#Y2-085 – Sammis – Star 345kV
Generation Interconnection

General

The Interconnection Customer is proposing a 1050MW Capacity natural gas facility to be interconnected to the ATSI transmission system and located in Carroll County, OH. ATSI is a FirstEnergy (FE) company. The proposed in-service date for this project is January 1, 2017.

This Generation Interconnection Feasibility Study provides analysis results to aid the Interconnection Customer in assessing the practicality and cost of incorporating the facility into the PJM system.

Option 1:

The Y2-085 project will tap the Sammis – Star 345kV line for this option.

Facilities to Accommodate the Interconnection

Scope of Direct Connection Work

The Y2-085 project will tap the Sammis – Star 345kV line. To accommodate this interconnection, installation of a new three-breaker ring bus 345kV substation, disconnect switches, relaying, metering, RTU, SCADA and other miscellaneous supporting equipment will be required. The new 345kV three-breaker ring bus will be located approximately 23 miles from the Sammis substation. The direct connects are estimated to cost approximately **$6,742,100**, with an extra **$1,684,900** tax gross-up if applicable, to interconnect and take a minimum of **17 months** after the receipt of an executed Construction Service Agreement to complete this work (See **Table 1** below for cost breakdown and details). The cost estimate above does not include any of the upgrades listed in the Network Impacts section of the report.

The Interconnection Customer is responsible for meeting all criteria as specified in the applicable sections of the "FirstEnergy Requirements for Transmission Connected Facilities" document.

The Interconnection Customer is responsible for constructing all of the Interconnection Customer-owned facilities on the Interconnection Customer's side of the Point of Interconnection.

Direct Connect Cost Estimate

The total preliminary cost estimate for Direct Connection work performed by ATSI is listed in the following table:

Table 1. Direct Connect Cost Estimate

Description	Total Cost	Tax	Total with Tax
Install new 345kV three-breaker ring bus generation interconnection switching station approximately 23 miles from Sammis on the existing Sammis – Star 345kV line	$5,799,800	$1,449,400	$7,249,200
At the Sammis substation, modify relay settings and line name references on the 345kV Star line exit (now Y2-085 Interconnection line exit)	$26,000	$6,500	$32,500
At the Star substation, modify relay settings and line name references on the 345kV Sammis line exit (now Y2-085 Interconnection line exit)	$26,000	$6,500	$32,500
Install a loop, approximately 0.1 mile in length, to the new 345kV three-breaker ring bus substation adjacent to the 345kV Sammis – Star line	$776,700	$194,100	$970,800
Engineering Oversight and Commissioning	$113,600	$28,400	$142,000
Total	**$6,742,100**	**$1,684,900**	**$8,427,000**

The following assumptions were made by ATSI when putting together the direct connection cost estimate listed in Table 1 above. If any of these assumptions prove not to be correct, this could cause time delays and changes in cost estimates:

- *The Interconnection Customer will acquire all easements, properties and permits relating to construction of both the new 345kV three-breaker ring bus substation and the associated attachment facilities.*
- *Interconnection Customer will be responsible for the rough grade of the property and an access road to the proposed 3-breaker ring bus site.*
- *No environmental issue with any properties associated with this project.*
- *No delays acquiring necessary permits for implementing the defined direct connect and network upgrades.*
- *PJM will allow transmission system outages when requested.*

Revenue Metering and SCADA Requirements

For PJM: The Interconnection Customer will install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for Interconnection Customer's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 24.1 to 24.2.

For ATSI: The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:
www.firstenergycorp.com/feconnect
www.pjm.com/planning/design-engineering/to-tech-standards.aspx

Network Impacts

The Y2-085 project was studied as a 1050MW Capacity injection into the ATSI area as a tap of the Sammis - Star 345kV line. Project Y2-085 was evaluated for compliance with reliability criteria for summer peak conditions in 2016.

Potential network impacts were as follows:

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

No violations were found.

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.)

Item 1a. The SMITHTON 62-YUKON 138 kV line (from bus 235252 to bus 235277 ckt 1) loads from 97.07% to 98.2% (**DC power flow**) of its emergency rating (297 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('AP_SB_467'). This project contributes approximately 20.8 MW to the thermal violation.

CONTINGENCY 'AP_SB_467' / HATFIELD500-RONCO500
STK BKR AT HATFIELD500 #8
OPEN BRANCH FROM BUS 235108 TO BUS 235774 CKT 1
OPEN BUS 235582
END

Short Circuit
(Summary of impacted circuit breakers)

PJM has completed the short circuit analysis of the Y2-085 queue project **SAMMIS-STAR 345kV**. One option was considered during this study: the option was a tap of the SAMMIS - STAR 345 kV line.

PJM analysis found **2 new breakers** to be over-duty in the ATSI transmission area. The new over-duty breakers are listed below:

Bus_ NO	BUS	BREAKER	Duty % with Y2-085_ATSI	Duty % without Y2-085_ATSI	Duty % Difference	Notes
9021	BABB 138 138.kV	12-B-2	102.20%	99.00%	3.20%	New Overduty
9713	HOYTDL S 138 138.kV	83-B-30	100.20%	99.40%	0.80%	New Overduty

The following upgrades in Table 2 below will mitigate the overdutied breakers listed above:

Table 2. Breaker Replacement Cost Estimate	
Description	**Total Cost**
Replace overdutied 138kV circuit breaker B-2 at Babb.	$203,500
Replace overdutied 138kV circuit breaker B-30 at Hoytdale.	$218,500
Total	**$422,000**

It is estimated to take approximately 10 months to complete the installation of these breakers by ATSI.

PJM analysis found **2 new breakers** to be over-duty in the DUQUESNE transmission area. **This is originally an ATSI project but a DUQUESNE bus is 3 or more buses away.** The new over-duty breakers are listed below:

Bus_ NO	BUS	BREAKER	Duty % with Y2-085_ATSI	Duty % without Y2-085_ATSI	Duty % Difference	Notes	ISD
0	BV J3+4 345.kV	Clinton314#3	100.20%	100.00%	0.20%	New Overduty	12/31/14
0	BV J3+4 345.kV	Clinton314#4	100.20%	100.00%	0.20%	New Overduty	12/31/16

Duquesne has plans to replace the breakers identified as overdutied with an 80kA interrupting rating. The in-service dates are listed in the table above under the column heading "ISD". Should the developer choose to go in service before the overdutied breakers are replaced, additional studies will need to be performed to see what limitations will be on the project output.

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)

Item 2a. The SHEPLER H J-SMITHTON 62 138 kV line (from bus 235247 to bus 235252 ckt 1) loads from 102.37% to 103.5% (**DC power flow**) of its emergency rating (297 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('AP_SB_467'). This project contributes approximately 20.8 MW to the thermal violation.

