Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AB2-051

Chesapeake 230kV
765.5 MW Capacity / 840 MW Energy

Revised September / 2018

General

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff §207, as well as the Facilities Study Agreement between Gilmerton energy Center, LLC, (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider (TP)). IC, has proposed a natural gas fired single shaft combustion turbine generating facility located on South Military Highway in Chesapeake, VA. The installed facilities will have a total capability of 765.5 MW with 840 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is March 15, 2021. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AB2-051 will interconnect with the transmission owner system via a new breaker bay that connects into the Chesapeake Energy Center (CEC) 230kV double breaker double bus substation.

Cost Summary

The AB2-051 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$1,765,511
Direct Connection Network Upgrades	$0
Non Direct Connection Network Upgrades	$7,372,654
Allocation for New System Upgrades	$ 454,651
Contribution for Previously Identified Upgrades	$0
Total Costs	**$9,592,816**

© PJM Interconnection 2018. All rights reserved.

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AB2-051 is a request to interconnect 840 MW (Capacity 765.5 MW) from a new generation facility consisting of two single-shaft combined cycle generating units. The proposed facility will interconnect with into the ITO's Chesapeake Energy Center 230kV substation with a new breaker bay. The Point of Interconnection (POI) will be the Attachment Line terminal structure with a disconnect switch located outside of the existing Chesapeake Energy Center substation fenced area.

2. Amendments to the System Impact Study data or System Impact Study Results

PJM Retool May 2018

© PJM Interconnection 2018. All rights reserved.

New System Reinforcements

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

<table>
<tr><th>Violation #</th><th>Overloaded Facility</th><th>Upgrade Description</th><th>Network Upgrade Number</th><th>Upgrade Cost</th><th>AB2-051 Allocation</th></tr>
<tr><td># 1</td><td>6CHSTF B-6BASIN 230 kV line</td><td>ITO currently has a reliability project which will reconductor 0.14 miles Chesterfield – Basin 230kV of 1109 ACAR with a conductor which will increase the line rating to approximately 706 MVA (normal), 706 MVA (emergency), and 812 MVA (load dump). It is estimated to take 15-18 months to engineer, permit and construct, scheduled to be complete by 6/1/2018.</td><td>b2990</td><td></td><td>$0</td></tr>
<tr><td># 2</td><td>8ELMONT-8LDYSMTH 500 kV line</td><td>Replace the Elmont 500kV wave trap on the Elmont – Ladysmith 500kV line. This work is estimated to take 20-24 months to complete based on typical permitting parameters
<table>
<tr><th>Queue</th><th>Impact (MW)</th><th>Cost</th></tr>
<tr><td>AB2-051</td><td>241.35</td><td>$50,374</td></tr>
<tr><td>AB2-068</td><td>416.56</td><td>$86,983</td></tr>
<tr><td>AB2-190</td><td>35.98</td><td>$7,517</td></tr>
</table></td><td>n5483</td><td>$144,827</td><td>$50,374</td></tr>
<tr><td># 3</td><td>6CHARCTY-6LAKESD 230 kV line</td><td>Rebuild 21.32 miles of the Chesterfield - Lakeside 230kV transmission line by 6/1/2020</td><td>b2745</td><td>Not Applicable</td><td></td></tr>
<tr><td># 4</td><td>Yadkin 230kV breaker 210512</td><td>Replace 230kV breaker with a 50kA duty</td><td>n5484</td><td>$404,277</td><td>$404,277</td></tr>
<tr><td colspan="5">Total New Network Upgrades</td><td>$454,651</td></tr>
</table>

© PJM Interconnection 2018. All rights reserved.

3. Interconnection Customer's Submitted Milestone Schedule

Nothing supplied

4. Scope of Customer's Work

AB2-051 will build a natural gas fired generating facility located in Chesapeake, VA which consists of two single-shaft combined cycle generators. The generators of AB2-051 are connected to the POI via two 240/23 kV 456/608/760 MVA (ON/F1/F2) generator step-up transformers (GSU) and a 0.30 mile transmission line. The Point of Interconnection (POI) will be the Attachment Line terminal structure with a disconnect switch located outside of the existing Chesapeake Energy Center substation fenced area.

