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July 13, 2017

Via Electronic Filing

Ms. Barcy McNeal
Administration/Docketing
Ohio Power Siting Board
180 East Broad Street, 11th Floor
Columbus, Ohio 43215-3793

Re: Guernsey Power Station, LLC
Case No. 16-2443-EL-BGN

Dear Ms. McNeal:

On March 16, 2017, Guernsey Power Station, LLC ("Guernsey") filed an Application for a Certificate of Environmental Compatibility and Public Need for an Electric Generation Facility in Guernsey County, Ohio. Attached for filing in the above referenced docket is a copy of the Generator Interconnection System Impact Study Report dated June 2017.

Please do not hesitate to contact me if you have any questions.

Sincerely,

Sally W Bloomfield

Sally W. Bloomfield

Attachment

Cc: Jonathan Pawley (w/Attachment)
Jon Whitis (w/Attachment)

Generator Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position #AB2-067

Kammer-Vassell 765 kV

June 2017

General

Guernsey Power Station, LLC proposes to install an 1100.0 MW (1100.0 MW Capacity) 2x1 Combined Cycle Natural Gas generating facility in Guernsey County, OH (see Figure 2). The generating facility will interconnect to a newly proposed three (3) circuit breaker 765 kV switching station connecting to AEP's Kammer – Vassell 765 kV circuit (See Figure 1).

The requested Backfeed date is September 1, 2019.
The requested in-service date is September 1, 2020.

The objective of this System Impact Study is to determine budgetary cost estimates and approximate construction timelines for identified transmission facilities required to connect the proposed generating facilities to the AEP Transmission System. These reinforcements include the Attachment Facilities, Local Upgrades, and Network Upgrades required to maintain the reliability of the AEP Transmission System. Stability analysis is included as part of this study.

Attachment Facilities

Point of Interconnection (Kammer – Vassell 765 kV)

To accommodate the interconnection on the Kammer – Vassell 765 kV circuit a new three (3) circuit breaker 765 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed 40 miles east of the Kammer 765 kV substation (see Figure 1). Installation of associated protection and control equipment, 765 kV line risers, SCADA, and 765 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

New Switching Station Work and Cost:

- Construct a new three (3) breaker 765 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus. Installation of associated protection and control equipment, 765 kV line risers, SCADA, and 765 kV revenue metering will also be required.
- **Estimated 765 kV Station Cost: $25,000,000**
- **Estimated 765 kV Revenue Metering Cost: $465,000**
- **Kammer – Vassell 765 kV T-Line Cut In Cost: $3,100,000**

Protection and Relay Work and Cost:

- Install line protection and controls at the new 765 kV switching station.
- **Estimated Cost: $1,000,000**
- Upgrade line protection and controls at the Kammer 765 kV substation to coordinate with the new 765 kV switching station.
- **Estimated Cost: $600,000**
- Upgrade line protection and controls at the Vassell 765 kV substation to coordinate with the new 765 kV switching station.
- **Estimated Cost: $600,000**

Guernsey Power Station is expected to obtain, at its cost, a 1200' x 500' station site for the new 765 kV switching station and all necessary permits. Ownership of the new 765 kV switching station and associated equipment shall be transferred from Guernsey Power Station to AEP upon successful completion of the required work.

A 765 kV line extension is required to loop through the proposed 765 kV switching station. The proposed 765 kV switching station is assumed to be located immediately adjacent to the existing transmission lines. A supplemental line easement for the tap structures will be required. It is expected that Guernsey Power Station will obtain the supplemental easement when the station property is purchased.

It is understood that Guernsey Power Station is responsible for all costs associated with this interconnection. The cost of Guernsey Power Station's generating plant and the costs for the line connecting the generating plant to Guernsey Power Station's switching station are not included in this report; these are assumed to be Guernsey Power Station's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Local and Network Impacts

The impact of the proposed generating facility on the AEP System was assessed for adherence with applicable reliability criteria. AEP planning criteria require that the transmission system meet performance parameters prescribed in the AEP FERC Form 715[1] and Connection Requirements for AEP Transmission System[2]. Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. The Queue Project AB2-067 was evaluated as a 1100.0 MW (Capacity 1100.0 MW) injection into a tap of the Kammer – Vassell 765 kV line in the AEP area. Project AB2-067 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB2-067 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis - 2020

Generator Deliverability

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

None

Multiple Facility Contingency

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

None

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)

None

Short Circuit

(Summary of impacted circuit breakers)

None

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1 https://www.aep.com/about/codeofconduct/OASIS/TransmissionStudies/GuideLines/AEP_East_FERC_715_2016_Final_Part_4.pdf

2 https://www.aep.com/about/codeofconduct/OASIS/TransmissionStudies/Requirements/AEP_Interconnection_Requirements_rev1.pdf

Stability Analysis

No problems identified – See Attachment 1 at the end of this report

Voltage Variations

None

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.

Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

Not Applicable

Additional Limitations of Concern

None

Light Load Analysis

Not required

System Reinforcements

None

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 18 to 24 months if no line work is required. If line work is required, construction time would be between 36 to 48 months after signing an interconnection agreement.

Conclusion

Based upon the results of this System Impact Study, the construction of the 1100.0 MW (1100.0 MW Capacity) natural gas generating facility of Guernsey Power Station (PJM Project #AB2-067) will require the following additional interconnection charges. This plan of service will interconnect the proposed generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the Guernsey Power Station generating facility.

Cost Breakdown for Point of Interconnection (Kammer-Vassell 765 kV)			
Upgrade Category	**Description**	**Upgrade #**	**Cost**
Direct Connection Network Upgrade Cost Estimate	New 765 kV Switching Station	**n5352**	**$25,000,000**
Non-Direct Connection Network Upgrade Cost Estimates	765 kV Revenue Metering	**n5353**	**$465,000**
	Install line protection and controls at the new 765 kV switching station.	**n5354**	**$1,000,000**
	Kammer – Vassell 765 kV T-Line Cut In	**n5355**	**$3,100,000**
	Upgrade line protection and controls at the Kammer 765 kV substation to coordinate with the new 765 kV switching station.	**n5356**	**$600,000**
	Upgrade line protection and controls at the Vassell 765 kV substation to coordinate with the new 765 kV switching station.	**n5357**	**$600,000**
Total Estimated Cost for Project AB2-067			**$30,765,000**

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Figure 1: Point of Interconnection (Kammer - Vassell 765 kV)
Single-Line Diagram