CONTINGENCY 'AP_SB_467' / HATFIELD500-RONCO500 STK BKR AT HATFIELD500 #8
OPEN BRANCH FROM BUS 235108 TO BUS 235774 CKT 1
OPEN BUS 235582
END

Item 2b. The 02CRNBRY-02JACKSN 138 kV line (from bus 239281 to bus 238833 ckt 1) loads from 107.39% to 108.22% (**DC power flow**) of its emergency rating (339 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 17.39 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_064' /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1 /* CABOT 500.00 02CRNBRY 500.00
END

Item 2c. The 02BRBRTN-02WAKRON 138 kV line (from bus 238581 to bus 239161 ckt 1) loads from 109.29% to 111.28% (**DC power flow**) of its emergency rating (332 MVA) for the tower line contingency outage of CONTINGENCY DESCRIPTION ('C5-TWL-CR014'). This project contributes approximately 40.83 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR014' /* N MED-STAR, JUNIPER-STAR 345
DISCONNECT BRANCH FROM BUS 239122 TO BUS 238976 CKT 1 /* 02STAR 345.00 02N MED 345.00
DISCONNECT BRANCH FROM BUS 239122 TO BUS 238850 CKT 1 /* 02STAR 345.00 02JUNIPE 345.00
END

Item 2d. The KEYSTONE-JACKMTN1 500 kV line (from bus 200011 to bus 200071 ckt 1) loads from 108.5% to 109.03% (**DC power flow**) of its emergency rating (3723 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('PJM20A_CONEMAGH-KEYSTONE'). This project contributes approximately 121.92 MW to the thermal violation.

CONTINGENCY 'PJM20A_CONEMAGH-KEYSTONE'
DISCONNECT BRANCH FROM BUS 200005 TO BUS 200011 CKT 1 /* CONEMAGH KEYSTONE 500 500
END

Item 2e. The KEYSTONE-JACKMTN1 500 kV line (from bus 200011 to bus 200071 ckt 1) loads from 110.67% to 111.2% (**DC power flow**) of its emergency rating (3723 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PJM4'). This project contributes approximately 123.36 MW to the thermal violation.

CONTINGENCY 'PJM4' /* KEYSTONE BREAKER 6
DISCONNECT BRANCH FROM BUS 200005 TO BUS 200011 CKT 1 /* CONEMAGH KEYSTONE 500 500
DISCONNECT BRANCH FROM BUS 200011 TO BUS 200810 TO BUS 200907 CKT 4/* KEYSTONE KEYSTONE 500 230
END

Item 2f. The 02JACKSN-02MAPLE 138 kV line (from bus 238833 to bus 238942 ckt 1) loads from 111.53% to 112.45% (**DC power flow**) of its emergency rating (306 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 17.39 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_064' /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1 /* CABOT 500.00 02CRNBRY 500.00
END

Item 2g. The JACKMTN1-JUNIATA 500 kV line (from bus 200071 to bus 200009 ckt 1) loads from 113.24% to 113.7% (**DC power flow**) of its emergency rating (3723 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('PJM24A'). This project contributes approximately 105.85 MW to the thermal violation.

CONTINGENCY 'PJM24A'
DISCONNECT BRANCH FROM BUS 200009 TO BUS 200072 CKT 1 /* JUNIATA KEYSTONE 500 500
END

Item 2h. The KEYSTONE-JACKMTN1 500 kV line (from bus 200011 to bus 200071 ckt 1) loads from 114.72% to 115.25% (**DC power flow**) of its emergency rating (3723 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PJM53'). This project contributes approximately 121.92 MW to the thermal violation.

CONTINGENCY 'PJM53' /* CONEMAUGH BREAKER 2
DISCONNECT BRANCH FROM BUS 200005 TO BUS 200011 CKT 1 /* CONEMAGH C14_CLCT 500 500
DISCONNECT BRANCH FROM BUS 200005 TO BUS 200031 CKT 1 /* CONEMAGH CONEMAGH 500 22
REMOVE MACHINE H FROM BUS 200031 /* CONEMAUGH 2
REMOVE MACHINE L FROM BUS 200031
END

Item 2i. The KEYSTONE-CONEM-GH 500 kV line (from bus 200011 to bus 200005 ckt 1) loads from 115.45% to 116.01% (**DC power flow**) of its emergency rating (3723 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('KEYSTONE_JACKMTN1_1'). This project contributes approximately 144.87 MW to the thermal violation.

CONTINGENCY 'KEYSTONE_JACKMTN1_1' /* 500/500KV, AREA 225/225.
DISCONNECT BRANCH FROM BUS 200011 TO BUS 200071 CKT 1
END

Item 2j. The KEYSTONE-CONEM-GH 500 kV line (from bus 200011 to bus 200005 ckt 1) loads from 117.16% to 117.73% (**DC power flow**) of its emergency rating (3723 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PJM3B1'). This project contributes approximately 145.75 MW to the thermal violation.

CONTINGENCY 'PJM3B1' /* KEYSTONE BUS BREAKER 3
DISCONNECT BRANCH FROM BUS 200071 TO BUS 200011 CKT 1 /* JUNIATA KEYSTONE 500 500 /* BUS 200072 => 200071 (JACKMNT1)
DISCONNECT BRANCH FROM BUS 200011 TO BUS 200810 TO BUS 200907 CKT 4/* KEYSTONE KEYSTONE 500 230 #4
END

Item 2k. The CABOT-KEYSTONE 500 kV line (from bus 235104 to bus 200011 ckt 1) loads from 120.58% to 121.67% (**DC power flow**) of its emergency rating (2598 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('APS_B_G693'). This project contributes approximately 177.09 MW to the thermal violation.

CONTINGENCY 'APS_B_G693' / 200011 KEYSTONE 500 235118 01SOBEND 500 1
OPEN BRANCH FROM BUS 200011 TO BUS 235118 CKT 1
END

Item 2l. The CABOT-KEYSTONE 500 kV line (from bus 235104 to bus 200011 ckt 1) loads from 120.58% to 121.67% (**DC power flow**) of its emergency rating (2598 MVA) for

the single line contingency outage of CONTINGENCY DESCRIPTION ('APS_B_G693'). This project contributes approximately 177.09 MW to the thermal violation.

CONTINGENCY 'APS_B_G693' / 200011 KEYSTONE 500 235118 01SOBEND 500 1
OPEN BRANCH FROM BUS 200011 TO BUS 235118 CKT 1
END

Item 2m. The 02HOYTDL-02CRNBRY 138 kV line (from bus 238813 to bus 239281 ckt 1) loads from 125.44% to 126.98% (**DC power flow**) of its emergency rating (309 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_065'). This project contributes approximately 29.35 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_065' /* LINE 02CRNBRY 500 TO 01WYLIER 500 CK 1
DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1 /* 02CRNBRY 500.00 WYLIE RIDGE 500.00
END

Item 2n. The N.MESHPN 230/115 kV transformer (from bus 200825 to bus 200706 ckt 3) loads from 142.0% to 142.83% (**DC power flow**) of its emergency rating (188 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_PN230-SX-#11_B'). This project contributes approximately 9.6 MW to the thermal violation.

