

***Generation Interconnection
Facilities Study Report***

For

***PJM Transmission Interconnection Request
Queue Position AE1-196***

“Hokes – Jackson 69 kV”

July 2021

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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

Cottontail Solar 8, LLC, (hereinafter referred to as “IC”) has proposed a solar generating facility located in West Manchester Township, York County, Pennsylvania. The installed facilities for AE1-196 will have a total Maximum Facility Output (MFO) of 20 MW with 12.6 MW of this output being recognized by PJM as Capacity. The generation facility will interconnect with Metropolitan Edison (ME), a FirstEnergy Company (FE), hereinafter referred to as “Transmission Owner” (TO), by tapping the Hokes - Jackson 69 (79) kV line and constructing a one-span tap. The transmission line tap will be located approximately 0.02 miles from Hokes substation.

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

The tap location on the Hokes - Jackson (79) 69 kV line was moved from being located approximately 0.72 miles from Hokes substation to being located immediately outside Hokes substation approximately 0.02 miles away. The purpose of this change is to reduce the length of reconductoring required between the tap point and the Hokes 69 kV substation (PJM Network Upgrade # n6182). This change in location has not resulted in material modification since the SIS phase.

Stability and Reactive Power Assessment: The results of the stability analysis showed no instability issues. The project also meets the reactive power requirement at the high side of the facility main transformer.

3. Interconnection Customer's Milestone Schedule

IC's requested Commercial Operation Date (COD) for the generation facility is December 31, 2022. A Project Kickoff meeting must occur as soon as possible to meet Transmission Owner's Assumed Milestone Schedule listed below.

Milestone Schedule:

10/31/2022	Initial Back-feed through Project Substation Date
12/31/2022	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, 69 kV (AE1-196) generator lead line and connection to the tap point on the Hokes – Jackson (79) 69 kV line.

Point of Interconnection (POI): The interconnection of the project will be accomplished by tapping the Hokes – Jackson (79) 69 kV line and constructing a one-span tap. The transmission line tap will be located approximately 0.02 miles from Hokes substation where IC-owned 69 kV attachment line conductor will terminate on the insulators on the dead-end takeoff structure and will be defined as the POI.

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 69 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 69 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 69 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 69 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 69 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 GSU transformer must have a Delta or ungrounded wye connection on the high (utility) side.

5. Description of Facilities Included in the Facilities Study

Attachment Facilities

- AE1-196 Generator Lead Termination (New line tap on Hokes – Jackson 69 kV (79) line)
 - Transmission Owner will design, furnish and be responsible for the installation of one-span of 69 kV line toward the developer's new AE1-196 Interconnection Facility. This work will include, but not be limited to, the rebuild of three (3) existing wood poles, one (1) span (approximately 200 feet) of conductor and shield wire to be installed toward the developer substation.
- AE1-196 Customer Substation
 - Review nameplates, drawings, and add to HV circuit diagram

Direct Connection

- SCADA/ Fiber Communication
 - Installation of two (2) 700 MHz radio systems (70% penetration of FE territory) to support SCADA switch installs.
- Project Management
 - Review of scope regarding Project Management, Commissioning, Environmental, Forestry, Real Estate, and Right of Way.

Non-Direct Connection

- AE1-196 Generator Lead Termination (New line tap on Hokes – Jackson 69 kV (79) line)
 - Transmission Owner will design, furnish and be responsible for the installation of two (2) load-break disconnect switches with SCADA control on the Hokes – Jackson (79) 69 kV line.

- Hokes Substation
 - Upgrade relay settings
- Jackson Substation
 - Upgrade relay settings

Other Work

- AE1-196 Metering
 - Transmission Owner support for Customer-owned revenue metering at the new AE1-196 substation.

New System Upgrades

- Hokes Substation
 - Replace existing Jackson terminal conductor and terminate at existing dead-end structure
 - Rebuild the line from Hokes substation to the proposed AE1-196 customer tap with 795 ACSR (approx. 0.1 miles)
 (PJM Network Upgrade # n6182)

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:	\$ 176,420	\$ 31,120	\$ 207,540
Total Direct Connection (DC) Costs:	\$ 96,600	\$ 17,100	\$ 113,700
Total Non-Direct Connection (NDC) Costs:	\$ 902,980	\$ 159,080	\$ 1,062,060
Other Charges:	\$ 4,600	\$ 900	\$ 5,500
New System Upgrades	\$ 930,500	\$ 163,900	\$ 1,094,400

TOTAL Costs (ALL Categories)	\$ 2,111,100	\$ 372,100	\$ 2,483,200
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7. Summary of the Schedule for Completion of Work for the Facilities Study

<i>Attachment Facility</i>	<i>Duration</i>
AE1-196: Engineering, Procurement, and Construction	15 months

PJM n6182: Engineering, Procurement, and Construction	14 months
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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

Hokes – Jackson (79) 69 kV Line

Tap the Hokes – Jackson (79) 69 kV line outside of Hokes substation at str 79-142. Install disconnect switches with SCADA control and construct (1) span of 69 kV line toward the developer substation.

