Generation Interconnection

REVISED System Impact Study Report

for

Queue Project AE2-224

BEAR ROCK-JOHNSTOWN 230 KV

60 MW Capacity / 100 MW Energy

March 2022

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1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact Study Agreement between CPV Maple Hill Solar, LLC, the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is Mid-Atlantic Interstate Transmission Inc. ("MAIT" – Penelec zone).

2 Preface

The intent of the System Impact 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 possibility of sharing the reinforcement costs with other projects may be identified in the Feasibility Study, but the actual allocation will be deferred until the System Impact Study is performed.

The System Impact Study estimates do not include the feasibility, cost, or 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.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

An Interconnection Customer with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Cambria County, Pennsylvania. The installed facilities will have a total capability of 100 MW with 60 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is September 1, 2021. This study does not imply a TO commitment to this in-service date.

Queue Number	**AE2-224**
Project Name	BEARROCK-JOHNSTOWN 230 KV
Interconnection Customer	CPV Maple Hill Solar, LLC
State	PA
County	Cambria
Transmission Owner	MAIT - PENELEC
MFO	100
MWE	100
MWC	60
Fuel	Solar
Basecase Study Year	2022

3.1 Point of Interconnection

The interconnection of the project to the MAIT system will be accomplished by constructing a new 230 kV three (3) breaker ring bus substation and looping the Bear Rock - Johnstown 230 kV line into the new station. The new substation will be located approximately 15 miles from Johnstown substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed three-breaker ring bus site. The project will also require Non-Direct Connection upgrades at Altoona, Bear Rock, Lewistown, and Raystown substations.

Attachment 1 shows a one-line diagram of the proposed primary Direct Connection facilities for the AE2-224 generation project to connect to the FirstEnergy ("FE") transmission system. **Attachment 2** provides the proposed location for the point of interconnection. IC will be responsible for constructing the facilities on its side of the POI, including the Attachment Facilities which connect the generator to the FE transmission system's Direct Connection facilities.

3.2 Cost Summary

The AE2-224 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$294,800
Direct Connection Network Upgrade	$7,090,100
Non Direct Connection Network Upgrades	$2,034,700
System Upgrades	$0
Total Costs	**$9,419,600**

The costs provided above exclude the Contribution in Aid of Construction ("CIAC") Federal Income Tax Gross Up charge. If, at a future date, it is determined that the CIAC Federal Income Tax Gross Up charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

The required Attachment Facilities and Direct and Non-Direct Connection work for the interconnection of the AE2-224 generation project to the FE Transmission System is detailed in the following sections. The associated one-line with the generation project Attachment Facilities and the Primary Direct and Non-Direct Connection facilities are shown in Attachment 1.

Note: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. The allocation of costs for a network upgrade will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.

4 Transmission Owner Scope of Work

The interconnection of the project to the MAIT system will be accomplished by constructing a new 230 kV three (3) breaker ring bus substation and looping the Bear Rock - Johnstown 230 kV line into the new station. The new substation will be located approximately 15 miles from Johnstown substation. The IC will be responsible for acquiring all easements, properties, and permits that may be required to construct both the new interconnection switching station and the associated facilities. The IC will also be responsible for the rough grade of the property and an access road to the proposed three-breaker ring bus site. The project will also require Non-Direct Connection upgrades at Altoona, Bear Rock, Lewistown, and Raystown substations.

4.1 Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Install 230 kV terminal at new interconnection substation for the AE2-224 generator lead line.	$242,700
Review drawings and provide nameplates for customer's substation.	$52,100
Total Attachment Facility Costs	**$294,800**

4.2 Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Construct new three-breaker 230 kV ring bus interconnection substation.	$6,408,900
Project Management, Environmental, Forestry, and Real Estate	$681,200
Total Direct Connection Facility Costs	**$7,090,100**

4.3 Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Loop the Bear Rock – Johnstown 230 kV line into the new interconnection substation.	$699,400
Install anti-islanding equipment at Altoona substation.	$233,600

Description	Total Cost
Install anti-islanding equipment at Bear Rock substation.	$357,700
Install anti-islanding equipment at Lewistown substation.	$356,100
Install anti-islanding equipment at Raystown substation.	$262,800
SCADA upgrades associated with work at remote substations.	$125,100
Total Non-Direct Connection Facility Costs	**$2,034,700**

5 Schedule

Based on the scope of work for the Attachment Facilities and the Direct and/or Non-Direct Connection facilities, it is expected to take a minimum of **20 months** after the signing of an Interconnection Construction Service Agreement to complete the installation. This includes the requirement for the IC to make a preliminary payment that compensates FE for the first three months of the engineering design work that is related to the Attachment Facilities and Direct Connection work. Full initial deposit is required for the Non-Direct Connection work. This assumes that there will be no environmental issues with any of the new properties associated with this project, that there will be no delays in acquiring the necessary permits for implementing the defined interconnection work, and that all transmission system outages will be allowed when requested.