CONTINGENCY 'B_PN230-SX-#11_B' /* X1-109 TAP - N MESHOPPEN (ETP) 230 KV & N MESHOPPEN BK 4
DISCONNECT BRANCH FROM BUS 907460 TO BUS 200924 CKT 1F
DISCONNECT BRANCH FROM BUS 200924 TO BUS 200706 CKT 1F
DISCONNECT BRANCH FROM BUS 200706 TO BUS 200677 CKT 4
END

Item 2o. The NO MESHO-MESH2REA 115 kV line (from bus 200677 to bus 200825 ckt 3) loads from 142.03% to 142.85% (**DC power flow**) of its emergency rating (188 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_PN230-SX-#11_B'). This project contributes approximately 9.6 MW to the thermal violation.

CONTINGENCY 'B_PN230-SX-#11_B' /* X1-109 TAP - N MESHOPPEN (ETP) 230 KV & N MESHOPPEN BK 4
DISCONNECT BRANCH FROM BUS 907460 TO BUS 200924 CKT 1F
DISCONNECT BRANCH FROM BUS 200924 TO BUS 200706 CKT 1F
DISCONNECT BRANCH FROM BUS 200706 TO BUS 200677 CKT 4
END

Item 2p. The 02MAPLE-02SENECA 138 kV line (from bus 238942 to bus 239099 ckt 1) loads from 142.87% to 144.6% (**DC power flow**) of its emergency rating (350 MVA) for the

single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 37.42 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_064' /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1 /* CABOT 500.00 02CRNBRY 500.00
END

Item 2q. The 02SENECA-KRENDALE 138 kV line (from bus 239099 to bus 235205 ckt 1) loads from 147.91% to 149.69% (**DC power flow**) of its emergency rating (338 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 37.42 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_064' /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1 /* CABOT 500.00 02CRNBRY 500.00
END

Item 2r. The 02HOYTDL-02MAPLE 138 kV line (from bus 238813 to bus 238942 ckt 1) loads from 152.01% to 153.64% (**DC power flow**) of its emergency rating (309 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_065'). This project contributes approximately 31.24 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_065' /* LINE 02CRNBRY 500 TO 01WYLIER 500 CK 1
DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1 /* 02CRNBRY 500.00 WYLIE RIDGE 500.00
END

Item 2s. The 02SHNAGO-02MCDOWL 138 kV line (from bus 239107 to bus 238954 ckt 1) loads from 163.1% to 164.97% (**DC power flow**) of its emergency rating (153 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_065'). This project contributes approximately 17.77 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_065' /* LINE 02CRNBRY 500 TO 01WYLIER 500 CK 1
DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1 /* 02CRNBRY 500.00 WYLIE RIDGE 500.00
END

Item 2t. The SHANOR MANOR-BUTLER 138 kV line (from bus 235246 to bus 235152 ckt 1) loads from 161.56% to 163.82% (**DC power flow**) of its emergency rating (352 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 49.44 MW to the thermal violation.

```
CONTINGENCY 'B_LINE_SY_064'                    /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
 DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1          /* CABOT 500.00 02CRNBRY 500.00
 END
```

Item 2u. The KRENDALE-SHANOR MANOR 138 kV line (from bus 235205 to bus 235246 ckt 1) loads from 164.67% to 166.94% (**DC power flow**) of its emergency rating (352 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 49.44 MW to the thermal violation.

```
CONTINGENCY 'B_LINE_SY_064'                    /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
 DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1          /* CABOT 500.00 02CRNBRY 500.00
 END
```

Item 2v. The 02SHNAGO-02MCDOWL 138 kV line (from bus 239107 to bus 238954 ckt 1) loads from 169.15% to 171.05% (**DC power flow**) of its emergency rating (153 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('C2-BRK-ER127'). This project contributes approximately 18.04 MW to the thermal violation.

```
CONTINGENCY 'C2-BRK-ER127'                     /* CRANBERRY 500KV, BKR FAILURE - BKR B
 DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1          /* 02CRNBRY 500.00 01WYLIE R 500.00
 DISCONNECT BRANCH FROM BUS 239280 TO BUS 239281 CKT 2          /* 02CRNBRY 500.00 02CRNBRY 138.00
 END
```

Item 2w. The 02SHNAGO-02MCDOWL 138 kV line (from bus 239107 to bus 238954 ckt 1) loads from 169.15% to 171.05% (**DC power flow**) of its emergency rating (153 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('C2-BRK-ER126'). This project contributes approximately 18.04 MW to the thermal violation.

```
CONTINGENCY 'C2-BRK-ER126'                     /* CRANBERRY 500KV, BKR FAILURE - BKR A
```

DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1 /* 02CRNBRY 500.00 01WYLIE R 500.00
DISCONNECT BRANCH FROM BUS 239280 TO BUS 239281 CKT 1 /* 02CRNBRY 500.00 02CRNBRY 138.00
END

Item 2x. The OXBOW-LACK 230 kV line (from bus 200708 to bus 208009 ckt 1) loads from 183.69% to 184.54% (**DC power flow**) of its normal rating (488 MVA) for non-contingency condition. This project contributes approximately 25.68 MW to the thermal violation.

Item 2y. The N.MESHPN-OXBOW 230 kV line (from bus 200706 to bus 200708 ckt 1) loads from 188.11% to 188.96% (**DC power flow**) of its normal rating (478 MVA) for non-contingency condition. This project contributes approximately 25.25 MW to the thermal violation.

New System Reinforcements

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

For Item 1a, the overload of the SMITHTON 62-YUKON 138 kV line can be relieved by an existing baseline RTEP project b2169. The total estimated cost is $60,000 and the in-service date is 6/1/2017. New Rating will be 332 MVA. This overload is caused by a project later in the Y2 queue. Y2-085 will not have to pay a portion of this upgrade since it is a baseline project. However, should Y2-085 wish to go in-service before the baseline is complete, interim studies will have to be performed to see if it is possible to go in-service early. Should the baseline project be cancelled for any reason, Y2-085 will have to pay a portion of this upgrade.

Contribution to Previously Identified System Reinforcements

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

For Item 2a, the overload of the SHEPLER H J-SMITHTON 62 138 kV line can be relieved by an existing baseline RTEP project b2170. The total estimated cost is $120,000 and the in-service date is 6/1/2017. New Rating will be 376 MVA. This overload is caused by an earlier queue project. Y2-085 will not have to pay a portion of this upgrade since it is a baseline project. However, should Y2-085 wish to go in-service before the baseline is complete, interim studies will have to be performed to see if it is possible to go in-service early. Should the baseline project be cancelled for any reason, Y2-085 will have to pay a portion of this upgrade.