- The existing line consists of the following:
 - Single circuit wood monopole structures with distribution underbuild
 - Existing conductor is 2/0 Cu, 7 Strand and existing shield wire is unknown.
- The customer tap requires three (3) existing wood poles to be rebuilt and one (1) span (approximately 200') of conductor and shield wire installed towards the developer substation per the following:
 - One (1) 3-way tap structure at structure 79-142.
 - Two (2) wood switch structures at midspan.
 - The conductor assumed for the line tap is 336.4 kcmil ACSR shielded with one (1) 3#6 Alumoweld.
- Siting/Licensing:
 - Assume siting will not be required for 69kV.
- Assumptions:
 - An aerial LiDAR survey of the tap route will be required.
 - Assume OPGW is not needed.
 - Assume the outage requirements for construction on the new line can be met.
 - Switches will be 1200A with SCADA, MOABs, and high-speed whips.
 - Existing conductor and shield wire are sufficient to transfer to new structures.
 - Assume adjacent structures have adequate capacity to handle the new loading. An engineering analysis will be required.
 - Exact location of tap and station is not yet determined. Once this has been completed, a detailed engineering analysis will need to be conducted to confirm.

- Assume there is sufficient clearance to cross over existing distribution.

SCADA Communication

- Install (2) disconnect switches with SCADA control on the Hokes – Jackson (79) 69 kV line

Distribution

- Existing structures have distribution underbuild which will need to be transferred to the new poles.
- 120 V AC supply for transmission switches

Real Estate

- Assume all work will be performed within the existing ROW or on substation property with no additional ROW required.
- A rights and restrictions review by Real Estate will be required.
- Georeferenced ROW extents will be required to be provided to engineering.

Environmental

- Assume an environmental survey will be required to identify any construction constraints or additional permitting requirements.
- Assume some minor access improvements at existing structure locations. Terrain is flat.

Forestry

- Some clearing may be required. Priority tree rights may be expanded.

(PJM Network Upgrade # n6182)

Rebuild the line from Hokes substation to the proposed customer tap near structure 79-142, approximately 0.1 miles, with 795 ACSR

- Existing wire type is unknown but assumed to be 4/0 ACSR.
- Due to increase in wire size, a complete rebuild is assumed for this segment. It appears the existing line was constructed in 1978.
 - (1) tangent to be replaced with new structures
 - (1) deadend to be replaced with new structures
 - The new 3-way tap structure to be installed is assumed to be designed for 795 kcmil 26/7 ACSR conductor and not require replacement.
 - Install 0.1 miles of new 795 kcmil 26/7 ACSR conductor.
 - Install 0.1 miles of new 3#6 Alumoweld.
- Siting/Licensing:
 - No siting required with PaPUC for projects under 100kV.
 - Since rebuild is like-for-like, no public opposition is anticipated.
- Assumptions:
 - Structure types and quantities are assumed and will vary based on exact location of the new tap.
 - OPGW requirements to be confirmed prior to detailed design.

Distribution

- Underbuild is present on the line and will need to be transferred to the new structures.

Real Estate

- All work is assumed to occur within existing ROW. A rights and restrictions review will be required.
- Georeferenced ROW extents will be required to be provided to Engineering.

Environmental

- Approximately 0.1 miles of access roads will be required. Access is along railroad and may be somewhat challenging.

Forestry

- Some clearing may be required. Priority tree rights may be expanded.