5. Description of Facilities Included in the Facilities Study

Expand the existing Chesapeake Energy Center Substation to accommodate the installation of a new 230kV Line Terminal for the proposed Generation Interconnection. In Chesapeake Energy Center 230kV substation build a 230kV terminal point by extending the existing Bus #5 and Bus #6 with two 230kV circuit breakers to create a new connection point in support of the Attachment line for the AB2-051 generating facility. The routing of the Attachment line will require raising four 115kV lines outside of Chesapeake Energy Center 230kV substation. One span of conductor will also need to be replaced between structure number 259/78-79. An Anti-islanding Transfer Trip schemes will require upgrades at Chesapeake Energy Center, Elmont and Yadkin Substations. This queue has cost responsibility to replacing a wavetrap on the Elmont – Ladysmith 500kV line as well as an overdutied 230kV breaker at Yadkin substation.

6. Total Costs of Transmission Owner Facilities included in Facilities Study

	Direct		Indirect		
Work Description	Labor	Material	Labor	Material	Total Cost
Substation	$241,818	$162,051	$45,723	$17,142	$466,734
Transmission	$660,061	$438,067	$110,561	$89,830	$1,298,777
Total Attachment Facilities Cost	$901,879	$600,118	$156,542	$106,972	$1,765,511
Elmont – Ladysmith 500kV line wavetrap at Elmont (n5483)	$20,262	$22,893	$3,575	$3,644	$50,374
Yadkin 230kV breaker replacement (n5484)	$192,958	$152,349	$36,216	$22,754	$404,277
Chesapeake Energy Center substation expansion (n5644)	$930,436	$284,030	$161,123	$64,657	$1,440,246
Transmission lines relocation (n5645)	$2,913,822	$1,743,525	$478,827	$276,829	$5,413,003
Remote relay (n5646)	$48,641	$31,294	$11,029	$4,710	$95,674
Total Network Upgrades	$4,118,836	$2,634,466	$688,944	$385,059	$7,827,305
Total Project Costs	$5,020,715	$3,234,584	$845,486	$492,031	$9,592,816

© PJM Interconnection 2018. All rights reserved.

7. Summary of Milestone Schedules for Completion of Work Included in Facilities Study:

Facilities are estimated to take 32 - 44 months to construct. The estimated time to construct and build the proposed facilities is based on typical permitting timelines actual permitting requirements required by local zoning conditions may impact this schedule. The timeline is highly dependent on outage availability due to the number of transmission lines that will need to be reworked.

Proposed Schedule

- Detailed design: 6 - 12 months
- Permitting: 12 – 18 months (timeline starts two months after start of design)
- Construction: 18 - 24 months (timeline maybe longer due to outage restrictions)

B. Transmission Owner Facilities Study Results

1. Attachment Facilities

ITO will install one new 230kV backbone within the expanded substation with one additional structure inside the proposed fenced area to support the new Attachment Line through the proposed fenced area. ITO will install a terminal structure (structure will not include shield wire attachments) with a line switch outside the existing fenced area for AB2-051 generator lead to terminate on – the top switch pad on this switch will be the interconnection point between ITO and AB2-051. It will be the responsibility of AB2-051 to terminate risers to the top four-hole pad of this switch as well as all other structures beyond this structure back to the generator. The work required is as follows:

Attachment Transmission Line

1. Install one 230kV light-duty backbone structure with foundations inside the expanded CEC station.
2. Install one 230kV A-frame backbone structure with foundations inside the expanded CEC station. The A-frame will have shield wire attachments.
3. Install one 230kV A-frame backbone structure with foundations outside of the CEC station. The A-frame will not have shield wire attachments. This will include the installation of a 230kV switch with HD vacuum bottles. The customer will terminate their 230kV line on this structure and connect to the switch pads.
4. Install two spans (approximately 330 feet) of 3-phase 2-636 ACSR 24/7 conductor between the proposed backbone and the two A-frame structures. This shall include the installation of spacers, dampers, one set of 3-phase tee connectors for the substation installed risers, and connection to the switch pads on the proposed A-frame structure.
5. Install one span (approximately 95 feet) of two 7#7 alumoweld shield wires between the proposed backbone and A-frame structure. This shall include the installation of dampers.

© PJM Interconnection 2018. All rights reserved.

6. Install one span (approximately 90 feet) of one 7#7 alumoweld shield wire between the proposed backbone and the existing adjacent backbone. This shall include the installation of dampers.

Chesapeake Energy Center (CEC)

Purchase and install substation material:

1. Three (3), 230kV, Metering Accuracy CCVT's (purchased by DE)
2. Three (3), 230kV,2000:5 Metering Accuracy CT's (purchased by DE)
3. Install any conductor, connectors, conduit, control cable, structural steel, foundations and grounding material.

