Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD2-112

“Springdale CC II 138 kV”

50.4 MW Capacity / 20 MW Energy Uprate

July 2018

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network users, e.g. another generation interconnection, 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 impact study is performed.

The Feasibility 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.

General

The Interconnection Customer (IC) has proposed an increase in output of their existing Springdale combined cycle natural gas facility located at 198 Butler Street Ext., Springdale, PA 15144. The uprate will increase the maximum facility output (MFO) of the combined cycle facility by **50.4 MWE** for a total plant MFO of 610 MW. The uprate will also increase the Capacity value by **20 MW** for a total **of 590 MW** being recognized by PJM as Capacity. (See the summary table below.) The installed facilities will have a total capability of **610 MW** with **580 MW** of this output being recognized by PJM as Capacity. The proposed in-service date for this project is **May 31, 2022**. **This study does not imply an Allegheny Power Systems (APS) commitment to this in-service date.**

Uprate to B18_W03 and Z1-015 (no changes to existing equipment-installing chillers to increase output):

Queue No.	**MFO (MW)**	**Capacity (MW)**
Existing	590	529.6
AD2-112	20	50.4
Total	**610**	**580**

Point of Interconnection

AD2-112 "Springdale CC II 138 kV" uprate project will be at increase to the existing Springdale natural gas generation plant which interconnects to the APS transmission system at the Springdale 138 kV Substation bus.

Attachment 1 shows the one line diagram of the project and the existing point of interconnection with the Springdale 138 kV Substation.

Cost Summary

The **AD2-112 "Springdale CC II 138 kV"** project is an uprate to the existing Springdale facility. As such, there are no Attachment Facility or Direct Connection costs associated with this uprate:

Description	Total Cost
Attachment Facilities	$ 0
Direct Connection Network Upgrades	$ 0
Non Direct Connection Network Upgrades (APS)	$ 0
Total Costs	**$ 0**

In addition, the AD2-112 project may be responsible for a contribution to the following costs:

Description	Total Cost
New System Upgrades	$ 0
Previously Identified Upgrades[1]	$ 0
Total Costs	**$ 0**

Attachment Facilities

There is no Attachment Facilities work required for this project.

Direct Connection Cost Estimate

There is no Direct Connection scope of work required for this project.

Non-Direct Connection Cost Estimate

There is no Non-Direct Connection scope of work required for this project.

Schedule

The **AD2-112 "Springdale CC II 138 kV"** project is an uprate to the existing Springdale facility. As such, there is no Attachment Facility or Direct Connection work associated with this uprate.

JCPL Analysis

Power Flow Analysis

PJM performed a power flow analysis of the transmission system using a 2021 summer peak load flow model and the results were verified by FE. Additionally, FE performed an analysis of its underlying transmission <100 kV system. The AD2-112 project did not contribute to any overloads on the FE transmission system. The project increase the output of units 3, 4, and 5 at Springdale.

Short Circuit Analysis

PJM determined that no short circuit analysis was required as this project is an uprate to an existing facility and the electrical characteristics of the machines and GSUs did not change. FE concurred. The connection of the AD2-112 project to the system does not result in any newly overdutied circuit breakers on the FE transmission system and does not have a significant fault current contribution to existing overdutied circuit breakers.

[1] The AD2-112 project contributes to an overload of the "AA2-161 TAP-01YUKON 138 kV line" as shown in the "Network Impacts" section of this report below. There is a baseline upgrade project b3010 to replace terminal equipment at both the Keystone and Cabot 500 kV yards which resolves the overload. Therefore, the AD2-112 customer should not have cost responsibility for a reinforcement.

Stability Analysis

PJM will be responsible for completing a dynamic stability analysis, if necessary, as part of the System Impact Study. The results of this analysis will be reviewed by FE. Should stability concerns be identified in PJM's study, FE will develop appropriate system reinforcement(s) and include the estimated cost of any reinforcement(s) in FE's System Impact Study report.

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.

Metering

The IC will be require 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. PJM indicates that the existing metering is sufficient for this queue position.

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 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.

2. 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.

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

4. The execution of a back-up service agreement to serve the customer load supplied from the AD2-112 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.

