

Y3-068 George Washington 138kV

Generation Interconnection

General

Interconnection Customer (IC) proposes to install PJM Project #Y3-068, a 615.3 MW (615.3 MW Capacity) natural gas generating facility (2x1 Combined Cycle) to the American Electric Power (AEP) transmission system. This project comprises of two (2) possible interconnection points. The primary point of interconnection requested is a direct connection to the George Washington 138 kV station. The secondary point of interconnection requested is a direct connection to the Kammer 345 kV station

The requested in-service date is June 1, 2017.

The objective of this Feasibility 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 not included as part of this study.

Attachment Facilities

Primary Point of Interconnection (George Washington 138 kV Station):

Direct connection to the George Washington 138 kV station will require at a minimum four (4) to five (5) additional 138 kV circuit breakers. The site and layout of the existing station cannot accommodate these additional circuit breakers. A new 138 kV station will be required for this interconnection. The existing George Washington station would continue to be utilized for 69 kV connections. Protection schemes will need to be modified and 138 kV metering will need to be installed.

The following work is required to connect Project Y3-068:

Station Cost:

- A new twelve (12) breaker switching station (Figure 1) will need to be constructed to connect the proposed generation to AEP. SCADA, revenue metering, and associated equipment will also need to be installed. Estimated Cost (2013 Dollars): \$13,500,000

Protection and Relaying Cost:

- Line protections and controls at the existing George Washington 138 kV station will need to be upgraded to coordinate with the new switching station. Estimated Cost (2013 Dollars): \$200,000
- Line protections and controls at the Tidd 138 kV station will need to be upgraded to coordinate with the new switching station. Estimated Cost (2013 Dollars): \$200,000
- Line protection and controls at the following tap stations on the George Washington-Tidd 138 kV line will need to be upgraded to coordinate with the new switching station (2013 dollars):
 - Big Grave Creek \$250,000

- Valley Grove \$150,000
- West Liberty \$250,000

- Line protections and controls at the existing Kammer 138 kV station will need to be upgraded to coordinate with the new switching station. Estimated Cost (2013 Dollars): \$200,000
- Relay settings at the existing Natrium 138 kV station will need to be reviewed, but costs are not expected to significantly affect the total cost of the George Washington connection alternative.

Secondary Point of Interconnection (Kammer 345 kV Station):

The secondary point of interconnection evaluated is at the Kammer 345 kV station (Figure 4). Protection schemes will need to be modified and 345 kV metering will need to be installed.

The following work is required to connect Project Y3-068 to Kammer 345 kV station:

Station (Option 2 Kammer 345 kV):

- Expansion of the existing buses 1 and 2 at Kammer 345 kV will be necessary in order to add three new 345 kV breakers (Figure 3) to connect the proposed generation to the Kammer 345 kV substation. SCADA, revenue metering, and associated equipment will also need to be installed.

Protection and Relaying (Option 2 Kammer 345 kV):

- Line protections and controls at Kammer 345 kV station will need to be upgraded.

It is understood that the IC is responsible for all costs associated with these connections. The costs above are reimbursable to AEP.

Revenue Metering and SCADA Requirements

For PJM: IC 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 Sections 24.1 and 24.2. A link to the manuals is provided below.

<http://www.pjm.com/documents/manuals.aspx>

For AEP:

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers.

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 and Connection Requirements for AEP Transmission System¹. Therefore, these criteria were used to assess the impact of the proposed facility on the AEP System. MP project Y3-068 was studied as a 615.3 MW (615.3 MW capacity) natural gas generating facility consistent with the interconnection application. Project #Y3-068 was evaluated for compliance with reliability criteria for summer peak conditions in 2017.