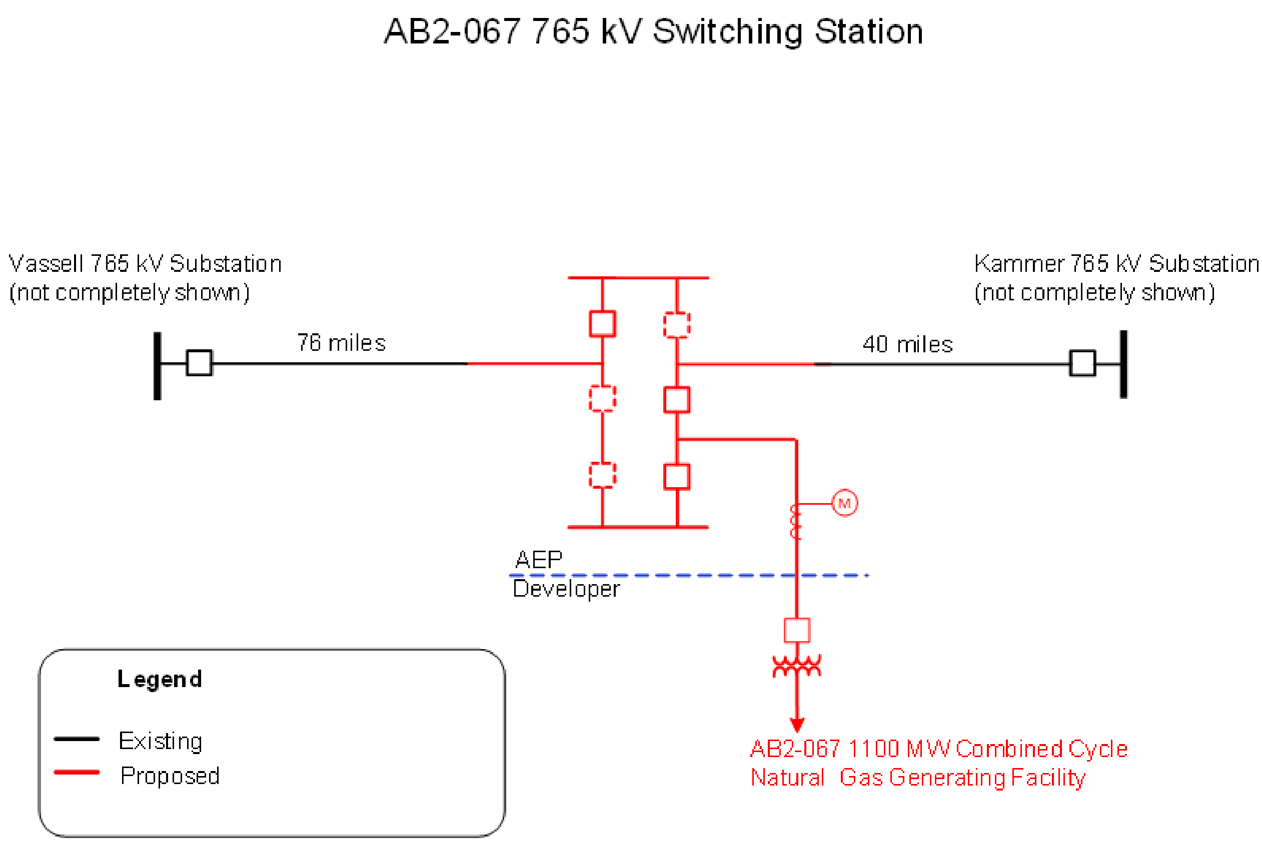

Figure 2: Point of Interconnection (Kammer – Vassell 765 kV)

Attachment 1 – Stability Analysis

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Executive Summary

Generator Interconnection Request AB2-067 is for a 1200 MW Maximum Facility Output (MFO) combined cycle generation facility. AB2-067 consists of two 1x1 combined cycle single shaft generators with a Point of Interconnection (POI) on the Kammer – Vassell 765 kV in the AEP system, Guernsey County, Ohio.

This report describes a dynamic simulation analysis of AB2-067 as part of the overall system impact study.

The load flow scenario for the analysis was based on the RTEP 2020 light load case, modified to include applicable queue projects. AB2-067 has been dispatched online at maximum power output, with 0.95 p.u. voltage at the generator bus.

AB2-067 was tested for compliance with NERC, PJM, Transmission Owner and other applicable criteria. 45 contingencies were studied, each with a 10 second simulation time period. Studied faults included:

a) Steady state operation (20 second);
b) Three phase faults with normal clearing time;
c) Single phase faults with stuck breaker;
d) Single phase bus faults with normal clearing time.
e) Single-phase faults with loss of multiple-circuit tower line.

No relevant high speed reclosing (HSR) contingencies were identified for this study. There are no delayed (Zone 2) clearing faults since dual pilot relays are employed.

For all simulations, the queue project under study along with the rest of the PJM system were required to maintain synchronism and with all states returning to an acceptable new condition following the disturbance.

For 39 of the fault contingencies tested on the 2020 light load case:

a) AB2-067 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 recovered to a minimum of 0.7 per unit after 2.5 seconds (except where protective action isolates that bus).
d) No transmission element tripped, other than those either directly connected or designed to trip as a consequence of that fault.

The post-fault responses of the Mitchell unit 1 were insufficiently damped for several three phase and single phase stuck breaker fault contingencies. Simulations using pre-AB2-067 show similar post-contingency behavior for the Mitchell unit 1 with a damping margin of < 3% therefore the insufficient damping is a pre-existing issue and not attributable to AB2-067.

No mitigations were found to be required.

1. Introduction

Generator Interconnection Request AB2-067 is for a 1200 MW Maximum Facility Output (MFO) combined cycle generation facility. AB2-067 consists of two 1x1 combined cycle single shaft generators with a Point of Interconnection (POI) on the Kammer – Vassell 765 kV in the AEP system, Guernsey County, Ohio.

This analysis is effectively a screening study to determine whether the addition of AB2-067 will meet the dynamic requirements of the NERC, PJM and Transmission Owner reliability standards.

In this report the AB2-067 project and how it is proposed to be connected to the grid are first described, followed by a description of how the project is modeled in this study. The fault cases are then described and analyzed, and lastly a discussion of the results is provided.

2. Description of Project

AB2-067 consists of 2 x 615 MW 1x1 single shaft combined cycle generator. AB2-067 will be connected to the POI via a 765/230 kV main collector transformer and two 230/ 22.5 kV transformers. AB2-067 connects at a tap of on the Kammer – Vassell 765 kV circuit, as shown in Figure 1.
Table 1 lists the parameters given in the impact study data and the corresponding parameters of the AB2-067 loadflow model.

Additional project details are provided in Attachments 1 through 4:

- Attachment 1 contains the Impact Study Data which details the proposed AB2-067 project.
- Attachment 2 shows the one line diagram of the AEP network in the vicinity of AB2-067.
- Attachment 3 provides a diagram of the PSS/E model in the vicinity of AB2-067.
- Attachment 4 gives the PSS/E loadflow and dynamic models of AB2-067.

