# *Generation Interconnection Facilities Study Report*

# *For*

# *PJM Transmission Interconnection Request Queue Position AE1-243*

# *“Warren Glen Storage 34.5 kV”*

***February 2022***

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## *Preface*

The intent of the Facility 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 Facility Study estimates attempt to identify the estimated 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 may be included in the study.

## A. Transmission Owner Facilities Study Summary

### *1. Description of Project*

NJ Battery Energy Storage Project 1, LLC, (hereinafter referred to as "IC") has proposed a new battery storage generating facility to be located in Bloomsbury, Hunterdon County, New Jersey. The installed facilities for AE1-243 will have a total Maximum Facility Output (MFO) of 20 MW with 0 MW of this output being recognized by PJM as Capacity. The generation facility will interconnect with Jersey Central Power & Light (JCPL), a FirstEnergy Company (FE), hereinafter referred to as "Transmission Owner" (TO), by interconnecting with the Gilbert – Morris Park (A27) 34.5 kV line near Warren Glen switching station. The transmission line tap will be located at the Reigel-Milford Substation approximately 5.5 miles from Gilbert Substation.

### *2. Amendments to the System Impact Study or System Impact Study Results*

There were no notable amendments since the System Impact Study.

### *3. Interconnection Customer's Milestone Schedule*

The Commercial Operation Date (COD) for the generation facility is October 31, 2023. Transmission Owner's proposed schedule does not match the Developer's requested Milestone Schedule. A Project Kickoff meeting must occur by June 1, 2022 to meet Transmission Owner's Assumed Milestone Schedule listed below.

**Milestone Schedule:**

| | |
|---|---|
| 08/31/2023 | Initial Back-feed through Project Substation Date |
| 10/31/2023 | Project Commercial Operation Date |

## *4. Customer's Scope of Work*

IC is responsible for all design and construction related to activities on their side of the Point of Interconnection (POI). This includes, but is not limited to, the generation step-up (GSU) transformer, 34.5 kV (AE1-243) generator lead line and connection to the tap point on the Gilbert – Morris Park (A27) 34.5 kV line.

**Point of Interconnection** (POI): The interconnection of the project will be accomplished by tapping the Gilbert – Morris Park (A27) 34.5 kV line near Warren Glen switch station. The line tap will be located approximately 5.5 miles from Gilbert Substation. The primary direct connection of this project will be accomplished by tapping the Gilbert – Morris Park (A27) 34.5 kV line and installing one span of overhead 34.5 kV line to the POI including two (2)-34.5 kV load-break air switches with SCADA control at the tap location and 34.5 kV interconnection metering.

IC is required to own, install, and maintain a fully-rated, fault-interrupting circuit breaker on the high-side of the GSU transformer, as well as the necessary revenue metering equipment. The revenue metering current and voltage transformers shall be installed on the high voltage side of the GSU, on the generation side of the fault-interrupting device, and within the local zone of fault protection for the facility. The protective relaying and metering design must comply with FirstEnergy's applicable standards as well as with PJM requirements.

The easements and associated rights of way for the TO owned substation along with the 34.5 kV line taps to the substation will be acquired by the IC and transferred to the TO at no cost. Site preparation for the TO owned substation, including clearing, grading and an access road, as necessary, is assumed to be by the IC. The access road design must be approved by FirstEnergy to ensure it provides adequate access to the substation to support construction and maintenance activities. Route selection, line design, and right-of-way acquisition for the IC's facilities are not included in this report and are the responsibility of the IC.

**Assumptions / Notes:**

- IC will coordinate design and alignment of proposed 34.5 kV generator lead line with the Transmission Owner for review of any clearance, right-of-way or right-of-way encroachment issues with TO owned facilities.
- IC will coordinate design and construction of proposed 34.5 kV lead line. For these areas, the IC shall provide TO with proposed drawings prior to construction and as-built drawings, confirmed by as-built survey data post-construction.
- Transmission Owner's preference would be to limit interference and avoid transmission line crossings with new 34.5 kV terminal positions. As a minimum, IC facilities should not encroach within 100 feet of TO centerline at blowout conditions. If IC's line design does not comply with this requirement TO would need to review this area as a special exception.
- Additional costs will be incurred by the IC, if final alignment of the 34.5 kV generator lead line causes encroachments, changes, or modifications to any existing or relocated TO facilities.
- IC is responsible to make all arrangements for electric distribution service (if required) for its generation station. No costs or schedule are included herein.
- All new generator only and new generator plus load facilities must be isolated from the FE Transmission System by a Power Transformer. The winding configurations of the transformer connecting to a non-effectively grounded portion of the FE Transmission system shall be determined by FE on a case-by-case basis. The IC has requested a non-standard GSU transformer winding configuration. This transformer is in violation of section 14.2.6 of FE's "Requirements for Transmission Connected Facilities" document and will not be accepted. The GSU transformer must have an un-grounded wye or delta connection on the high (utility) side.