The schedule for the required Network Impact Reinforcements will be more clearly identified in future study phases. The estimate elapsed time to complete each of the required reinforcements is identified in the "System Reinforcements" section of the report.

6 Transmission Owner Analysis

6.1 Power Flow Analysis

FE performed an analysis of its underlying transmission <100 kV system. The AE2-224 project did not contribute to any overloads on the FE transmission <100 kV system.

7 Interconnection Customer Requirements

7.1 System Protection

The IC must design its Customer Facilities in accordance with all applicable standards, including the standards in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx.

Preliminary protection requirements will be provided as part of the Facilities Study. Detailed protection requirements will be provided once the project enters the construction phase.

7.2 Compliance Issues and Interconnection Customer Requirements

The proposed Customer Facilities must be designed in accordance with FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx. In particular, the IC is responsible for the following:

1. The purchase and installation of a fully rated 230 kV circuit breaker to protect the AE2-224 generator lead line. A single circuit breaker must be used to protect this line; if the project has several GSU transformers, the individual GSU transformer breakers cannot be used to protect this line.

2. The purchase and installation of the minimum required FE generation interconnection relaying and control facilities. This includes over/under voltage protection, over/under frequency protection, and zero sequence voltage protection relays.

3. The purchase and installation of supervisory control and data acquisition ("SCADA") equipment to provide information in a compatible format to the FE Transmission System Control Center.

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

5. The execution of a back-up service agreement to serve the customer load supplied from the AE2-224 generation project metering point when the units are out-of-service. This assumes the intent of the IC is to net the generation with the load.

The IC will also be required to meet all PJM, ReliabilityFirst, and NERC reliability criteria and operating procedures for standards compliance. For example, the IC will need to properly locate and report the over and under voltage and over and under frequency system protection elements for its units as well as the submission of the generator model and protection data required to satisfy the PJM and ReliabilityFirst audits. Failure to comply with these requirements may result in a disconnection of service if the violation is found to compromise the reliability of the FE system.

7.3 Power Factor Requirements

The IC shall design its non-synchronous Customer Facility with the ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.95 lagging (supplying VARs) measured at the high-side of the facility substation transformer(s) connected to the FE transmission system.

8 Revenue Metering and SCADA Requirements

8.1 PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

8.1.1 Meteorological Data Reporting Requirement

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

8.2 FirstEnergy Requirements

The IC will be required to comply with all FE revenue metering requirements for generation interconnection customers which can be found in FE's "Requirements for Transmission Connected Facilities" document located at: http://www.pjm.com/planning/design-engineering/to-tech-standards/private-firstenergy.aspx.

9 Network Impacts

The Queue Project AE2-224 was evaluated as a 100.0 MW (Capacity 60.0 MW) injection at the tap of the Johnstown to Bear Rock 230 kV line in the PENELEC area. Project AE2-224 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AE2-224 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Load Flow

10 Generation Deliverability

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

None.

11 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None.

12 Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

#	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
1	200763	26BLAIRSVL	138.0	PENELEC	235253	01SOCIAL	138.0	AP	1	PJM_P1_APS_B_G692	Single	287	117.23	118.49	AC	3.97
2	200763	26BLAIRSVL	138.0	PENELEC	235253	01SOCIAL	138.0	AP	1	Base Case	Single	225	106.96	108.56	AC	3.6
3	938380	AE1-071 TAP	115.0	PENELEC	200520	26ROXBURY	115.0	PENELEC	1	PL:10:P22:100582	bus	160.0	117.11	119.82	AC	5.28

