Generation Interconnection
Facilities Study Report

For

PJM Transmission Interconnection Request
Queue Position AE2-121

"Milesburg – Tanney Junction 46 kV"

March 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

CE-Jacksonville LLC, (hereinafter referred to as "IC") has proposed a new solar generating facility to be located in Zion, Centre County, Pennsylvania. The installed facilities for AE2-121 will have a total Maximum Facility Output (MFO) of 10.64 MW with 6.384 MW of this output being recognized by PJM as Capacity. The generation facility will interconnect with Allegheny Power Systems (APS in the West Penn Power zone), a FirstEnergy Company (FE), hereinafter referred to as "Transmission Owner" (TO), by tapping the Milesburg – Stone Junction 46 kV line and constructing a one span tap.

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 transmission interconnection facility is **December 31, 2023**.

Milestone Schedule:

10/1/2023	Initial Back-feed Date
12/17/2023	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, 46 kV (AE2-121) generator lead line and connection to the tap point on the Milesburg – Stone Junction 46 kV line.

Point of Interconnection (POI): The interconnection of project will be accomplished by tapping the Milesburg – Stone Junction 46 kV line and constructing a one span tap. The transmission line tap will be located approximately 2 miles from Milesburg substation.

IC is required to own, install, and maintain a fully-rated, fault-interrupting circuit breaker on the high-side of the GSU transformer. The protective relaying design must comply with FirstEnergy's applicable standards as well as with PJM requirements.

The IC shall provide and install the mounting structures (or enclosures) and conduits necessary for the FirstEnergy metering installation and shall mount the FirstEnergy instrument transformers unless otherwise agreed to by FirstEnergy.

The easements and associated rights of way for the TO owned substation along with the 46 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 46 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 46 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 46 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 46 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(s) connecting to the FE system shall have a delta or ungrounded-wye winding configuration on the FE side. Additional detailed protection requirements to be provided during the construction stage.

5. Description of Facilities Included in the Facilities Study

Attachment Facilities

- AE2-121 Generator Lead Termination (New connection by tapping the Milesburg – Stone Junction 46 kV Line)
    - On the Milesburg-Tanney Junction 46 kV line, tap pole 727600-WP26 and construct a new 46 kV span using 556 ACSR conductor. Install 46 kV Tap Switch on this span. Provide 46 kV Revenue Meter Package.

Direct Connection

None.

Non-Direct Connection

- Milesburg – Tanney Junction 46 kV Line and tap switches:
  - On the Milesburg-Tanney Junction 46 kV line, construct a new 46 kV tap near pole 727660-WP26 and install 2 – 46 kV MOAB Switches with SCADA control on either side of the tap pole. Includes project management

- Nittany Substation
  - Relay settings changes

- Pleasant Gap Substation
  - Relay settings changes

- Milesburg Substation
  - Relay settings changes

Other

AE2-121 Customer substation drawing review

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:	**$17,600**	**$3,000**	**$20,600**
Total Direct Connection (DC) Costs:	**$ 0**	**$ 0**	**$ 0**
Total Non-Direct Connection (NDC) Costs:	**$451,600**	**$76,100**	**$527,700**
Other	**$30,000**	**$5,100**	**$35,100**
New System Upgrades	**$ 0**	**$ 0**	**$ 0**
TOTAL Costs (ALL Categories)	**$499,200**	**$84,200**	**$583,400**

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

Attachment Facility	*Duration*
AE2-121: 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