## *5. Description of Facilities Included in the Facilities Study*

**Attachment Facilities**

- New line tap on Gilbert – Morris Park (A27) 34.5 kV line
    - Construction of a new 34.5 kV line tap/ connection and 2-34.5 kV load-break air switches with SCADA control at the tap location, including one (1) span of 34.5 kV line to the Point of Interconnection at Gilbert – Morris Park (A27) 34.5 kV line. Line to be tapped near pole NJ210APGTX24.

**Non-Direct Connection**

- Gilbert – Morris Park (A27) 34.5 kV line
    - Install approximately 100 ft of 556 ACSR extension to developers new metering site. Install metering to be mounted on the customer owned pole.

- SCADA and Communications
    - Estimated installation of 700 MHz radio system (70% penetration of FE territory) to support the (3) SCADA switch.
    - Provide and install 34.5 kV instrument transformer package and bi-directional 4G cell meter at Customer site.

- Gilbert Substation
    - Revise remote relay and metering settings on the Morris Park 34.5 kV terminal.

- Morris Park Substation
    - Revise remote relay and metering settings on the Gilbert 34.5 kV terminal.

- New AE1-243 Customer Substation
    - Review nameplates, drawings, and add to HV circuit diagram

- Project Management
    - Review of scope regarding Project Management, Commissioning, Environmental, Forestry, Real Estate, and Right of Way.

**New System Upgrades**

None.

### *6. Total Cost of Transmission Owner Facilities Included in the Facilities Study*

| Description | Total (w/o Tax) | Tax (if applicable) | Total Cost (w/Tax) |
|---|---|---|---|
| **Attachment Facilities:** | **$104,800** | | |
| **Total Direct Connection (DC) Costs:** | **$0** | | |
| **Total Non-Direct Connection (NDC) Costs:** | **$939,600** | | |
| **New System Upgrades** | **$ 0** | | |
| **TOTAL Costs (ALL Categories)** | **$1,044,400** | | |

### *7. Summary of the Schedule for Completion of Work for the Facilities Study*

| *Attachment Facility* | *Duration* |
|---|---|
| AE1-243: Engineering, Procurement, and Construction | 14 months |

## B. Transmission Owner Facilities Study Results

This section describes facilities identified to be installed (attachment facilities), replaced, and/or upgraded (upgrade facilities) by FirstEnergy to accommodate the project. During detailed design and analysis other components may be identified for installation or replacement due to this interconnection.

### *1. Transmission Lines –New*

None.

### *2. Transmission Lines – Upgrade*

Gilbert – Morris Park (A27) 34.5 kV Line

Tap the Gilbert – Morris Park (A27) 34.5 kV line near pole NJ210APGTX24 with three (3) SCADA controlled switches and approximately 100 ft of 556 ACSR extension to the new metering site. Install metering to be mounted on the customer pole.

- Assumptions:
  - Developer will need to put in a request to get power near the site. There are electricity poles going down the driveway near the location (pole number NJ 497-PT, NJ-496-PT, and NJ 495-PT). The Developer will put in the request when ready.
  - The Interconnection is located at the Reigel-Milford Substation: 40°37’57” N 75°07’ 49” W.

SCADA Communication

Estimated installation of 700 MHz radio system (70% penetration of FE territory) to support the (3) SCADA switch replacements. Cellular would be utilized as a last resort. Estimated SCADA work at Gilbert & Morris Park substations to support updated relay settings.

- Assumptions:
  - Developer master radio site with backhaul transport located in proximity to new remote 700 MHz radio.
  - Feasibility of 700MHz system will need to be established before deployment.
  - 700 MHz Antenna can mount to T-Line/Bus/Tap structure.
  - Three (3) 700 MHz radio system is sufficient to provide SCADA transport for switches.
  - The existing SCADA transport at Gilbert & Morris Park substations is sufficient for additional SCADA telemetry.

### *3. New Substation/Switchyard Facilities*

AE1-243 Customer Substation

- Below Grade
  - None
- Above Grade
  - Review customer design drawings for Interconnection Compliance.

- Nameplate for customer isolation switch.
- Add customer information to engineering files and to the PN system diagram (CD) drawing.

- Relay & Communication (R&C)
  - None
- Additional Equipment to be Removed
  - None
- Assumptions
  - None

Revenue Metering

- Revenue metering located at Customer substation will be installed by JCPL.

### *4. Substation/Switchyard Facility Upgrades*

Gilbert Substation

- Below Grade
  - None
- Above Grade
  - None
- Relay & Communication (R&C)
  - Relay setting changes necessary for generation interconnection.
- Additional Equipment to be Removed
  - None
- Assumptions
  - None

Morris Park Substation

- Below Grade
  - None
- Above Grade
  - None
- Relay & Communication (R&C)
  - Relay setting changes necessary for generation interconnection.
- Additional Equipment to be Removed
  - None
- Assumptions
  - None

SCADA Communication

- SCADA point additions for the two (2) gang operated switches.
- EMS changes for AE2-243 generation.

### *5. Telecommunications Facilities – Upgrades*

The AE1-243 generation (collector) substation will be connected directly to an existing line within FirstEnergy's transmission system without a dedicated Transmission Owner interconnection substation and will therefore not require MPLS communications.