3. New Substation/Switchyard Facilities

AE1-196 Interconnecting Substation

- Below Grade
 - None
- Above Grade
 - Review nameplates, drawings, and add to HV circuit diagram
- R&C
 - None
- Additional Equipment to be Removed
 - None
- Assumptions
 - None

Revenue Metering

- Revenue metering located at Customer substation

4. Substation/Switchyard Facility Upgrades

Hokes Substation

- Below Grade
 - None
- Above Grade
 - Update relay settings
 - Replace terminal conductor to exceed TL (138 MVA SN/ 141 MVA SSTE/ 172 MVA WN/ 172 MVA WSTE) (**PJM Network Upgrade # n6182**)
 - Terminate new line conductor on existing dead-end structure (**PJM Network Upgrade # n6182**)
- R&C

- None
- Additional Equipment to be Removed
 - None
- Assumptions
 - None

Jackson Substation

- Below Grade
 - None
- Above Grade
 - Update relay settings
- R&C
 - None
- Additional Equipment to be Removed
 - None
- Assumptions
 - None

SCADA Communication

- Add to EMS screen

5. Telecommunications Facilities – Upgrades

The AE1-196 generation (collector) substation will be connected directly to an existing line (Hokes – Jackson (79) 69 kV 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. IC shall provide Transmission Owner with dial-up communication to the revenue meter.

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 will 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 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)
<u>Attachment Facilities</u>			
AE1-196 Generator Lead Termination: Tap the Hokes-Jackson (79) 69 kV line at structure 79-142 and install one (1) span of 69 kV line to the point of change of ownership with the Interconnection Customer.	\$ 148,320	\$ 26,120	\$ 174,440
AE1-196 Customer Substation: Review nameplates, drawings, and add to HC circuit diagram.	\$ 28,100	\$ 5,000	\$ 33,100
Total Attachment Facilities (AF) Costs	\$ 176,420	\$ 31,120	\$ 207,540
<u>Direct Connect Facilities</u>			

SCADA/Fiber Communication: Estimated installation of (2) 700 MHz radio systems (70% penetration of FE territory) to support SCADA switch installs. Assumed SCADA work is included in this cost. (PJM Network Upgrade Number n7333)	\$ 96,600	\$ 17,100	\$ 113,700
Total Direct Connect (DC) Costs	\$ 96,600	\$ 17,100	\$ 113,700
<u>Non-Direct Connect Facilities</u>			
Hokes-Jackson 69 kV Line Switches: At Hokes-Jackson (79) 69 kV line structure 79-142, install two (2) SCADA controlled disconnect switches, one each on either side of the tap. (PJM Network Upgrade Number n7334)	\$ 593,280	\$ 104,480	\$ 697,760
Project Management: Project Management, Commissioning, Environmental, Forestry, Real Estate, and Right of Way. (PJM Network Upgrade Number n7334)	\$ 137,300	\$ 24,200	\$ 161,500
Hokes Substation: Update relay settings. (PJM Network Upgrade Number n7335)	\$ 86,200	\$ 15,200	\$ 101,400
Jackson Substation: Update relay settings. (PJM Network Upgrade Number n7336)	\$ 86,200	\$ 15,200	\$ 101,400
Total Non Direct Connect (NDC) Costs	\$ 902,980	\$ 159,080	\$ 1,062,060
<u>Other Work</u>			
AE1-196 Metering: Customer-owned revenue metering at Hokes – Jackson 69 kV	\$ 4,600	\$ 900	\$ 5,500
Total Costs (All Categories)	\$ 1,180,600	\$ 208,200	\$ 1,388,800

Network Upgrades:
(PJM Network Upgrade # n6182)

Description	Total Cost (w/o Tax)	Tax (if applicable)	Total Cost (w/ Tax)
Hokes Substation: Replace Jackson terminal conductor at Hokes to exceed TL (138 MVA SN/ 141 MVA SSTE/ 172 MVA WN/ 172 MVA WSTE)	\$ 112,800	\$ 19,900	\$ 132,700
Hokes – Jackson (79) 69 kV Line: Rebuild the line from Hokes substation to the proposed customer tap near structure 79-142, approximately 0.1 miles, with 795 kcmil 26/7 ACSR Drake.	\$ 487,500	\$ 85,800	\$ 573,300
Project Management: Project Management, Commissioning, Environmental, Forestry, Real Estate, and Right of Way.	\$ 330,200	\$ 58,200	\$ 388,400
Total Network Upgrade Costs	\$ 930,500	\$ 163,900	\$ 1,094,400

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 **15 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.