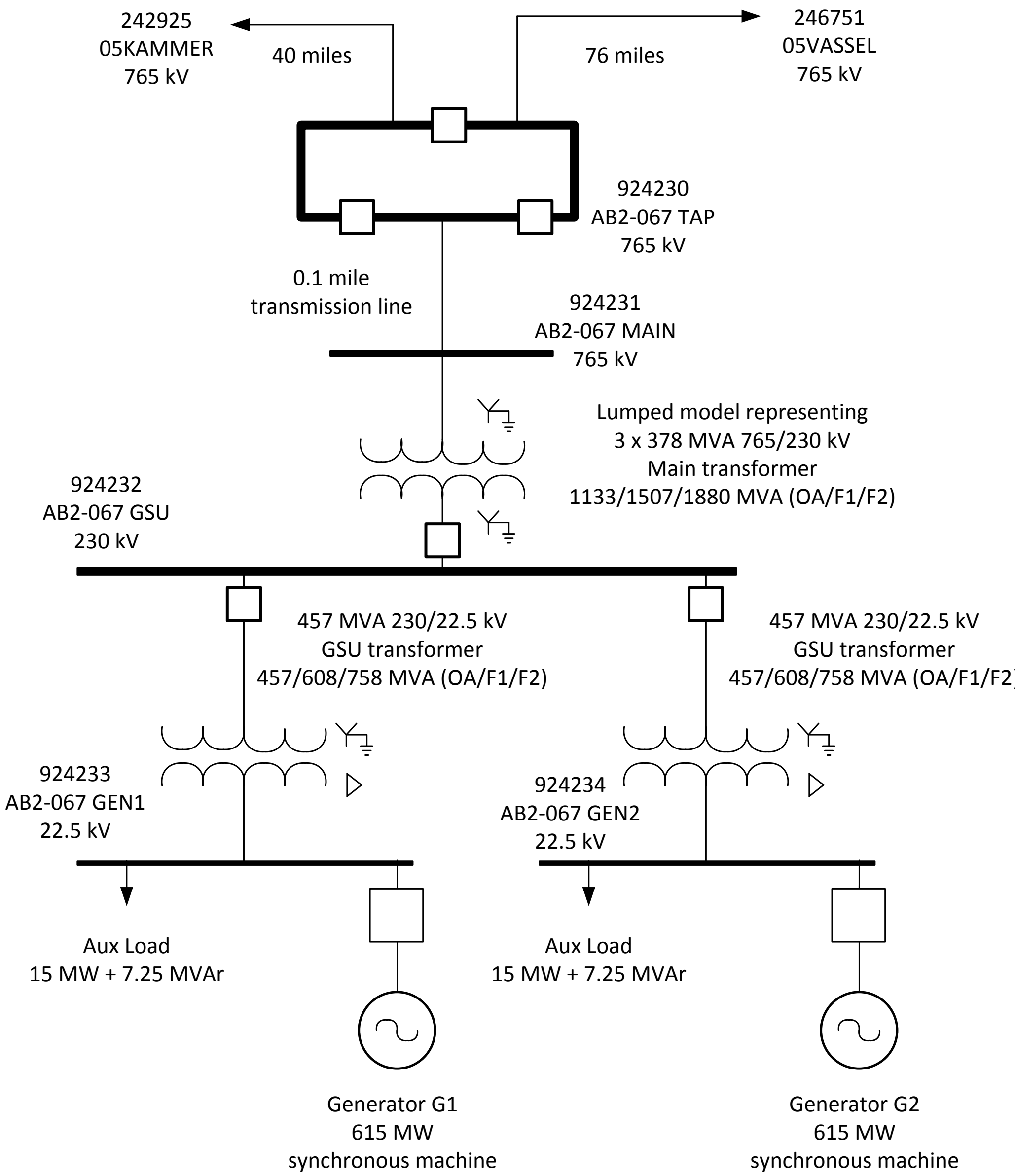

Figure 1: AB2-067 Plant Model

Table 1: AB2-067 Plant Model

	Impact Study Data	Model
Generators	2 x 615 MW 1x1 single shaft combined cycle generator MVA base = 758 MVA Vt = 22.5 kV Unsaturated sub-transient reactance = 0.23 pu @ MVA base	2 x 615 MW generators Pgen 615 MW Pmax 615 MW Pmin 0.0 MW Qgen -15.86 MVAr Qmax 372.0 MVAr Qmin -197.3 MVAr Mbase 758 MVA Zsorce 0.00 + j0.23 pu @ Mbase
GSU transformer	2 x 230/22.5 kV two winding transformer Rating = 457/608/758 MVA (OA/F1/F2) Transformer base = 457 MVA Impedance = 0.0022 + j0.11 pu @ MVA base Number of taps = 5 Tap step size = 2.5%	2 x 230/22.5 kV two winding transformer Rating = 457/608/758 MVA (OA/F1/F2) Transformer base = 457 MVA Impedance = 0.0022 + j0.11 pu @ MVA base Number of taps = 5 Tap step size = 2.5%
Main transformer	3 x 765/230 kV single phase transformers Rating = 378/502/626 MVA (OA/F1/F2) Transformer base = 378 MVA Impedance = 0.0024 + j0.12 pu @ MVA base Number of taps = 5 Tap step size = 2.5%	Lumped equivalent model representing 1 x 765/230 kV two winding (three-phase) transformer Rating = 1133/1507/1880 MVA (OA/F1/F2) Transformer base = 1133 MVA Impedance = 0.0024 + j0.12 pu @ MVA base Number of taps = 5 Tap step size = 2.5%
Auxiliary load	30 MW + 14.5 MVAr	15 MW + 7.25 MVAr modeled at low side of each GSU
Station load	0.7 MW + 0.5 MVAr	Not modeled to ensure correct MFO
Transmission line	Length = 0.1 miles	Modeled as zero impedance line

3. Loadflow and Dynamics Case Setup

The dynamics simulation analysis was carried out using PSS/E Version 33.7.0.
The load flow scenario and fault cases for this study are based on PJM's Regional Transmission Planning Process[3].
The selected load flow scenario is the RTEP 2020 light load case with the following modifications:

a) Addition of all applicable queue projects prior to AB2-067.
b) Addition of AB2-067 queue project.
c) Removal of withdrawn and subsequent queue projects in the vicinity of AB2-067.
d) Dispatch of units in the PJM system to maintain slack generators within limits.
e) Merchant transmission projects X3-028 and S57/S58 set online and at maximum power import into PJM.

The AB2-067 initial conditions are listed in Table 2, indicating maximum power output, with leading power factor.

Table 2: AB2-067 machine initial conditions

Bus	Name	Unit	PGEN	QGEN	ETERM	POI Voltage
924233	AB2-067 GEN1	G1	615 MW	-15.86 MVAr	0.95 pu	0.9972 pu
924234	AB2-067 GEN2	G2	615 MW	-15.86 MVAr	0.95 pu	0.9972 pu