Stone Jct (Milesburg – Nittany – Pleasant Gap) 46 kV line

- Tap the Stone Jct (Milesburg-Nittany-Pleasant Gap) 46kV line to provide interconnection facilities approximately 2.3 miles from the Milesburg substation.
- Existing line consists of:
  - 46kV single circuit wood monopoles.
  - Per GIS Viewer, existing line has 556 AA conductor.
- Proposed Tap will consist of the following installations:
  - (1) 46kV single circuit vertical configuration wood tap structure
  - (2) 46kV single circuit vertical configuration wood switch structures
  - 556.5 kcmil ACSR (approximately 500')
    - Note, no existing shield wire is present, it is assumed 3#6 Alumoweld will be used to span into the customer interconnection.
  - Transfer existing conductor to new structures, approximately 2 spans
- The proposed tap will require the following removals:
  - (1) 46 kV single circuit wood tangent structure
- Construction Considerations:
  - Existing configuration of line is horizontal, a phase roll will be required for the vertical configuration tap and vertical configuration switch structures.
- Siting/Licensing
  - A LON will be required to be filed with the PaPUC.
  - Assume no public opposition
- Assumptions
  - Exact location of tap is not yet determined. Once this has been done a detailed engineering analysis shall be conducted.
  - Adjacent structures to new switch structures are adequate to handle new loading. An engineering analysis will need to be conducted to confirm. See attached pdf for propose T-line layout.
  - For construction purposes it is assumed the Stone Jct (Milesburg-Nittany-Pleasant Gap) 46kV line will take an outage. If an outage is not possible, a temporary bypass will be required to do so. Further engineering analysis will be required.
  - It is assumed existing distribution underbuild will be transferred to new structures.

- An aerial LiDAR survey will be required.

ANCILLARY ESTIMATES (LINE)

IT/Network

- Fiber (Relaying and Communications)
  - None
- SCADA/Other
  - (2) MOAB switches with SCADA

Distribution

- Underbuild is present on existing line.

Real Estate

- Assume most work will be performed within the existing line ROW or on the interconnection facility property, new ROW may be required to span from existing line to interconnection facility.
- ROW may be expanded for guying purposes.

Environmental

- Assume minimal social and ecological impacts.
- Access roads are assumed to be needed, approximately 0.25 miles. Substation access roads may be utilized

Forestry

- Clearing may be required; priority tree rights may be expanded.

3. New Substation/Switchyard Facilities

None

4. Substation/Switchyard Facility Upgrades

Nittany Substation

- Below Grade
  - None
- Above Grade
  - None
- R&C
  - Revise relay settings for new interconnect tap.
- Additional Equipment to be Removed
  - None

- Assumptions
  - Relaying was updated under WP-21-190422-090034

Milesburg Substation

- Below Grade
  - None
- Above Grade
  - None
- R&C
  - Revise relay settings for new interconnect tap
- Additional Equipment to be Removed
  - None
- Assumptions
  - Relaying was updated under WP-21-190422-090034

ANCILLARY ESTIMATES (SUBSTATION)

IT/Network

- Fiber (Relaying and Communications)
  - None
- SCADA/Other
  - None

Distribution

- None

Real Estate

- None

Environmental

- None

Revenue Metering

- Revenue metering located at Customer Substation.

5. Telecommunications Facilities – Upgrades

The AE2-121 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

Transmission Owner's Revenue Metering Requirements may be found FirstEnergy Corporation

Requirements for Transmission Connected Facilities dated August 6, 2021 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 shall provide, own, operate, test, and maintain the revenue metering at the Interconnection Customer's expense as specified in Requirements for Transmission Connected Facilities section 12.3.2 and Attachment F.

The meter and associated equipment shall be located on the source side of the customer's fault interrupting device, as close to the POI as possible. Preferably outside of IC station fence.

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 Pennsylvania Public Utility Commission (PaPUC) 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 Pennsylvania Public Utility Commission (PaPUC) 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

Description	Total Cost (w/o Tax)	Tax (if applicable)	Total Cost (w/ Tax)
Attachment Facilities			
AE2-121 Generator Lead Termination (New connection by tapping the Milesburg – Stone Junction 46 kV Line):	$17,600	$3,000	$20,600

