#Y1-069 – Bay Shore Fostoria Central 345kV
Generation Interconnection

General

The Interconnection Customer is proposing a 799MW Capacity natural gas facility to be interconnected to the ATSI transmission system and located in Lucas County, OH. ATSI is a FirstEnergy (FE) company. The proposed in-service date for this project is April 30, 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 Y1-069 project will simultaneously tap of the Bay Shore – Fostoria Central 345kV line and the Bay Shore – Monroe 345kV line for this option.

Facilities to Accommodate the Interconnection

Scope of Direct Connection Work

The Y1-069 project will simultaneously tap of the Bay Shore – Fostoria Central 345kV line and the Bay Shore – Monroe 345kV line. To accommodate this interconnection, installation of a new 345kV five-breaker ring bus or breaker-and-a-half substation, disconnect switches, along with relaying, metering, RTU, SCADA and other miscellaneous supporting equipment will be required (See **Figure 1** below). The new 345kV five-breaker ring bus will be paid for by the Interconnection Customer, but will be owned and operated by FirstEnergy. The direct connects are estimated to cost approximately **$16,190,900** with an extra to interconnect and take a minimum of **18 months** after the receipt of an executed Construction Service Agreement to complete the direct connection work (See **Table A** below for cost breakdown). If applicable, add 23.03% tax gross-up to the cost estimate above. The cost estimate above does not include any of the upgrades listed in the Network Impacts section of the report. It is expected to take up to **6 years** to complete all FE network upgrades associated with thermal violations listed in the Network Impacts section of the report.

Please note that the FirstEnergy/ATSI costs include a CIAC (Contribution in Aid of Construction) Federal Income Tax Gross Up charge which may or may not be charged based on whether or not this project meets the eligibility requirements of IRS Notice 88-129.

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.

Fiber optic communications channels are required between Bayshore substation and the new sectionalizing ring bus. Two independent fiber routes may be required. Relay upgrades will be required at Bayshore substation. Pending review by AEP and ITC, relay upgrades may be required at Fostoria Central and Monroe substations. Further protection requirements will be provided in the System Impact and Facility Connection studies.

Direct Connection Cost Estimate

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

Table A. Direct Connection Cost Breakdown

Description	Total Cost	Tax	Total with Tax
Loop in the Bayshore-Fostoria Central 345kV line and Bayshore-Monroe 345kV line into the proposed interconnecting substation utilizing steel pole structures	$ 2,574,900	$643,500	$3,218,400
Engineering Oversight and Commissioning	$256,900	$64,200	$321,100
Install new 345kV generation interconnection switching station (5 breaker ring bus)	$13,009,100	$2,941,400	$15,950,500
Updated relaying on the 345kV Fostoria Central and Monroe lines	$350,000	$79,200	$429,200
Total	**$16,190,900**	**$3,728,300**	**$19,919,200**

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 Y1-069 project was studied as a 799MW Capacity injection into the ATSI area as a simultaneously tap of the Bay Shore – Fostoria Central 345kV line and the Bay Shore – Monroe 345kV line. Project Y1-069 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Potential network impacts were as follows:

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

No violations 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.)

No violations found.

Short Circuit
(Summary of impacted circuit breakers)

PJM has completed the short circuit analysis of the Y1-069 queue project **Bay Shore-Fostoria Central 345kV**. One option was considered during this study: the primary option was a tap of the Bay Shore and Fostoria and the Bay Shore and Monroe 345kV lines.

PJM analysis found **1 new breaker** to be over-duty in the ATSI transmission area. The new over-duty breakers are listed below and will be re-evaluated during the System Impact Study if this option is chosen:

Bus_NO	BUS	BREAKER	Duty % with Y1-069_ATSI	Duty % without Y1-069_ATSI	Duty % Difference	Notes
9303	MURRAY 138 138.kV	453-B-4	100.30%	99.50%	0.80%	New Over-duty

In addition, the analysis also showed a significant fault contribution (i.e. above 3%) to 9 breakers, which were already identified as over-duty in the ATSI transmission area. The breaker is listed below:

Bus_NO	BUS	BREAKER	Duty % with Y1-069_ATSI	Duty % without Y1-069_ATSI	Duty % Difference	Notes
0	GRENFIELD138 138.kV	501-B-68	204.00%	162.40%	41.60%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-1	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-21	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-227	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-23	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-242	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-36	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-38	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-40	144.20%	114.40%	29.80%	Over 100%, > 3% contribution

ATSI has verified that all of the Greenfield 138kV circuit breakers are part of a baseline upgrade. Therefore, this project will not be responsible for any cost allocation to upgrading the Greenfield 138kV circuit breakers.

In addition, the analysis also showed a significant fault contribution (i.e. above 3%) to 3 breakers, which were already identified as over-duty on GenOn-owned facilities. The breaker is listed below. This project may have a contribution to these breakers and this will be verified during the System Impact Study:

Bus_NO	BUS	BREAKER
0	04AVON LK138 138.kV	2045-B-6
0	04AVON LK138 138.kV	2045-B-5
0	04AVON LK138 138.kV	2045-B-7

If these GenOn breaker overloads are verified in the System Impact Study, it will be the Interconnection Customer's responsibility to work with GenOn to get these breakers replaced.