Primary Point of Interconnection Potential network impacts were as follows (George Washington 138kV station):

Normal System (2017 Summer Conditions Capacity Output)

- No problems identified

1

Single Contingency (2017 Summer Conditions Capacity Output)

AEP Identified Overloads					
#	Contingency Name	Contingency Description	Facility Description	Limiting Element	Mitigation
1	'7707_B2_TOR725'	Contingency '7707_B2_TOR725' Open branch from bus 243026 to bus 243143 ckt 1 / 243026 05KAMMR1 138 243143 05WBELLA 138 1 Open branch from bus 243143 to bus 245101 ckt 1 / 243143 05WBELLA 138 245101 W BELAIR 69.0 1 Open branch from bus 245082 to bus 245101 ckt 1 / 245082 BELLAIRE 69.0 245101 W BELAIR 69.0 1 Open branch from bus 245093 to bus 245101 ckt 1 / 245093 NEFFS 69.0 245101 W BELAIR 69.0 1 end	The BELMONT – WEST BETHESDA 69.0 kV line (from 244980 to 245025 ckt 1) loads from 95% to 100.8% (AC power flow) of its emergency rating (31 MVA) for single line contingency outage of contingency description ('7707_B2_TOR725').	The COPPER ~ #1 ~ 3 ~ Conductor Section 1	Reconductor entire 1.31 mile section of BELMONT – WEST BETHESDA 69.0 kV line
2	'7707_B2_TOR725'	Contingency '7707_B2_TOR725' Open branch from bus 243026 to bus 243143 ckt 1 / 243026 05KAMMR1 138 243143 05WBELLA 138 1 Open branch from bus 243143 to bus 245101 ckt 1 / 243143 05WBELLA 138 245101 W BELAIR 69.0 1 Open branch from bus 245082 to bus 245101 ckt 1 / 245082 BELLAIRE 69.0 245101 W BELAIR 69.0 1 Open branch from bus 245093 to bus 245101 ckt 1 / 245093 NEFFS 69.0 245101 W BELAIR 69.0 1 end	The SPEIDEL – WEST BETHESDA 69.0 kV line (from 245018 to 245025 ckt 1) loads from 95% to 100.8% (AC power flow) of its emergency rating (31 MVA) for single line contingency outage of contingency description ('7707_B2_TOR725').	The COPPER ~ #1 ~ 3 ~ Conductor Section 1	Reconductor entire 2.91 mile section of SPEIDEL – WEST BETHESDA 69.0 kV line

Table 1 – AEP Identified Overloads

Multiple Contingency (2017 Summer Conditions Capacity Output)

- No problems identified

Contribution to Previously Identified Overloads (2017 Summer Conditions Capacity Output)

- No problems identified

Normal System (2017 Summer Conditions Full Output)

- No problems identified

Single Contingency (2017 Summer Conditions Full Output)

- No problems identified

Multiple Contingency (2017 Summer Conditions Full Output)

AEP Identified Overload - Multiple Contingency					
#	Contingency Name	Contingency Description	Facility Description	Limiting Element	Mitigation
1	'4743_C2_05TIDD 345-CC'	Contingency '4743_C2_05TIDD 345-CC' Open branch from bus 235707 to bus 242946 ckt 1 / 235707 01WYLIE R 345 242946 05TIDD 345 1 Open branch from bus 242946 to bus 253965 ckt 1 / 242946 05TIDD 345 253965 15COLLIE 345 1 end	The MAHANS LANE – 05TIDD 138.0 kV line (from 235363 to 243127 ckt 1) loads from 99.2% to 113.7% (AC power flow) of its emergency rating (205 MVA) for the breaker failure contingency outage of contingency description '4743_C2_05TIDD 345-CC'.	The ACSR ~ 556.5 ~ 26/7 ~ DOVE Conductor Section 1 is a limiting element.	A sag study has been requested for the ACSR ~ 556.5 ~ 26/7 ~ DOVE Conductor Section 1 to determine if the line section can be operated above its emergency rating of 205 MVA. The results could prove that no additional upgrades are necessary, that some upgrades on the circuit are necessary, or that the entire 12.32 mile section of line would need to be rebuilt.

Table 2 – AEP Identified Overloads

Contribution to Previously Identified Overloads (2017 Summer Conditions Energy Output)

- No problems identified

Network Impacts

The Queue Project #Y3-068 was studied as a 615.3MW (Capacity615.3MW) injection at the George Washington 138 kV substation in the AEP area. Project #Y3-068 was evaluated for compliance with reliability criteria for summer peak conditions in 2017. Potential network impacts were as follows:

Option 1	
Contingency Name	Description
5213_B2_TOR773	CONTINGENCY '5213_B2_TOR773' OPEN BRANCH FROM BUS 243012 TO BUS 243026 CKT 1 / 243012 05G WASH 138 243026 05KAMMR1 138 1 END
7642_C2_05KAMMR1 138-T	CONTINGENCY '7642_C2_05KAMMR1 138-T' OPEN BRANCH FROM BUS 242937 TO BUS 243026 CKT 2 / 242937 05KAMMER 345 243026 05KAMMR1 138 2 OPEN BRANCH FROM BUS 243012 TO BUS 243026 CKT 1 / 243012 05G WASH 138 243026 05KAMMR1 138 1 END

Table 3 – PJM Identified Contingencies

Generator Deliverability

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

Table 4 below provides a summary of the impacts caused by Y2-058 on the AEP transmission system and other TO areas for generator deliverability:

Option 1												
Y3-068 Generator Deliverability												
#	Type	Contingency Name	Affected Area	Facility Description	Bus		Loading		Rating		MW Cont.	FG App.
					From	To	Initial	Final	Type	MVA		
1	N-1	5213_B2_TOR773	AEP - AEP	SHADYSID-MONROE* 69 kV line	245098	245091	12.61	108.7	ER	46	44.2	1
2	N-1	5213_B2_TOR773	AEP - AEP	G WASHON-C.COL IR 69 kV line	245935	245922	49.51	119.67	ER	41	69.36	2
3	N-1	5213_B2_TOR773	AEP - AEP	DILLES-SHADYSID 69 kV line	245086	245098	31.3	127.4	ER	46	44.2	4
4	N-1	5213_B2_TOR773	AEP - AEP	GLENDALÉ-BRUES 69 kV line	245937	245920	16.51	130.16	ER	48	54.55	5

Table 4 – PJM Generator Deliverability

Multiple Facility Contingency

(Double Circuit Tower Line(DCTL), Line with Failed Breaker(LFFB) and Bus Fault(Bus) contingencies for the full energy output.)

Table XX below provides a summary of the impacts caused by Y3-068 on the AEP transmission system and other TO areas for multiple facility contingency:

Y3-068 Multiple Facility Contingency													
#	Type	Contingency		Affected Area	Facility Description	Bus		Loading		Rating		MW Cont.	FG App.
		Name				From	To	Initial	Final	Type	MVA		
1	LFFB	7642_C2_05KAMMR1	138-T	AEP - AEP	G WASHON-C.COL IR 69 kV line	245935	245922	45.61	122.64	ER	41	68.98	3

Table 5 – PJM Multiple Facility Contingency

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)

Table 14 below provides a summary of the impacts caused by Y2-058 on the AEP transmission system and other TO areas for contribution to previously identified overloads:

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection request.

Note: 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 analyzes all overload conditions associated with the overloaded element(s) identified.

As a result of the aggregate energy resources in the area, no violations were identified.

Short Circuit

(Summary of impacted circuit breakers)

PJM has completed the short circuit analysis of the **Y3-068** queue project. Our analysis found **17 new breakers**, to be over-duty in the AEP transmission area. The new over-duty breakers are listed below:

Option 1: – Summary of Breakers

#	Substation	Breaker	Increase in Interrupting Duty
1	05G WASH 138 kV	Breaker A	Interrupting duty increased from 99.10% to 224.50%.
2	05G WASH 138 kV	Breaker B	Interrupting duty increased from 91.40% to 216.20%.
3	05G WASH 138 kV	Breaker J	Interrupting duty increased from 80.10% to 204.20%.
4	05KAMMR1 138 kV	Breaker O	Interrupting duty increased from 98.20% to 113.80%.
5	05KAMMR1 138 kV	Breaker S	Interrupting duty increased from 96.00% to 110.20%.
6	05KAMMR1 138 kV	Breaker I	Interrupting duty increased from 93.00% to 106.20%.
7	05KAMMR1 138 kV	Breaker L	Interrupting duty increased from 93.00% to 106.20%.
8	05KAMMR1 138 kV	Breaker U	Interrupting duty increased from 93.00% to 106.20%.
9	05NATRIU 138 kV	Breaker I	Interrupting duty increased from 96.20% to 101.20%.
10	05NATRIU 138 kV	Breaker K	Interrupting duty increased from 95.40% to 100.30%.
11	05NATRIU 138 kV	Breaker G	Interrupting duty increased from 136.90% to 143.90%.
12	05KAMMR1 138 kV	Breaker J	Interrupting duty increased from 103.80% to 119.50%.
13	05KAMMR1 138 kV	Breaker K	Interrupting duty increased from 103.80% to 119.50%.
14	05KAMMR1 138 kV	Breaker M	Interrupting duty increased from 103.80% to 119.50%.
15	05KAMMR1 138 kV	Breaker N	Interrupting duty increased from 103.80% to 119.50%.
16	05KAMMR1 138 kV	Breaker G	Interrupting duty increased from 102.20% to 117.60%.
17	05KAMMR1 138 kV	Breaker H	Interrupting duty increased from 102.20% to 117.60%.