15 month Schedule

Activity	Start Month	End Month
Preliminary Engineering	1	3
Siting, Permits & Real Estate	2	5
Detailed Engineering	2	5
Equipment Delivery	6	7
Below Grade Construction – Substation	7	10
Below Grade Construction – T-Lines	12	13
Above Grade Construction – Substation	10	14
Above Grade Construction – T-Lines	13	14
Testing & Commissioning	15	15

10. Information Required for Interconnection Service Agreement

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
AE1-196 Generator Lead Termination: Tap the Hokes-Jackson (79) 69 kV line at structure 79-142 and install one (1) span of 69 kV line to the point of change of ownership with the Interconnection Customer.	\$ 107,200	\$ 16,980	\$ 23,900	\$ 240	\$ 148,320
AE1-196 Customer Substation: Review nameplates, drawings, and add to HC circuit diagram.	\$ 23,000	\$ 0	\$ 5,100	\$ 0	\$ 28,100
Total Attachment Facilities Cost	\$ 130,200	\$ 16,980	\$ 29,000	\$ 240	\$ 176,420
SCADA/Fiber Communication: Estimated installation of (2) 700 MHz radio systems (70% penetration of FE territory) to support SCADA switch installs. Assumed SCADA work is included in this cost.	\$ 68,200	\$ 13,000	\$ 15,200	\$ 200	\$ 96,600
Total Direct Connection Cost	\$ 68,200	\$ 13,000	\$ 15,200	\$ 200	\$ 96,600
Hokes-Jackson 69 kV Line Tap: Tap the Hokes-Jackson (79) 69 kV line at structure 79-142 and install SCADA controlled disconnect switches on either side of the tap.	\$ 428,800	\$ 67,920	\$ 95,600	\$960	\$ 593,280

Project Management: Project Management, Commissioning, Environmental, Forestry, Real Estate, and Right of Way.	\$ 112,300	\$ 0	\$ 25,000	\$ 0	\$ 137,300
Hokes Substation: Update relay settings.	\$ 70,500	\$ 0	\$ 15,700	\$ 0	\$ 86,200
Jackson Substation: Update relay settings.	\$ 70,500	\$ 0	\$ 15,700	\$ 0	\$ 86,200
Total Non-Direct Connection Cost	\$ 682,100	\$ 67,920	\$ 152,000	\$ 960	\$ 902,980
AE1-196 Metering: Customer-owned revenue metering at Hokes – Jackson 69 kV	\$ 3,800	\$ 0	\$ 800	\$ 0	\$ 4,600
Other Charges	\$ 3,800	\$ 0	\$ 800	\$ 0	\$ 4,600
Total Project Costs	\$ 884,300	\$ 97,900	\$ 197,000	\$ 1,400	\$ 1,180,600

Network Upgrades:
(PJM Network Upgrade # n6182)

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Hokes Substation: Replace Jackson terminal conductor at Hokes to exceed TL (138 MVA SN/ 141 MVA SSTE/ 172 MVA WN/ 172 MVA WSTE)	\$ 88,200	\$ 4,900	\$ 19,700	\$ 0	\$ 112,800
Hokes – Jackson (79) 69 kV Line: Rebuild the line from Hokes substation to the proposed customer tap near structure 79-142, approximately 0.1 miles, with 795 kcmil 26/7 ACSR Drake	\$ 381,600	\$ 20,600	\$ 85,000	\$ 300	\$ 487,500

Project Management: Project Management, Commissioning, Environmental, Forestry, Real Estate, and Right of Way.	\$ 270,000	\$ 0	\$ 60,200	\$ 0	\$ 330,200
Total Network Upgrade Costs	\$ 739,800	\$ 25,500	\$ 164,900	\$ 300	\$ 930,500

Attachment #1: Protection Study

PROTECTION/ RELAY AND COMMUNICATION EQUIPMENT SCOPE

Short Circuit Values

69 kV

Positive Seq. Impedance = $1.12374 + j5.49444\Omega$

Zero Seq. Impedance = $2.13367 + j8.73572\Omega$

Single Line to Ground Fault Current = 5915.17 A

Three Phase Fault Current = 7103.40 A

Fault values are from the current system condition on the 79 Hokes-Jackson 69 kV Line without the proposed generation project and extension of the 79 Hokes-Jackson 69 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 79 Hokes-Jackson 69 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.

Protection Requirements for PV installation on 69 kV Line

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 CT (Current Transformer).

Customer shall install Breaker on the Utility Side of 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 placed inside the SEL-351-7s that are used for the fault protection. This relay is to be located on high side of 69kV transformer. Install 3 Phase PTs [Potential Transformers] (WYE Gnd -WYE Gnd- Broken Delta) on 69kV side of existing transformer.