Power Factor Requirements

The existing 590 MW portion of the Customer Facility shall retain its existing ability to maintain a power factor of at least 0.95 leading (absorbing VARs) to 0.90 lagging (supplying VARs) measured at the generator's terminals. The increase of 20 MW to the Customer Facilities associated with the AD2-112 project shall be designed with the ability to maintain a Power Factor of at least 1.0 (unity) to 0.90 lagging (supplying VARs) measured at the point of interconnection.

As part of the System Impact Study, FE will perform an analysis of the reactive capability of the plant. The IC must provide reactive capability curves (i.e., D-curves) and the MW output breakdown for each unit prior to the start of the System Impact Study.

Network Impacts

The Queue Project AD2-112 was evaluated as a 75 MW (Capacity 45.0 MW) injection at the Springdale 138 kV substation in the APS area. Project AD2-112 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD2-112 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

Contingency Descriptions

Contingency Name	Description
AP-P1-2-WP-138-048-A	CONTINGENCY 'AP-P1-2-WP-138-048-A' /* HUNTINGDON - YUKON 138KV DISCONNECT BRANCH FROM BUS 235277 TO BUS 920570 CKT 1 /* 01YUKON 138 AA2-161 TAP 138 END
AP-P1-2-WP-138-049-A	CONTINGENCY 'AP-P1-2-WP-138-049-A' /* SPRINGDALE - YUKON 138KV DISCONNECT BRANCH FROM BUS 235277 TO BUS 920580 CKT 1 /* 01YUKON 138 AA2-161 TAP 138 END
AP-P7-1-WPP-138-100_A	CONTINGENCY 'AP-P7-1-WPP-138-100_A' /* 75A DISCONNECT BRANCH FROM BUS 235195 TO BUS 235238 CKT 1 /* 01HUNTDN 138 01ROBBIN 138 DISCONNECT BRANCH FROM BUS 235277 TO BUS 920580 CKT 1 /* 01YUKON 138 AA2-161 TAP 138 END
AP-P7-1-WPP-138-113_B	CONTINGENCY 'AP-P7-1-WPP-138-113_B' /* 82B DISCONNECT BRANCH FROM BUS 920570 TO BUS 235277 CKT 1 /* AA2-161 TAP 138 01YUKON 138 DISCONNECT BRANCH FROM BUS 235275 TO BUS 235283 CKT 1 /* 01WYCOFF 138 01WYCOFJ 138 DISCONNECT BRANCH FROM BUS 235275 TO BUS 235965 CKT 1 /* 01WYCOFF 138 01WYCOFF 25 DISCONNECT BRANCH FROM BUS 235256 TO BUS 235283 CKT 1 /* 01SPGDL 138 01WYCOFJ 138

	DISCONNECT BRANCH FROM BUS 920580 TO BUS 235283 CKT 1 /* AA2-161 TAP 138 01WYCOFJ 138 END

Generator Deliverability

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

None.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

None.

Contribution to Previously Identified Overloads[1]

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

Overload Number	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Flowgate Appendix
1	DCTL	AP-P7-1-WPP-138-100_A	AP - AP	AA2-161 TAP-01YUKON 138 kV line	920570	235277	1	DC	142.98	146.57	ER	287	10.31	1
2	N-1	AP-P1-2-WP-138-049-A	AP - AP	AA2-161 TAP-01YUKON 138 kV line	920570	235277	1	DC	123.43	126.84	ER	287	9.79	
3	DCTL	AP-P7-1-WPP-138-113_B	AP - AP	AA2-161 TAP-01YUKON 138 kV line	920580	235277	1	DC	134.62	137.45	ER	332	9.39	2
4	N-1	AP-P1-2-WP-138-048-A	AP - AP	AA2-161 TAP-01YUKON 138 kV line	920580	235277	1	DC	106.64	109.59	ER	332	9.81	

Note: Please see Attachment 3 for projects providing impacts to flowgate violations. The values in the Reference column correspond to the proper Appendix in the Attachment.

Steady-State Voltage Requirements

(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

To be determined in the Impact Study Phase.

Short Circuit

(Summary of impacted circuit breakers)

None.

Affected System Analysis & Mitigation

(Summary of impacts on systems external to PJM)

NYISO Impacts:

NYISO Impacts to be determined during later study phases (as applicable).

Delivery of Energy Portion of Interconnection Request

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.