13 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

#	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKTID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC| DC	MW IMPACT
1	200740	26BLAIRSVL	138.0	PENELEC	200763	26BLRSVLE	115.0	PENELEC	1	PN-P1_2-PN-230-0103	Operation	364	97.87	100.09	AC	9.49
2	200763	26BLAIRSVL	138.0	PENELEC	235253	01SOCIAL	138.0	AP	1	PN-P1_2-PN-230-0103	Operation	287	121.43	124.24	AC	9.49
3	200763	26BLAIRSVL	138.0	PENELEC	235253	01SOCIAL	138.0	AP	1	Base Case	Operation	287	115.23	117.50	AC	5.99
4	200767	26HOMER CT	230.0	PENELEC	200795	26SHELOCTA	230.0	PENELEC	1	AP-P1-2-WP-345-311T	Operation	287	110.51	113.50	AC	26.87
5	200767	26HOMER CT	230.0	PENELEC	200795	26SHELOCTA	230.0	PENELEC	1	Base Case	Operation	287	102.28	105.52	AC	23.2

14 System Reinforcements

#	Index	Facility	Upgrade Description	Cost	AE2-224 Allocation	NUN
1,2	1	26BLAIRSVL 138.0 kV - 01SOCIAL 138.0 kV Ckt 1	APS Project ID: b3007.1 Reconductor the Blairsville East to Social Hall 138 kV line and upgrade terminal equipment - AP portion. 4.8 miles total. The new conductor will be 636 ACSS replacing the existing 636 ACSR conductor. At Social Hall, meters, relays, bus conductor, a wavetrap, circuit breaker and disconnects will be replaced. PENELEC Project ID: b3007.2 Reconductor the Blairsville East to Social Hall 138 kV line and upgrade terminal equipment - PENELEC portion. 4.8 miles total. The new conductor will be 636 ACSS replacing the existing 636 ACSR conductor. At Blairsville East, the wave trap and breaker disconnects will be replaced. **MVA Rating required for AE2-224 = 341 MVA SE** Time Estimate: Both baseline projects are 'Pending Resolution' baselines originally identified for generator deactivations that have since withdrawn. AE2-224 is an eligible queue project that can take advantage of these baseline projects even though they are currently on hold. During the RTEP process these baselines may be identified as adequate solutions or replaced with a new solution that mitigates violations seen in the RTEP analysis. Note: Although Queue Project AE2-224 may not have cost responsibility for these upgrades, Queue Project AE2-224 may need these upgrades in-service to be deliverable to the PJM system. If Queue Project AE2-224 desires to come into service prior to completion of the upgrades, Queue Project AE2-224 will need an interim study.	$4,420,000 & $7,000,000	$0	b3007.1 & b3007.2
3	2	AE1-071 TAP 115.0 kV - 26ROXBURY 115.0 Ckt 1	**Reinforcement scope, cost and schedule will be determined via the 2022 RTEP process.** **MVA Rating required for AE2-224 = 192 MVA SE** **Note: Although Queue Project AE2-224 may not have cost responsibility for this upgrade, Queue Project AE2-224 may need this upgrade in-service to be deliverable to the PJM system. If Queue Project AE2-224 desires to come into service prior to completion of the upgrade, Queue Project AE2-224 will need an interim study.**	Determined by RTEP	$0	New Baseline Upgrade
			TOTAL COST	**Determined by RTEP**	**$0**	

15 Flow Gate Details

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact. It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

15.1 Index 1

(PENELEC - AP) The 26BLAIRSVL-01SOCIAL 138 kV line (from bus 200763 to bus 235253 ckt 1) loads from 108.74% to 109.9% (AC power flow) of its emergency rating (287 MVA) for the single line contingency outage of 'PN-P1_2-PN-230-0103'. This project contributes approximately 3.56 MW to the thermal violation.

CONTINGENCY 'PN-P1_2-PN-230-0103' /* SHELOCTA - KEYSTONE 230 KV LINE
OPEN BRANCH FROM BUS 200795 TO BUS 200810 CKT 1 /* 26SHELOCTA 230.00 26KEYSTONE 230.00
END