PJM analysis also 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 Y1-069_ATSI	Duty % without Y1-069_ATSI	Duty % Difference	Notes
0	05E LIMA 138.kV	C2	100.20%	99.50%	0.70%	New Overduty
0	05E LIMA 138.kV	D2	100.20%	99.50%	0.70%	New Overduty

The following upgrades listed in **Table 2** and **Table 3** will mitigate the overduty breakers listed above:

Table 2. ATSI Breaker Replacement Cost Estimate			
Description	**Total Cost**	**Tax**	**Total with Tax**
Replace overdutied 138kV circuit breaker 4 at Murray.	$318,800	$74,100	$392,900

Table 3. AEP Breaker Replacement Cost Estimate	
Description	**Total Cost**
Replace overdutied 138kV circuit breaker C2 at East Lima.	$850,000
Replace overdutied 138kV circuit breaker D2 at East Lima.	$850,000
Total	**$1,700,000**

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 1 below provides a summary of the impacts caused by Y1-069 on the ATSI transmission system and other TO areas for contribution to previously identified overloads:

Table 1: Contributions to Previously Identified Overloads								
Item #	Project	Contribution MVA	Overloaded Element	Overload %		Rating		Contingent Element
				From	To	Type	MVA	
1a	Y1-069	21.22	02CW TP1-02AS Q-1 138 kV line	103.55%	105.05%	Emergency	215	'C5-TWL-NR062'
1b	Y1-069	30.35	02AVON 345/138 kV transformer	104.79%	105.60%	Emergency	602	'B_TRANS_SY_60A'
1c	Y1-069	22.38	02OTTAWA-02LAKVEW 138 kV line	110.17%	111.39%	Emergency	278	None
1d	Y1-069	14.14	02CAMDEN-02HENRTA 138 kV line	110.01%	111.59%	Emergency	135	'C5-TWL-CR040'
1e	Y1-069	14.14	02BRKSID-02TROY 138 kV line	114.31%	115.89%	Emergency	135	'C5-TWL-CR040'
1f	Y1-069	21.06	02HAYES-02GRNFLD 138 kV line	119.66%	121.27%	Emergency	195	'C5-TWL-CR041'
1g	Y1-069	76.45	02HAYES 345/138 kV transformer	138.43%	140.44%	Emergency	573	'C5-TWL-CR041'
1h	Y1-069	32.85	02AVERY-02SHNROK 138 kV line	141.98%	144.54%	Emergency	194	'C5-TWL-CR041'
1i	Y1-069	38.95	02JONSON-02LRN Q2 138 kV line	150.31%	153.37%	Emergency	193	'513'
1j	Y1-069	16.58	MELMORE-05HOWARD 138 kV line	161.42%	162.91%	Emergency	167	'C5-TWL-CR041'
1k	Y1-069	72.89	02OTTAWA-02LAKVEW 138 kV line	206.28%	209.41%	Emergency	339	'C5-TWL-CR040'
1l	Y1-069	72.89	02LAKVEW-02GRNFLD 138 kV line	252.15%	256.48%	Emergency	243	'C5-TWL-CR040'
1m	Y1-069	11.28	02EDGEWT-02USSTEL 138 kV line	104.54%	105.62%	Emergency	157	'C5-TWL-CR012A'

Item 1a. (ATSI)The 02CW TP1-02AS Q-1 138 kV line (from bus 238645 to bus 238541 ckt 1) loads from 103.55% to 105.05% (**DC power flow**) of its rating (215 MVA) for the tower line contingency ('C5-TWL-NR062'). This project contributes approximately 21.22 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-NR062'                    /* AVON-JUNIPER AND EMILY-FOX 138KV LINE OUTAGES
 DISCONNECT BRANCH FROM BUS 238551 TO BUS 238850 CKT 1          /* 02AVON 345.00 02JUNIPE 345.00
 DISCONNECT BRANCH FROM BUS 238710 TO BUS 238775 CKT 1          /* 02EYQ-14 138.00 02GXQ-14 138.00
 DISCONNECT BRANCH FROM BUS 238775 TO BUS 238776 CKT 1          /* 02GXQ-14 138.00 02GXTP14 138.00
 DISCONNECT BRANCH FROM BUS 238776 TO BUS 238809 CKT 1          /* 02GXTP14 138.00 02HMLQ14 138.00
 DISCONNECT BRANCH FROM BUS 238735 TO BUS 238809 CKT 1          /* 02FOXQ14 138.00 02HMLQ14 138.00
 DISCONNECT BUS 238775                         /* 02GXQ-14 138.00
 SET BUS 238710 LOAD TO 40.4 MW                /* 02EYQ-14 138.00
 END
```

Item 1b. (ATSI)The 02AVON 345/138 kV transformer (from bus 238551 to bus 238552 ckt 92) loads from 104.79% to 105.6% (**DC power flow**) of its rating (602 MVA) for the single line contingency ('B_TRAN_SY_60A'). This project contributes approximately 30.35 MW to the thermal violation.