Table 6 – Option 1, Summary of Breakers

Option 1 Estimated Cost:

All identified breakers are scheduled to be replaced with the Kammer Area project and should be in service no later than 6/1/2015.

New System Reinforcements

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

Y3-068 Generator Deliverability Reinforcements					
#	Contingency Name	Facility Description	Description	Schedule	Cost
1	'7707_B2_TOR725'	BELMONT – WEST BETHESDA 69.0 kV line	The COPPER ~ #1 ~ 3 ~ Conductor Section 1 Conductor Section 1 is the limiting element. Reconductor entire 1.31 mile section of BELMONT – WEST BETHESDA 69.0 kV line. Estimated Cost (2013 Dollars): \$1,572,000		\$1,572,000
2	'7707_B2_TOR725'	SPEIDEL – WEST BETHESDA 69.0 kV line	The COPPER ~ #1 ~ 3 ~ Conductor Section 1 Conductor Section 1 is the limiting element. Reconductor entire 2.91 mile section of SPEIDEL – WEST BETHESDA 69.0 kV line. Estimated Cost (2013 Dollars): \$3,492,000		\$3,492,000
3	'4743_C2_05TIDD 345-CC'	MAHANS LANE – 05TIDD 138.0 kV line	The ACSR ~ 556.5 ~ 26/7 ~ DOVE Conductor Section 1 is the limiting element. A sag study has been requested for the ACSR ~ 556.5 ~ 26/7 ~ DOVE Conductor Section 1 to determine if the line section can be operated above its emergency rating of 205 MVA. It is required to be completed before 6/1/2015.		\$146,900

Table 7 – Option 1, AEP Generator Deliverability Reinforcements

Y3-068 Generator Deliverability Reinforcements					
#	Contingency Name	Facility Description	Description	Schedule	Cost
1	5213_B2_TOR773	SHADYSID-MONROE* 69 kV line	Reconductor the entire 18.69 mile section of the Shadyside – Monroe 69 kV line.		\$22,428,000
2	5213_B2_TOR773	G WASHON-C.COL IR 69 kV line	The G WASHON-C.COL IR 69 kV line: Reconductor the entire 2 mile section of the line.		\$2,400,000
3	5213_B2_TOR773	DILLES-SHADYSID 69 kV line	The DILLES-SHADYSID 69 kV line: Reconductor the entire 5.83 mile section of the line.		\$6,996,000
4	5213_B2_TOR773	GLENDALÉ-BRUES 69 kV line	The GLENDALÉ-BRUES 69 kV line: Reconductor the entire 5.02 mile section of the line.		\$6,024,000

Table 8 – Option 1, PJM Generator Deliverability Reinforcements

AEP Table - Y3-068 Multiple Facility Contingency Reinforcements					
#	Contingency Name	Facility Description	Description	Schedule	Cost
1	'4743_C2_05TIDD 345-CC'	The MAHANS LANE – 05TIDD 138.0 kV line (from 235363 to 243127 ckt 1) loads from 99.2% to 113.7% (AC power flow) of its emergency rating (205 MVA) for the breaker failure contingency outage of contingency description '4743_C2_05TIDD 345-CC'	Same as Table 7, Item #3		

Table 9 – Option 1, AEP Multiple Facility Contingency Reinforcements

PJM Table - Y3-068 Multiple Facility Contingency Reinforcements					
#	Contingency Name	Facility Description	Description	Schedule	Cost
1	7642_C2_05KAMMR1 138-T	G WASHON-C.COL IR 69 kV line	Same as Table 8, item 2		

Table 10 – Option 1, PJM Multiple Facility Contingency Reinforcements

Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of the surrounding generation. Any potential 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 Transmission Interconnection request.