Bus Number	*Bus Name*	*Full Contribution*
200812	*26ALY HYDR*	*0.21*
200886	*26ARWF_N39*	*0.23*
200890	*26BF_G21_K23*	*0.07*
200503	*26C.SLOPE*	*11.15*
200915	*26CHSTN_FL*	*0.16*
200805	*26COLVER13*	*17.01*
202158	*26CON.GEN1*	*0.12*
202160	*26CON.GEN2*	*0.14*
200891	*26CSLMN_L13*	*0.1*
200945	*26CT_V3-030*	*0.11*
200846	*26FORWARD*	*0.1*
200888	*26HIGHLAND*	*0.23*
200837	*26HOMER C1*	*10.49*
200838	*26HOMER C2*	*8.53*
200839	*26HOMER C3*	*9.03*
200636	*26IUP CO-G*	*0.48*
200892	*26LOOKOUT*	*0.1*
203034	*26NA_O38_P22*	*0.2*
200649	*26PENNTECH*	*0.36*
200905	*26Q36*	*0.13*
200925	*26R32*	*0.26*
202225	*26SCI_S29B*	*0.04*
200833	*26SEWRDB34*	*8.28*
200913	*26SHAW-D*	*0.06*
200715	*26SHAWVL 1*	*1.15*
200722	*26SHAWVL 2*	*1.18*
200665	*26SHAWVL 3*	*1.44*
200666	*26SHAWVL 4*	*1.4*
200809	*26SITHE*	*0.61*
200889	*26STNY CRK*	*0.17*
200852	*26WARR RDG*	*0.06*
200813	*26YOUGH*	*0.05*
936851	*AD2-108*	*-0.74*
936991	*AD2-133 C*	*1.56*
938351	*AE1-053*	*0.84*

938951	*AE1-123*	*0.91*
938991	*AE1-128 C*	*7.89*
940861	*AE2-074 C*	*0.87*
941191	*AE2-113 C*	*3.51*
941231	*AE2-117 C*	*0.76*
941241	*AE2-118 C*	*0.76*
941321	*AE2-126 C*	*0.74*
941331	*AE2-129 C*	*0.95*
941351	*AE2-131 C*	*0.95*
942121	*AE2-224 C*	*5.69*
942361	*AE2-249 C*	*1.09*
942511	*AE2-264 C*	*3.56*
LTF	*BLUEG*	*3.77*
LTF	*CALDERWOOD*	*0.38*
LTF	*CANNELTON*	*0.23*
LTF	*CATAWBA*	*0.23*
LTF	*CBM-N*	*1.66*
LTF	*CHEOAH*	*0.35*
LTF	*COFFEEN*	*0.39*
LTF	*COTTONWOOD*	*1.5*
LTF	*DUCKCREEK*	*0.85*
LTF	*EDWARDS*	*0.39*
LTF	*FARMERCITY*	*0.26*
LTF	*G-007A*	*2.08*
LTF	*GIBSON*	*0.15*
LTF	*HAMLET*	*0.36*
292340	*K-022*	*0.01*
LTF	*NEWTON*	*1.02*
LTF	*NYISO*	*7.22*
LTF	*PRAIRIE*	*1.89*
LTF	*SMITHLAND*	*0.15*
LTF	*TILTON*	*0.47*
LTF	*TRIMBLE*	*0.42*
LTF	*TVA*	*1.24*
LTF	*UNIONPOWER*	*0.55*
LTF	*VFT*	*5.75*
913141	*Y1-033 C OP1*	*0.05*
916201	*Z1-069 C*	*0.11*
931091	*AB1-160 C*	*0.03*

15.2 Index 2

(PENELEC - PENELEC) The AE1-071 TAP-26ROXBURY 115 kV line (from bus 938380 to bus 200520 ckt 1) loads from 117.11% to 119.82% (AC power flow) of its emergency rating (160 MVA) for the bus fault outage of 'PL:10:P22:100582'. This project contributes approximately 5.28 MW to the thermal violation.

```
CONTINGENCY 'PL:10:P22:100582'                    /* JUNIATA 230KV BUS 2
  DISCONNECT BUS 208005                           /*
  END
```