```
CONTINGENCY 'B_TRAN_SY_60A'                    /* TRAN 02AVON 345 TO
02AVON 138 CK 91
 DISCONNECT BRANCH FROM BUS 238551 TO BUS 238552 CKT 91          /*
02AVON 345.00 02AVON 138.00
 END
```

Item 1c. (ATSI)The 02OTTAWA-02LAKVEW 138 kV line (from bus 239030 to bus 238874 ckt 1) loads from 110.17% to 111.39% (**DC power flow**) of its normal rating (278 MVA) for non-contingency condition. This project contributes approximately 22.38 MW to the thermal violation.

Item 1d. (ATSI)The 02CAMDEN-02HENRTA 138 kV line (from bus 239319 to bus 239318 ckt 1) loads from 110.01% to 111.59% (**DC power flow**) of its rating (135 MVA) for the tower line contingency ('C5-TWL-CR040'). This project contributes approximately 14.14 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR040'                     /* DAVIS BESSE-BEAVER
+ DAVIS BESSE-HAYES 345KV
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1          /* 02DAV-
BE 345.00 02HAYES 345.00
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1          /* 02DAV-
BE 345.00 02BEAVER 345.00
 END
```

Item 1e. (ATSI)The 02BRKSID-02TROY 138 kV line (from bus 238586 to bus 239216 ckt 1) loads from 114.31% to 115.89% (**DC power flow**) of its rating (135 MVA) for the tower line contingency ('C5-TWL-CR040'). This project contributes approximately 14.14 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR040'                     /* DAVIS BESSE-BEAVER
+ DAVIS BESSE-HAYES 345KV
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1          /* 02DAV-
BE 345.00 02HAYES 345.00
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1          /* 02DAV-
BE 345.00 02BEAVER 345.00
 END
```

Item 1f. (ATSI)The 02HAYES-02GRNFLD 138 kV line (from bus 239290 to bus 238768 ckt 2) loads from 119.66% to 121.27% (**DC power flow**) of its rating (195 MVA) for the tower line contingency ('C5-TWL-CR041'). This project contributes approximately 21.06 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR041'                    /* DAVIS BESSE-BEAVER
+ BEAVER-HAYES 345KV
 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1          /*
02BEAVER 345.00 02HAYES 345.00
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1          /* 02DAV-
BE 345.00 02BEAVER 345.00
 END
```

Item 1g. (ATSI)The 02HAYES 345/138 kV transformer (from bus 239289 to bus 239290 ckt 1) loads from 138.43% to 140.44% (**DC power flow**) of its rating (573 MVA) for the tower line contingency ('C5-TWL-CR041'). This project contributes approximately 76.45 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR041'                    /* DAVIS BESSE-BEAVER
+ BEAVER-HAYES 345KV
 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1          /*
02BEAVER 345.00 02HAYES 345.00
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1          /* 02DAV-
BE 345.00 02BEAVER 345.00
 END
```

Item 1h. (ATSI)The 02AVERY-02SHNROK 138 kV line (from bus 238549 to bus 239108 ckt 1) loads from 141.98% to 144.54% (**DC power flow**) of its rating (194 MVA) for the tower line contingency ('C5-TWL-CR041'). This project contributes approximately 32.85 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR041'                    /* DAVIS BESSE-BEAVER
+ BEAVER-HAYES 345KV
 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1          /*
02BEAVER 345.00 02HAYES 345.00
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1          /* 02DAV-
BE 345.00 02BEAVER 345.00
 END
```

Item 1i. (ATSI)The 02JONSON-02LRN Q2 138 kV line (from bus 238845 to bus 238915 ckt 1) loads from 150.31% to 153.37% (**DC power flow**) of its rating (193 MVA) for the tower line contingency ('513'). This project contributes approximately 38.95 MW to the thermal violation.

```
CONTINGENCY '513'
 OPEN BRANCH FROM BUS 238551 TO BUS 238569 CKT 1          / 238551
02AVON 345 238569 02BEAVER 345 1
 OPEN BRANCH FROM BUS 238551 TO BUS 238569 CKT 2          / 238551
02AVON 345 238569 02BEAVER 345 2
 END
```

Item 1j. (AEP)The MELMORE-05HOWARD 138 kV line (from bus 892000 to bus 243024 ckt 1) loads from 161.42% to 162.91% (**DC power flow**) of its rating (167 MVA) for the tower line contingency ('C5-TWL-CR041'). This project contributes approximately 16.58 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR041'                    /* DAVIS BESSE-BEAVER
+ BEAVER-HAYES 345KV
 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1        /*
02BEAVER 345.00 02HAYES 345.00
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1    /* 02DAV-
BE 345.00 02BEAVER 345.00
 END
```

Item 1k. (ATSI)The 02OTTAWA-02LAKVEW 138 kV line (from bus 239030 to bus 238874 ckt 1) loads from 206.28% to 209.41% (**DC power flow**) of its rating (339 MVA) for the tower line contingency ('C5-TWL-CR040'). This project contributes approximately 72.89 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR040'                    /* DAVIS BESSE-BEAVER
+ DAVIS BESSE-HAYES 345KV
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1    /* 02DAV-
BE 345.00 02HAYES 345.00
 DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1    /* 02DAV-
BE 345.00 02BEAVER 345.00
 END
```