Purchase and install relay material:

1. One (1), 1425 – Generation/NUG/PJM/IPP Metering Panel
2. One (1), 1808 – 28" Dual SEL-311L Line Diff. w/ Reclosing Panel
3. One (1), 4524 – Revenue Metering C.T. M.U. Box
4. One (1), 4531 – Generator Interconnect CCVT Potential M.U. Box
5. One (1), 1323 – 28" SEL-487E/735 PMU & PQ Monitoring Panel

2. Transmission Line – Upgrades

PJM Network Upgrade #n5645 – transmission line upgrades. The routing of the Attachment line for this project will require the raising of four 115kV lines outside of Chesapeake Energy Center 230kV substation.

Chesapeake – Greenwich 115kV Line 120

1. Install a 115kV double deadend steel H-frame structure with foundations between structure number 120/3 & 4.
2. Transfer existing conductor/shield wire to the proposed H-frame. The conductor was recently installed. One shield wire is OPGW that will need to be adjusted by going back to the splice and adding additional wire back into the spans (replace clamps) or cut OPGW and add splice.

Chesapeake – Churchland 115kV Line 87

1. Install a 115kV double deadend steel H-frame structure with foundations to replace structure number 87/10. Install close to existing structure to allow transfer of strain assemblies.
2. Transfer existing conductor/shield wire to the proposed H-frame. The conductor/shield wire was recently installed.
3. Remove H-frame structure number 87/10.
4. Install a 115kV double deadend steel H-frame structure with foundations to replace structure number 87/11 & 12.
5. Transfer existing conductor/shield wire to the proposed H-frame. The conductor/shield wire was recently installed.
6. Remove H-frame structure number 87/11 & 12.

Chesapeake – Cradock 115kV Line 66

1. Install a 115kV double deadend steel H-frame structure with foundations to replace structure number 66/25.

© PJM Interconnection 2018. All rights reserved.

2. Transfer existing conductor/shield wire to the proposed H-frame.
3. Remove double circuit 3-pole H-frame structure number 66/25.
4. Install a 115kV double deadend steel H-frame structure with foundations to replace structure number 66/24.
5. Transfer existing conductor/shield wire to the proposed H-frame.
6. Remove double circuit 3-pole H-frame structure number 66/24.
7. Remove one span (approximately 413 feet) of 3-phase 2-336 ACSR and two 3#6 alumoweld shield wires between the proposed H-frame structure numbers 66/24-25.
8. Install one span (approximately 413 feet) of single circuit 3-phase 2-336 ACSR conductor and two 7#7 alumoweld shield wires between the proposed H-frame structures. This will include the installation of spacers and dampers.

Chesapeake – Gosport 115kV Line 62

1. Install a 115kV double deadend steel 3-pole structure with foundations to replace structure number 62/68.
2. Transfer existing conductor/shield wire to the proposed 3-pole structure. This includes a OPGW shield wire.
3. Remove guyed 3-pole structure number 62/68.
4. Install a 115kV double deadend steel H-frame structure with foundations to replace structure number 62/67.
5. Transfer existing conductor/shield wire to the proposed H-frame. This includes a OPGW shield wire.
6. Remove H-frame structure number 62/67.
7. Install a 115kV double deadend steel H-frame structure with foundations to replace structure number 62/66.
8. Transfer existing conductor/shield wire to the proposed H-frame. This includes a OPGW shield wire.
9. Remove H-frame structure number 62/66.
10. Remove one span (approximately 447 feet) of 3-phase 2-336 ACSR and one 3#6 alumoweld shield wire between the proposed H-frame structure numbers 62/66-67.
11. Install one span (approximately 447 feet) of single circuit 3-phase 2-336 ACSR conductor and one 7#7 alumoweld shield wire between the proposed H-frame structure numbers 62/66-67. This will include the installation of spacers and dampers.
12. The existing OPGW shield wire will need to be adjusted by going back to the splice and removing additional wire from the spans (replace clamps) or cut OPGW and add splice.

Idle Line is required to be removed to create space for the relocation of lines #62 and 66

1. Remove eight spans (approximately 0.55 miles) of 3-phase 1109 ACAR conductor and one 3#6 alumoweld shield wire between the CEC 115kV lattice backbone and idle structure number I120/9.
2. Remove two guyed single pole deadend structures (I120/1 & 2).
3. Remove one single pole suspension structure (I120/3).
4. Remove one guyed single pole double deadend structure (I120/4).
5. Remove one pole and crossarm from two 3-pole double circuit suspension structures (I120/7 & 8).
6. Remove one guyed 3-pole deadend structure (I120/9).

© PJM Interconnection 2018. All rights reserved.