Overload Number	Type	Contingency Name	Affected Area	Facility Description	Bus From	Bus To	Circuit	Power Flow	Loading % Initial	Loading % Final	Rating Type	Rating MVA	MW Contribution	Flowgate Appendix
5	N-1	AP-P1-2-WP-138-049-A	AP - AP	AA2-161 TAP-01YUKON 138 kV line	920570	235277	1	DC	130.28	135.61	ER	287	15.31	
6	N-1	AP-P1-2-WP-138-048-A	AP - AP	AA2-161 TAP-01YUKON 138 kV line	920580	235277	1	DC	112.55	117.17	ER	332	15.34	

Light Load Analysis -2021

Light Load Studies to be conducted during later study phases (as required by PJM Manual 14B).

Not required for this fuel type.

System Reinforcements

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)
None

Stability and Reactive Power Requirement for Low Voltage Ride Through

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined in the Impact Study phase.

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

None

Contribution to Previously Identified System Reinforcements[1]

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

Violation #	Overloaded Facility	Upgrade Description	Baseline Upgrade Number
1, 2, 3,4	AA2-161 TAP-01YUKON 138 kV line	(APS) Replace terminal equipment at Keystone and Cabot 500 kV buses. At Keystone, bus tubing and conductor, a wavetrap, and meter will be replaced. At Cabot, a wavetrap and bus conductor will be replaced. [PJM Upgrade Id: b3010]. The scheduled in-service date is 06/01/2021.	b3010

Note: This reinforcement is being completed under a Baseline RTEP project (b3010). AD2-112 will not have cost responsibility for this upgrade.

Attachment 1. AD2-112 ‘Springdale CC II 138 kV’
One Line Diagram

Attachment 2: AD2-112 ‘Springdale CC II 138 kV’
Project Location

Attachment 3:

Appendices

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. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators.

It should be noted the project/generator MW contributions presented in the body of the report and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 1

(AP - AP) The AA2-161 TAP-01YUKON 138 kV line (from bus 920570 to bus 235277 ckt 1) loads from 142.98% to 146.57% (**DC power flow**) of its emergency rating (287 MVA) for the tower line contingency outage of 'AP-P7-1-WPP-138-100_A'. This project contributes approximately 10.31 MW to the thermal violation.

CONTINGENCY 'AP-P7-1-WPP-138-100_A' /* 75A
DISCONNECT BRANCH FROM BUS 235195 TO BUS 235238 CKT 1 /* 01HUNTDN 138 01ROBBIN 138
DISCONNECT BRANCH FROM BUS 235277 TO BUS 920580 CKT 1 /* 01YUKON 138 AA2-161 TAP 138
END

Bus Number	*Bus Name*	*Full Contribution*
235776	*01AL DAM5*	*0.41*
235610	*01SPRGD1*	*1.2*
235611	*01SPRGD2*	*1.2*
235612	*01SPRGD3*	*4.57*
235613	*01SPRGD4*	*4.52*
235614	*01SPRGD5*	*4.76*
932561	*AC2-076*	*1.65*
936851	*AD2-108*	*1.76*
936881	*AD2-112 C*	*6.59*
936882	*AD2-112 E*	*3.72*
LTF	*AMIL*	*0.05*
LTF	*BAYOU*	*0.21*
LTF	*BIG_CAJUN1*	*0.33*
LTF	*BIG_CAJUN2*	*0.66*
LTF	*BLUEG*	*0.31*
LTF	*CALDERWOOD*	*0.12*
LTF	*CANNELTON*	*0.05*
LTF	*CATAWBA*	*0.09*

LTF	*CBM-N*	*0.27*
LTF	*CELEVELAND*	*0.25*
LTF	*CHEOAH*	*0.11*
LTF	*CHILHOWEE*	*0.04*
LTF	*CHOCTAW*	*0.22*
LTF	*CLIFTY*	*1.32*
LTF	*COTTONWOOD*	*0.83*
LTF	*DEARBORN*	*0.04*
LTF	*EDWARDS*	*0.09*
LTF	*ELMERSMITH*	*0.16*
LTF	*FARMERCITY*	*0.06*
LTF	*G-007A*	*0.34*
LTF	*GIBSON*	*0.1*
LTF	*HAMLET*	*0.29*
LTF	*MORGAN*	*0.36*
LTF	*NEWTON*	*0.23*
LTF	*NYISO*	*4.04*
LTF	*PRAIRIE*	*0.46*
LTF	*ROWAN*	*0.17*
LTF	*SANTEETLA*	*0.03*
LTF	*SMITHLAND*	*0.04*
LTF	*TATANKA*	*0.11*
LTF	*TILTON*	*0.1*
LTF	*TRIMBLE*	*0.06*
LTF	*TVA*	*0.16*
LTF	*UNIONPOWER*	*0.18*