Item 1l. (ATSI)The 02LAKVEW-02GRNFLD 138 kV line (from bus 238874 to bus 238768 ckt 1) loads from 252.15% to 256.48% (**DC power flow**) of its rating (243 MVA) for the tower line contingency ('C5-TWL-CR040'). This project contributes approximately 72.89 MW to the thermal violation.

```
CONTINGENCY 'C5-TWL-CR040'                    /* DAVIS BESSE-BEAVER
+ DAVIS BESSE-HAYES 345KV
```

DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 /* 02DAV-BE 345.00 02HAYES 345.00
DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1 /* 02DAV-BE 345.00 02BEAVER 345.00
END

Item 1m. (ATSI) The 02EDGEWT-02USSTEL 138 kV line (from bus 238690 to bus 239145 ckt 1) loads from 104.54% to 105.62% (**DC power flow**) of its emergency rating (157 MVA) for the tower line contingency ('C5-TWL-CR012A'). This project contributes approximately 11.28 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR012A' /* BEAV-JOHNSON, BEAV-HENRIETTA 138
DISCONNECT BRANCH FROM BUS 238570 TO BUS 238845 CKT 1 /* 02BEAVER 138.00 02JONSON 138.00
DISCONNECT BRANCH FROM BUS 238570 TO BUS 239318 CKT 1 /* 02BEAVER 138.00 02HENRTA 138.00
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.)

Not required.

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 1a, the overload of the 02CW TP1-02AS Q-1 138 kV line can be relieved by reconductoring the existing 1.7 mile section of the Crestwood tap to Astor substation with 795 kcmil ACSS high-temp conductor, replacing the existing 795 kcmil ACSR conductor. The total estimated cost to perform this work is **$864,800** with an extra **$216,200** tax gross-up if applicable (**$1,081,000** total with tax included).

For Item 1b, the overload of the 02AVON 345/138 kV transformer can be relieved by replacing the existing Avon substation 448MVA 345/138kV #92 transformer with 700MVA transformer. The total estimated cost to perform this work is **$5,924,200** with an extra **$1,480,500** tax gross-up if applicable (**$7,404,700** total with tax included).

For Items 1c, 1k, and 1l, the overloads of the 02OTTAWA-02LAKVEW 138 kV line and 02LAKVEW-02GRNFLD 138 kV line can be relieved by the following proposed by ATSI below in **Table 1a**. The total estimated cost to perform this work is **$50,940,800** with an extra **$11,874,200** tax gross-up if applicable (**$62,815,000** total with tax included).

Table 1a. Reinforcements for Ottawa-Lakeview 138kV Line and Lakeview – Greenfield 138kV line Overloads			
Reinforcement Description	**Upgrade Cost**	**Tax**	**Total with Tax**
Build new 28 mile Hayes – West Freemont #2 138kV line	$5,744,900	$1,435,700	$7,180,600
Install 28 miles of OPGW fiber on new Hayes – West Freemont #2 138kV line	$640,500	$160,100	$800,600
Add a new position at the Hayes substation for the new Hayes – West Freemont #2 138kV line	$1,014,900	$253,700	$1,268,600
Add a new 138kV circuit breaker at the Hayes substation for the new Hayes – West Freemont #2 138kV line and modify relaying for the Groton 138kV substation	$1,194,900	$277,700	$1,472,600
Add a new 138kV circuit breaker and associated equipment at the West Freemont substation. This exit assumes a new breaker string is constructed for the first 138kV exit to Hayes substation	$727,100	$181,800	$908,900
Add two new 138kV circuit breakers at West Freemont substation to create a new line exit for the new Hayes – West Freemont #1 138kV line	$2,114,400	$478,100	$2,592,500
Install new Groton 138/69kV substation near existing Bellvue – Greenfield 69kV line	$9,475,100	$2,202,100	$11,677,200
Nameplate and drawing modifications	$104,300	$24,500	$128,800
Loop new Groton 138/69kV substation into the new Hayes – West Freemont 138kV line	$1,261,800	$293,300	$1,555,100
Loop new Groton 138/69kV substation into the Bellvue – Greenfield West 69kV line	$152,900	$35,600	$188,500
Build new 28 mile Hayes – West Freemont #1 138kV line. The exact route will be determined after route selection studies are completed.	$24,757,100	$5,668,100	$30,425,200
Install 28 miles of OPGW fiber on new Hayes – West Freemont #1 138kV line. This includes additional 9 miles of fiber from new Groton substation to Hayes substation.	$3,752,900	$863,500	$4,616,400
Total estimated cost:	**$50,940,800**	**$11,874,200**	**$62,815,000**

For Item 1d, the overload of the 02CAMDEN-02HENRTA 138 kV line can be relieved by raising or rebuilding structures on the Camden – Henrietta section of the Brookside – Henrietta 138kV line to obtain an increased operating temperature of 212°F. The total estimated cost to perform this work is **$163,600** with an extra **$40,900** tax gross-up if applicable (**$204,500** total with tax included).