3. New Substation/Switchyard Facilities

See Chesapeake Energy Center Attachment Facility and Upgrade Substation scope.

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n5644 – Expand Chesapeake Energy Center, ITO to build a 230kV terminal point by extending the existing Bus #5 and Bus #6 with two 230kV circuit breakers to create a new connection point.

Chesapeake Energy Center (CEC)

Purchase and install substation material:

1. Two (2), 230 kV, 3000A, 50kAIC, SF-6 Circuit Breakers.
2. Four (4), 230 kV, 3000A, Center Break Switches.
3. Three (3), 180 kV, 144 kV MCOV surge arresters.
4. One (1), 230kV Single Circuit Backbones (by TLE)
5. Ground Grid as required.
6. Fence, Stone and Cable Trough as required.
7. Install any conductor, connectors, conduit, control cable, structural steel, foundations and
1. grounding material

Purchase and install relay material:

1. Two (2), 1510 – 28" Dual SEL-351-7 Transmission Breaker w/ Reclosing Panel
2. Two (2), 4510 - SEL-2411 Breaker Annunciator
3. One (1), 1603 – 28" SEL-451 Islanding Control Scheme Panel
4. Two (2), 4526_A – Circuit Breaker Fiber Optic M.U. Box
5. One (1), 5201 – 26" USI 2002 Digital Fault Recorder

PJM Network Upgrade #n5646 - Remote protection and communication work. ITO protection requirements to reliably interconnect the proposed generating facility with the transmission system determined that work is required at Greenwich and Yadkin 230kV substations. These costs include the following:

Greenwich 230kV Substation

Project Summary

Installation of Islanding CT-51C Transfer Trip set to Line 262 at Greenwich Substation.

Purchase and install:

1. Install conductor and connectors

Purchase and install relay material:

1. One (1), CT – 51C Islanding Transfer trip set

Yadkin 230kV Substation

Project Summary

Installation of Islanding CT-51C Transfer Trip to Line 2158 at Yadkin Substation.

Purchase and install:

1. Install conductor and connectors

Purchase and install relay material:

1. One (1), 1604 – 24" Transmission Islanding Transfer Trip Panel

© PJM Interconnection 2018. All rights reserved.

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Greenwich	$13,359	$11,471	$3,802	$1,711	$30,343
Yadkin	$13,359	$11,471	$3,802	$1,711	$30,343
Total Remote Relay Upgrades	$40,077	$34,413	$11,406	$5,133	$91,029

PJM Network Upgrade #n5483 – Replace the Elmont 500kV wavetrap. Replace the 3000A Elmont 500kV wave trap on the Elmont – Ladysmith 500kV line with a 5000A device. This work is estimated to take 20-24 months to complete based on typical permitting parameters.

Purchase and install:

1. One (1), 5000A Vertically Mounted Wave Trap
2. Install any foundations, grounding, conductor, connectors, and structural steel as necessary.

PJM Network Upgrade #n5484 – Replace the Yadkin 230kV circuit breaker. Replace the existing Yadkin circuit breaker #210512 with a 230kV, 3000A, 50kA Circuit Breaker.

Purchase and install:

1. One (1), 230kV, 3000A, 50kA Circuit Breaker
2. Install any foundations, grounding, conduit, control cable, conductor and connectors as necessary

Purchase and install relay material:

1. One (1), 1604 – 24" Transmission Islanding Transfer Trip Panel
2. One (1), 4510 - SEL-2411 Breaker Annunciator
3. One (1), 4526_A – Circuit Breaker Fiber Optic M.U. Box

5. Metering & Communications

PJM Requirements

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

The IC will be required to install and maintain Phasor Measurement Units (PMU's). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

ITO Requirements

Metering and SCADA/Communication equipment must meet the requirements outlined in section 3.1.6 Metering and Telecommunications of ITO's Facility Interconnection Connection Requirement NERC Standard FAC-001 which is publically available at www.dom.com.

© PJM Interconnection 2018. All rights reserved.

At the IC's expense, the ITO will supply and own at the Point of Interconnection bi-directional revenue metering equipment that will provide the following data:

a. Hourly compensated MWh received from the Customer Facility to the ITO;
b. Hourly compensated MVARh received from the Customer Facility to the ITO;
c. Hourly compensated MWh delivered from the ITO to the Customer Facility; and
d. Hourly compensated MVARh delivered from the ITO to the Customer Facility.