LTF	*VFT*	*0.95*
916001	*Z1-015*	*0.71*
920571	*AA2-161 C*	*417.76*
920572	*AA2-161 E*	*22.8*

Appendix 2

(AP - AP) The AA2-161 TAP-01YUKON 138 kV line (from bus 920580 to bus 235277 ckt 1) loads from 134.62% to 137.45% (**DC power flow**) of its emergency rating (332 MVA) for the tower line contingency outage of 'AP-P7-1-WPP-138-113_B'. This project contributes approximately 9.39 MW to the thermal violation.

```
CONTINGENCY 'AP-P7-1-WPP-138-113_B'                    /* 82B
  DISCONNECT BRANCH FROM BUS 920570 TO BUS 235277 CKT 1        /* AA2-161
TAP 138 01YUKON 138
  DISCONNECT BRANCH FROM BUS 235275 TO BUS 235283 CKT 1        /*
01WYCOFF 138 01WYCOFJ 138
  DISCONNECT BRANCH FROM BUS 235275 TO BUS 235965 CKT 1        /*
01WYCOFF 138 01WYCOFF 25
  DISCONNECT BRANCH FROM BUS 235256 TO BUS 235283 CKT 1        /* 01SPGDL
138 01WYCOFJ 138
  DISCONNECT BRANCH FROM BUS 920580 TO BUS 235283 CKT 1        /* AA2-161
TAP 138 01WYCOFJ 138
  END
```

Bus Number	*Bus Name*	*Full Contribution*
235776	*01AL DAM5*	*0.38*
235610	*01SPRGD1*	*1.09*
235611	*01SPRGD2*	*1.09*
235612	*01SPRGD3*	*4.17*
235613	*01SPRGD4*	*4.12*
235614	*01SPRGD5*	*4.34*
932561	*AC2-076*	*1.53*
936851	*AD2-108*	*1.6*
936881	*AD2-112 C*	*6.*
936882	*AD2-112 E*	*3.39*
LTF	*AMIL*	*0.06*
LTF	*BAYOU*	*0.23*
LTF	*BIG_CAJUN1*	*0.35*
LTF	*BIG_CAJUN2*	*0.71*

LTF	*BLUEG*	*0.36*
LTF	*CALDERWOOD*	*0.12*
LTF	*CANNELTON*	*0.06*
LTF	*CATAWBA*	*0.08*
LTF	*CBM-N*	*0.26*
LTF	*CELEVELAND*	*0.24*
LTF	*CHEOAH*	*0.11*
LTF	*CHILHOWEE*	*0.04*
LTF	*CHOCTAW*	*0.24*
LTF	*CLIFTY*	*1.51*
LTF	*COTTONWOOD*	*0.9*
LTF	*DEARBORN*	*0.09*
LTF	*EDWARDS*	*0.1*
LTF	*ELMERSMITH*	*0.18*
LTF	*FARMERCITY*	*0.07*
LTF	*G-007A*	*0.45*
LTF	*GIBSON*	*0.12*
LTF	*HAMLET*	*0.28*
LTF	*MORGAN*	*0.39*
LTF	*NEWTON*	*0.27*
LTF	*NYISO*	*3.83*
LTF	*PRAIRIE*	*0.52*
LTF	*ROWAN*	*0.17*
LTF	*SANTEETLA*	*0.03*
LTF	*SMITHLAND*	*0.04*
LTF	*TATANKA*	*0.12*

LTF	*TILTON*	*0.12*
LTF	*TRIMBLE*	*0.07*
LTF	*TVA*	*0.17*
LTF	*UNIONPOWER*	*0.18*
LTF	*VFT*	*1.24*
916001	*Z1-015*	*0.64*
920571	*AA2-161 C*	*433.01*
920572	*AA2-161 E*	*23.63*