Generation Interconnection Facilities Study Report

For

PJM Transmission Interconnection Request Queue Position AA1-111/AB1-092/AD2-055

"Moshannon-East Towanda 230 kV"

August 2021

Table of Contents

Contents

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 ("IC"). 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.

The Facility Study estimates attempt to identify the estimated time required to obtain property rights and permits for construction of the required facilities. The IC 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

Renovo Energy Center, LLC, (hereinafter referred to as "Renovo" or "IC") has proposed a natural gas fired combined cycle generating facility located in Clinton County, Pennsylvania. The installed facilities for AA1-111 will have a Maximum Facility Output (MFO) of 463 MW with 463 MW of this output being recognized by PJM as Capacity. The AB1-092 queue position is a 41 MW uprate with 17 MW of this output being recognized by PJM as capacity. The AD2-055 queue position is a 44 MW uprate (35 MW Capacity uprate) to the previous projects. The total installed facilities will have a Maximum Facility Output of 548 MW with 515 MW of this output being recognized by PJM as Capacity. The proposed Commercial Operation Date for this project is June 30, 2025.

Queue	**Maximum Facility Output (MFO)** **(MW)**	**Energy** **(MW)**	**Capacity** **(MW)**
AA1-111	463	463	463
AB1-092	504	41	17
AD2-055	548	44	35
Total	548	548	515

The generation facility will interconnect with Mid-Atlantic Interstate Transmission, LLC (hereinafter referred to as "MAIT", "Transmission Owner" or "TO") a FirstEnergy Company ("FE"), at a newly constructed 230 kV three breaker (a fourth breaker, associated with the 345/230 kV transformer PJM Network Upgrade #n5740 referenced later will be installed concurrently) ring bus substation tapped off of the Marshall - Moshannon 230 kV Line, between the tap points for Lobo (West Penn Power) and Chapman (PPL EU). The new interconnection substation will be connected to the NYISO system (NYSEG is the affected transmission

owner) by looping the Homer City - Mainesburg 345 kV Line (see NYISO queue position Q654) to a new three breaker 345 kV ring bus and a 345/230 kV transformer connected to the aforementioned 230 kV ring bus. The scope of work related to install the 345/230 kV transformer in the 230 kV interconnecting substation, and the 345 kV ring bus to the new interconnecting substation and NYSEG 345 kV lines is included in this report as PJM Network Upgrade n5740.

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

This report is based on the PJM System Impact Study as follows:

- The AA1-111 System Impact Study dated April 2021.
- The AB1-092 System Impact Study dated April 2021
- The AD2-055 System Impact Study dated April 2021.

The Interconnection Customer has elected Option to Build for all the Attachment Facilities and Direct Connection Network Upgrades associated with these queue positions (other than the remote communications upgrades). PJM has determined Network Upgrade n5740 to be a Direct Connection Network Upgrade and is eligible to be included in the Option to Build election.

Looping of the Homer City - Mainesburg 345 kV Line into the AA1-111/AB1-092/AD2-055 345 kV ring bus substation is the responsibility of NYSEG and is not included in this report.

It is assumed that PJM baseline b2767 and supplemental s2053 at Homer City are being performed independently of the scope of work included in this report.

No provisions for the interconnection of NYISO generation queue position Q693 to the 345 kV ring bus are included.

3. Interconnection Customer's Milestone Schedule

IC's AA1-111/AB1-092/AD2-055 Commercial Operation Date (COD) for the generation facility is June 2025.

IC's Requested Milestone Schedule:

- Back feed Power: October 31, 2024
- First Fire: December 31, 2024
- Commercial Operations Date: June 30, 2025

A Project Kickoff meeting must occur by December 1, 2021 to meet these dates.

4. Interconnection 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, 230 kV (AA1-111/AB1-092/AD2-055) generator lead line and connection to the new three breaker ring bus (a fourth breaker, associated with the 345/230 kV transformer PJM Network Upgrade #n5740 referenced later will be installed concurrently) interconnection substation.

Point of Interconnection (POI): The POI will be located within the new 230 kV ring bus interconnection substation where IC-owned 230 kV attachment line conductor will terminate on the insulators on the dead-end takeoff structure and will be defined as the POI. The Marshall-Moshannon 230 kV Line will be cut and looped into the new 345/230 kV interconnect substation. This cut will take place between the Chapman tap and the Lobo tap at approximately 41.34193389 north latitude, 77.76245611 west longitude.

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 land rights for facilities to be owned or turned over to the TO associated with this project will be acquired by the IC and transferred to the TO at no cost. The access road design must be approved by FirstEnergy to ensure it provides adequate access to the substations, 230 kV line taps, and 345 kV tie line 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 230 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 230 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 230 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 230 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.
- The GSU Transformer(s) shall be grounded-wye on the FE Transmission side, and delta on the generator side.
- New or upgraded protective relaying and communications shall be in accordance with "PJM Protection Standards" (PJM Manual 7).
- FirstEnergy Technical Standards and Approved Vendors and Contractors list can be found at https://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy .

5. Description of Facilities Included in the Facilities Study

Attachment Facilities

Interconnection Customer has elected the Option to Build all Attachment Facilities and will design, furnish and construct the new 230 kV line terminal and take off structure. This work will include, but not be limited to, installation of a 230 kV line exit take-off structure, foundations, disconnect switch and associated equipment to accommodate the termination of the 230 kV generator lead line.

Direct Connection Network Upgrades

AA1-111/AB1-092/AD2-055 Three Breaker 230 kV Ring Bus PJM Network Upgrade #n4956

The Interconnection Customer has elected Option to Build for this facility:

- Construct a 230 kV three breaker ring bus near Chapman substation that loops in Marshall-Moshannon 230kV line and provides interconnection facilities to Renovo Energy Center. The POI will be at the TO-owned deadend structure inside the substation yard where the generator lead line terminates. See Section B3 of this report for a detailed scope of work.

Microwave additions PJM Network Upgrade #n6968

- Install microwave tower & MPLS router to facilitate communications backhaul. @ AA1-111/AB1-092/AD2-055 (Interconnection Substation). The Interconnection Customer has elected Option to Build for this facility.
- Install MPLS router, (2) MPR radios, antennas, and new MW shelter at existing PA State owned tower CLEA51 to support communication backhaul. @ CLEA51 (not included in Option to Build, will be FE responsibility)
- Install MPLS, MPR radio and antenna at FE owned CLEA11 MW tower to facilitate communications backhaul. @ CLEA11(not included in Option to Build, will be FE responsibility)

AA1-111/AB1-092/AD2-055 Stability Mitigation PJM Network Upgrade #n5740

The Interconnection Customer has elected Option to Build for these facilities:

- A new 345 kV three breaker ring bus is to be constructed for the stability mitigation for this project with a loop-in of the Homer City - Mainesburg 345 kV line and interconnecting to the 345/230 kV transformer in the interconnection substation. See Section B3 of this report for a detailed scope of work.
- A fourth 230 kV breaker in the ring bus, a 345 kV breaker and a 345/230 kV transformer in the interconnection substation. See Section B4 of this report for a detailed scope of work.
- A 345 kV line between the 345 kV ring bus and the interconnection substation. See Section B1 of this report for a detailed scope of work.

Non-Direct Connection

Marshall - Moshannon 230 kV Line PJM Network Upgrade #n4957

- The Marshall - Moshannon 230 kV Line will be cut and looped into the new interconnection substation. This cut will take place between the Chapman tap and the Lobo tap at approximately 41.341895 north latitude, 77.763578 west longitude.

Moshannon Substation Relaying and Control PJM Network Upgrade #n4959

- Modify substation nameplates and drawings for new AA1-111/AB1-092/AD2-055 interconnection.
- Modify Relay Settings
- Remove anti-islanding relays

Lobo Substation Modifications PJM Network Upgrade #n6969

- Modify substation nameplates and drawings for new AA1-111/AB1-092/AD2-055 interconnection.

Marshall Substation Modifications PJM Network Upgrade #n4958

- Modify nameplates and drawings for new AA1-111/AB1-092/AD2-055 interconnection.
- Modify relay settings

Homer City Substation Modifications PJM Network Upgrade #n5086

- Modify nameplates and drawings for new n5740 345 kV ring bus.
- Relay modifications and PLC tuning
- Potential balancing authority revenue metering modifications

Mainesburg Substation Modifications PJM Network Upgrade #n5087

- Modify nameplates and drawings for new n5740 345 kV ring bus.
- Relay modifications and PLC tuning

Chapman Substation Modifications (PPL) PJM Network Upgrade #n7432

- Revise overcurrent relay settings for 12 kV protection as needed.
- Revise transformer protection settings as needed.

6. Summary of Costs for Transmission Owner Facilities Included in the Facilities Study

The following table summarizes the total estimated costs according to FERC criteria. The estimated costs are in 2021 dollars. This cost excludes a Federal Income Tax Gross Up charges on Contributions in Aid of Construction (CIAC). This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Item	*Total Cost*
Attachment Facilities	$ 0
Direct Connection Facilities	$2,244,911
Non-Direct Connect Facilities	$2,907,322
Other Charges (Oversight)	$2,253,045
Total Cost	$7,405,278

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

To be determined in coordination with the Interconnection Customer Option to Build facilities schedule, which is the critical path regarding scheduling work for this project.

