voltages may be detected at the point of generator interconnection:

- The aggregate capacity of the generator system connected to a single PCC is less than or equal to 30 kW,
- The interconnection equipment is certified to pass a non-islanding test for the system to which it is to be connected,
- The aggregate generator capacity is less than 50% of the total local electric power system minimum annual integrated electrical demand for a 15 minute time period, and export of real or reactive power by the generator to the FirstEnergy system is not permitted.

Response to abnormal frequency

30. When the system frequency is in a range given in Table 3, the generator shall cease to energize the FirstEnergy system within the clearing time as indicated. Clearing time is the time between the start of the abnormal condition and the generator ceasing to energize the FirstEnergy system.

31. For generators greater than 30 kW, the frequency and time delay set points shall be field adjustable. Field-adjustable set points shall be protected against unauthorized adjustment.

Table 3: Interconnection Response to Abnormal Frequency

Generator Size	Frequency Range (Hz)	Clearing time
≤ 30 kW	> 60.5	0.16 Sec
	< 59.3	0.16 Sec
> 30 kW	> 60.5	0.16 Sec
	< 59.3 [1]	0.25 Sec [2]
	< 57.0	0.16 Sec

[1] < {59.8 – 57.0 Hz} Allowable setting under approval from FirstEnergy.

[2] {0.16 to 300 Sec} Allowable setting under approval from FirstEnergy.

Islanding Protection

32. The generator protection and controls must be able to detect an island condition and disconnect the generator from the FirstEnergy system within two seconds of the formation of an island. The anti-islanding requirement can be satisfied by using any of the following methods, subject to the approval of FirstEnergy.

    - Direct Transfer Trip Scheme,
    - Use of frequency relays and voltage relays,
    - The generator's protection package or the inverter is certified to pass an anti-islanding test (certified to comply with IEEE 1547),
    - Non-exporting customer generator with reverse power relaying applied at the point of interconnection.

Direct Transfer Trip (DTT) Scheme

33. FirstEnergy will make the determination if a DTT scheme is required on a case-by-case basis. A DTT scheme will typically be required when <u>both</u> of the following are true:

    - The generator is any of the following types; a synchronous machine, a non-certified inverter, or a self-excited induction generator, each capable of sustaining a load when separated from the utility system;
    - The minimum circuit load on the line section connected to the generator following the opening of any automatic sectionalizing devices is not greater than 3 times the aggregate generation capacity.

34. The DTT scheme design, equipment and type of communication channel shall be proposed by the generator owner and submitted to FirstEnergy for review and acceptance.

35. The DTT scheme must be designed to automatically trip and separate the generator from the FirstEnergy distribution system upon loss of communication channel. The generator shall not reconnect to the system until

the communication channel is proven to functioning normally.

36. Responsibilities for purchase, installation and ownership of DTT equipment will be as follows:

- The generator owner shall own and provide a direct-transfer trip receiver(s) at their facility to receive tripping signals originating from a FirstEnergy location(s).
- The generator owner shall bear the costs to purchase and install the required DTT transmitting and associated relaying equipment at the required FirstEnergy location(s). FirstEnergy will perform or coordinate the installation of the equipment at the cost of the generator owner. FirstEnergy will own and be responsible to maintain and perform periodic maintenance and testing of this equipment.
- The generator owner is responsible for the design, installation and maintenance of a dedicated communication channel(s) between the FirstEnergy location(s) and the generation owner's facility, including any rental, license and attachment fees for the communications channel.
- When DTT equipment needs replacement due to age or continued unreliable performance, the generator owner is responsible for purchase and installation costs of the new equipment. This must be established in the Interconnection agreement with the generator owner.

37. If the generator owner wishes to install communications cables or equipment on FirstEnergy poles, the generator owner will be responsible to secure a license agreement or pole attachment agreement for those attachments, and assume typical licensed attachment responsibilities in terms of make-ready work costs and annual attachment fees. Cable attachment will be in the communications space on the poles.

38. When a DTT tripping signal originates from a FirstEnergy substation breaker, the preferred location for DTT transmitter and associated equipment is within the FirstEnergy substation control room or approved outdoor enclosure within the substation perimeter if a control room is not available.

39. FirstEnergy will establish a demarcation point for any DTT communication cables leaving the substation property. FirstEnergy will perform or coordinate the installation of the cable and conduit up to the demarcation point including the box enclosure. FirstEnergy will determine the enclosure location. All material and installation costs will be borne by the generator owner. The generator owner will be responsible to install cable and conduit originating from their end up to the demarcation point. Details of the planned installation including any trenching must be approved by FirstEnergy.

40. The generator owner may be responsible to compensate FirstEnergy for any labor expenses involved with troubleshooting or testing of the DTT communications or protection system. This requirement is to be contractually

addressed in the Interconnection Agreement with the generator owner.

Disconnect Switch Requirements

41. FirstEnergy requires that a disconnect device with a visibly open means be provided, installed, and paid for by the generator owner, which is readily accessible to and lockable by FirstEnergy personnel, in order to safely disconnect the generator from the FirstEnergy system.[6]

42. The disconnect device may be installed either at the primary voltage level or secondary voltage level at the discretion of FirstEnergy. The generator disconnect device must be clearly labeled to show its intended function.

Interconnection Transformer Requirements

43. All generation must be isolated from the FirstEnergy primary distribution system by a transformer in order to properly integrate the grounding scheme of the generator to the grounding scheme of the distribution system.

44. The grounding scheme of the interconnection transformer shall not cause overvoltages on the un-faulted phases during ground-fault conditions that exceed the rating of equipment connected to the FirstEnergy distribution system.