Generation within the PJM500 system (area 225 in the PSS/E case) and within the vicinity of AB2-067 has been dispatched online at maximum output (PMAX). The dispatch of generation in the vicinity of AB2-067 is given in Attachment 5.

[3] Manual 14B: PJM Region Transmission Planning Process, Rev 33, May 5 2016, Attachment G : PJM Stability, Short Circuit, and Special RTEP Practices and Procedures.

4. <u>Fault Cases</u>

Tables 3 to 15 list the contingencies that were studied, with representative worst case total clearing times provided by PJM. Each contingency was studied over a 20 second simulation time interval.
The studied contingencies include:

f) Steady state operation (20 second);

g) Three phase faults with normal clearing time;

h) Single phase faults with stuck breaker;

i) Single phase bus faults with normal clearing time.

j) Single-phase faults with loss of multiple-circuit tower line.

No relevant high speed reclosing (HSR) contingencies were identified for this study.
There are no delayed (Zone 2) clearing faults since dual pilot relays are employed.

The contingencies listed above were applied to:

- AB2-067 TAP 765 kV (POI)
- Kammer 765 kV
- Vassell 765 kV

The three phase faults with normal clearing time were performed under network intact conditions.
Additional three phase faults at the POI with normal clearing time were performed with prior outage of:

a) Circuits out of AB2-067 TAP

b) Circuits out of Kammer

c) Circuits out of Vassel

Clearing times listed in Tables 3 to 15 are as per Revision 19 of "*2016 Revised Clearing times for each PJM company"* spreadsheet.
Attachment 2 contains the one-line diagrams of the AEP and APS networks in the vicinity of AB2-067, showing where faults were applied.
The positive sequence fault impedances for single line to ground faults were derived from the stability case directly by using the ASCC fault calculation method and zero/positive sequence impedance ratio provided by PJM.

5. Evaluation Criteria

This study is focused on AB2-067, along with the rest of the PJM system, maintaining synchronism and having all states return to an acceptable new condition following the disturbance. The recovery criteria applicable to this study are as per PJM's Regional Transmission Planning Process and Transmission Owner criteria:

a) AB2-067 is able to ride through the faults (except for faults where protective action trips a generator(s)),

b) The system with AB2-067 included is transiently stable and post-contingency oscillations should be 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.