Note: 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 analyzes all overload conditions associated with the overloaded element(s) identified. As a result of the aggregate energy resources in the area, the following violations were identified.

No violations were reported

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

To be determined

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

The analysis will be done in the Impact Study

Conclusion

Based upon the result of this Feasibility Study, the construction of the IC (PJM Project #Y3-068) natural gas generation project will require additional interconnection charges.

The cost for the primary point of interconnection (George Washington 138kV station):

- Estimated new switching station cost (2013 Dollars): **\$13,500,000**
- Estimated protection and relaying cost (2013 Dollars): **\$1,250,000**
- Estimated local/network upgrade cost (2013 Dollars): **\$42,912,000**

Total estimated cost for project Y3-068 (2013 Dollars): **\$57,808,900**

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.

Appendices Option 1 – George Washington 138 kV

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 gauge 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.

Appendix 1

(AEP - AEP) The SHADYSID-MONROE* 69 kV line (from bus 245098 to bus 245091 ckt 1) loads from 12.61% to 108.7% (**DC power flow**) of its emergency rating (46 MVA) for the single line contingency outage of '5213_B2_TOR773'. This project contributes approximately 44.2 MW to the thermal violation.

CONTINGENCY '5213_B2_TOR773'

OPEN BRANCH FROM BUS 243012 TO BUS 243026 CKT 1 / 243012 05G WASH 138
243026 05KAMMR1 138 1

END

Bus Number	Bus Name	Full Contribution
915481	Y3-068 OP1	44.2

Appendix 2

(AEP - AEP) The G WASHON-C.COL IR 69 kV line (from bus 245935 to bus 245922 ckt 1) loads from 49.51% to 119.67% (**DC power flow**) of its emergency rating (41 MVA) for the single line contingency outage of '5213_B2_TOR773'. This project contributes approximately 69.36 MW to the thermal violation.

CONTINGENCY '5213_B2_TOR773'

OPEN BRANCH FROM BUS 243012 TO BUS 243026 CKT 1 / 243012 05G WASH 138
243026 05KAMMR1 138 1

END

Bus Number	Bus Name	Full Contribution
915481	Y3-068 OP1	69.36

Appendix 3

(AEP - AEP) The G WASHON-C.COL IR 69 kV line (from bus 245935 to bus 245922 ckt 1) loads from 45.61% to 122.64% (**DC power flow**) of its emergency rating (41 MVA) for the line fault with failed breaker contingency outage of '7642_C2_05KAMMR1 138-T'. This project contributes approximately 68.98 MW to the thermal violation.

CONTINGENCY '7642_C2_05KAMMR1 138-T'

OPEN BRANCH FROM BUS 242937 TO BUS 243026 CKT 2 / 242937 05KAMMER 345
243026 05KAMMR1 138 2

OPEN BRANCH FROM BUS 243012 TO BUS 243026 CKT 1 / 243012 05G WASH 138
243026 05KAMMR1 138 1

END

Bus Number	Bus Name	Full Contribution
915481	Y3-068 OP1	68.98

Appendix 4

(AEP - AEP) The DILLES-SHADYSID 69 kV line (from bus 245086 to bus 245098 ckt 1) loads from 31.3% to 127.4% (**DC power flow**) of its emergency rating (46 MVA) for the single line contingency outage of '5213_B2_TOR773'. This project contributes approximately 44.2 MW to the thermal violation.

CONTINGENCY '5213_B2_TOR773'

OPEN BRANCH FROM BUS 243012 TO BUS 243026 CKT 1 / 243012 05G WASH 138
243026 05KAMMR1 138 1

END

Bus Number	Bus Name	Full Contribution
915481	Y3-068 OP1	44.2

Appendix 5

(AEP - AEP) The GLENDALE-BRUES 69 kV line (from bus 245937 to bus 245920 ckt 1) loads from 16.51% to 130.16% (**DC power flow**) of its emergency rating (48 MVA) for the single line contingency outage of '5213_B2_TOR773'. This project contributes approximately 54.55 MW to the thermal violation.