Bus Number	*Bus Name*	*Full Contribution*
236828	*01GRAYMONT*	*0.45*
200812	*26ALY HYDR*	*0.4*
200852	*26WARR RDG*	*0.11*
934371	*AD1-061 C*	*-0.39*
936061	*AD2-009 C*	*-2.66*
936421	*AD2-055*	*2.15*
936991	*AD2-133 C*	*1.06*
936992	*AD2-133 E*	*4.85*
938381	*AE1-071 C*	*41.87*
938382	*AE1-071 E*	*25.62*
938753	*AE1-101 BAT*	*3.08*
938751	*AE1-101 C*	*-6.2*
939171	*AE1-147 C*	*1.34*
939172	*AE1-147 E*	*0.89*
940201	*AE2-001 C*	*1.34*
940202	*AE2-001 E*	*0.9*
940681	*AE2-055 C*	*1.41*
940682	*AE2-055 E*	*0.94*
941231	*AE2-117 C*	*1.47*
941232	*AE2-117 E*	*0.98*
941241	*AE2-118 C*	*1.47*
941242	*AE2-118 E*	*0.98*
941261	*AE2-120 C*	*1.35*
941262	*AE2-120 E*	*0.9*
941271	*AE2-121 C*	*0.71*
941272	*AE2-121 E*	*0.47*
941321	*AE2-126 C*	*0.76*
941322	*AE2-126 E*	*0.51*
941331	*AE2-129 C*	*0.76*
941332	*AE2-129 E*	*0.51*
941351	*AE2-131 C*	*0.76*
941352	*AE2-131 E*	*0.51*
942121	*AE2-224 C*	*3.17*
942122	*AE2-224 E*	*2.11*
942351	*AE2-248 C*	*1.11*
942352	*AE2-248 E*	*0.74*

942491	*AE2-262 C*	*4.66*
942492	*AE2-262 E*	*3.13*
942501	*AE2-263 C*	*4.38*
942502	*AE2-263 E*	*2.92*
942511	*AE2-264 C*	*4.78*
942512	*AE2-264 E*	*3.19*
LTF	*CATAWBA*	*0.03*
LTF	*CBM-N*	*0.49*
LTF	*CBM-S1*	*0.26*
LTF	*CBM-W1*	*1.2*
LTF	*CBM-W2*	*2.62*
LTF	*CIN*	*0.41*
LTF	*G-007*	*0.37*
LTF	*HAMLET*	*0.08*
LTF	*IPL*	*0.27*
LTF	*LGEE*	*0.11*
LTF	*MEC*	*0.71*
LTF	*MECS*	*1.03*
293301	*N-039 E*	*3.83*
LTF	*NYISO*	*2.15*
293802	*O-038 E*	*2.39*
LTF	*O-066*	*2.13*
294515	*P-022 E*	*0.96*
290086	*Q-036 E*	*2.35*
LTF	*WEC*	*0.12*
921642	*AA2-000*	*28.41*
930511	*AB1-092*	*1.04*
930821	*AB1-127 C*	*-0.47*
930831	*AB1-128 C*	*-0.47*
925512	*AC1-025 E*	*0.17*

Affected Systems

16 Affected Systems

16.1 NYISO

A NYISO affected systems study is not required.

Short Circuit

17 Short Circuit

The following Breakers are overduty:

None.

Stability

18 Stability Analysis and Reactive Power Assessment

Generator Interconnection Request AE2-224 is for a 100.0 MW Maximum Facility Output (MFO) solar generating facility, which consists of 40 X 2.5 MW TMEIC PVH-L2700GR inverters. Project AE2-224 will be connected to the FirstEnergy (FE) transmission system by constructing a new 230 kV ring bus substation and looping the Bear Rock – Johnstown 230 kV Line into the new station. The new substation is approximately 5.6 miles from Bear Rock Substation and 14.6 miles from Johnstown Substation. The Point of Interconnection (POI) is where the Interconnection Customer's gen-tie line attaches to the FE substation dead-end structure. The AE2-224 generating facility will be located in Cambria County, Pennsylvania.

This report describes a dynamic simulation analysis of AE2-224 as part of the overall system impact study. The load flow scenario for the analysis was based on the RTEP 2022 peak load case, modified to include applicable queue projects. AE2-224 has been dispatched online at maximum power output with 1.015 pu scheduled voltage at the interconnection point.

AE2-224 was tested for compliance with NERC, PJM, Transmission Owner, and other applicable criteria. 37 contingencies were studied, each with a 20 second simulation time period (with 1.0 second initial run prior to any events). Studied faults included:

a) Steady state operation (Category P0);

b) Three phase faults with normal clearing time on the intact network (Category P1);

c) Single phase to ground faults with delayed clearing due to a stuck breaker (Category P4);

d) Single phase faults placed at 80% of the line with delayed (Zone 2) clearing at line end remote from the fault due to primary communications/relay failure (Category P5);

For all 37 fault contingencies tested on the 2022 peak load case:

a) AE2-224 was able to ride through the faults (except for faults where protective action trips a generator(s)).

b) Post-contingency oscillations were positively damped with a damping margin of at least 3%.

c) Following fault clearing, all bus voltages recover to a minimum of 0.7 per unit after 2.5 seconds (except where protective action isolates that bus).

d) No transmission element trips, other than those either directly connected or designed to trip as a consequence of that fault.