6. Summary of Results

Plots from the dynamic simulations are provided in Attachment 6, with results summarized in Table 3 through Table 15.

For all 45 of the fault contingencies tested on the 2020 light load case:

a) AB2-067 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 recovered to a minimum of 0.7 per unit after 2.5 seconds (except where protective action isolates that bus).

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

The post-fault responses of the Mitchell unit 1 were insufficiently damped for several three phase and single phase stuck breaker fault contingencies. Simulations using pre-AB2-067 show similar post-contingency behavior for the Mitchell unit 1 with a damping margin of < 3% therefore the insufficient damping is a pre-existing issue and not attributable to AB2-067.

7. Recommendations and Mitigations

No mitigations were found to be required.

Table 3: Steady State Operation

Fault ID	Duration	Result No Mitigation
SS.01	Steady state 20 sec	Stable

Table 4: Three-phase Faults with Normal Clearing

Fault ID	Fault description	Clearing Time Near & Remote (Cycles)	Result No Mitigation
3N.01	Fault at AB2-067 TAP 765 kV on AB2-067 circuit (Trips AB2-067 units G1 and G2).	4.5	Stable*
3N.02	Fault at AB2-067 TAP 765 kV on Kammer circuit.	4.5	Stable*
3N.03	Fault at AB2-067 TAP 765 kV on Vassell circuit.	4.5	Stable
3N.04	Fault at Kammer 765 kV on AB2-067 TAP circuit.	4.5	Stable*
3N.05	Fault at Kammer 765 kV on Mitchell circuit (Trips Mitchell unit 1).	4.5	Stable
3N.06	Fault at Kammer 765 kV on South Canton circuit (Trips South Canton 765/345 kV Transformer 3).	4.5	Stable*
3N.07	Fault at Kammer 765 kV on Mitchell 765/345 kV Transformer TR4.	4.5	Stable*
3N.08	Fault at Kammer 765 kV on Kammer 765/500 kV Transformer TR2 (Trips Kammer - 502 Junction 500 kV circuit).	4.5	Stable*
3N.09	Fault at Kammer 765 kV on Belmont – Mountaineer circuit (Trips Belmont 765/500 kV Transformer and 500/138 kV Transformers 1 & 2).	4.5	Stable*
3N.10	Fault at Vassell 765 kV on AB2-067 TAP circuit.	4.5	Stable
3N.11	Fault at Vassell 765 kV on Maliszewski circuit.	4.5	Stable
3N.12	Fault at Vassell 765 kV on Vassell 765/345 kV Transformer 1.	4.5	Stable

*Post fault oscillations observed in Mitchell unit 1, with a damping margin of < 3%. The same oscillations were also observed on the pre-project case so the damping issue is not attributable to AB2-067.