45. The ground source contribution current of the interconnection transformer shall not disrupt the coordination of the overcurrent devices of the distribution circuit whether or not the generator is in operation.

Maintenance Requirements

46. The generator owner shall maintain all equipment associated with the generator system, including DTT communications equipment, according to good utility practices and according to equipment manufacturer's recommendations and keep it in proper working condition.

47. The generator owner shall keep a written log and test records showing the periodic testing of such equipment. These records must be available to FirstEnergy upon request.

Acceptance Testing

48. Test results or equipment pre-certification shall be supplied by the generator owner, that verify, to the satisfaction of FirstEnergy, compliance with the IEEE 1547 Standard, Section 5 "Interconnection Test Specifications and Requirements."

[6] Exception: In New Jersey, an outdoor disconnect switch is not a requirement for Level 1 interconnections per NJ Net metering regulations. See NJ Administrative Code, NJAC 14:8-4.1 et seq.(2008)

49. The generator owner must provide FirstEnergy the opportunity to perform an inspection prior to interconnection to verify correct protective settings and wiring connections.

50. Acceptance testing shall be performed on all generators and generating equipment not pre-certified by a nationally recognized testing laboratory as suitable for utility interconnection meeting the intent of these technical requirements. A qualified third party testing organization shall perform these tests at the expense of the generator owner.

51. Acceptance testing of the protective schemes, where required, must be completed on new or modified installations.

Communications and Control

52. FirstEnergy may require the generator owner to provide a listing of two or more persons and their telephone numbers such that the FirstEnergy dispatching office can contact the generator owner for emergency switching operations 24 hours a day. This is a necessary safety requirement.

53. For generators rated 2000 kVA or larger, individually or in aggregate, who are exporting energy on a wholesale basis, will require the generator owner to furnish a SCADA remote terminal unit (RTU) which will interface with the FirstEnergy energy management system (EMS). The RTU, the communications channel and all related equipment will be furnished and maintained by the generator owner. The RTU must communicate with the FirstEnergy EMS via DNP 3.0 protocol. The following control, status, and metering points will be required:
    - Tripping control of generator or interconnection breaker.
    - Generator real and reactive power output measured at the high-side of the generator step-up transformer.
    - Generator voltage at the point of interconnection.
    - Indication that a direct-transfer trip operation has occurred where DTT is used.

54. Where tripping control of generator breaker is required, the tripping command originating from the FirstEnergy dispatching office must also activate a closing lockout function which must be manually reset before the generator breaker can be re-connected to the system.

Metering Requirements

55. Metering instrument transformers are to be protected from the distribution system by a fuse or other protective device such that failure of an instrument transformer does not cause a distribution protection device to open.

56. In the case of an existing retail customer that is adding generation their facility, the retail billing meter will need to be replaced with a bi-directional meter. A review of the wiring and current transformers may need to be performed to verify the ampacity ratings are sufficient for the size of the generator. Cost responsibilities for meter replacement are defined in the retail net metering tariffs.

57. Wholesale generation facilities must comply with the metering requirements of the appropriate RTO.

58. Wholesale generation facilities must comply with the FirstEnergy requirements specified in the document entitled “FirstEnergy Revenue Metering Requirements For Generation Facilities Connected 46 kV and Lower.”

59. Generators with an aggregate capacity of 1000 kVA or larger may require the installation of an interval metering system, which will transfer metering data to the FirstEnergy MV-90 system[7]. The meter will be provided by FirstEnergy. The generator owner will be responsible to provide at their cost a dedicated communications channel, which will interface with FirstEnergy’s MV-90 system.

60. Cost responsibilities associated with the purchase, installation, and testing and of revenue metering equipment will be determined on a case-by-case basis under the direction of the FirstEnergy Corporate Metering Department and in accordance with the rules found in filed tariffs. These details are to be addressed in the facilities study.

61. Metering equipment must meet the specifications of FirstEnergy and the appropriate RTO.

Definitions

Area Network System - A type of electric distribution system served by multiple transformers interconnected in an electrical network circuit, which is generally used in large metropolitan areas that are densely populated, in order to provide highly reliable service. Area network has the same meaning as the term “distribution secondary grid network” found in institute of electrical and electronics engineers (IEEE) standard 1547.

Certified Equipment – Equipment which has been submitted by a manufacturer to an OSHA-approved nationally recognized testing laboratory, and has been tested and listed by the laboratory for continuous interactive operation with an electric distribution system in compliance with the applicable codes and standards listed in the IEEE 1547 and UL 1741 Standards.

Flicker – A variation of input voltage sufficient in duration to allow visual observation of a change in electric light source intensity.

[7] MV-90 is FirstEnergy’s system for collecting interval metering data.

Harmonic Distortion – Continuous distortion of the normal sine wave; typically caused by nonlinear loads or by inverters.

Inverter – A device or system that changes direct current power to alternating current power. Inverters that are self-commutating can be configured for stand-alone service. Inverters that are line-commutated cannot be configured for stand-alone service.

Point of Common Coupling – The point at which the generator facility is connected to the shared portion, or potentially shared portion of the FirstEnergy system. The IEEE 1547 standard establishes this point as the location where voltage and harmonic limits are measured and applied.

Regional Transmission Organization (RTO) – An independent, FERC-approved organization of sufficient regional scope, which coordinates the interstate movement of electricity under FERC-approved Tariffs by operating the transmission system and competitive wholesale electricity markets, and ensuring reliability and efficiency through expansion planning and interregional coordination.

Single Phasing Condition – Occurs when one or two phases of the three phase supply line are disconnected.

Unintentional Island - An unplanned condition where one or more generator's and a portion of the FirstEnergy system remain energized solely through the point of interconnection.