## *6. Metering & Communications*

IC shall install, own, operate, test and maintain the necessary revenue metering equipment. Revenue billing data from the meter is accessed by FirstEnergy over a cellular connection provided by FirstEnergy. If local cellular service is not applicable, the applicant will be required to provide appropriate communication circuits.

The revenue metering system (particularly the revenue metering current transformers) shall be designed to accurately meter the light loads that will occur when the facility is not generating power and only back-feeding station service from the Transmission Owner. This may require the use of high accuracy extended range current transformers.

Transmission Owner's Revenue Metering Requirements may be found FirstEnergy Corporation Requirements for Transmission Connected Facilities dated October 3, 2016 document located at the following links:

www.firstenergycorp.com/feconnect

www.pjm.com/planning/design-engineering/to-tech-standards.aspx

These requirements are in addition to any metering required by PJM.

Transmission Owner will provide the telecommunication circuits for the SCADA RTU and the telephone in the Transmission Owner interconnection substation.

Transmission Owner will obtain real-time, site-specific, generation data from PJM, via the required communication link from IC to PJM. Transmission Owner will work with PJM and IC to ensure the generation data provided to PJM meets Transmission Owner's requirements.

## *7. Environmental, Real Estate and Permitting*

The following are possible environmental, real estate and permitting issues:

- Environmental permitting, Real Estate acquisition, and New Jersey Board of Public Utilities (NJBPU) notifications vary, some up to twelve (12) months after preliminary engineering is completed to secure the required approvals.
- Prior to agreement by Developer to purchase the property, a Phase 1 Environmental Assessment should be conducted for the entire site to avoid assumption of environmental liabilities by Developer or Transmission Owner.
- The Transmission Owner interconnection substation may involve environmental surveys, permits, approvals and plans with federal, state, and/or local agencies.
- Assumed Developer is to provide all access rights, easements, ROW and permits necessary to complete the Project to the satisfaction of Transmission Owner. Environmental permitting shall encompass all federal, state and local requirements, consultations and agency coordination. Confirmation of meeting all permitting requirements shall be provided to Transmission Owner, prior to start of construction. Following construction and energization, confirmation of permit closeout shall be provided to the satisfaction of Transmission Owner, prior to transfer of ownership. If any of these elements are not included in the final agreement between Transmission Owner and Developer,

twelve (12)-to-eighteen (18) months should be added to the Project Schedule to secure necessary permits, and additional costs would apply.

- Developer will provide copies of all of the relative environmental permits and other necessary approvals to Transmission Owner before Transmission Owner accepts the interconnection facilities.
- Developer is required to install an access road from the new interconnection substation to the nearest public road (must be approved by Transmission Owner) and obtain access rights for Transmission Owner. Developer is responsible to maintain access road and ensure unimpeded access for Transmission Owner at all times.
- Developer is responsible for all property acquisition (including easements/rights-of-way (ROW)) for transmission, distribution and communication facilities needed for the generator interconnection.
- If Developer owns the project property, in fee title, Transmission Owner will require a fee property transfer for the interconnection substation site which may require subdivision approval, together with permanent access rights to and from the substation, as well as a perpetual easement for any transmission lines to the substation. Developer is responsible for all costs, including but not limited to subdivision, associated with the property transfer.
- If Developer leases the project property, the Developer will be required to obtain fee property from the underlying fee property owner, on behalf of Transmission Owner, for the interconnection substation site, together with permanent access rights to and from the substation, as well as a perpetual easement for any transmission lines to the substation.
- All property rights must be surveyed and metes and bounds descriptions prepared for incorporation into Transmission Owner's document forms, for transfer of title.
- The Transmission Owner interconnection substation and transmission line loop will involve New Jersey Board of Public Utilities (NJBPU) notification/approval.
- All work occurs within an existing transmission line right-of-way or on Developer's property with access to all existing structures possible via that property and the right-of- way following established access routes that do not cross wetlands or streams.
- Developer will develop, and secure regulatory approval for, all necessary Erosion and Sediment Control (E&SC) plans and National Pollutant Discharge Elimination System (NPDES) permits.
- Developer will obtain all necessary permits.
- Developer will conduct all necessary wetlands and waterways studies and permits.
- Developer will conduct all necessary historical and archaeological studies.
- If the Developer plans to cross the transmission line right of way with facilities or access roads, please refer to the Transmission Rights-of-Way Restrictions information located at:

  https://www.firstenergycorp.com/help/safety/real-estate-power-lines/transmission-right-of-way.html#ROWform