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

345kV Tie Line PJM Network Upgrade #n5740

The Interconnection Customer has elected Option to Build this facility:

- Construct a new 345 kV tie line from the proposed 345/230 kV Substation to the 345 kV ring bus substation, approximately 0.25 miles.
- The line will be designed and constructed by the Interconnection Customer in compliance with FirstEnergy standards. Conductor on the line will be two bundle 954 kcmil 45/7 ACSR, shielded with a single OPGW and a single 7#6 Alumoweld.
- Siting/Licensing
    - A Letter of Notification will be required to be filed with the PA Public Utility Commission.
- Fiber (Relaying And Communications)
    - OPGW from 345/230 kV interconnection substation to the 345 kV ring bus substation
- SCADA/Other
    - None
- Distribution
    - None
- Real Estate
    - New ROW will be required for the new line.
    - A rights and restrictions review by Real Estate will be required.
    - Georeferenced ROW extents will be required to be provided to Engineering.
- Environmental
    - An environmental review will be required to identify any construction constraints or additional permitting requirements.
    - Access roads will be required, approximately 0.3 miles. Terrain is relatively flat.
- Forestry
    - Some clearing will be required.
- Assumptions
    - Exact location of the line is not yet determined. Once this has been completed, a detail engineering analysis will need to be conducted to confirm. See the Attachment 3 for the assumed line layout and overall proposed site layout.
    - The 345kV line loop on the NYSEG Homer City-Mainesburg 345kV line will be constructed by NYSEG and will not affect the construction of this scope of work.
    - Assume the work for the three breaker AA1-111/AB1-092/AD2-055 interconnection substation is complete prior to the start of the work captured in this scope.
    - An aerial LiDAR survey of the project area will be required.

2. Transmission Lines – Upgrade

Marshall - Moshannon 230 kV line PJM Network Upgrade #n4957

The Marshall-Moshannon 230 kV Line will be cut and looped into the new interconnect substation. This cut will take place between the Chapman tap and the Lobo tap at approximately 41.341895 north latitude, 77.763578 west longitude. See Attachment 3 for an IC proposed general arrangement plan. This inclusion of this proposed plan in this report does not constitute FE approval of same.

Scope of work:

- Loop the Marshall-Moshannon 230 kV Line into the proposed AA1-111/AB1-092/AD2-055 230 kV ring bus.
- The existing line is constructed on single circuit wood H-frame structures. The existing conductor is 1033.5 kcmil 54/7 ACSR, shielded with (2) 3/8" 7-strand EHS steel shield wires.
- Proposed conductor will be 1033 ACSS, assumed shield wires are (2) 7#6 Alumoweld on horizontal segments and a single 7#6 Alumoweld on vertical segments on each leg of the loop.
- The line loop is assumed to require the installation of 6 structures, consisting of:
  - (3) single circuit wood 3-pole deadend structures, standard structure TR-230075
  - (3) single circuit steel monopole deadend structures, standard structure TR-230230
- Existing tangent H-frame structures 341 and 342 will be removed and replaced with single circuit wood 3-pole deadend structures, included in the above count.
  - The conductors and shield wires in the span between existing structures 341 and 342 will be removed.
- The combined length of the line loop is approximately 1500'.
- Siting/Licensing
  - A Letter of Notification will be required to be filed with the Pa Public Utility Commission.
  - Assume no local opposition to the project.
  - Assume minimal social and ecological impacts.
- Real Estate
  - New ROW will be required for the new line loop.
  - A rights and restrictions review by FE Real Estate will be required.
  - Georeferenced ROW extents will be required to be provided to FE Engineering.
- Environmental
  - An environmental review will be required to identify any construction constraints or additional permitting requirements.
  - Access roads will be required on the line loop, approximately 0.4 miles. Terrain is rolling hills.
- Forestry
  - Clearing will be required.
- Assumptions
  - Assume existing structures 340A and 343 are in good condition and have adequate capacity for the new loading arrangement. An engineering analysis will be required to confirm.
  - An aerial LiDAR survey of the project area will be required.
  - Assume OPGW is not required.

Homer City–Mainesburg 345 kV line (PJM Network Upgrade Not Applicable)

The Homer City–Mainesburg 345 kV line will be cut and looped into the new interconnect substation. This cut is not in the scope of this report and will be performed by NYSEG.

3. New Substation/Switchyard Facilities

AA1-111/AB1-092/AD2-055 230 kV Interconnection Substation PJM Network Upgrade #n4956

The Interconnection Customer has elected Option to Build for this facility.

A new 230 kV three breaker ring bus substation is to be constructed for this interconnection (a fourth breaker, associated with the 345/230 kV transformer PJM Network Upgrade #n5740 referenced later will be installed concurrently) near Chapman substation that loops in the Marshall–Moshannon 230 kV line and provides interconnection facilities to Renovo Energy Center with the MAIT transmission system. The 230 kV ring bus should be designed for expansion to a six breaker ring bus. The POI will be at the TO-owned deadend structure inside the substation yard where the generator lead line terminates.

Scope of work:

- Below Grade
    - Siting, surveying, grading, ground grid, fence, and stone. Approx 530'x 300'
    - Foundations, conduit, grounding, and trench.
- Above Grade
    - Install three (3) 230 kV 50 kA SF6 circuit breakers
    - Install six (6) 230 kV, 2000 A disconnect switches and structures.
    - Install three (3) 230 kV, 2000 A line MOABs
    - Install nine (9) 230 kV CVTs and structures
    - Install nine (9) 230 kV surge arresters
    - Install two (2) 230 kV, 3000 A wideband line traps, line tuners, and coax
    - Install one (1) prefabricated control building.
    - Install one (1) 230 kV SSVT
    - Three (3) 230 kV dead end H frames
    - One lot of strain conductor, rigid bus, insulators, steel supports, etc.
    - Install future switch stands and use as bus supports
- R&C
    - Install two (2) prewired relaying panels consisting of dual SEL-421, SEL-501 BFT, and SATEC PM 174 to be used for Moshannon and Marshall line exits
    - Install one (1) prewired relaying panel consisting of (1) RFL9785 for DCB, (2) RFL9780 for BFT DTT, (2) Balanced Hybrids & (1) Skewed Hybrid to be used on Moshannon line exit
    - Install two (1) prewired relaying panel consisting of (1) RFL9785 for DCB, (2) RFL9780 for BFT DTT, (1) RFL9780 for Anti-Islanding, (3) Balanced Hybrids & (1) Skewed Hybrid to be used for Marshall line exit
    - Install one (1) prewired relaying panel consisting of dual SEL-411L, SEL-501 BFT, and SATEC PM174 to be used for generator line exit.
    - Install one SCADA RTU, (1) SEL3530 RTAC and Arbiter 1094B GPS Clock
    - Install fiber patch panel.
- Fiber (Relaying And Communications)
    - Fiber communication from interconnect substation to new generation station.
- SCADA/Other
    - New SCADA RTU at interconnect substation.
- Distribution
    - Distribution to provide backup station service.
- Real Estate

    - Required for new substation by developer.
- Environmental
    - Required for new substation.
- Revenue Metering
    - Revenue metering to be located at generation facility
- Additional Equipment To Be Removed
    - None
- Assumptions
    - Access road provided by developer

AA1-111/AB1-092/AD2-055 Stability Mitigation PJM Network Upgrade #n5740

The Interconnection Customer has elected Option to build for this facility.

A new 345 kV three breaker ring bus substation is to be constructed for the stability near the AA1-111/AB1-092/AD2-055 interconnection substation to loop in the Homer City–Mainesburg 345 kV Line and a connection to the 345/230 kV transformer in the AA1-111/AB1-092/AD2-055 interconnection substation. This PJM network upgrade has been expanded to include the scope of work previously considered as NYISO Queue Position Q654.

NYSEG will be responsible for final connections to the Homer City-Mainesburg 345 kV line.

Scope of work:

- Below Grade
    - Foundations, conduit, and grounding for new equipment.
    - Oil containment for new transformer.
- Above Grade
    - Install three (3) 345 kV 50 kA SF6 circuit breakers
    - Install six (6) 345 kV, 3000 A disconnect switches and structures.
    - Install three (3) 345 kV, 3000 A line MOABs
    - Install four (4) 345 kV, 3000 A wideband line traps, line tuners, and coaxial cable, and structures
    - Install nine (9) 345 kV CVTs and structures
    - Install nine (9) 345 kV surge arresters
    - Install three (3) 345 kV A frame dead end
    - One lot of strain conductor, bus supports, rigid bus, etc.
- Relaying & Communications
    - 345 kV line relays and PLC equipment to match Homer City line terminal
    - 345 kV line relays and PLC equipment to match Mainesburg line terminal
    - Install one (1) prewired relaying panel consisting of dual SEL-411L-1, SEL-501 BFT, and SATEC PM174 meter to be used for the 345 kV line to 345/230 kV substation
- SCADA/Other
    - New SCADA RTU.
- Environmental
    - Required for new substation.
- Revenue Metering
    - Revenue metering required at FE to be determined
    - Tie line metering as per PJM Manual 01

- Additional Equipment to be Removed
    - None
- Assumptions
    - All work to be concurrent with 230 kV ring bus build
    - Interconnection Customer has elected Option to Build

4. Substation/Switchyard Facility Upgrades

Moshannon Substation Relaying and Control PJM Network Upgrade #n4959

- Below Grade
    - None
- Above Grade
    - Modify substation nameplates and drawings for new AA1-111/AB1-092/AD2-055 interconnection.
- Relaying & Communications
    - Modify Relay Settings
- Additional Equipment to be Removed
    - (1) RFL9780 for Anti-Islanding
- Additional Assumptions
    - Tuning of carrier equipment may be needed.

Lobo Substation Modifications PJM Network Upgrade #n6969

- Below Grade
    - None
- Above Grade
    - Modify substation nameplates and drawings for new AA1-111/AB1-092/AD2-055 interconnection.
- Relaying & Communications
    - None
- Additional Equipment to be Removed
    - None
- Additional Assumptions
    - None

Marshall Substation Modifications PJM Network Upgrade #n4958

- Below Grade
    - None
- Above Grade
    - Modify nameplates and drawings for new AA1-111/AB1-092/AD2-055 interconnection.
- Relaying & Communications
    - Modify relay settings
- Additional Equipment to be Removed
    - None
- Additional Assumptions
    - Tuning of carrier equipment may be needed.

Homer City Substation Modifications PJM Network Upgrade #n5086

- Below Grade

    - None
- Above Grade
    - Modify nameplates and drawings for new AA1-111/AB1-092/AD2-055 interconnection.
- Relaying & Communications
    - Modify relay settings
- Additional Equipment to be Removed
    - None
- Additional Assumptions
    - Tuning of carrier equipment may be needed.