CONTINGENCY '5213_B2_TOR773'

OPEN BRANCH FROM BUS 243012 TO BUS 243026 CKT 1 / 243012 05G WASH 138
243026 05KAMMR1 138 1

END

Bus Number	Bus Name	Full Contribution
Y2-068	Y2-068	2.97
915481	Y3-068 OP1	54.55

Secondary Point of Interconnection (Kammer 345kV station):

Network Impacts

The Queue Project #Y3-068 was studied as a 615.3 MW (Capacity 615.3 MW) injection at the Kammer 345 kV substation in the AEP area. Project #Y3-068 was evaluated for compliance with reliability criteria for summer peak conditions in 2017.

Potential network impacts were as follows:

Option 2	
Contingency Name	Description
1270_B2_TOR578_A	CONTINGENCY '1270_B2_TOR578_A' OPEN BRANCH FROM BUS 242932 TO BUS 914080 CKT 1 / 242932 05CANTNC 345 242946 05TIDD 345 1 END
3117_C2_05CANTNC 345-K_A	CONTINGENCY '3117_C2_05CANTNC 345-K_A' OPEN BRANCH FROM BUS 238781 TO BUS 242932 CKT 1 / 238781 02HANNA 345 242932 05CANTNC 345 1 OPEN BRANCH FROM BUS 242932 TO BUS 914080 CKT 1 / 242932 05CANTNC 345 242946 05TIDD 345 1 END
41_B2_TOR544	CONTINGENCY '41_B2_TOR544' OPEN BRANCH FROM BUS 242925 TO BUS 242930 CKT 1 / 242925 05KAMMER 765 242930 05SCANTO 765 1 OPEN BRANCH FROM BUS 242930 TO BUS 242943 CKT 3 / 242930 05SCANTO 765 242943 05SCANTO 345 3 OPEN BRANCH FROM BUS 242943 TO BUS 243092 CKT 4 / 242943 05SCANTO 345 243092 05SCANTE 138 4 END

Table 11 – Option 2, PJM Contingencies

Generator Deliverability

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

Option 2												
Y3-068 Generator Deliverability												
#	Type	Contingency Name	Affected Area	Facility Description	Bus		Loading		Rating		MW Cont.	FG App.
					From	To	Initial	Final	Type	MVA		
1	N-1	1270_B2_TOR578_A	AEP - AP	05TIDD-WYLIE RIDGE 345 kV line	242946	235707	94.34	100.09	ER	1166	67.1	1
2	N-1	41_B2_TOR544	AEP - AEP	05KAMMER-05WBELLA 345 kV line	242937	242948	87.45	95.64	ER	1176	143.3	3

Table 12 – Option 2, Generator Deliverability

Light Load Analysis

Light Load Studies to be conducted during later study phases (applicable to wind, coal, nuclear, and pumped storage projects).

Multiple Facility Contingency

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

Y3-068 Multiple Facility Contingency												
#	Type	Contingency Name	Affected Area	Facility Description	Bus		Loading		Rating		MW Cont.	FG App.
					From	To	Initial	Final	Type	MVA		
1	LFFB	3117_C2_05CANTNC 345-K_A	AEP - AP	05TIDD-WYLIE RIDGE 345 kV line	242946	235707	95.95	101.71	ER	1166	67.21	2

Table 13 – Option 2, Multiple Facility Contingency

Short Circuit

(Summary form of Cost allocation for breakers will be inserted here if any)

#	Substation	Breaker	Increase in Interrupting Duty
1	05KAMMR2 138 kV	Breaker D	Interrupting duty increased from 99.40% to 107.60%.
2	05KAMMR2 138 kV	Breaker E	Interrupting duty increased from 114.10% to 123.40%.

Table 14 – Option 2, Short Circuit Results

All identified breakers are scheduled to be replaced with the Kammer Area project and should be in service no later than 6/1/2015.

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

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

To be determined

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

Stability studies were not performed as part of this Feasibility Study. The stability assessments will be performed during the System Impact Study.

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

(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)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

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

Appendices Option 2 – Kammer 345 kV

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 gauge 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.

Appendix 1

(AEP - AP) The 05TIDD-WYLIE RIDGE 345 kV line (from bus 242946 to bus 235707 ckt 1) loads from 94.34% to 100.09% (**DC power flow**) of its emergency rating (1166 MVA) for the single line contingency outage of '1270_B2_TOR578_A'. This project contributes approximately 67.1 MW to the thermal violation.