On the Milesburg-Tanney Junction 46 kV line, tap pole 727600-WP26 and construct a new 46 kV span using 556 ACSR conductor. Install 46 kV Tap Switch on this span. Provide 46 kV Revenue Meter Package.			
Total Attachment Facilities (AF) Costs	$17,600	$3,000	$20,600
Direct Connect Facilities			
None			
Total Direct Connect (DC) Costs	$ 0	$ 0	$ 0
Non-Direct Connect Facilities			
Milesburg–Tanney Junction 46 kV Line: On the Milesburg-Tanney Junction 46 kV line, construct a new 46 kV tap near pole 727660- WP26 and install 2 – 46 kV Line Switches on either side of the tap pole. Includes project management	$175,300	$29,600	$204,900
Nittany Substation: Relay settings changes	$92,100	$15,500	$107,600
Pleasant Gap Substation: Relay settings changes	$92,100	$15,500	$107,600
Milesburg Substation: Relay settings changes	$92,100	$15,500	$107,600
Total Non Direct Connect (NDC) Costs	$451,600	$76,100	$527,700
Other			
AE2-121 Customer Substation: Customer substation review	$30,000	$5,100	$35,100
Total Other Costs	$30,000	$5,100	$35,100
Total AF + DC + NDC+OTH Costs	$499,200	$84,200	$583,400

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	4
Detailed Engineering	2	4
Equipment Delivery	6	7
Below Grade Construction – Substation	7	9
Below Grade Construction – T-Lines	11	12
Above Grade Construction – Substation	9	13
Above Grade Construction – T-Lines	12	13
Testing & Commissioning	14	14

10. Information Required for Interconnection Service Agreement

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
AE2-121 Generator Lead Termination (New connection by tapping the Milesburg – Stone Junction 46 kV Line): Construct a new 46 kV tap near pole 727660-WP26 using 556 ACSR conductor on the Milesburg - Tanney Junction line. Install 2 – 46 kV Line	$8,200	$4,400	$2,800	$2,200	$17,600

Switches. Install 46 kV Tap Switch. Provide 46 kV Revenue Meter Package.					
Total Attachment Facilities Cost	**$8,200**	**$4,400**	**$2,800**	**$2,200**	**$17,600**
None	$0	$0	$0	$0	$0
Total Direct Connection Cost	**$0**	**$0**	**$0**	**$0**	**$0**
AE2-121 Milesburg–Tanney Junction Line: On the Milesburg-Tanney Junction 46 kV line, construct a new 46 kV tap near pole 727660- WP26 and install 2 – 46 kV MOAB Switches with SCADA control on either side of the tap pole. Includes project management	$85,800	$39,700	$29,800	$20,000	$175,300
Nittany Substation: Relay settings changes	$68,400	$0	$23,700	$0	$92,100
Pleasant Gap Substation: Relay settings changes	$68,400	$0	$23,700	$0	$92,100
Milesburg Substation: Relay settings changes	$68,400	$0	$23,700	$0	$92,100
Total Non-Direct Connection Cost	**$291,000**	**$39,700**	**$100,900**	**$20,000**	**$451,600**
AE2-121 Customer Substation: Customer substation review	$22,300	$0	$7,700	$0	$30,000
Total Other Cost	**$22,300**	**$0**	**$7,700**	**$0**	**$30,000**
Total Project Costs	**$321,500**	**$44,100**	**$111,400**	**$22,200**	**$499,200**

Attachment #1: Protection Study

PROTECTION & RELAY AND COMMUNICATION EQUIPMENT SCOPE

Short Circuit Values at Milesburg – Tanney Junction 46 kV Line

Positive Seq. Impedance = 0.01536 + j0.11013 Ohms
Zero Seq. Impedance = 0.03012 + j0.25668 Ohms
Single Line to Ground Fault Current = 7831 Amps
Three Phase Fault Current = 11289 Amps

Fault values are expressed in current system conditions without the proposed generation. Future changes in fault currents are possible and it's the customer's responsibility to upgrade their equipment and/or protection equipment coordination when necessary.