Intertie relaying located on High side of existing 69kV transformer will need to trip Solar Generation offline during a fault event on 69kV Line and Solar Generation is feeding the fault. This can be achieved by either tripping a device on high side of Step Up transformer or by tripping individual PV strings offline. This tripping can be done via Fiber or microwave communication if preferred.

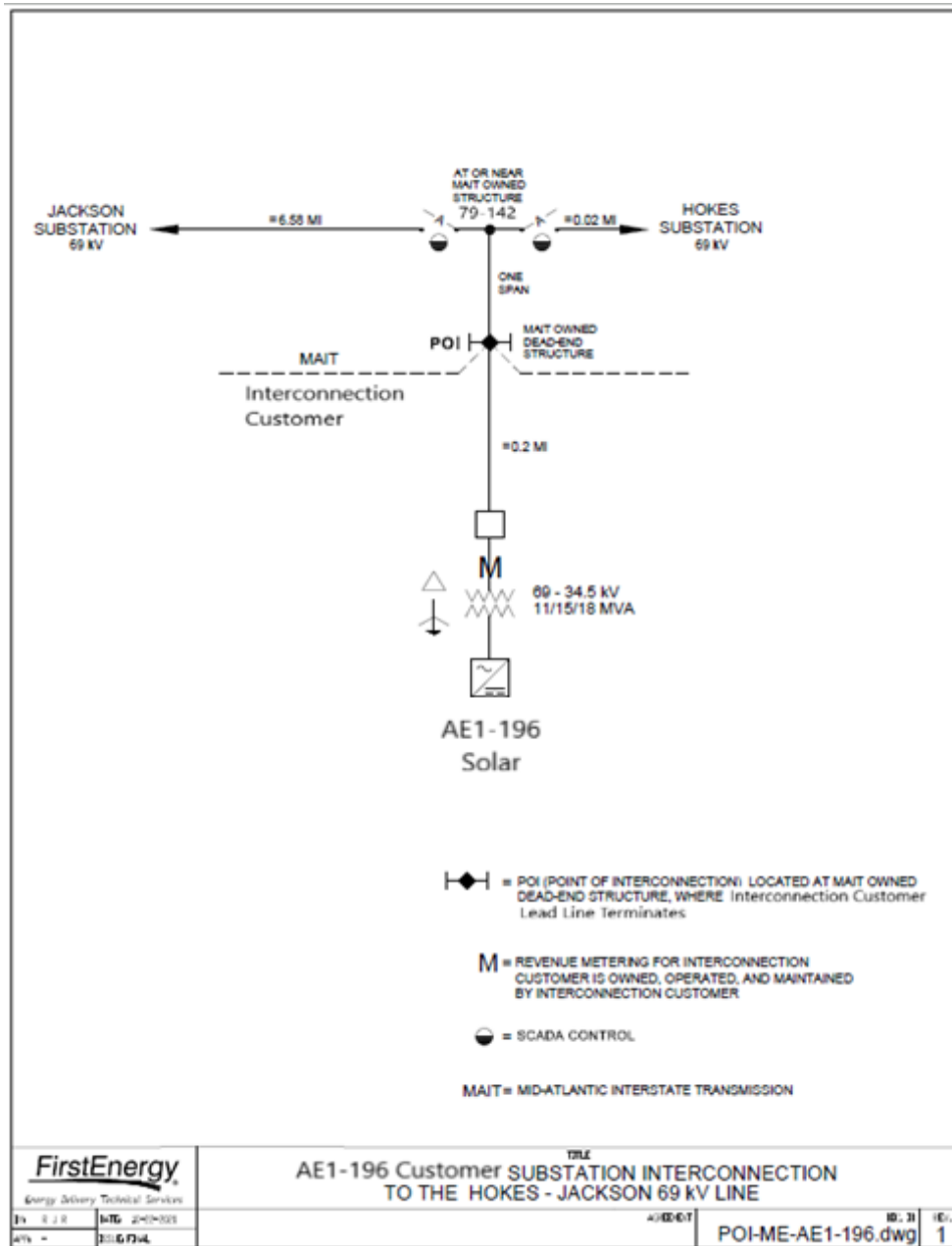
All relays, relay schemes, and relay settings that include 69kV voltages or currents or trip any 69kV circuit breakers shall require the review and approval of FirstEnergy.

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.