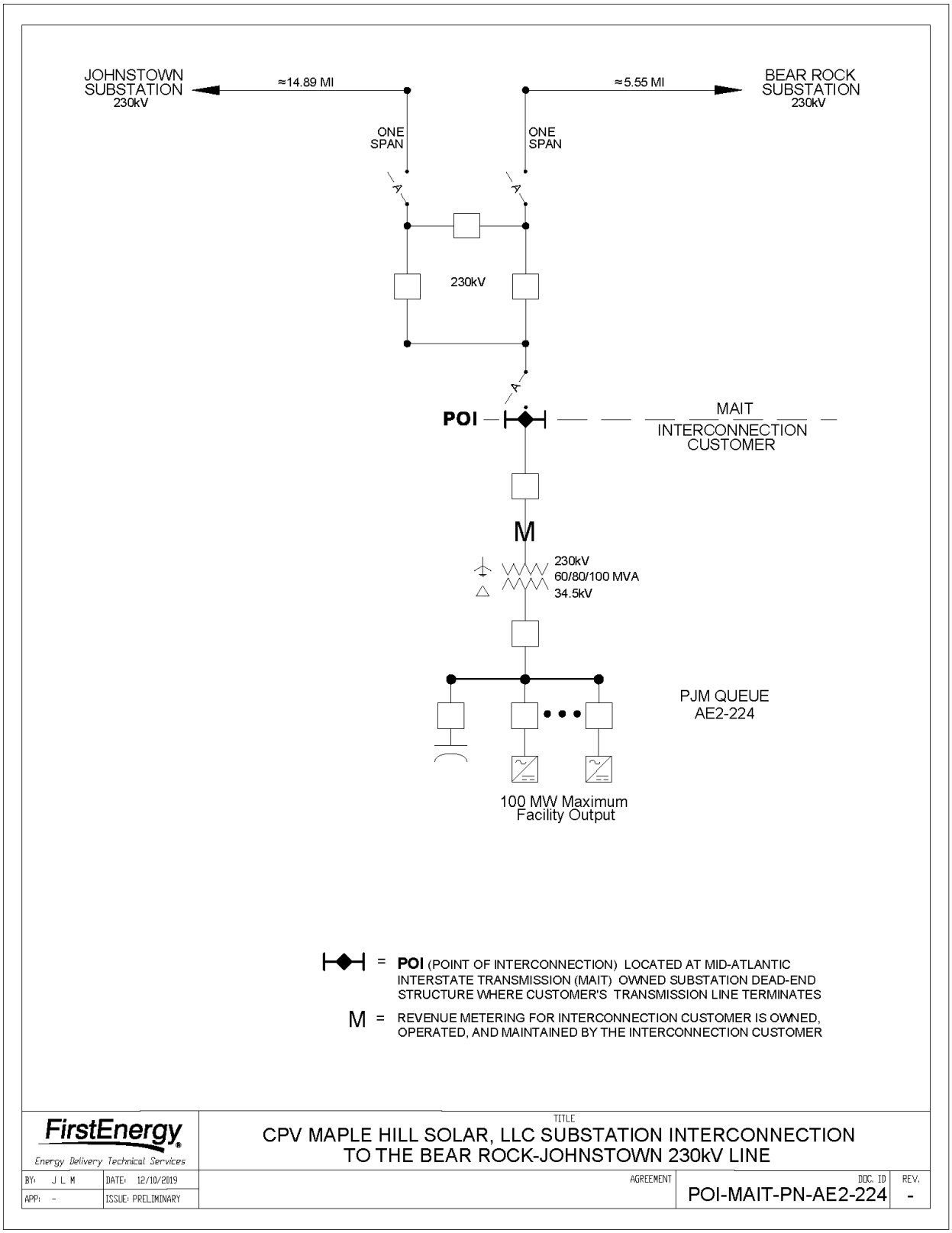
Based on the Impact Study Data provided, AE2-224 **does not meet** the reactive power requirement at the high side of main transformer. Reactive power compensation is required for this project. AE2-224 needs to have an estimated additional 11.03 MVAR capacitive reactive power to fulfill the power factor requirement.

Light Load

19 Light Load Analysis

Not applicable to solar projects.

20 Attachment One: One Line Diagram



21 Attachment Two: Project Location