For Items 1e, the overload of the 02BRKSID-02TROY 138 kV line can be relieved by raising or rebuilding structures on the Brookside – Troy section of the Brookside – Henrietta 138kV line to obtain an increased operating temperature of 212°F. The total estimated cost to perform this work is **$238,900** with an extra **$59,800** tax gross-up if applicable (**$298,900** total with tax included).

For Item 1f, the overload of the 02HAYES-02GRNFLD 138 kV line can be relieved by upgrading the Greenfield – Hayes 138kV line design temperature from 150°F to 212°F. The total estimated cost to perform this work is **$131,500** with an extra **$32,900** tax gross-up if applicable (**$164,400** total with tax included).

For Item 1g, the overload of the 02HAYES 345/138 kV transformer can be relieved by adding a second 345/138kV transformer at the Hayes substation. The total estimated cost to perform this work is **$4,444,000** with an extra **1,032,800** tax gross-up if applicable (**$5,476,800** total with tax included).

For Item 1h, the overload of the 02AVERY-02SHNROK 138 kV line can be relieved by upgrading the Avery – Shinrock 138kV line design temperature from 150°F to 212°F from Avery substation to Greenfield substation by replacing 4 H-frame structures. The total estimated cost to perform this work is **$248,700** with an extra **$59,600** tax gross-up if applicable (**$308,300** total with tax included).

For Item 1i, the overload of the 02JONSON-02LRN Q2 138 kV line can be relieved by replacing a 600A wave trap on Lorain line terminal at Johnson substation, upgrading line drops and metering on the 138kV Johnson line terminal at the Lorain substation, and reconductoring 1.54 miles of the Johnson – Lorain 138kV line with 605 kcmil ACSS, replacing the existing 636 kcmil ACSR conductor. The total estimated cost to perform this work is **$934,700** with an extra **$233,700** tax gross-up if applicable. The cost breakdown is shown below in **Table 1b**:

Table 1b. Reinforcements for Johnson-Lorain 138kV Line Overload

Reinforcement Description	Upgrade Cost	Tax	Total with Tax
Reconductor 1.54 miles of the Johnson – Lorain 138kV line with 605 kcmil ACSS conductor, replacing the existing 636 kcmil ACSR conductor. Six wire the 3.63 mile double circuit section of 636 ACSR and de-energized 4/0 copper conductor.	$810,700	$202,600	$1,013,300
Replace 600A wave trap on Lorain line terminal at Johnson substation.	$80,500	$20,200	$100,700
Upgrade line drops and meter on 138kV Johnson line terminal at Lorain substation.	$43,500	$10,900	$54,400
Total estimated cost:	**$934,700**	**$233,700**	**$1,168,400**

For Item 1j, the overload of the MELMORE-05HOWARD 138 kV line can be relieved by rebuilding 27 miles of the Howard – Melmore 138kV line. Also, Howard 138kV bus and risers will need to be replaced and the Howard 138kV CT settings will need to be adjusted. The total estimated cost to perform this work is **$32,760,000**. The cost breakdown is shown below in **Table 1c**:

Table 1c. Reinforcements for Melmore-Howard 138kV Line Overload	
Reinforcement Description	**Upgrade Cost**
Rebuild 27 miles of the Melmore – Howard 138kV line.	$32,400,000
Replace Howard 138kV bus	$300,000
Replace Howard 138kV risers	$50,000
Engineering study to adjust ratio setting of the Howard 138kV CT (400A connected, 2000A capable)	$10,000
Total estimated cost:	**$32,760,000**

For Item 1m, PJM identified the overload of the 02EDGEWT-02USSTEL 138 kV line. According to FE/ATSI, will be mitigated by a line reconfiguration that will that will make this a radial line in 2013, which will not be the responsibility of this Y1-069 project.

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 Y1-069 project will tap the Bay Shore – Fostoria Central 345kV line for this option.

Facilities to Accommodate the Interconnection

Scope of Direct Connection Work

The Y1-069 project will tap of the Bay Shore – Fostoria Central 345kV line. To accommodate this interconnection, installation of a new three-breaker ring bus 345kV substation, ten disconnect switches, along with relaying, metering, RTU, SCADA and other miscellaneous supporting equipment will be required. If this option is chosen, the direct connect costs will be provided in the System Impact Study

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.

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 Y1-069 project was studied as a 799MW Capacity injection into the ATSI area as a tap of the Bay Shore – Fostoria Central 345kV line. Project Y1-069 was evaluated for compliance with reliability criteria for summer peak conditions in 2015.