## *8. Summary of Results of Study*

| Work Description | Direct | | Indirect | | Total Cost without Tax |
|---|---|---|---|---|---|
| | Labor | Material | Labor | Material | |
| | | | | | |
| Construct a 34.5 line tap/connection including 1 span of 34.5kV line to the point of interconnection at Gilbert-Morris Park (A27) 34.5kV Generation Interconnection. (One (1) 34.5 kV switch on the generator lead line and the span of 34.5 kV circuit are considered Attachment Facilities) | $35,800 | $20,400 | $14,500 | $1,800 | $72,500 |
| Review AE1-243 Substation customer design drawings for Interconnection Compliance. | $23,000 | | $9,300 | | $32,300 |
| **Total Attachment Facilities** | **$58,800** | **$20,400** | **$23,800** | **$1,800** | **$104,800** |
| | | | | | |
| **Total Direct Connection Cost** | **$0** | **$0** | **$0** | **$0** | **$0** |
| | | | | | |
| Construct a 34.5 line tap/connection and 2-34.5kV load-break air switches with SCADA control at tap location. (The one (1) switch on the main circuit next to the tap is considered a Non-Direct Connection cost) (Network Upgrade n6146) | $322,000 | $183,200 | $130,400 | $16,800 | $652,400 |
| Estimated installation of 700 MHz radio system (70% penetration of FE territory) to support the (3) SCADA switch replacements. Assumed SCADA work is included in this cost. (Network Upgrade n6146) | $102,300 | $19,500 | $41,400 | $1,800 | $165,000 |

| Work Description | Direct | | Indirect | | Total Cost without Tax |
|---|---|---|---|---|---|
| | Labor | Material | Labor | Material | |
| Provide and install 34.5 kV instrument transformer package and bi-directional 4G cell meter at AE1-243 site (new battery facility.) (Network Upgrade n6146) | $3,800 | | $1,500 | | $5,300 |
| Project Management | $23,000 | | $9,300 | | $32,300 |
| **Gilbert Substation:** Relay setting changes necessary for generation interconnect. (Network Upgrade n6147) | $30,100 | | $12,200 | | $42,300 |
| **Morris Park Substation:** Relay setting changes necessary for generation interconnection. (Network Upgrade n6148) | $30,100 | | $12,200 | | $42,300 |
| **Total Non-Direct Connection Network Upgrades** | **$511,300** | **$202,700** | **$207,000** | **$16,800** | **$939,600** |
| | | | | | |
| **Total Project Costs w/o Tax** | **$570,100** | **$223,100** | **$230,800** | **$20,400** | **$1,044,400** |

Generation projects meeting IRS "Safe Harbor" provisions generally do not incur "CIAC" (Contribution in Aid to Construction), a tax collected by the utility for the state or federal government. First Energy does not expect to collect CIAC for this project. If for any reason, "CIAC" would be required for this project, it would be the responsibility of the party owning the generator to pay this cost.

First Energy reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering facilities, owned by First Energy.

### *9. Schedules and Assumptions*

A proposed **14 month Direct Connection** schedule is estimated to complete the engineering, construction and the associated activities, from the date of a fully executed Interconnection Construction Service Agreement and Construction Kick-Off Meeting. This schedule assumes that all issues covered by the "Environmental, Real Estate and Permitting Issues" section of this document are resolved, and outages (typically not granted from June through September) will occur as planned. Construction cannot begin until after all applicable permits and/or easements have been obtained.

**14 month Schedule**

| Activity | Start Month | End Month |
|---|---|---|
| | | |
| Preliminary Engineering | 1 | 3 |
| Siting, Permits & Real Estate | 2 | 12 |
| Detailed Engineering | 2 | 12 |
| Above Grade Construction – Substation | 9 | 14 |
| Below Grade Construction – Substation | 11 | 14 |
| Equipment Delivery | 12 | 14 |
| Below Grade Construction – T-Lines | 13 | 14 |
| Above Grade Construction – T-Lines | 13 | 14 |
| Testing & Commissioning | 14 | 14 |

***10. Information Required for Interconnection Service Agreement***

| Work Description | Direct | | Indirect | | Total Cost without Tax |
|---|---|---|---|---|---|
| | Labor | Material | Labor | Material | |
| | | | | | |
| Construct a 34.5 line tap/connection including 1 span of 34.5kV line to the point of interconnection at Gilbert-Morris Park (A27) 34.5kV Generation Interconnection. (One (1) 34.5 kV switch on the generator lead line and the span of 34.5 kV circuit are considered Attachment Facilities) | $35,800 | $20,400 | $14,500 | $1,800 | $72,500 |
| Review AE1-243 Substation customer design drawings for Interconnection Compliance. | $23,000 | | $9,300 | | $32,300 |
| **Total Attachment Facilities** | **$58,800** | **$20,400** | **$23,800** | **$1,800** | **$104,800** |
| | | | | | |
| **Total Direct Connection Cost** | **$0** | **$0** | **$0** | **$0** | **$0** |
| | | | | | |

| Work Description | Direct | | Indirect | | Total Cost without Tax |
|---|---|---|---|---|---|
| | Labor | Material | Labor | Material | |
| Construct a 34.5 line tap/connection and 2-34.5kV load-break air switches with SCADA control at tap location. (The one (1) switch on the main circuit next to the tap is considered a Non-Direct Connection cost) (Network Upgrade n6146) | $322,000 | $183,200 | $130,400 | $16,800 | $652,400 |
| Estimated installation of 700 MHz radio system (70% penetration of FE territory) to support the (3) SCADA switch replacements. Assumed SCADA work is included in this cost. (Network Upgrade n6146) | $102,300 | $19,500 | $41,400 | $1,800 | $165,000 |
| Provide and install 34.5 kV instrument transformer package and bi-directional 4G cell meter at AE1-243 site (new battery facility.) (Network Upgrade n6146) | $3,800 | | $1,500 | | $5,300 |
| Project Management | $23,000 | | $9,300 | | $32,300 |
| **Gilbert Substation:** Relay setting changes necessary for generation interconnect. (Network Upgrade n6147) | $30,100 | | $12,200 | | $42,300 |
| **Morris Park Substation:** Relay setting changes necessary for generation interconnection. (Network Upgrade n6148) | $30,100 | | $12,200 | | $42,300 |
| **Total Non-Direct Connection Network Upgrades** | **$511,300** | **$202,700** | **$207,000** | **$16,800** | **$939,600** |
| | | | | | |
| **Total Project Costs w/o Tax** | **$570,100** | **$223,100** | **$230,800** | **$20,400** | **$1,044,400** |