For Item 2b, the overload of the 02CRNBRY-02JACKSN 138 kV line can be relieved by rebuilding portions of the existing 2.0 mile single circuit Cranberry to Jackson section of the Cranberry – Maple 138 kV line to reconductor with new 954 kcmil ACSS. At the Maple substation, replace the substation conductor in series with the 138 kV Cranberry line. The total estimated cost to perform this work is **$3,964,600**(add extra **$990,900** in tax gross-up if

applicable for a total of **$4,955,500**) and will take approximately **29 months** to complete. The cost breakdown for this overload is summarized below in **Table 2a**. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

Table 2a. Reinforcements for 02CRNBRY-02JACKSN 138kV Line Overload			
Reinforcement Description	**Upgrade Cost**	**Tax**	**Total with Tax**
Rebuilding existing 2.0 miles of the Cranberry – Jackson section of the Cranberry - Maple 138kV line to reconductor with new 954 kcmil ACSS conductor.	$3,943,600	$985,600	$4,929,200
Replace Maple substation conductor in series with the 138kV Cranberry line	$21,000	$5,300	$26,300
Total estimated cost:	**$3,964,600**	**$990,900**	**$4,955,500**

For Item 2c, the overload of the 02BRBRTN-02WAKRON 138 kV line can be relieved by adding a new West Akron exit at the Star substation, relocating transfer bus and Wadsworth exit, adding a new circuit breaker at the West Akron substation to create a new 138kV West Akron – Star exit, creating a new 13 mile Star – West Akron 138kV line utilizing an open position on a portion of the existing N. Medina – West Akron 138kV line and in an existing corridor from Star substation to the existing N. Medina – West Akron 138kV line. The total estimated cost to perform this work is **$9,674,400**(add extra **$2,417,000** in tax gross-up if applicable for a total of **$12,092,400**) and will take approximately **39 months** to complete. The cost breakdown for this overload is summarized below in **Table 2b**. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

Table 2b. Reinforcements for 02BRBRTN-02WAKRON 138kV Line Overload			
Reinforcement Description	**Upgrade Cost**	**Tax**	**Total with Tax**
At the Star SS, add new West Akron exit. Relocate transfer bus and Wadsworth exit.	$1,268,900	$316,100	$1,586,000
At the West Akron SS, add 1 new circuit breaker to create new 138 kV West Akron – Star line exit.	$1,390,600	$347,600	$1,738,200
Create a new 13 mile Star to West Akron 138 kV line utilizing an open position on a portion of the existing N. Medina – W. Akron 138 kV line and in an existing corridor from Star substation to the existing N. Medina – W. Akron 138 kV line.	$7,014,900	$1,753,300	$8,768,200
Total estimated cost:	**$9,674,400**	**$2,417,000**	**$12,092,400**

For Items 2d, 2e, and 2h, the overloads of the KEYSTONE-JACKMTN1 500 kV line can be relieved by existing baseline RTEP project b0284.3 that replaces the wave trap at Keystone on the future Jacks Mountain terminal. With the trap replaced, the rating of the line is 4239 MVA. Upgrade b0284.3 is presently scheduled to be complete prior to Q3 of 2017. This overload is

caused by an earlier queue project. Y2-085 will not have to pay a portion of this upgrade since it is a baseline project. However, should Y2-085 wish to go in-service before the baseline is complete, interim studies will have to be performed to see if it is possible to go in-service early. Should the baseline project be cancelled for any reason, Y2-085 will have to pay a portion of this upgrade.

For Item 2f, the overload of the 02JACKSN-02MAPLE 138 kV line can be relieved by rebuilding portions of the existing 4.8 mile single circuit Maple to Jackson section of the Cranberry – Maple 138 kV line to reconductor with new 954 kcmil ACSS. At the Maple SS, replace the substation conductor in series with the 138 kV Cranberry line. The total estimated cost to perform this work is **$5,009,500**(add extra **$1,252,000** in tax gross-up if applicable for a total of **$6,261,500**) and will take approximately **29 months** to complete. The cost breakdown for this overload is summarized below in **Table 2c**. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

Table 2c. Reinforcements for 02JACKSN-02MAPLE 138kV Line Overload			
Reinforcement Description	**Upgrade Cost**	**Tax**	**Total with Tax**
Rebuilding portions of the existing 4.8 miles of the Maple – Jackson section of the Cranberry - Maple 138kV line to reconductor with new 954 kcmil ACSS conductor.	$4,988,500	$1,246,700	$6,235,200
Replace Maple substation conductor in series with the 138kV Cranberry line(same as from Table 2a)	$21,000	$5,300	$26,300
Total estimated cost:	**$5,009,500**	**$1,252,000**	**$6,261,500**

For Item 2g, the overload of the JACKMTN1-JUNIATA 500 kV line can be relieved by the following:

To address the overload of Jacks Mountain 1 – Juniata 500 kV line, PPL EU proposes to rebuild 16 miles of the Jacks Mountain 1 – Juniata 500 kV line with 3x1590 ACSR and replace three breakers and the associated switches for 4000A rated breakers and switches in Juniata Bay 2. It is assumed that the North and South buses will already be rebuilt with 5" Aluminum tube for the network impacts associated with Y2-080. The total estimated upgraded cost is **$110,240,000**. The cost breakdown for this overload is summarized below in **Table 2d**. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

Table 2d. Reinforcements for JACKMTN1-JUNIATA 500kV Line Overload	
Reinforcement Description	**Upgrade Cost**
Transmission work	$104,000,000
Substation work	$6,240,000
Total estimated cost:	**$110,240,000**

This magnitude estimate was prepared without extensive research and field review. The feasibility of this solution is dependent on the ability to take an extended outage of the Jacks Mountain 1 – Juniata 500 kV line.

For Items 2i and 2j, the overloads of the KEYSTONE-CONEM-GH 500 kV line can be relieved by existing baseline RTEP projects b0285.1 and b0285.2 to replace the wave trap at Keystone and Conemaugh respectively on the Keystone-Conemaugh 500 kV line. The in-service date for b0285.1 and b0285.2 is 6/1/2018. These projects may need accelerated to address the violation however both projects are tied to the Jacks Mountain project which is presently being evaluated by PJM and may be cancelled. This project will need to be studied without Jacks Mountain, in the System Impact Study, to evaluate the need for this upgrade. The new rating will be 4239 MVA with the traps replaced. Should the baseline project be cancelled for any reason, Y2-085 will have to pay a portion of this upgrade.