Potential network impacts were as follows:

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

No violations 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.)

The 05FOSTOR 345/138 kV transformer (from bus 242936 to bus 243006 ckt 1) loads from 79% to 108.07% (**DC power flow**) of its normal rating (549 MVA) for the tower line contingency ('517'). This project contributes approximately 159.61 MW to the thermal violation.

CONTINGENCY '517'
OPEN BRANCH FROM BUS 238563 TO BUS 913490 CKT 1 / 238563 02BAY SH 345 242936 05FOSTOR 345 1
OPEN BRANCH FROM BUS 238889 TO BUS 242936 CKT 1 / 238889 02LEMOYN 345 242936 05FOSTOR 345 1
END

Short Circuit
(Summary of impacted circuit breakers)

PJM has completed the short circuit analysis of the Y1-069 queue project **Bay Shore-Fostoria Central 345kV**. One option was considered during this study: the secondary option was a tap of the Bay Shore and Fostoria and the Bay Shore and Monroe 345kV lines.

PJM analysis found **1 new breaker** to be over-duty in the ATSI transmission area. The new over-duty breakers are listed below:

Bus_NO	BUS	BREAKER	Duty % with Y1-069_ATSI	Duty % without Y1-069_ATSI	Duty % Difference	Notes
9303	MURRAY 138 138.kV	453-B-4	100.30%	99.50%	0.80%	New Over-duty

In addition, the analysis also showed a significant fault contribution (i.e. above 3%) to 12 breakers, which were already identified as over-duty in the ATSI transmission area. The breaker is listed below. This project will have a contribution to these:

Bus_NO	BUS	BREAKER	Duty % with Y1-069_ATSI	Duty % without Y1-069_ATSI	Duty % Difference	Notes
0	GRENFIELD138 138.kV	501-B-68	204.00%	162.40%	41.60%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-1	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-21	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-227	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-23	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-242	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-36	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-38	144.20%	114.40%	29.80%	Over 100%, > 3% contribution
0	GRENFIELD138 138.kV	501-B-40	144.20%	114.40%	29.80%	Over 100%, > 3% contribution

In addition, the analysis also showed a significant fault contribution (i.e. above 3%) to 3 breakers, which were already identified as over-duty on GenOn-owned facilities. The breaker is listed below. This project may have a contribution to these:

Bus_NO	BUS	BREAKER
0	04AVON LK138 138.kV	2045-B-6
0	04AVON LK138 138.kV	2045-B-5
0	04AVON LK138 138.kV	2045-B-7

If these GenOn breaker overloads are verified in the System Impact Study, it will be the Interconnection Customer's responsibility to work with GenOn to get these breakers replaced.

If this option is chosen, circuit breakers mitigations and cost estimates will be provided in the System Impact Study report.

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 2 below provides a summary of the impacts caused by Y1-069 on the ATSI transmission system and other TO areas for contribution to previously identified overloads:

Table 2: Contributions to Previously Identified Overloads								
Item #	Project	Contribution MVA	Overloaded Element	Overload %		Rating		Contingent Element
				From	To	Type	MVA	
2a	Y1-069	29.98	05TIFFIN-05FREMCT 138 kV line	100.72%	103.08%	Emergency	205	'517'
2b	Y1-069	20.60	02CW TP1-02AS Q-1 138 kV line	103.69%	105.14%	Emergency	215	'C5-TWL-NR062'
2c	Y1-069	10.86	02EDGEWT-02USSTEL 138 kV line	104.68%	105.71%	Emergency	157	'C5-TWL-CR012A'
2d	Y1-069	9.12	05HAVILN-S-073B 138 kV line	106.73%	107.61%	Emergency	167	'421'
2e	Y1-069	15.4	02CAMDEN-02HENRTA 138 kV line	108.98%	110.71%	Emergency	135	'C5-TWL-CR040'
2f	Y1-069	22.28	02OTTAWA-02LAKVEW 138 kV line	110.12%	111.35%	Emergency	278	None
2g	Y1-069	15.4	02BRKSID-02TROY 138 kV line	113.29%	115.02%	Emergency	135	'C5-TWL-CR040'
2h	Y1-069	19.86	02HAYES-02GRNFLD 138 kV line	121.16%	122.69%	Emergency	195	'C5-TWL-CR041'
2i	Y1-069	72.66	02HAYES 345/138 kV transformer	139.07%	140.95%	Emergency	573	'C5-TWL-CR041'
2j	Y1-069	31.54	02AVERY-02SHNROK 138 kV line	142.39%	144.85%	Emergency	194	'C5-TWL-CR041'
2k	Y1-069	37.99	02JONSON-02LRN Q2 138 kV line	150.51%	153.49%	Emergency	193	'513'
2l	Y1-069	16.65	MELMORE-05HOWARD 138 kV line	161.30%	162.79%	Emergency	167	'C5-TWL-CR041'
2m	Y1-069	70.58	02OTTAWA-02LAKVEW 138 kV line	206.68%	209.70%	Emergency	339	'C5-TWL-CR040'
2n	Y1-069	8.84	05HOWARD-02BRKSID 138 kV line	223.78%	224.54%	Emergency	173	'C5-TWL-SR063'
2o	Y1-069	70.58	02LAKVEW-02GRNFLD 138 kV line	255.70%	259.89%	Emergency	243	'C5-TWL-CR040'

Item 2a. The 05TIFFIN-05FREMCT 138 kV line (from bus 243130 to bus 243008 ckt 1) loads from 100.72% to 103.08% (**DC power flow**) of its rating (205 MVA) for the tower line contingency ('517'). This project contributes approximately 29.98 MW to the thermal violation.