Table 5: Single-phase Faults with Stuck Breaker

Fault ID	Fault description	Clearing Time Normal & Delayed (Cycles)	Result No Mitigation
1B.01	Fault at AB2-067 TAP 765 kV on AB2-067 circuit (Trips AB2-067 units G1 and G2). Breaker stuck to Kammer circuit. Fault cleared with loss of Kammer circuit.	4.5 / 12	Stable*
1B.02	Fault at AB2-067 TAP 765 kV on AB2-067 circuit (Trips AB2-067 units G1 and G2). Breaker stuck to Vassell circuit. Fault cleared with loss of Vassell circuit.	4.5 / 12	Stable*
1B.03	Fault at AB2-067 TAP 765 kV on Kammer circuit. Breaker stuck to Vassell circuit. Fault cleared with loss of Vassell circuit and AB2-067 circuit (Trips AB2-067 units G1 and G2).	4.5 / 12	Stable*
1B.04	Fault at AB2-067 TAP 765 kV on Vassell circuit. Breaker stuck to Kammer circuit. Fault cleared with loss of Kammer circuit and AB2-067 circuit (Trips AB2-067 units G1 and G2).	4.5 / 12	Stable*
1B.05	Fault at Kammer 765 kV on AB2-067 TAP circuit. Breaker QQ1 stuck. Fault cleared with loss Kammer bus section 1 (Trips Mitchell 765/345 kV Transformer TR4).	4.5 / 12	Stable*
1B.06	Fault at Kammer 765 kV on AB2-067 TAP circuit. Breaker QQ2 stuck. Fault cleared with loss Kammer bus section 2 (Open 765 kV side of Kammer 765/500 kV Transformer TR2).	4.5 / 12	Stable*
1B.07	Fault at Kammer 765 kV on Mitchell circuit (Trips Mitchell unit 1). Breaker PP1 stuck. Fault cleared with loss Kammer bus section 1 (Trips Mitchell 765/345 kV Transformer TR4).	4.5 / 12	Stable
1B.08	Fault at Kammer 765 kV on Mitchell circuit (Trips Mitchell unit 1). Breaker PP stuck. Fault cleared with loss of Belmont – Mountaineer circuit (Trips Belmont 765/500 kV Transformer and 500/138 kV Transformers 1 & 2).	4.5 / 12	Stable
1B.09	Fault at Kammer 765 kV on South Canton circuit (Trips South Canton 765/345 kV Transformer 3). Breaker NN1 stuck. Fault cleared with loss of Kammer bus section 1 (Trips Mitchell 765/345 kV Transformer TR4).	4.5 / 12	Stable
1B.10	Fault at Kammer 765 kV on South Canton circuit (Trips South Canton 765/345 kV Transformer 3). Breaker NN stuck. Fault cleared with loss of Kammer bus section 2 (Open 765 kV side of Kammer 765/500 kV Transformer TR2).	4.5 / 12	Stable
1B.11	Fault at Kammer 765 kV on Mitchell 765/345 kV Transformer TR4. Breaker NN1 stuck. Fault cleared with loss of South Canton circuit (Trips South Canton 765/345 kV Transformer 3).	4.5 / 12	Stable
1B.12	Fault at Kammer 765 kV on Mitchell 765/345 kV Transformer TR4. Breaker PP1 stuck. Fault cleared with loss of Mitchell circuit (Trips Mitchell unit 1).	4.5 / 12	Stable
1B.13	Fault at Kammer 765 kV on Mitchell 765/345 kV Transformer TR4. Breaker QQ1 stuck. Fault cleared with loss of AB2-067 circuit.	4.5 / 12	Stable*
1B.14	Fault at Kammer 765 kV on Kammer 765/500 kV Transformer TR2 (Trips Kammer - 502 Junction 500 kV circuit). Breaker MM2 stuck. Fault cleared with no loss of supply.	4.5 / 12	Stable*

Fault ID	Fault description	Clearing Time Normal & Delayed (Cycles)	Result No Mitigation
1B.15	Fault at Kammer 765 kV on Belmont – Mountaineer circuit (Trips Belmont 765/500 kV Transformer and 500/138 kV Transformers 1 & 2). Breaker PP stuck. Fault cleared with loss of Mitchell circuit (Trips Mitchell unit 1).	4.5 / 12	Stable
1B.16	Fault at Kammer 765 kV on Belmont – Mountaineer circuit (Trips Belmont 765/500 kV Transformer and 500/138 kV Transformers 1 & 2). Breaker PP2 stuck. Fault cleared with loss of Kammer bus section 2 (Open 765 kV side of Kammer 765/500 kV Transformer TR2).	4.5 / 12	Stable*
1B.17	Fault at Vassell 765 kV on AB2-067 TAP circuit. Breaker C1 stuck. Fault cleared with no loss of supply.	4.5 / 12	Stable
1B.18	Fault at Vassell 765 kV on Maliszewski circuit. Breaker B1 stuck. Fault cleared with no loss of supply.	4.5 / 12	Stable
1B.19	Fault at Vassell 765 kV on Vassell 765/345 kV Transformer 1. Breaker D1 stuck. Fault cleared with no loss of supply.	4.5 / 12	Stable

*Post fault oscillations observed in Mitchell unit 1, with a damping margin of < 3%. The same oscillations were also observed on the pre-project case so the damping issue is not attributable to AB2-067.

Table 6: Single-phase Bus Faults with Normal Clearing

Fault ID	Fault description	Clearing Time Normal and Delayed (Cycles)	Result No Mitigation
1S.01	Fault at Maliszewski 765 kV Bus. Fault cleared with loss of: • Maliszewski – Vassell 765 kV circuit. • Maliszewski – Marysville 765 kV circuit. • Maliszewski 765/138 kV Transformer. • Maliszewski – Maliszewski bus section 1 138 kV circuits SR, and ZB. CONTINGENCY ‘7224_C1_05MALIS 765-1'	4.5	Stable