The IC will supply and own metering equipment that will provide Instantaneous net MW and MVar per unit values in accordance with PJM Manuals M-01 and M-14D, and Sections 8.1 through 8.5 of Appendix 2 to the ISA;

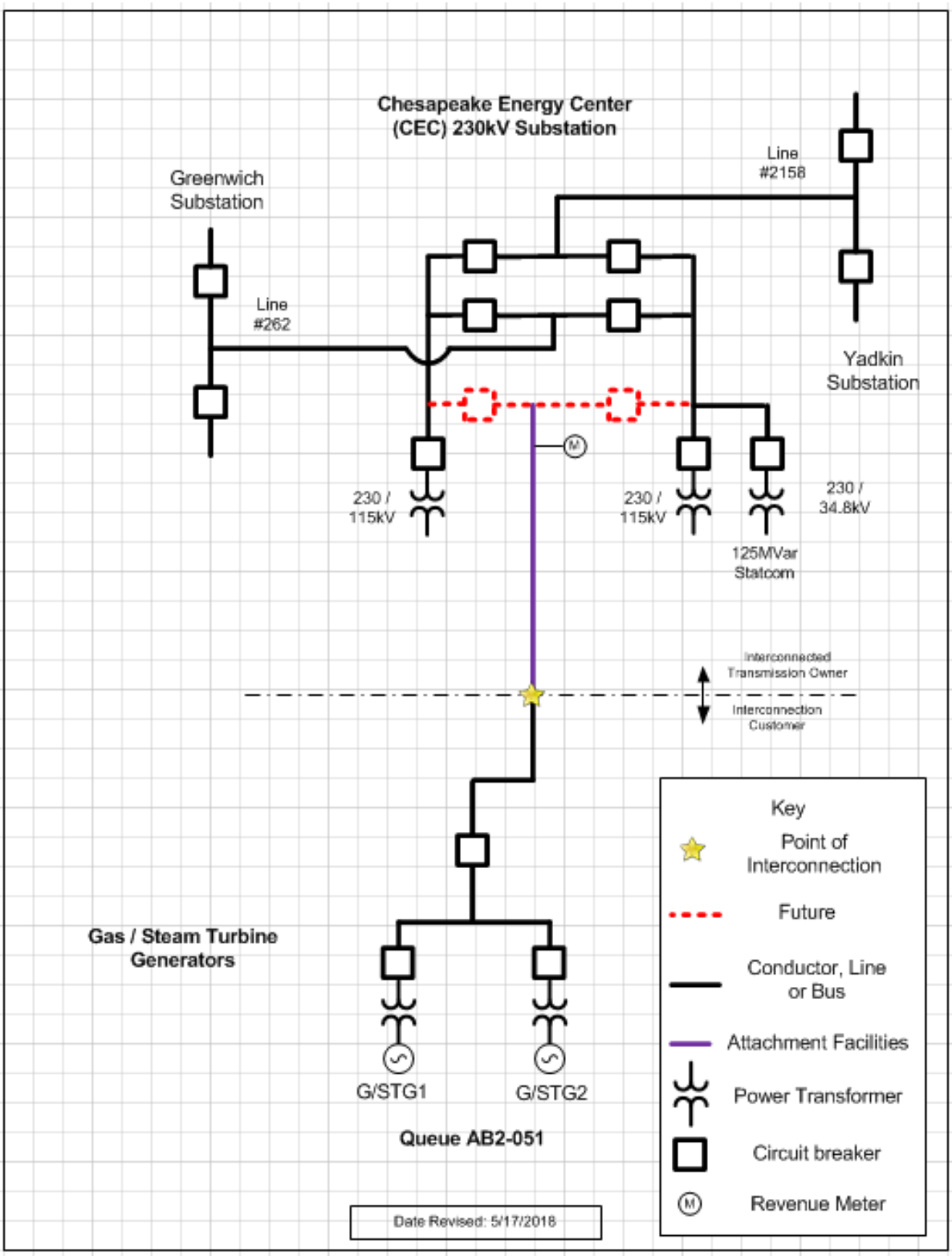
The IC will access revenue meter via wireless transceivers or fiber cabling to meter with RS-485 or Ethernet communication port for dial-up reads. IC must provide revenue and real time data to PJM from Interconnection Customer Market Operations Center per "PJM Telemetry Data Exchange Summary" document available at PJM.com.

6. Environmental, Real Estate and Permitting Issues

Interconnection Customer to be responsible for SCC permits associated with the generator lead / attachment transmission line. ITO will be responsible for local approvals to expand the Chesapeake Energy Center substation.

© PJM Interconnection 2018. All rights reserved.

Attachment 1.
Single Line



© PJM Interconnection 2018. All rights reserved.