Mainesburg Substation Modifications PJM Network Upgrade #n5087

- Below Grade
    - None
- Above Grade
    - Modify nameplates and drawings for new AA1-111/AB1-092/AD2-055 interconnection.
- Relaying & Communications
    - Modify relay settings
- Additional Equipment to be Removed
    - None
- Additional Assumptions
    - Tuning of carrier equipment may be needed.

Chapman Substation Modifications PJM Network Upgrade #n7432

- Below Grade
    - None
- Above Grade
    - Modify nameplates and drawings for new AA1-111/AB1-092/AD2-055 interconnection.
- Relaying & Communications
    - Modify relay settings
- Additional Equipment to be Removed
    - None
- Additional Assumptions
    - Tuning of carrier equipment may be needed.

AA1-111/AB1-092/AD2-055 Interconnection Substation Additions -- Install 345-230kV Transformer for Stability Mitigation PJM Network Upgrade #n5740

The Interconnection Customer has elected Option to build for this facility.

At the AA1-111/AB1-092/AD2-055 Interconnection Substation, install one 345/230 kV transformer, one 230 kV breaker in the ring bus, one 345 kV breaker and associated equipment. Scope assumes the AA1-111/AB1-092/AD2-055 Interconnection Substation was constructed for expansion to an ultimate 6 breaker ring bus.

Scope of work:

- Below Grade
    - Foundations, conduit, and grounding for new equipment.
    - Oil containment for new transformer.
- Above Grade

- Install one (1) 230 kV, 50 kA 3000A SF6 circuit breaker
- Install two (2) 230 kV 2000 A manually operated disconnect switches
- Install one (1) 230 kV 2000 A MOAB and support structure.
- Install one (1) 345-230 kV, 336/448/560 MVA transformer.
- Install one (1) 345 kV, 50kA 3000 A SF6 circuit breaker
- Install one (1) 230 kV CVT
- Install three (3) 345 kV CVTs
- Install one (1) 345 kV A frame dead end
- Install one (1) 345 kV 2000 A MOAB
- Install three (3) 345 kV, 209 kV MCOV surge arresters
- One lot of strain conductor, bus supports, rigid bus, etc. for 697/781/870/921MVA SN/SSTE/WN/WSTE loadability.

- Relaying & Communications
  - Install one (1) prewired relaying panel consisting of dual SEL-411L, SEL-501 BFT, and SATEC PM174 meter to be used for the 345 kV line exit
  - Install two (2) prewired relaying panels consisting of SEL-487E, SEL-587, SEL-487B, and SEL-551 to provide transformer protection
  - Install new revenue meter for line that goes to 345 kV ring bus substation
- SCADA/Other
  - Modify SCADA RTU for new relaying and breaker points.
- Environmental
  - Modify SPCC plan for new transformer
- Revenue Metering
  - Revenue metering required at FE to be determined
  - Tie line metering as per PJM Manual 01
- Additional Equipment to be Removed
  - None
- Assumptions
  - All work to be concurrent with 230 kV ring bus build
  - Interconnection Customer has elected Option to Build

5. Telecommunications Facilities – Upgrades

IC will design, provide, install, own and maintain a fiber-optic communications cable between the new interconnection substation, and IC's generation (collector) substation. Two (2) fiber-optic channels are required for each generator protection scheme to obtain high- speed tripping capability for any fault within the zone of protection. Should subsequent/additional PJM studies indicate that stability issues exist, the primary and backup relay fiber-optic communication channels must be in separately routed cable paths and additional fiber-optic connection costs would apply (not included herein).

Microwave additions PJM Network Upgrade #n6968

- Install MW tower & MPLS router to facilitate communications backhaul. @ AA1-111/AB1-092/AD2-055 (Interconnection Substation). The Interconnection Customer has elected Option to Build for this item.

  - Install MPLS router, (2) MPR radios, antennas, and new MW shelter at existing PA State owned tower CLEA51 to support communication backhaul. @ CLEA51 (FirstEnergy scope)

- Install MPLS, MPR radio and antenna at FE owned CLEA11 MW tower to facilitate communications backhaul. @ CLEA11(FirstEnergy scope)

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 Interconnection Customer 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.

Primary and backup Balancing Authority metering will need to be installed at 345 kV per PJM Manual 01.

Communications for transmission line protection between the new interconnection substation, and IC's generation (collector) substation, will be via fiber optics (see "Telecommunication Facilities" section above).