Remote-End Protection Requirements:

- This scope assumes that the remote-end line protection at Milesburg, Nittany, and Pleasant Gap will have been upgraded as part of the other generator interconnection projects which plan to connect to this line and are further ahead in the PJM Queue, such as AE2-001 or AE2-120. In this case, only a protection study and possible relay setting changes are required. If for any reason the relays are not replaced for these projects prior to AE2-121 going in-service, then the line protection relaying at Milesburg, Nittany, and Pleasant Gap shall be upgraded as part of AE2-121 to new standard non-BES line protection panels with SEL-421 primary, SEL-421 backup, and SEL-501 failure to trip.

Generator Protection Requirements:

- The Interconnection Customer is to design their protective system to clear any faults within their zones of protection with one or more of their local breakers. The fault interrupting device at the point of interconnection shall be a fully rated circuit breaker.
- The Generator Step-Up (GSU) transformer(s) connecting to the FE system shall have a delta or ungrounded-wye winding configuration on the FE side.
- If the inverters associated with this project comply with IEEE 1547 and are UL 1741 certified for anti-islanding, no additional communication equipment is required for anti-islanding transfer trip, as these inverters will de-energize upon loss of the utility source. If the inverters do not comply with IEEE 1547, or are not UL 1741 certified, further analysis will be necessary to determine if anti-islanding communication equipment is required.
- Each zone of protection covering the 46kV portion of the IC's system, the GSU Transformer(s), and the 46kV interconnection breaker, shall be protected by two independent relay schemes meeting the following redundancy requirements. Primary and backup relaying shall use independent CTs, and independent PTs or independent windings from the same PTs. Primary and backup relaying shall not have any common wiring, isolating switches, or auxiliary tripping relays. Redundancy of a protection

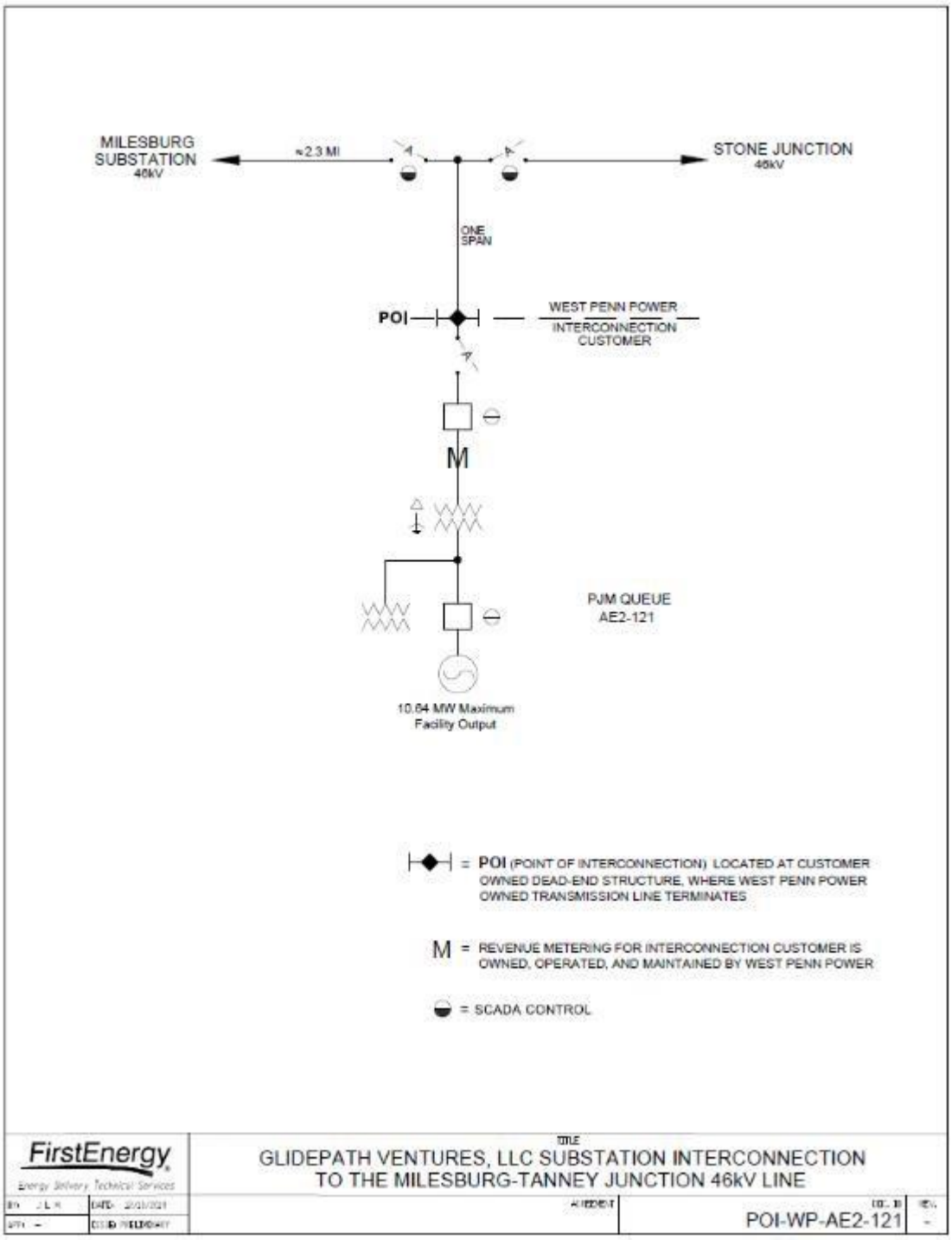
system can be achieved by ensuring that there is no single point of failure between two locally independent primary and backup protection schemes for a given element. Relays from the same manufacturer are acceptable for both the primary and backup schemes.