CONTINGENCY '1270_B2_TOR578_A'

OPEN BRANCH FROM BUS 242932 TO BUS 914080 CKT 1

/ 242932 05CANTNC 345

242946 05TIDD 345 1

END

Bus Number	Bus Name	Full Contribution
242931	05BEVERL	2.04
243190	05CDG1	2.06
243191	05CDG2	9.04
243185	05CDG3	9.73
243192	05KMG1H	11.62
243193	05KMG1L	9.9
243194	05KMG2H	11.62
243195	05KMG2L	9.9
243196	05KMG3H	11.62
243197	05KMG3L	9.9
243189	05MLG2	3.87
243045	05MUSKNG	25.15
235344	HANNIBAL	0.07
247581	W3-111 C	0.49
247582	W3-112 C	0.37
247583	W3-113 C	0.37
903781	W3-128	40.08
914081	Y2-050 C OP1	231.56
Y2-068	Y2-068	109.72

915481	Y3-068 OP2	67.1
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Appendix 2

(AEP - AP) The 05TIDD-WYLIE RIDGE 345 kV line (from bus 242946 to bus 235707 ckt 1) loads from 95.95% to 101.71% (**DC power flow**) of its emergency rating (1166 MVA) for the line fault with failed breaker contingency outage of '3117_C2_05CANTNC 345-K_A'. This project contributes approximately 67.21 MW to the thermal violation.

CONTINGENCY '3117_C2_05CANTNC 345-K_A'

OPEN BRANCH FROM BUS 238781 TO BUS 242932 CKT 1 / 238781 02HANNA 345
242932 05CANTNC 345 1

OPEN BRANCH FROM BUS 242932 TO BUS 914080 CKT 1 / 242932 05CANTNC 345
242946 05TIDD 345 1

END

Bus Number	Bus Name	Full Contribution
243191	05CDG2	9.04
243185	05CDG3	9.73
243192	05KMG1H	11.64
243193	05KMG1L	9.91
243194	05KMG2H	11.64
243195	05KMG2L	9.91
243196	05KMG3H	11.64
243197	05KMG3L	9.91
243189	05MLG2	3.88
243045	05MUSKNG	25.22
247581	W3-111 C	0.49
247950	W3-111 E	0.8
247582	W3-112 C	0.37
247951	W3-112 E	0.6
247583	W3-113 C	0.37
247952	W3-113 E	0.59
903781	W3-128	40.2
914081	Y2-050 C OP1	231.51

914082	Y2-050 E OP1	24.12
Y2-068	Y2-068	110.19
915481	Y3-068 OP2	67.21

Appendix 3

(AEP - AEP) The 05KAMMER-05WBELLA 345 kV line (from bus 242937 to bus 242948 ckt 1) loads from 87.45% to 95.64% (**DC power flow**) of its emergency rating (1176 MVA) for the single line contingency outage of '41_B2_TOR544'. This project contributes approximately 143.33 MW to the thermal violation.

CONTINGENCY '41_B2_TOR544'

OPEN BRANCH FROM BUS 242925 TO BUS 242930 CKT 1 / 242925 05KAMMER 765
242930 05SCANTO 765 1

OPEN BRANCH FROM BUS 242930 TO BUS 242943 CKT 3 / 242930 05SCANTO 765
242943 05SCANTO 345 3

OPEN BRANCH FROM BUS 242943 TO BUS 243092 CKT 4 / 242943 05SCANTO 345
243092 05SCANTE 138 4

END

Bus Number	Bus Name	Full Contribution
243192	05KMG1H	20.06
243193	05KMG1L	17.09
243194	05KMG2H	20.06
243195	05KMG2L	17.09
243196	05KMG3H	20.06
243197	05KMG3L	17.09
243188	05MLG1	3.36
243189	05MLG2	8.27
242894	05MTG1	3.11
253922	15STJOE1	-9.83
235344	HANNIBAL	0.1
235590	PLEASANTS 1	1.5
235591	PLEASANTS 2	1.5
290784	S-070 1	0.04
290785	S-070 2	0.04
235577	WILLOW I 1	2.76
235578	WILLOW I 2	8.55

900404	X3-028 C	1.44
900405	X3-028 E	1.92
910701	X3-051	31.37
913181	Y1-044	0.35
914121	Y2-054	0.7
915131	Y3-036	1.85
915481	Y3-068 OP2	143.33