7. Environmental, Real Estate and Permitting

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

See Sections B1, B2, and B3

8. Interconnection Cost Details

The following table provides a breakdown of the costs according to the description of work required to accommodate the requested interconnection. The estimated costs are in 2021 dollars. This cost excludes a Federal Income Tax Gross Up charges (CIAC (Contribution in Aid of Construction)). This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

PJM #	Classification	Description	Total Cost	Direct Labor	Direct Materials	Indirect Labor	Indirect Materials
	Attachment Facilities Total		$0	$0	$0	$0	$0
N4956	Direct Connection Network Upgrade	Security Equipment on 230kV three breaker ring bus. @ PN-S-943G	$688,174	$238,692	$293,582	$51,704	$104,196
N5740	Direct Connection Network Upgrade	Security Equipment on 345kV three breaker ring bus. @ PN-S-2964A	$688,174	$238,692	$293,582	$51,704	$104,196
N6968	Direct Connection Network Upgrade	Install MPLS router, (2) MPR radios, antennas, and new MW shelter at existing PA State owned tower CLEA51 to support communication backhaul. @ CLEA51	$561,319	$257,504	$241,468	$55,779	$6,568
	Direct Connection Network Upgrade	Install MPLS, MPR radio and antenna at FE owned CLEA11 MW tower to facilitate communications backhaul. @ CLEA11	$307,244	$151,140	$120,098	$32,739	$3,267
	Direct Connection Total		**$2,244,911**	**$886,028**	**$948,730**	**$191,926**	**$218,227**
N5087	Non-Direct Connection Network Upgrade	Revise Relay settings at Mainesburg.	$21,666	$17,809	$0	$3,857	$0
N5086	Non-Direct Connection Network Upgrade	Revise Relay settings at Homer City.	$21,666	$17,809	$0	$3,857	$0
N4957	Non-Direct Connection Network Upgrade	Loop the Marshall-Moshannon 230kV line into the proposed AA1-111 substation. @ Marshall-Moshannon 230kV Line Loop	$2,410,728	$1,639,833	$306,796	$355,214	$108,885

N4958	Non-Direct Connection Network Upgrade	Modify substation nameplates and drawings. @Marshall	$57,473	$47,240	$0	$10,233	$0
N4959	Non-Direct Connection Network Upgrade	Modify substation nameplates and drawings. Remove RFL-9780 for anti-islanding. @ Moshannon	$72,876	$54,133	$0	$18,743	$0
N6969	Non-Direct Connection Network Upgrade	Modify substation nameplates and drawings. @ Lobo	$242,339	$180,013	$0	$62,326	$0
N7432	Non-Direct Connection Network Upgrade	Relay setting changes at Chapman (PPL)	$80,574	$67,958	$4,590	$7,491	$535
	Non-Direct Connection Network Upgrade Total		**$2,907,322**	**$2,024,795**	**$311,386**	**$461,721**	**$109,420**
-	Other Charges	OPTION TO BUILD OVERSIGHT: Construct a 230kV three breaker ring bus near Chapman substation that loops in Moshannon – Lobo 230kV line and provides interconnection facilities to Renovo Energy Center.	$729,220	$599,384	$0	$129,836	$0
-	Other Charges	OPTION TO BUILD OVERSIGHT: Install 1-345-230kV transformer, 1-230kV breaker, 1-345kV breaker and associated equipment. @ AA1-111 - 345/230kV Substation	$313,335	$257,547	$0	$55,788	$0
-	Other Charges	OPTION TO BUILD OVERSIGHT: Construct a new tie line from the proposed FE 230 kV AA1-111 ring bus to the proposed FE 345 kV ring bus substation, approximately 0.25 miles.	$527,690	$431,298	$2,189	$93,426	$777
-	Other Charges	OPTION TO BUILD OVERSIGHT: Install a 345kV 3-BKR Ring Bus	$682,800	$561,229	$0	$121,571	$0
	Total Other Charges		**$2,253,045**	**$1,849,458**	**$2,189**	**$400,621**	**$777**
Total			**$7,405,278**	**$4,760,281**	**$1,262,305**	**$1,054,268**	**$328,424**

Classification	**Total Cost**	**Direct Labor**	**Direct Materials**	**Indirect Labor**	**Indirect Materials**
Attachment Facilities	**$0**	**$0**	**$0**	**$0**	**$0**
Direct Connection Network Upgrades	**$2,244,911**	**$886,028**	**$948,730**	**$191,926**	**$218,227**
Non-Direct Connection Network Upgrades	**$2,907,322**	**$2,024,795**	**$311,386**	**$461,721**	**$109,420**
Other	**$2,253,045**	**$1,849,458**	**$2,189**	**$400,621**	**$777**

FirstEnergy reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering facilities, owned by FirstEnergy. These costs will be specified in Schedule E of the Interconnection Service Agreement.