CONTINGENCY '517'
OPEN BRANCH FROM BUS 238563 TO BUS 913490 CKT 1 / 238563 02BAY SH 345 242936 05FOSTOR 345 1
OPEN BRANCH FROM BUS 238889 TO BUS 242936 CKT 1 / 238889 02LEMOYN 345 242936 05FOSTOR 345 1
END

Item 2b. The 02CW TP1-02AS Q-1 138 kV line (from bus 238645 to bus 238541 ckt 1) loads from 103.69% to 105.14% (**DC power flow**) of its rating (215 MVA) for the tower line contingency ('C5-TWL-NR062'). This project contributes approximately 20.6 MW to the thermal violation.

CONTINGENCY 'C5-TWL-NR062' /* AVON-JUNIPER AND EMILY-FOX 138KV LINE OUTAGES
DISCONNECT BRANCH FROM BUS 238551 TO BUS 238850 CKT 1 /* 02AVON 345.00 02JUNIPE 345.00

DISCONNECT BRANCH FROM BUS 238710 TO BUS 238775 CKT 1 /* 02EYQ-14 138.00 02GXQ-14 138.00
DISCONNECT BRANCH FROM BUS 238775 TO BUS 238776 CKT 1 /* 02GXQ-14 138.00 02GXTP14 138.00
DISCONNECT BRANCH FROM BUS 238776 TO BUS 238809 CKT 1 /* 02GXTP14 138.00 02HMLQ14 138.00
DISCONNECT BRANCH FROM BUS 238735 TO BUS 238809 CKT 1 /* 02FOXQ14 138.00 02HMLQ14 138.00
DISCONNECT BUS 238775 /* 02GXQ-14 138.00
SET BUS 238710 LOAD TO 40.4 MW /* 02EYQ-14 138.00
END

Item 2c. The 02EDGEWT-02USSTEL 138 kV line (from bus 238690 to bus 239145 ckt 1) loads from 104.68% to 105.71% (**DC power flow**) of its normal rating (157 MVA) for the tower line contingency ('C5-TWL-CR012A'). This project contributes approximately 10.86 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR012A' /* BEAV-JOHNSON, BEAV-HENRIETTA 138
DISCONNECT BRANCH FROM BUS 238570 TO BUS 238845 CKT 1 /* 02BEAVER 138.00 02JONSON 138.00
DISCONNECT BRANCH FROM BUS 238570 TO BUS 239318 CKT 1 /* 02BEAVER 138.00 02HENRTA 138.00
END

Item 2d. The 05HAVILN-S-073B 138 kV line (from bus 243017 to bus 290795 ckt 1) loads from 106.73% to 107.61% (**DC power flow**) of its normal rating (167 MVA) for the tower line contingency ('421'). This project contributes approximately 9.12 MW to the thermal violation.

CONTINGENCY '421'
OPEN BRANCH FROM BUS 243211 TO BUS 243232 CKT 1 / 243211 05ALLEN 345 243232 05SORENS 345 1
OPEN BRANCH FROM BUS 242933 TO BUS 243231 CKT 1 / 242933 05CONVOY 345 243231 05ROB PK 345 1
END

Item 2e. The 02CAMDEN-02HENRTA 138 kV line (from bus 239319 to bus 239318 ckt 1) loads from 108.98% to 110.71% (**DC power flow**) of its normal rating (135 MVA) for the tower line contingency ('C5-TWL-CR040'). This project contributes approximately 15.4 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR040' /* DAVIS BESSE-BEAVER + DAVIS BESSE-HAYES 345KV
DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 /* 02DAV-BE 345.00 02HAYES 345.00

DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1 /* 02DAV-BE 345.00 02BEAVER 345.00
END

Item 2f. The 02OTTAWA-02LAKVEW 138 kV line (from bus 239030 to bus 238874 ckt 1) loads from 110.12% to 111.35% (**DC power flow**) of its normal rating (278 MVA) for non-contingency condition. This project contributes approximately 22.28 MW to the thermal violation.