## Attachment #1: Protection Study

**PROTECTION/ RELAY AND COMMUNICATION EQUIPMENT SCOPE**

**Short Circuit Values**

34.5 kV

Positive Seq. Impedance = 0.93602 + j2.87149 Ohms
Zero Seq. Impedance = 3.01283 + j14.5417 Ohms
Single Line to Ground Fault Current = 2,864 Amps
Three Phase Fault Current = 6,596 Amps

Fault values are from the current system condition on the Gilbert – Morris Park (A27) 34.5 kV line without the proposed generation project and extension of the Gilbert – Morris Park (A27) 34.5 kV line to the POI. The faults provided are bolted, symmetrical values for normal system conditions. It should be similar short circuit values at the interconnection point with the extension of the Gilbert – Morris Park (A27) 34.5 kV line but future changes in fault currents are possible and it is the customer's responsibility to upgrade their equipment and/or protective equipment coordination when necessary.

**General Connection Requirement**

All proposed generation interconnection points and load-serving delivery points must comply with the technical requirements detailed in the FirstEnergy "Transmission Connection Requirements" document.

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**Protection Requirements for Line Tapped Generation on 34.5kV**

Customer shall install a Delta High (utility) side or Ungrounded Wye High (utility) side transformer. The transformer shall be protected by independent protection schemes, namely, Primary Differential and Backup Differential or Backup Overcurrent, with current inputs from independent Current Transformer (CT). Customer shall install a breaker on the Utility Side of the Step-Up Transformer.

There should be two levels of anti-island protection. If the inverters meet the testing requirements of IEEE-1547.1 and are UL1741 certified, Anti-islanding Direct Transfer Trip will not be required and the inverters themselves have one level of anti-island protection.

The second level of anti-island protection, the intertie relay, could be a SEL-351-7 or similar and provide just the intertie functionality (over and under voltage, over and under frequency and ground overvoltage) but this functionality can be place inside the SEL-351-7s that are used for the fault protection. This relay is to be located on high side of 34.5 kV transformer. Install 3 Phase Potential Transformers (PTs) (Wye Gnd -Wye Gnd) on the 34.5 kV side of existing transformer.

Intertie relaying located on the high side of existing 34.5 kV transformer will need to trip the Solar Generation offline during a fault event on 34.5 kV line and the Solar Generation is feeding the fault. This can be achieved by either tripping a device on high side of the Step-Up transformer or by tripping individual PV strings offline. This tripping can be done via Fiber or microwave communication if preferred.