For Items 2k and 2l, the overloads of the CABOT-KEYSTONE 500 kV line can be relieved by replacing a wave trap and meter at Keystone. No change in impedance. The new rating will be 3301 MVA. The total estimated cost to perform this work is **$221,500**(add extra **$50,600** in tax gross-up if applicable for a total of **$272,100**) and will take approximately **8 months** to complete. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

For Item 2m, the overload of the 02HOYTDL-02CRNBRY 138 kV line can be relieved by reconductoring the 21.2 mile Cranberry – Hoytdale 138 kV line with single 795 kcmil ACSS conductor, replacing the existing single 795 ACSR. The total estimated cost to perform this work is **$22,601,000**(add extra **$5,648,000** in tax gross-up if applicable for a total of **$28,249,000**) and take approximately **38 months** to complete. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

For Items 2n and 2o, the overloads of the N.MESHPN 230/115 kV transformer and the NO MESHO-MESH2REA 115 kV line can be relieved by replacing the North Meshoppen #3 transformer with a larger unit and removing the reactor. The total estimated cost to perform this work is **$9,216,400**(add extra **$2,102,300** in tax gross-up if applicable for a total of **$11,318,700**) and will take approximately **15 months** to complete. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

For Items 2p and 2q, the overloads of the 02MAPLE-02SENECA 138 kV line and 02SENECA-KRENDALE 138 kV line can be relieved by installing new 138 kV line exit at Krendale for new 138 kV Krendale – Maple line, installing new 138 kV line exit at Maple for new 138 kV Krendale – Maple line, and creating a new second Krendale – Maple 138 kV line by rebuilding the existing single circuit H-frame line as a new double circuit line, utilizing 954 kcmil ACSR conductor for both circuits. The total estimated cost to perform this work is **$20,700,400**(add extra **$5,173,200** in tax gross-up if applicable for a total of **$25,873,600**) and will take approximately **35 months** to complete. The cost breakdown for this overload is summarized

below in **Table 2e**. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

Table 2e. Reinforcements for 02MAPLE-02SENECA 138kV Line and 02SENECA-KRENDALE 138kV Line Overloads			
Reinforcement Description	**Upgrade Cost**	**Tax**	**Total with Tax**
Install new 138kV line exit at Krendale for new 138kV Krendale – Maple line	$713,900	$178,500	$892,400
Install new 138kV line exit at Maple for new 138kV Krendale – Maple line	$738,200	$184,500	$922,700
Create a new second Krendale – Maple 138kV line by rebuilding existing single circuit H-frame line as a new double circuit line, utilizing 954 kcmil ACSR conductor for both circuits	$19,248,300	$4,810,200	$24,058,500
Total estimated cost:	**$20,700,400**	**$5,173,200**	**$25,873,600**

For Item 2r, the overload of the 02HOYTDL-02MAPLE 138 kV line can be relieved by replacing primary, backup and BFT relaying for the 138 kV Maple line exit at the Hoytdale SS and replacing primary, backup and BFT relaying for the 138 kV Hoytdale line exit at the Maple SS. The total estimated cost to perform this work is **$333,800**(add extra **$83,600** in tax gross-up if applicable for a total of **$417,400**) and will take approximately **8 months** to complete. The cost breakdown for this overload is summarized below in **Table 2f**. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

Table 2f. Reinforcements for 02HOYTDL -02MAPLE 138kV Line Overload			
Reinforcement Description	**Upgrade Cost**	**Tax**	**Total with Tax**
Replace primary, backup and BFT relaying for the 138 kV Maple line exit at the Hoytdale SS.	$166,900	$41,800	$208,700
Replace primary, backup and BFT relaying for the 138 kV Hoytdale line exit at the Maple SS.	$166,900	$41,800	$208,700
Total estimated cost:	**$333,800**	**$83,600**	**$417,400**

For Items 2s, 2v, and 2w, the overloads of the 02SHNAGO-02MCDOWL 138 kV line can be relieved by replacing the primary, backup and BFT relaying at the McDowell SS for the 138 kV Shenango line exit and replacing the primary, backup and BFT relaying at the Shenango SS for the 138 kV McDowell line exit. The total estimated cost to perform this work is **$339,400**(add extra **$85,000** in tax gross-up if applicable for a total of **$424,400**) and will take approximately **8 months** to complete. The cost breakdown for this overload is summarized below in **Table 2g**. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

Table 2g. Reinforcements for 02SHNAGO -02MCDOWL 138kV Line Overload

Reinforcement Description	Upgrade Cost	Tax	Total with Tax
Replace primary, backup and BFT relaying for the 138 kV Shenango line exit at the McDowell SS.	$172,500	$43,200	$215,700
Replace primary, backup and BFT relaying for the 138 kV McDowell line exit at the Shenango SS.	$166,900	$41,800	$208,700
Total estimated cost:	**$339,400**	**$85,000**	**$424,400**

For Item 2t, the overload of the SHANOR MANOR-BUTLER 138 kV line can be relieved by reconductoring Shanor Manor-Butler with 954 ACSS conductor and replacing terminal equipment at Shanor Manor and Butler. The total estimated cost to perform this work is **$8,195,100**(add extra **$2,425,900** in tax gross-up if applicable for a total of **$10,621,000**) and will take approximately **18 months** to complete. The cost breakdown for this overload is summarized below in **Table 2h**. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

Table 2h. Reinforcements for SHANOR MANOR-BUTLER 138kV Line Overload

Reinforcement Description	Upgrade Cost	Tax	Total with Tax
Rebuild and reconductor approximately 4.4 miles of the Butler – Krendale 138kV line(Butler – Shanor Manor section)	$7,681,200	$2,273,700	$9,954,900
At Shanor Manor, replace 1-1200A, 138kV LB line switch with 1-2000A LB line switch and replace 2-1200A, 138kV line and bus tie switches with 2-2000A, 138kV switches, replace line risers with 3500AL conductor for required 520 MVA SE rating.	$191,200	$56,600	$247,800
At Butler substation, on the Krendale 138kV terminal, replace 1-138kV breaker with 1-3000A, 138kV breaker, replace 2-138kV disconnect switches with 2-2000A 138kV switches. Reconductor breaker risers and No. 2A 138kV bus with 3500AL conductor, for required 520MVA SE rating.	$322,700	$95,600	$418,300
Total estimated cost:	**$8,195,100**	**$2,425,900**	**$10,621,000**

For Item 2u, the overload of the KRENDALE-SHANOR MANOR 138 kV line can be relieved by reconductoring Krendale-Shanor Manor with 954 ACSS conductor and replacing terminal equipment at Shanor Manor and Krendale. The total estimated cost to perform this work is **$6,183,600**(add extra **$1,830,400** in tax gross-up if applicable for a total of **$8,830,400**) and will take approximately **18 months** to complete. The cost breakdown for this overload is summarized below in **Table 2i**. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

Table 2i. Reinforcements for KRENDALE-SHANOR MANOR 138kV Line Overload			
Reinforcement Description	**Upgrade Cost**	**Tax**	**Total with Tax**
Rebuild and reconductor with 954 kcmil ACSS conductor approximately 3 miles of the Butler – Krendale 138kV line(Krendale – Shanor Manor section)	$5,721,500	$1,693,600	$7,415,100
At Shanor Manor, replace 1-1200A, 138kV LB line switch with 1-2000A LB line switch and replace 2-1200A, 138kV line and bus tie switches with 2-2000A, 138kV switches, replace line risers with 3500AL conductor for required 520 MVA SE rating.	$191,200	$56,600	$247,800
At Krendale substation, on the Butler 138kV terminal, replace 1-138kV breaker with 1-3000A, 138kV breaker, replace 2-138kV disconnect switches with 2-2000A 138kV switches, replace breaker and line risers with 3500 AL, revise relay settings, for required 520MVA SE rating.	$270,900	$80,200	$351,100
Total estimated cost:	**$6,183,600**	**$1,830,400**	**$8,014,000**