- A protection scheme containing generator Intertie functions is required, and must be able to provide tripping for the following functions: Overfrequency, Underfrequency, Phase and Zero-Sequence Overvoltage, Phase Undervoltage, Directional Overcurrent, and Directional Power. The current source for the intertie relaying is to be from CTs on the 46kV interconnection breaker. The voltage source for the intertie relaying shall located between the high side of the GSU Transformer and the 46kV interconnection breaker.
- C800 or C400 CTs must be used on the 46kV portion of the IC's system, and the CTs should not saturate for the maximum expected through-fault current at the tap ratio in use.
- The relaying system and interrupting device control circuits shall have a reliable source of power independent from the AC system or immune to AC system disturbance or loss (for example - DC battery and charger) to assure proper operation of the protection scheme.

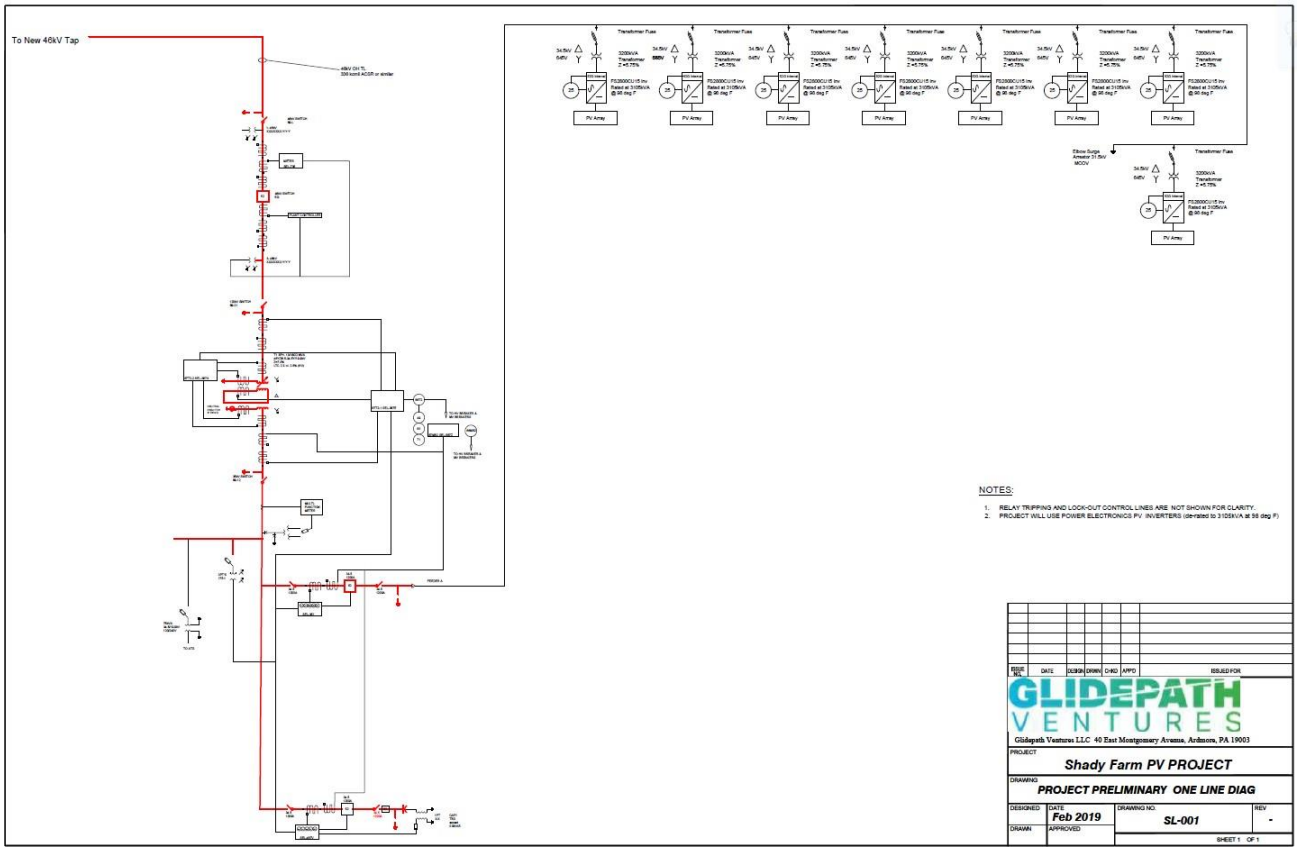
After receipt of the Facilities Study report, the Applicant shall submit to FirstEnergy for review, an updated Single Line Diagram showing the interconnecting transformer winding connections and the relaying associated with the interconnection, to demonstrate adherence to the "Requirements for Transmission Connected Facilities" document and the Protection Requirements