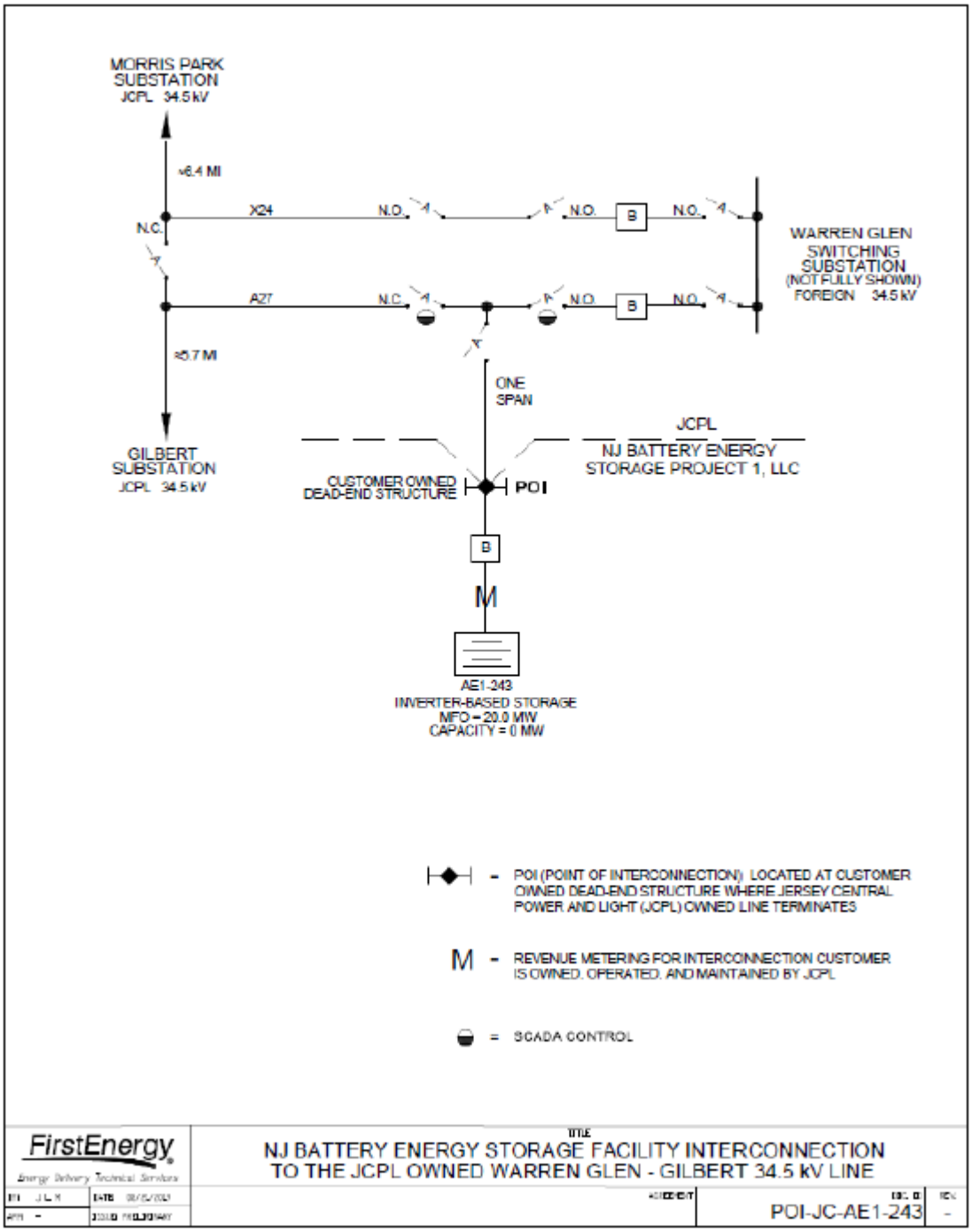
All relays, relay schemes, and relay settings that include 34.5 kV voltages or currents or trip any 34.5 kV circuit breakers shall require the review and approval of FirstEnergy.

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

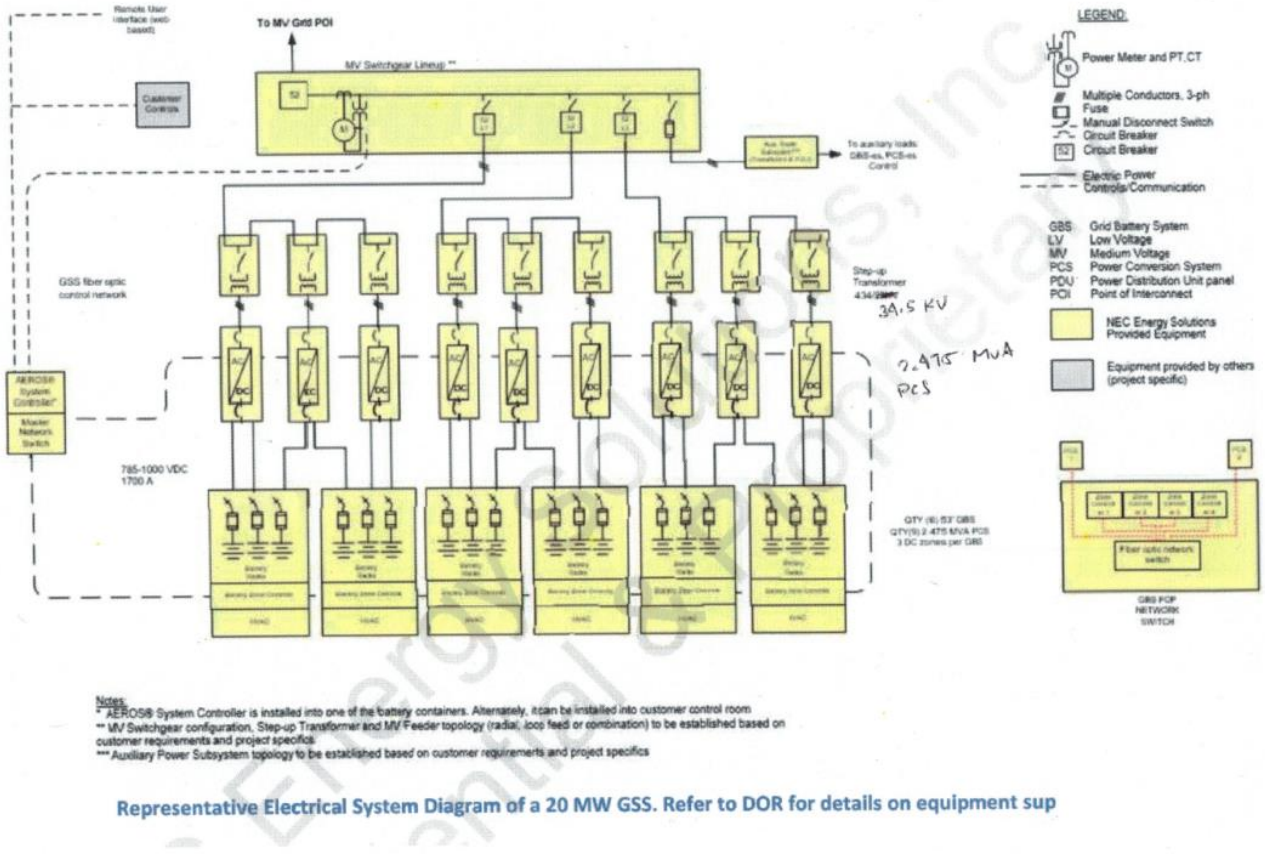
**The customer is solely responsible for protecting its own equipment in such a manner that electrical faults or other disturbances on the FE system do not damage its equipment.**