For Item 2x, the overload of the LACK-OXBOW 230 kV line can be relieved by the following upgrades from PENELEC and PPL:

PENELEC:

Reconductor 16.33 miles of 1033 ACSR line with 1033 ACSS high temperature conductor from Oxbow to PPL's Lackawanna. At the Oxbow substation, replace the 1200A disconnect switch on the 230 kV Lackawanna line. The total estimated cost to perform this work is **$8,816,200**(add extra **$2,605,300** in tax gross-up if applicable for a total of **$11,421,500**) and take approximately **24 months** to complete.

PPL:

Rebuild LACK 230kV bay to 3000 Amps and rebuild 0.4 miles of LACK-OXBO (NMES) 230kV line to double-bundle 1590 (3200 Amps). The total estimated cost to perform this work is **$4,700,000** and will take approximately **18 to 24 months** to complete.

This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

For Item 2y, the overload of the N.MESHPN-OXBOW 230 kV line can be relieved by reconductoring 10.58 miles of 1033 ACSR with 1033 ACSS high temperature conductor from North Meshoppen to Oxbow. At the North Meshoppen substation, replace the 1033 AAC conductor with 1033 ACSS high temperature conductor on the Oxbow terminal. The total estimated cost to perform this work is **$5,988,200**(add extra **$1,769,600** in tax gross-up if applicable for a total of **$7,757,800**) and will take approximately **24 months** to complete. This overload is caused by an earlier queue project. Therefore, Y2-085 will have a cost allocation to these overloads and cost allocations will be given during the System Impact Study phase.

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.

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

Option 2:

The Y2-085 project will tap the South Canton – Sammis 345kV line for this option.

Facilities to Accommodate the Interconnection

Scope of Direct Connection Work

The Y2-085 project will tap the South Canton – Sammis 345kV line. To accommodate this interconnection, installation of a new three-breaker ring bus 345kV substation, disconnect switches, relaying, metering, RTU, SCADA and other miscellaneous supporting equipment will be required. The new 345kV three-breaker ring bus will be located approximately 26 miles from the Sammis substation. The direct connection cost estimate will be provided in the System Impact Study if this option is chosen.

The Interconnection Customer is responsible for meeting all criteria as specified in the applicable sections of the "FirstEnergy Requirements for Transmission Connected Facilities" document.

The Interconnection Customer is responsible for constructing all of the Interconnection Customer-owned facilities on the Interconnection Customer's side of the Point of Interconnection.

Direct Connect Cost Estimate

To be provided in the System Impact Study if this option is chosen.

Revenue Metering and SCADA Requirements

For PJM: The Interconnection Customer will install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for Interconnection Customer's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 24.1 to 24.2.

For ATSI: The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:
www.firstenergycorp.com/feconnect
www.pjm.com/planning/design-engineering/to-tech-standards.aspx

Network Impacts

The Y2-085 project was studied as a 1050MW Capacity injection into the ATSI area as a tap of the South Canton - Sammis 345kV line. Project Y2-085 was evaluated for compliance with reliability criteria for summer peak conditions in 2016.

Potential network impacts were as follows:

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

No violations were found.

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.)

Item 3a. The SMITHTON 62-YUKON 138 kV line (from bus 235252 to bus 235277 ckt 1) loads from 97.07% to 98.22% (**DC power flow**) of its emergency rating (297 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('AP_SB_467'). This project contributes approximately 21.09 MW to the thermal violation.

CONTINGENCY 'AP_SB_467' / HATFIELD500-RONCO500
STK BKR AT HATFIELD500 #8
OPEN BRANCH FROM BUS 235108 TO BUS 235774 CKT 1
OPEN BUS 235582
END

Short Circuit
(Summary of impacted circuit breakers)

PJM has completed the short circuit analysis of the Y2-085 queue project **SAMMIS-STAR 345kV**. One option was considered during this study: the option was a tap of the SAMMIS - SCANTO 345 kV line.

PJM analysis found **2 new breakers** to be over-duty in the AEP transmission area. **This is originally an ATSI project but an AEP bus is 3 or more buses away.** The new over-duty breakers are listed below:

Bus_ NO	BUS	BREAKER	Duty % with Y2-085_ATSI	Duty % without Y2-085_ATSI	Duty % Difference	Notes
0	05SCANTO 345.kV	B	102.00%	97.70%	4.30%	New Overduty
0	05SCANTO 345.kV	A	101.90%	97.60%	4.30%	New Overduty

The cost estimates to replace these breakers will be provided in the System Impact Study should this option be chosen.

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)

Item 4a. The SHEPLER H J-SMITHTON 62 138 kV line (from bus 235247 to bus 235252 ckt 1) loads from 102.37% to 103.52% (**DC power flow**) of its emergency rating (297 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('AP_SB_467'). This project contributes approximately 21.09 MW to the thermal violation.

CONTINGENCY 'AP_SB_467' / HATFIELD500-RONCO500
STK BKR AT HATFIELD500 #8
OPEN BRANCH FROM BUS 235108 TO BUS 235774 CKT 1
OPEN BUS 235582
END

Item 4b. The 02S8-ATT 345/138 kV transformer (from bus 238544 to bus 239082 ckt 8) loads from 104.51% to 105.62% (**DC power flow**) of its emergency rating (371 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('DQE_161'). This project contributes approximately 25.58 MW to the thermal violation.

CONTINGENCY 'DQE_161' /* LINE 02AT TO 02PERRY 345 CK 1
DISCONNECT BRANCH FROM BUS 238547 TO BUS 239036 CKT 1
END

Item 4c. The 02CRNBRY-02JACKSN 138 kV line (from bus 239281 to bus 238833 ckt 1) loads from 107.4% to 108.28% (**DC power flow**) of its emergency rating (339 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 18.54 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_064' /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1 /* CABOT 500.00 02CRNBRY 500.00
END

Item 4d. The 02CRNBRY-02JACKSN 138 kV line (from bus 239281 to bus 238833 ckt 1) loads from 107.6% to 108.43% (**DC power flow**) of its emergency rating (339 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('AP_SB_464'). This project contributes approximately 17.5 MW to the thermal violation.