Table 7: Single-phase Faults with Loss of Multiple-Circuit Tower Line

Fault ID	Fault description	Clearing Time Near & Remote (Cycles)	Result No Mitigation
1T.01	Fault at Kammer 345 kV on Muskingum River circuit resulting in tower failure. Fault cleared with additional loss of: • Beverly – Holloway 345 kV circuit. CONTINGENCY '474'	4.5	Stable
1T.02	Fault at Kammer 345 kV on West Bellaire circuit resulting in tower failure. Fault cleared with additional loss of: • Beverly – Holloway 345 kV circuit. • West Bellaire – Tidd 345 kV circuit. CONTINGENCY '476'	4.5	Stable
1T.03	Fault at Kammer 345 kV on Muskingum River circuit resulting in tower failure. Fault cleared with additional loss of: • Beverly – Muskingum River 345 kV circuit. CONTINGENCY '473'	4.5	Stable
1T.04	Fault at Kammer 345 kV on West Bellaire circuit resulting in tower failure. Fault cleared with additional loss of: • Tidd – Holloway 345 kV circuit. CONTINGENCY '8945'	4.5	Stable

Table 8: Three-phase Faults with Normal Clearing – Prior outage of AB2-067 TAP - Kammer 765 kV circuit

Fault ID	Fault description	Clearing Time (Cycles)	Result No Mitigation
MA.3N.01	Fault at AB2-067 TAP 765 kV on Vassell circuit (Trips AB2-067 units G1 and G2).	4.5	Stable

Table 9: Three-phase Faults with Normal Clearing – Prior outage of AB2-067 TAP - Vassell 765 kV circuit

Fault ID	Fault description	Clearing Time (Cycles)	Result No Mitigation
MB.3N.01	Fault at AB2-067 TAP 765 kV on Kammer circuit (Trips AB2-067 units G1 and G2).	4.5	Stable*

*Post fault oscillations observed in Mitchell unit 1, with a damping margin of < 3%. The same oscillations were also observed on the pre-project case so the damping issue is not attributable to AB2-067.

Table 10: Three-phase Faults with Normal Clearing – Prior outage of Vassell - Maliszewski 765 kV circuit

Fault ID	Fault description	Clearing Time (Cycles)	Result No Mitigation
MC.3N.02	Fault at AB2-067 TAP 765 kV on Kammer circuit.	4.5	Stable*

*Post fault oscillations observed in Mitchell unit 1, with a damping margin of < 3%. The same oscillations were also observed on the pre-project case so the damping issue is not attributable to AB2-067.

Table 11: Three-phase Faults with Normal Clearing – Prior outage of Vassell 765/345 kV Transformer 1

Fault ID	Fault description	Clearing Time (Cycles)	Result No Mitigation
MD.3N.02	Fault at AB2-067 TAP 765 kV on Kammer circuit.	4.5	Stable*

*Post fault oscillations observed in Mitchell unit 1, with a damping margin of < 3%. The same oscillations were also observed on the pre-project case so the damping issue is not attributable to AB2-067.

Table 12: Three-phase Faults with Normal Clearing – Prior outage of Kammer - South Canton 765 kV circuit (Trips South Canton 765/345 kV Transformer 3)

Fault ID	Fault description	Clearing Time (Cycles)	Result No Mitigation
ME.3N.03	Fault at AB2-067 TAP 765 kV on Vassell circuit.	4.5	Stable

Table 13: Three-phase Faults with Normal Clearing – Prior outage of Mitchell 765/345 kV Transformer TR4

Fault ID	Fault description	Clearing Time (Cycles)	Result No Mitigation
MF.3N.03	Fault at AB2-067 TAP 765 kV on Vassell circuit.	4.5	Stable

Table 14: Three-phase Faults with Normal Clearing – Prior outage of Kammer 765/500 kV Transformer TR2 (Trips Kammer - 502 Junction 500 kV circuit)

Fault ID	Fault description	Clearing Time (Cycles)	Result No Mitigation
MG.3N.03	Fault at AB2-067 TAP 765 kV on Vassell circuit.	4.5	Stable

Table 15: Three-phase Faults with Normal Clearing – Prior outage of Kammer - Belmont - Mountaineer circuit (Trips Belmont 765/500 kV Transformer and 500/138 kV Transformers 1 & 2)

Fault ID	Fault description	Clearing Time (Cycles)	Result No Mitigation
MH.3N.03	Fault at AB2-067 TAP 765 kV on Vassell circuit.	4.5	Stable

Attachment 1. Impact Study Data

Attachment 2. AEP and APS One Line Diagram

Attachment 3. PSS/E Model One Line Diagram

Attachment 4. AB2-067 PSS/E Dynamic Model

Attachment 5. AB2-067 PSS/E Case Dispatch

Attachment 6. Plots from Dynamic Simulations

The above attachments can be provided upon request.