provided in the Facilities Study report. The interconnecting customer shall not order equipment prior to FE approval of the updated Single Line Diagram and assumes financial responsibility for equipment ordered prior to approval of the updated Single Line Diagram if not approved for use at the interconnection.

Attachment #2: One-Line Diagrams

FirstEnergy Facilities One-Line



IC Facilities One-Line



Attachment #3: Project Site Plan

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

CE-JACKSONVILLE SOLAR PROJECT SITE PLAN

ISSUE NO.	DATE	DESIGN	DRWN	CHKD	APP'D	ISSUED FOR

GLIDEPATH VENTURES

Glidepath Ventures LLC 40 East Montgomery Avenue, Ardmore, PA 19003

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 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 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:	46 kV
• Maximum phase-to-phase:	48.3 kV
• Basic impulse level (BIL):	250 kV
• Maximum continuous current carrying capacity:	2000 A

- Design fault current: 40 kA

Clearances and Spacing

- Recommended rigid bus center-to-center phase spacing: 48”
- Minimum phase-to-phase, metal-to-metal distance: 21”
- Recommended phase-to-ground: 18”
- Minimum phase-to-ground: 17”
- Minimum vertical clearance from live parts to grade: 9’-10”
- Minimum horizontal clearance from live parts: 4’-4”
- Minimum bottom of insulator to top of foundation: 8’-6”