CONTINGENCY 'AP_SB_464' / CABOT500-CRANBERRY500 STK BKR AT CABOT500 #1
OPEN BRANCH FROM BUS 235104 TO BUS 239280 CKT 1
OPEN BRANCH FROM BUS 235104 TO BUS 235153 CKT 1
OPEN BRANCH FROM BUS 235104 TO BUS 235153 CKT 3
END

Item 4e. The KEYSTONE-JACKMTN1 500 kV line (from bus 200011 to bus 200071 ckt 1) loads from 108.5% to 109.03% (**DC power flow**) of its emergency rating (3723 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('PJM20A_CONEMAGH-KEYSTONE'). This project contributes approximately 122.05 MW to the thermal violation.

CONTINGENCY 'PJM20A_CONEMAGH-KEYSTONE'
DISCONNECT BRANCH FROM BUS 200005 TO BUS 200011 CKT 1 /* CONEMAGH KEYSTONE 500 500
END

Item 4f. The KEYSTONE-JACKMTN1 500 kV line (from bus 200011 to bus 200071 ckt 1) loads from 110.67% to 111.2% (**DC power flow**) of its emergency rating (3723 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PJM4'). This project contributes approximately 123.78 MW to the thermal violation.

CONTINGENCY 'PJM4' /* KEYSTONE BREAKER 6
DISCONNECT BRANCH FROM BUS 200005 TO BUS 200011 CKT 1 /* CONEMAGH KEYSTONE 500 500
DISCONNECT BRANCH FROM BUS 200011 TO BUS 200810 TO BUS 200907 CKT 4/* KEYSTONE KEYSTONE 500 230
END

Item 4g. The DRY RUN-CHARLEROI 138 kV line (from bus 235169 to bus 235161 ckt 1) loads from 108.95% to 111.13% (**DC power flow**) of its emergency rating (243 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('AP_SB_363'). This project contributes approximately 32.79 MW to the thermal violation.

CONTINGENCY 'AP_SB_363' / MITCHELL BREAKER FAILURE - TIE BREAKER FROM BUS 1-2
OPEN BRANCH FROM BUS 235124 TO BUS 235260 CKT 1
OPEN BRANCH FROM BUS 235124 TO BUS 235247 CKT 1
OPEN BRANCH FROM BUS 235124 TO BUS 235161 CKT 1
OPEN BUS 235572
OPEN BUS 235573
END

Item 4h. The 02JACKSN-02MAPLE 138 kV line (from bus 238833 to bus 238942 ckt 1) loads from 111.54% to 112.52% (**DC power flow**) of its emergency rating (306 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 18.54 MW to the thermal violation.

CONTINGENCY 'B_LINE_SY_064' /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1 /* CABOT 500.00 02CRNBRY 500.00
END

Item 4i. The JACKMTN1-JUNIATA 500 kV line (from bus 200071 to bus 200009 ckt 1) loads from 113.24% to 113.7% (**DC power flow**) of its emergency rating (3723 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('PJM24A'). This project contributes approximately 105.41 MW to the thermal violation.

CONTINGENCY 'PJM24A'
DISCONNECT BRANCH FROM BUS 200009 TO BUS 200072 CKT 1 /* JUNIATA KEYSTONE 500 500
END

Item 4j. The KEYSTONE-JACKMTN1 500 kV line (from bus 200011 to bus 200071 ckt 1) loads from 114.72% to 115.25% (**DC power flow**) of its emergency rating (3723 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PJM53'). This project contributes approximately 122.05 MW to the thermal violation.

CONTINGENCY 'PJM53' /* CONEMAUGH BREAKER 2
DISCONNECT BRANCH FROM BUS 200005 TO BUS 200011 CKT 1 /* CONEMAGH C14_CLCT 500 500
DISCONNECT BRANCH FROM BUS 200005 TO BUS 200031 CKT 1 /* CONEMAGH CONEMAGH 500 22
REMOVE MACHINE H FROM BUS 200031 /* CONEMAUGH 2
REMOVE MACHINE L FROM BUS 200031
END

Item 4k. The KEYSTONE-CONEM-GH 500 kV line (from bus 200011 to bus 200005 ckt 1) loads from 115.45% to 116.02% (**DC power flow**) of its emergency rating (3723 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('KEYSTONE_JACKMTN1_1'). This project contributes approximately 145.45 MW to the thermal violation.

CONTINGENCY 'KEYSTONE_JACKMTN1_1' /* 500/500KV, AREA 225/225.
DISCONNECT BRANCH FROM BUS 200011 TO BUS 200071 CKT 1
END

Item 4l. The KEYSTONE-CONEM-GH 500 kV line (from bus 200011 to bus 200005 ckt 1) loads from 117.16% to 117.73% (**DC power flow**) of its emergency rating (3723 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('PJM3B1'). This project contributes approximately 146.74 MW to the thermal violation.

CONTINGENCY 'PJM3B1' /* KEYSTONE BUS BREAKER 3
DISCONNECT BRANCH FROM BUS 200071 TO BUS 200011 CKT 1 /* JUNIATA KEYSTONE 500 500 /* BUS 200072 => 200071 (JACKMNT1)
DISCONNECT BRANCH FROM BUS 200011 TO BUS 200810 TO BUS 200907 CKT 4/* KEYSTONE KEYSTONE 500 230 #4
END

Item 4m. The CABOT-KEYSTONE 500 kV line (from bus 235104 to bus 200011 ckt 1) loads from 120.59% to 121.68% (**DC power flow**) of its emergency rating (2598 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('APS_B_G693'). This project contributes approximately 178.32 MW to the thermal violation.

CONTINGENCY 'APS_B_G693' / 200011 KEYSTONE 500 235118 01SOBEND 500 1
OPEN BRANCH FROM BUS 200011 TO BUS 235118 CKT 1
END

Item 4n. The CABOT-KEYSTONE 500 kV line (from bus 235104 to bus 200011 ckt 1) loads from 120.59% to 121.68% (**DC power flow**) of its emergency rating (2598 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('APS_B_G693'). This project contributes approximately 178.32 MW to the thermal violation.

CONTINGENCY 'APS_B_G693' / 200011 KEYSTONE 500 235118 01SOBEND 500 1
OPEN BRANCH FROM BUS 200011 TO BUS 235118 CKT 1
END

Item 4o. The 02HOYTDL-02CRNBRY 138 kV line (from bus 238813 to bus 239281 ckt 1) loads from 125.44% to 126.94% (**DC power flow**) of its emergency rating (309 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_065'). This project contributes approximately 28.58 MW to the thermal violation.

```
CONTINGENCY 'B_LINE_SY_065'                    /* LINE 02CRNBRY 500 TO 01WYLIER 500 CK 1
 DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1          /* 02CRNBRY 500.00 WYLIE RIDGE 500.00
 END
```

Item 4p. The 02MAPLE-02SENECA 138 kV line (from bus 238942 to bus 239099 ckt 1) loads from 142.88% to 144.6% (**DC power flow**) of its emergency rating (350 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 37.29 MW to the thermal violation.

```
CONTINGENCY 'B_LINE_SY_064'                    /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
 DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1          /* CABOT 500.00 02CRNBRY 500.00
 END
```