Item 2g. The 02BRKSID-02TROY 138 kV line (from bus 238586 to bus 239216 ckt 1) loads from 113.29% to 115.02% (**DC power flow**) of its normal rating (135 MVA) for the tower line contingency ('C5-TWL-CR040'). This project contributes approximately 15.4 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR040' /* DAVIS BESSE-BEAVER + DAVIS BESSE-HAYES 345KV
DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 /* 02DAV-BE 345.00 02HAYES 345.00
DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1 /* 02DAV-BE 345.00 02BEAVER 345.00
END

Item 2h. The 02HAYES-02GRNFLD 138 kV line (from bus 239290 to bus 238768 ckt 2) loads from 121.16% to 122.69% (**DC power flow**) of its normal rating (195 MVA) for the tower line contingency ('C5-TWL-CR041'). This project contributes approximately 19.86 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR041' /* DAVIS BESSE-BEAVER + BEAVER-HAYES 345KV
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1 /* 02BEAVER 345.00 02HAYES 345.00
DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1 /* 02DAV-BE 345.00 02BEAVER 345.00
END

Item 2i. The 02HAYES 345/138 kV transformer (from bus 239289 to bus 239290 ckt 1) loads from 139.07% to 140.95% (**DC power flow**) of its normal rating (573 MVA) for the tower line contingency ('C5-TWL-CR041'). This project contributes approximately 72.66 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR041' /* DAVIS BESSE-BEAVER + BEAVER-HAYES 345KV
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1 /* 02BEAVER 345.00 02HAYES 345.00

DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1 /* 02DAV-BE 345.00 02BEAVER 345.00
END

Item 2j. The 02AVERY-02SHNROK 138 kV line (from bus 238549 to bus 239108 ckt 1) loads from 142.39% to 144.85% (**DC power flow**) of its normal rating (194 MVA) for the tower line contingency ('C5-TWL-CR041'). This project contributes approximately 31.54 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR041' /* DAVIS BESSE-BEAVER + BEAVER-HAYES 345KV
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1 /* 02BEAVER 345.00 02HAYES 345.00
DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1 /* 02DAV-BE 345.00 02BEAVER 345.00
END

Item 2k. The 02JONSON-02LRN Q2 138 kV line (from bus 238845 to bus 238915 ckt 1) loads from 150.51% to 153.49% (**DC power flow**) of its normal rating (193 MVA) for the tower line contingency ('513'). This project contributes approximately 37.99 MW to the thermal violation.

CONTINGENCY '513'
OPEN BRANCH FROM BUS 238551 TO BUS 238569 CKT 1 / 238551 02AVON 345 238569 02BEAVER 345 1
OPEN BRANCH FROM BUS 238551 TO BUS 238569 CKT 2 / 238551 02AVON 345 238569 02BEAVER 345 2
END

Item 2l. The MELMORE-05HOWARD 138 kV line (from bus 892000 to bus 243024 ckt 1) loads from 161.3% to 162.79% (**DC power flow**) of its normal rating (167 MVA) for the tower line contingency ('C5-TWL-CR041'). This project contributes approximately 16.65 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR041' /* DAVIS BESSE-BEAVER + BEAVER-HAYES 345KV
DISCONNECT BRANCH FROM BUS 238569 TO BUS 239289 CKT 1 /* 02BEAVER 345.00 02HAYES 345.00
DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1 /* 02DAV-BE 345.00 02BEAVER 345.00
END

Item 2m. The 02OTTAWA-02LAKVEW 138 kV line (from bus 239030 to bus 238874 ckt 1) loads from 206.68% to 209.7% (**DC power flow**) of its normal rating (339 MVA) for the tower line contingency ('C5-TWL-CR040'). This project contributes approximately 70.58 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR040' /* DAVIS BESSE-BEAVER + DAVIS BESSE-HAYES 345KV
DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 /* 02DAV-BE 345.00 02HAYES 345.00
DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1 /* 02DAV-BE 345.00 02BEAVER 345.00
END

Item 2n. The 05HOWARD-02BRKSID 138 kV line (from bus 243024 to bus 238586 ckt 1) loads from 223.78% to 224.54% (**DC power flow**) of its normal rating (173 MVA) for the tower line contingency ('C5-TWL-SR063'). This project contributes approximately 8.84 MW to the thermal violation.

CONTINGENCY 'C5-TWL-SR063' /* GALION-LEASIDE & GALION-GM COMMON TOWER
DISCONNECT BRANCH FROM BUS 238746 TO BUS 238891 CKT 1 /* 02GALION 138.00 02LESIDE 138.00
DISCONNECT BRANCH FROM BUS 238746 TO BUS 238758 CKT 1 /* 02GALION 138.00 02GM MAN 138.00
END

Item 2o. The 02LAKVEW-02GRNFLD 138 kV line (from bus 238874 to bus 238768 ckt 1) loads from 255.7% to 259.89% (**DC power flow**) of its normal rating (243 MVA) for the tower line contingency ('C5-TWL-CR040'). This project contributes approximately 70.58 MW to the thermal violation.

CONTINGENCY 'C5-TWL-CR040' /* DAVIS BESSE-BEAVER + DAVIS BESSE-HAYES 345KV
DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 /* 02DAV-BE 345.00 02HAYES 345.00
DISCONNECT BRANCH FROM BUS 238654 TO BUS 238569 CKT 1 /* 02DAV-BE 345.00 02BEAVER 345.00
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.