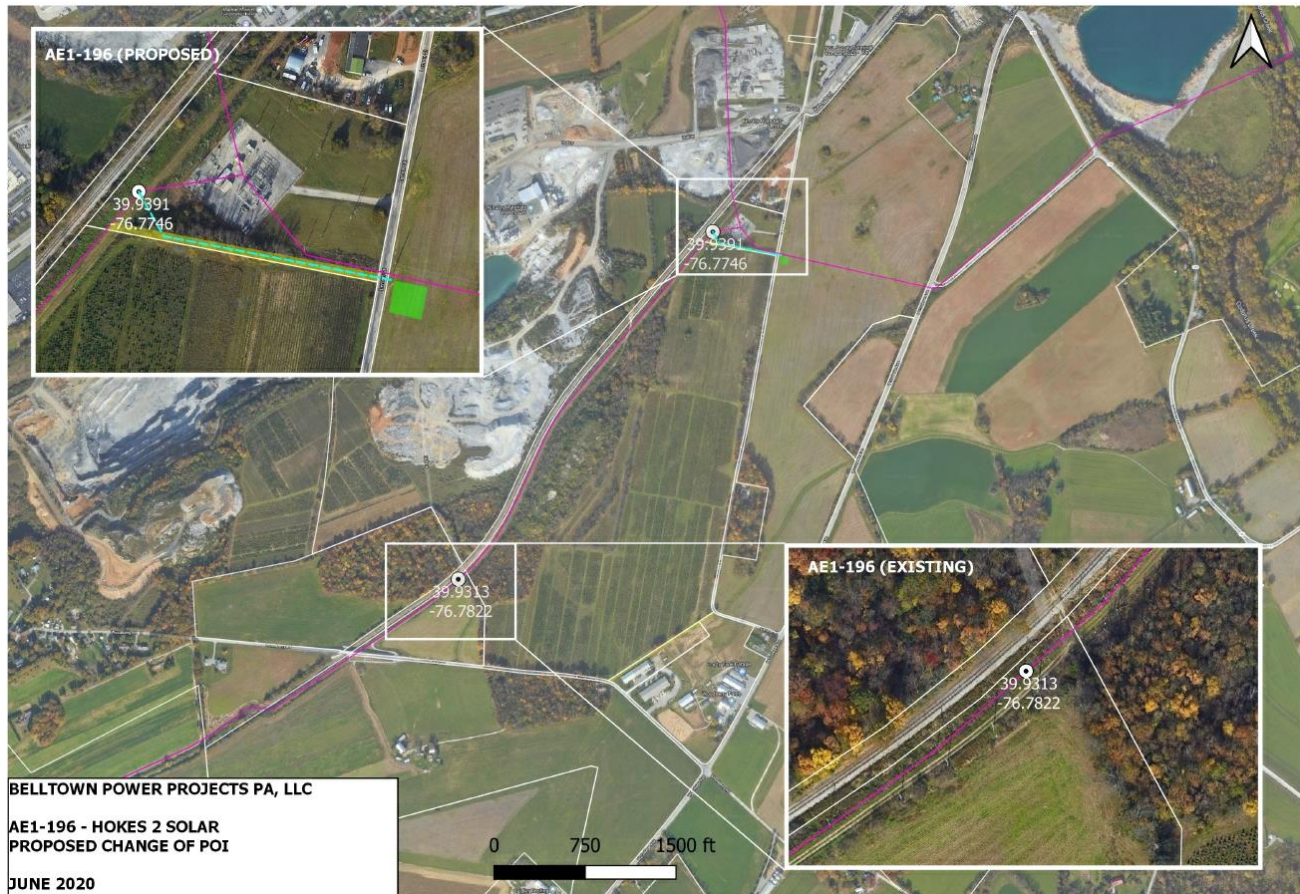
Attachment #2: One-Line Diagrams

FirstEnergy Facilities One-Line



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
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: | 69 kV |
| • Maximum phase-to-phase: | 72.5 kV |
| • Basic impulse level (BIL): | 350 kV |
| • Maximum continuous current carrying capacity: | 2000 A |

- Design fault current: 40 kA

Clearances and Spacing

- Recommended rigid bus center-to-center phase spacing: 60"
- Minimum phase-to-phase, metal-to-metal distance: 31"
- Recommended phase-to-ground: 29"
- Minimum phase-to-ground: 25"
- Minimum vertical clearance from live parts to grade: 10'-5"
- Minimum horizontal clearance from live parts: 4'-11"
- Minimum bottom of insulator to top of foundation: 8'-6"