9. Schedules and Assumptions

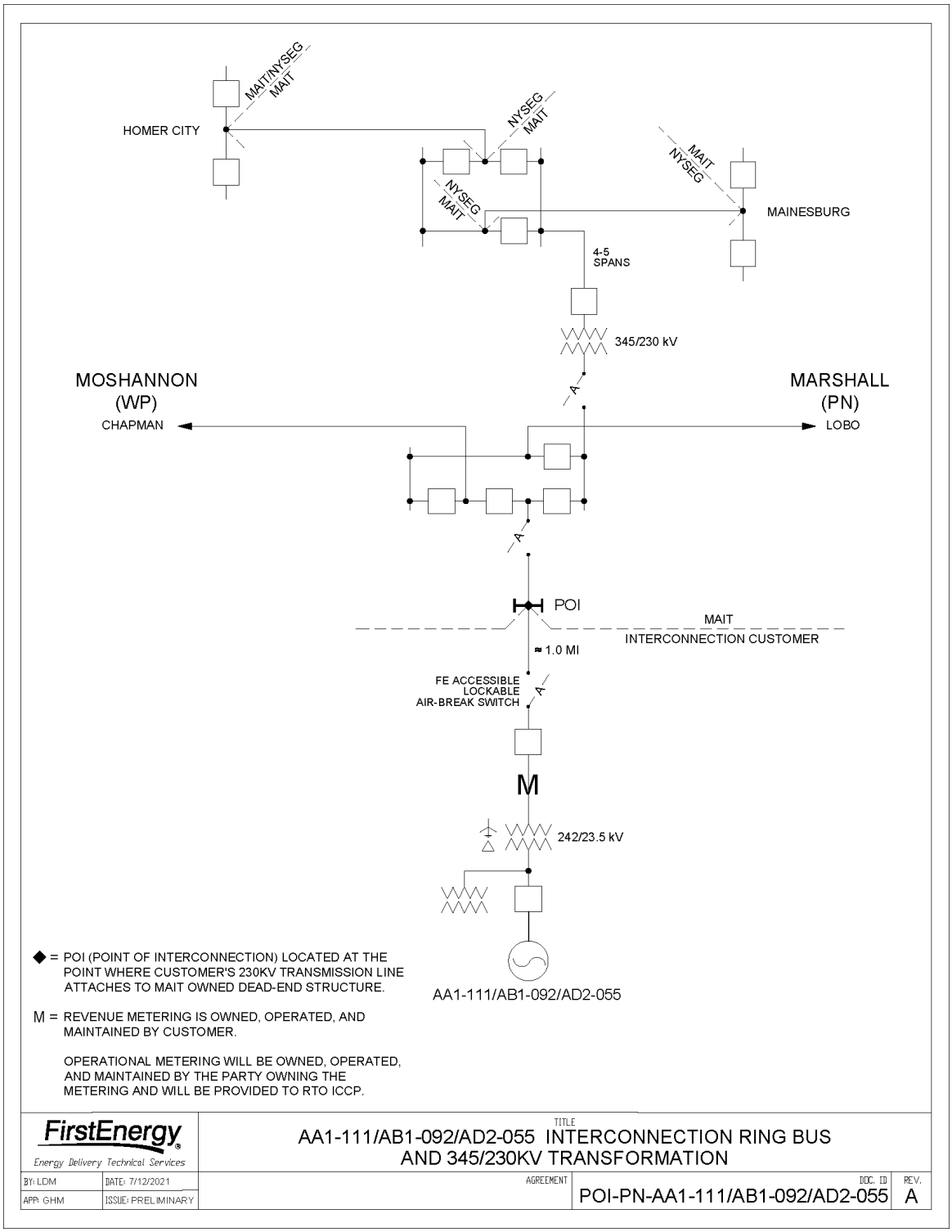
A construction schedule will be determined in coordination with the Interconnection Customer Option to Build facilities schedule, which is the critical path regarding scheduling work for this project.

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.