## Attachment #2: One-Line Diagrams

**FirstEnergy Facilities One-Line**



## IC Facilities One-Line

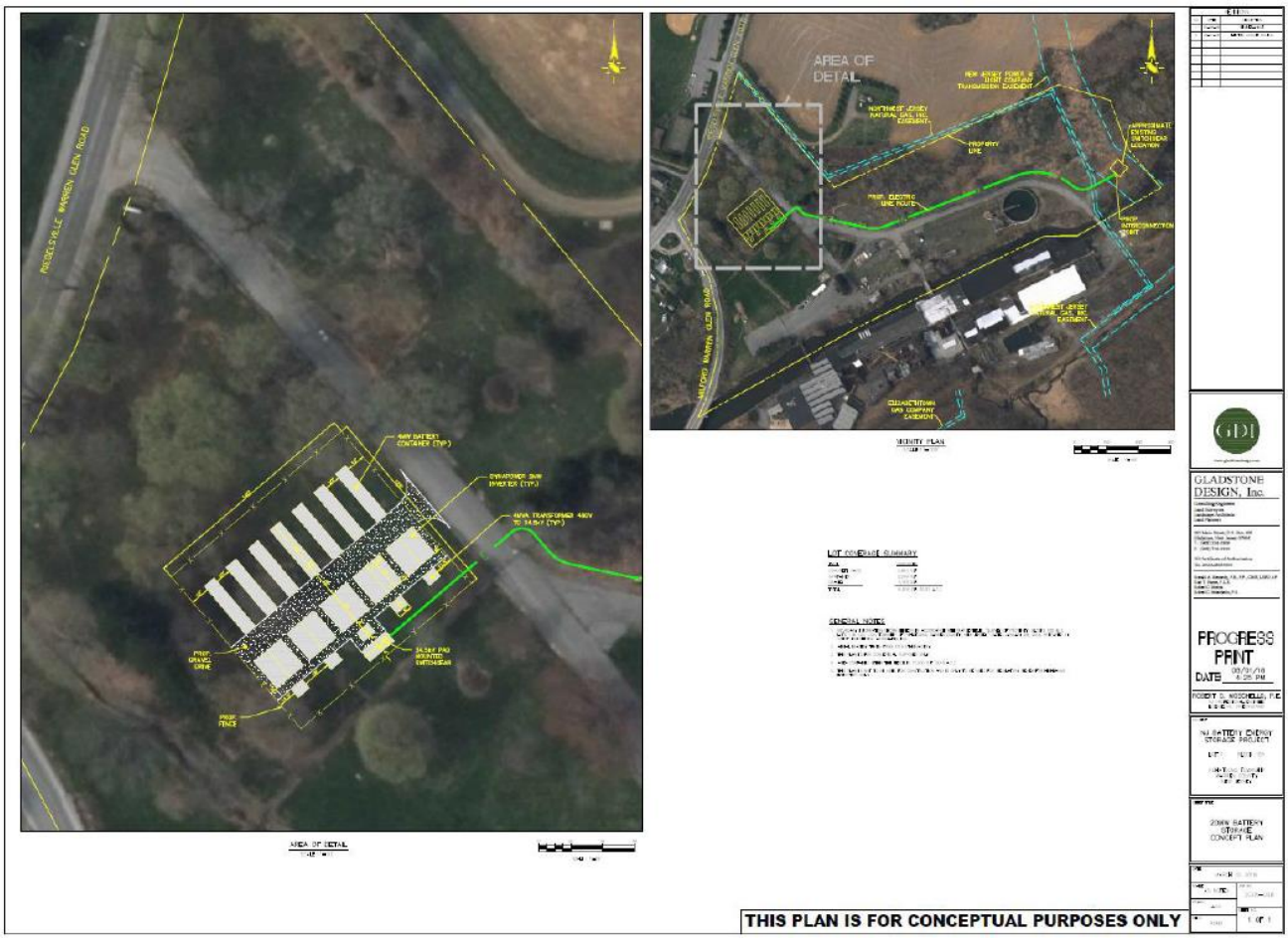



Notes:
* AEROS® System Controller is installed into one of the battery containers. Alternately, it can be installed into customer control room
** MV Switchgear configuration, Step-up Transformer and MV Feeder topology (radial, loop feed or combination) to be established based on customer requirements and project specifics
*** Auxiliary Power Subsystem topology to be established based on customer requirements and project specifics

**Representative Electrical System Diagram of a 20 MW GSS. Refer to DOR for details on equipment sup**

## Attachment #3: Project Site Plan

**IC Site Plan, IC Substation Location and Point of Interconnection to FE**



## Attachment #4: Generation Connection Requirements

# Generation Connection Requirements

The proposed interconnection facilities must be designed in accordance with the Transmission Owner's *Requirements for Transmission Connected Facilities* documents located at either of the following links:

www.firstenergycorp.com/feconnect

www.pjm.com/planning/design-engineering/to-tech-standards.aspx

The following is an excerpt taken from Transmission Owner's *Requirements for Transmission Connected Facilities* document:

*For all generation facilities, other than wind-powered and other non-synchronous generating facilities, the minimum requirement shall be the provision of a reactive power capability sufficient to maintain a composite power delivery at continuous rated power output at a power factor as defined in the table below. This requirement will be measured at either the POI or generator terminals as specified in the table below. These reactive requirements apply to both the initial installation as well as to any incremental change in unit MW capability. FE will coordinate with the Connecting Party to identify the optimal generator step-up transformer tap to make such a capability available when demanded.*

*For all wind-powered or other non-synchronous generating facilities the minimum requirement shall be the provision of a reactive power capability sufficient to maintain a composite power delivery at a power factor as defined in the table. This requirement will be measured at either the POI or generator's terminals as specified in the table below. These reactive requirements apply to both the initial installation as well as to any incremental change in unit MW capability. FE will coordinate with the Connecting Party to identify the optimal generator step-up transformer tap to make such a capability available when needed.*

| Generation Type | New / Increase | Size | Power Factor Requirement | Measurement Location |
|---|---|---|---|---|
| Synchronous | New | > 20 MW | 0.95 leading to 0.90 lagging | Generator's Terminals |
| Synchronous | New | <= 20 MW | 0.95 leading to 0.90 lagging | Point of Interconnection |
| Wind or Non-Synchronous | New | All | 0.95 leading to 0.95 lagging | Point of Interconnection |
| Synchronous | Increase | > 20 MW | 1.0 (unity) to 0.90 lagging | Generator's Terminals |
| Synchronous | Increase | <= 20 MW | 1.0 (unity) to 0.90 lagging | Point of Interconnection |
| Wind or Non-Synchronous | Increase | All | 0.95 leading to 0.95 lagging | Generator's Terminals |

*Any different reactive power requirements that FE and/or PJM determines to be appropriate for wind-powered or other non-synchronous generation facilities will be stated in the applicable interconnection agreement(s).*
*Induction generators and other generators with no inherent VAR (reactive power) control capability, or those that have a restricted VAR capability less than the defined requirements, must provide dynamic supplementary reactive support located at the generation facility with electrical characteristics equivalent to that provided by a similar-sized synchronous generator.*

**Design Requirements**

Developer is responsible for specifying appropriate equipment and facilities such that the parallel generation is compatible with Transmission Owner's Transmission System. Developer is also responsible for meeting any applicable federal, state, and local codes.

**Design Criteria**

Facilities owned and operated by Transmission Owner shall comply with the applicable Transmission Owner technical requirements and standards posted on the PJM website per the PJM Tariff, and the following criteria. Where there are different requirements for the same criterion, the more restrictive shall apply. Developer must abide by any PJM, RFC or NERC criteria imposed that is more restrictive than those of Transmission Owner.

**General Design Requirements**

| | |
|---|---|
| • System phasing (counter clockwise) | 1-2-3 |
| • System frequency: | 60 hertz |
| • Elevation, AMSL: | Less than 1000 meters |
| • ***Isokeraunic level:*** | 40 |
| • Maximum ambient temperature: | 40 degrees C |
| • Minimum ambient temperature: | -40 degrees C |
| • Maximum conductor operating temperature: | Contact Transmission Owner |
| • Wind Loading (round shapes): | Per ASCE 10, per Fig. 250-2B depending on location<br>Per ASCE 7-98, per Fig. 6-1 depending on location |
| • Ice loading – Substations (no wind): | 25 mm |
| • Seismic zone: | Per ASCE Manual 113 Substation Structure Design Manual. Equipment qualification per IEEE 693-2005 and IEE 1527-2006<br>Per ASCE 7-98, per Fig. 9.4.1.1(a) and (b). Equipment qualification per IEEE 693-97 |

**Voltage and Current Ratings**

| | |
|---|---|
| • Nominal phase-to-phase: | 34.5 kV |
| • Maximum phase-to-phase: | 38 kV |
| • Basic impulse level (BIL): | 200 kV |
| • Maximum continuous current carrying capacity: | 2000 A |
| • Design fault current: | 40 kA |

**Clearances and Spacing**

| | |
|---|---|
| • Recommended rigid bus center-to-center phase spacing: | 36" |
| • Minimum phase-to-phase, metal-to-metal distance: | 18" |
| • Recommended phase-to-ground: | 15" |
| • Minimum phase-to-ground: | 13" |
| • Minimum vertical clearance from live parts to grade: | 9'-6" |
| • Minimum horizontal clearance from live parts: | 4'-0" |
| • Minimum bottom of insulator to top of foundation: | 8'-6" |