Item 4q. The 02SENECA-KRENDALE 138 kV line (from bus 239099 to bus 235205 ckt 1) loads from 147.91% to 149.69% (**DC power flow**) of its emergency rating (338 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 37.29 MW to the thermal violation.

```
CONTINGENCY 'B_LINE_SY_064'                    /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
 DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1          /* CABOT 500.00 02CRNBRY 500.00
 END
```

Item 4r. The 02HOYTDL-02MAPLE 138 kV line (from bus 238813 to bus 238942 ckt 1) loads from 152.01% to 153.6% (**DC power flow**) of its emergency rating (309 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_065'). This project contributes approximately 30.45 MW to the thermal violation.

```
CONTINGENCY 'B_LINE_SY_065'                    /* LINE 02CRNBRY 500 TO 01WYLIER 500 CK 1
 DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1          /* 02CRNBRY 500.00 WYLIE RIDGE 500.00
 END
```

Item 4s. The 02SHNAGO-02MCDOWL 138 kV line (from bus 239107 to bus 238954 ckt 1) loads from 163.1% to 164.94% (**DC power flow**) of its emergency rating (153 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_065'). This project contributes approximately 17.49 MW to the thermal violation.

```
CONTINGENCY 'B_LINE_SY_065'                    /* LINE 02CRNBRY 500 TO 01WYLIER 500 CK 1
 DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1          /* 02CRNBRY 500.00 WYLIE RIDGE 500.00
 END
```

Item 4t. The SHANOR MANOR-BUTLER 138 kV line (from bus 235246 to bus 235152 ckt 1) loads from 161.56% to 163.79% (**DC power flow**) of its emergency rating (352 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 48.7 MW to the thermal violation.

```
CONTINGENCY 'B_LINE_SY_064'                    /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
 DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1          /* CABOT 500.00 02CRNBRY 500.00
 END
```

Item 4u. The KRENDALE-SHANOR MANOR 138 kV line (from bus 235205 to bus 235246 ckt 1) loads from 164.67% to 166.9% (**DC power flow**) of its emergency rating (352 MVA) for the single line contingency outage of CONTINGENCY DESCRIPTION ('B_LINE_SY_064'). This project contributes approximately 48.7 MW to the thermal violation.

```
CONTINGENCY 'B_LINE_SY_064'                    /* LINE 01CABOT 500 TO 02CRNBRY 500 CK 1
 DISCONNECT BRANCH FROM BUS 235104 TO BUS 239280 CKT 1          /* CABOT 500.00 02CRNBRY 500.00
 END
```

Item 4v. The 02SHNAGO-02MCDOWL 138 kV line (from bus 239107 to bus 238954 ckt 1) loads from 169.15% to 171.02% (**DC power flow**) of its emergency rating (153 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('C2-BRK-ER126'). This project contributes approximately 17.76 MW to the thermal violation.

```
CONTINGENCY 'C2-BRK-ER126'                     /* CRANBERRY 500KV, BKR FAILURE - BKR A
 DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1          /* 02CRNBRY 500.00 01WYLIE R 500.00
```

DISCONNECT BRANCH FROM BUS 239280 TO BUS 239281 CKT 1 /* 02CRNBRY 500.00 02CRNBRY 138.00
END

Item 4w. The 02SHNAGO-02MCDOWL 138 kV line (from bus 239107 to bus 238954 ckt 1) loads from 169.15% to 171.02% (**DC power flow**) of its emergency rating (153 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('C2-BRK-ER127'). This project contributes approximately 17.76 MW to the thermal violation.

CONTINGENCY 'C2-BRK-ER127' /* CRANBERRY 500KV, BKR FAILURE - BKR B
DISCONNECT BRANCH FROM BUS 239280 TO BUS 235703 CKT 1 /* 02CRNBRY 500.00 01WYLIE R 500.00
DISCONNECT BRANCH FROM BUS 239280 TO BUS 239281 CKT 2 /* 02CRNBRY 500.00 02CRNBRY 138.00
END

Item 4x. The N.WAV115-E.SAYRE 115 kV line (from bus 130836 to bus 200676 ckt 1) loads from 179.87% to 180.75% (**DC power flow**) of its emergency rating (128 MVA) for the bus fault outage of CONTINGENCY DESCRIPTION ('C1_PN230-BS-#5A'). This project contributes approximately 6.93 MW to the thermal violation.

CONTINGENCY 'C1_PN230-BS-#5A' /* EAST TOWANDA #1 230 KV BUS FAULT
DISCONNECT BRANCH FROM BUS 200701 TO BUS 200675 CKT 1
DISCONNECT BRANCH FROM BUS 200675 TO BUS 130763 CKT 1
DISCONNECT BRANCH FROM BUS 200674 TO BUS 200675 CKT 3
END

Item 4y. The N.WAV115-E.SAYRE 115 kV line (from bus 130836 to bus 200676 ckt 1) loads from 179.87% to 180.75% (**DC power flow**) of its emergency rating (128 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION ('C2_PN230-SB-#3F'). This project contributes approximately 6.93 MW to the thermal violation.

CONTINGENCY 'C2_PN230-SB-#3F' /* EAST TOWANDA 230 KV STUCK CB - (#3 XF)
DISCONNECT BRANCH FROM BUS 200675 TO BUS 130763 CKT 1
DISCONNECT BRANCH FROM BUS 200701 TO BUS 200675 CKT 1
DISCONNECT BRANCH FROM BUS 200674 TO BUS 200675 CKT 3
END

Item 4z. The N.WAV115-E.SAYRE 115 kV line (from bus 130836 to bus 200676 ckt 1) loads from 181.7% to 182.58% (**DC power flow**) of its emergency rating (128 MVA) for the line fault with failed breaker contingency outage of CONTINGENCY DESCRIPTION

('C2_PN230-SB-#3D'). This project contributes approximately 6.98 MW to the thermal violation.

CONTINGENCY 'C2_PN230-SB-#3D' /* EAST TOWANDA 230 KV STUCK CB - (GROVER)
DISCONNECT BRANCH FROM BUS 200675 TO BUS 130763 CKT 1
DISCONNECT BRANCH FROM BUS 200857 TO BUS 200701 CKT 1
DISCONNECT BRANCH FROM BUS 200701 TO BUS 200675 CKT 1
DISCONNECT BRANCH FROM BUS 200701 TO BUS 200702 CKT 1
DISCONNECT BUS 200701
DISCONNECT BRANCH FROM BUS 200674 TO BUS 200675 CKT 3
END

New System Reinforcements
(Upgrades required to mitigate reliability criteria violations, I.e. "Network Impacts", initially caused by the addition of this project's generation.)

If this option is chosen, reinforcements and cost estimates will be provided with the System Impact Study report.

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

If this option is chosen, reinforcements and cost estimates will be provided with the System Impact Study report.

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.

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