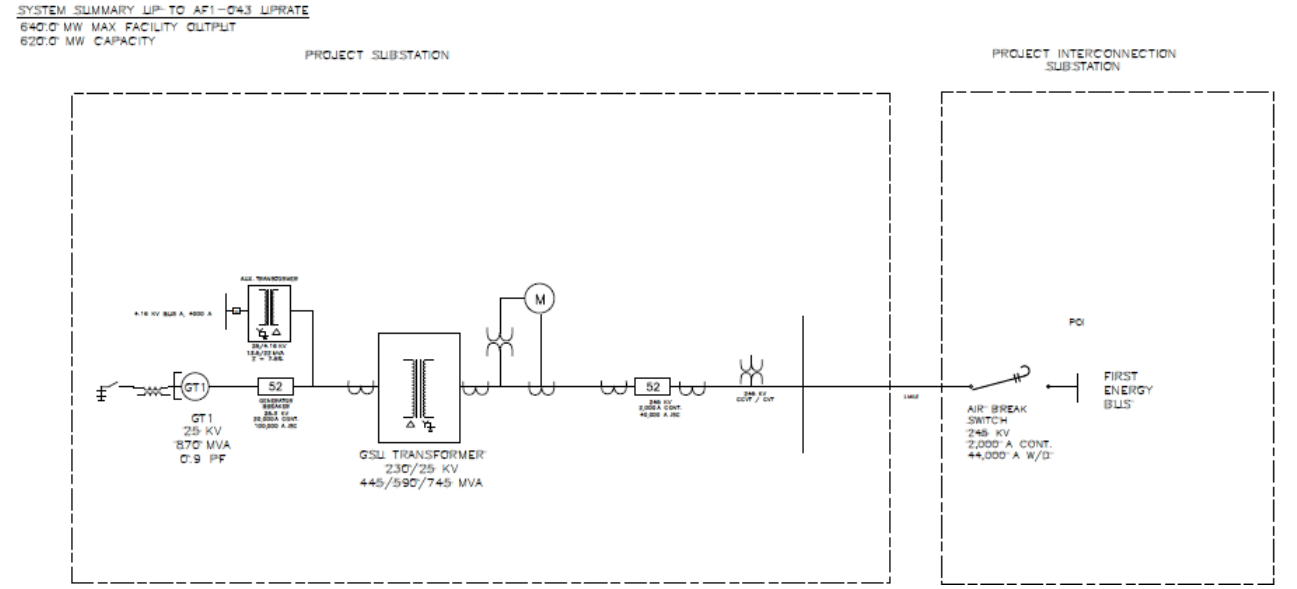
Attachment #1: Reserved

Attachment #2: One-Line Diagrams

AA1-111/AB1-092/AD2-055 Direct Connection Facilities One-Line

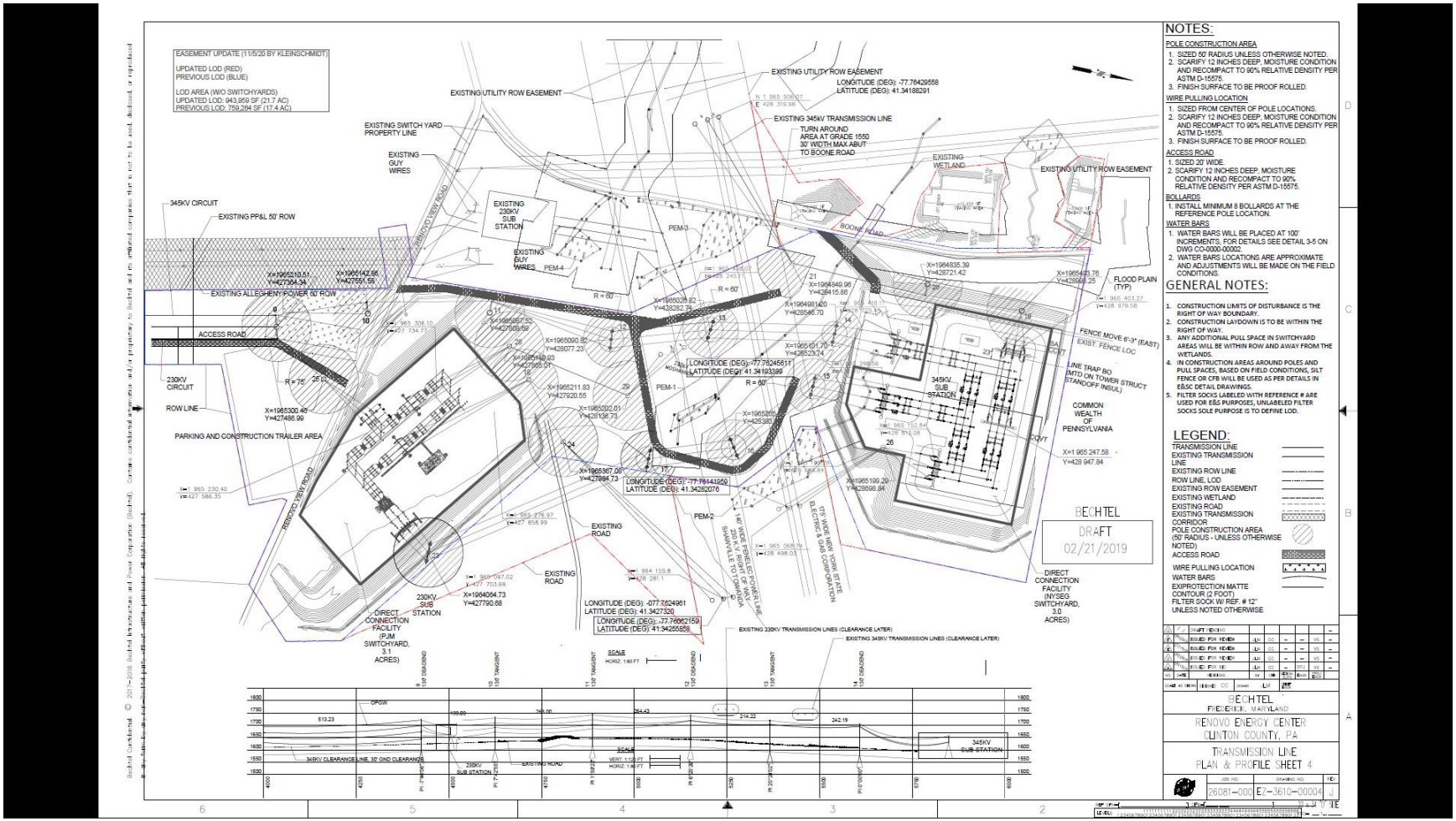


IC Facilities One-Line
Not Approved for Construction



Attachment #3: Project Site Plan

IC Site Plan, IC Substation Location and Point of Interconnection to FE
Not Approved for Construction



Attachment #4: Generation Connection Requirements

Generation Connection Requirements

FirstEnergy Technical Standards and Approved Vendors and Contractors list can be found at https://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy .