

***Generation Interconnection
Facility Study Report***

For

***PJM Generation Interconnection Request
Queue Position AC1-107***

***Chickahominy 500kV
1600MW Capacity / 1600MW Energy***

July 2019

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 Chickahominy Power, LLC, (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider (TP)). The IC has proposed a natural gas combined cycle generating facility located in Charles City, Virginia (Charles City County). The installed facilities will have a total capability of 1600 MW with 1600 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is September 25, 2022. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-107 will interconnect with the ITO transmission system via the expansion of the existing Chickahominy 500kV substation.

Cost Summary

The AC1-107 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	\$ 2,507,776
Direct Connection Network Upgrades	\$ 0
Non Direct Connection Network Upgrades	\$ 1,592,378
Allocation for New System Upgrades	\$ 2,935,793
Contribution for Previously Identified Upgrades	\$ 0
Total Costs	\$ 7,035,947

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AC1-107 is a request to interconnect a 1600 MW combined cycle gas-fired generating facility located in Charles City County, VA. The scope of the project AC1-107 includes necessary network upgrades and attachment facilities to connect the generation to the Dominion transmission network. Attachment Facility and Network upgrade construction is estimated to be 12 – 18 months.

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

None

3. Interconnection Customer's Submitted Milestone Schedule

- | | |
|---|--------------------|
| • Plan to break ground | September 1, 2019 |
| • Permits – state level Permit By Rule and county level Final Site Plan approval complete | August 1, 2019 |
| • Substantial site work completed | May 15, 2020 |
| • Delivery of major electrical equipment | September 1, 2020 |
| • Back Feed Power | February 7, 2021 |
| • Commercial Operation | September 25, 2022 |

4. Scope of Customer's Work

IC will build a gas-fired combined cycle generating facility in Charles City County, Virginia. The generating facility (Chickahominy Power, LLC) will be comprised of 3 1x1 natural gas burning 7HA.02 General Electric combustion turbines each coupled with a 3PL reheat HRSG. The generating facility will connect to the Point of Interconnection (POI) via 3 500/23 kV wye ground/delta main power transformers with ratings of 600/800/1000 MVA. The AC1-107 POI will be at the Chickahominy 500kV substation.

5. Description of Facilities Included in the Facilities Study

The project will add a 500 kV circuit breaker in the ring bus at Chickahominy substation and build a short 500 kV transmission line to connect the generation to the ring bus. The ITO will build and own one span of the transmission line between the Chickahominy substation backbone and a new structure outside the fence. A line switch will be installed just outside of Chickahominy substation, on the property provided by the developer, and risers will be dropped from the line to the switches. Metering equipment, including metering accuracy CT's and metering accuracy CCVT's, will be installed just before the line switches. The developer collector station will be located on the property adjoining the Dominion Substation. The developer will bring the bus from the adjacent collector station to the line switches over the fence.

The substation general arrangement drawing (Attachment 2) was developed by the ITO during PJM's Generation Queue Process. The single line is shown in Attachment 1.

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

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Attachment Facilities	\$1,291,516	\$908,936	\$218,614	\$88,710	\$2,507,776
Total Attachment Facilities Cost					
Chickahominy 500kV sub expansion (n6075)	\$551,013	\$877,654	\$97,077	\$66,634	\$1,592,378
Chickahominy wave trap replacement on line #557 to Elmont. (n5464)	\$198,947	\$175,709	\$28,435	\$25,419	\$428,509
Ladysmith and Elmont wave trap replacements (n5483)	\$258,519	\$228,323	\$36,949	\$33,030	\$556,821
Ladysmith and Possum Pt. wave trap replacements (n6063)	\$158,736	\$140,195	\$22,688	\$20,281	\$341,900
North Anna wave trap replacement for Midlothian line #576. (n6055)	\$84,602	\$74,720	\$12,092	\$10,809	\$182,224
Chickahominy and Surry wave trap replacements. (n5466)	\$464,276	\$410,047	\$66,358	\$59,319	\$1,000,000
Replace 230kV SC122 cap bank breaker at Chickahominy. (n6122)	\$173,336	\$209,857	\$27,858	\$15,288	\$426,339
Total Network Upgrades	\$1,889,429	\$2,116,504	\$291,456	\$230,781	\$4,528,171
Total Project Costs	\$3,180,945	\$3,025,440	\$510,070	\$319,491	\$7,035,947

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

Facilities are estimated to take 22 - 32 months to construct and this is based on the ability to obtain outages to construct and test the proposed facilities.

Proposed Schedule

- Detailed design: 10 - 14 months
- Permitting: 6 -12 months (Timeline runs concurrent with design)
- Construction 12 - 18 months

B. Transmission Owner Facilities Study Results

1. Attachment Facilities

The Attachment Facilities include that portion of the interconnecting switching station which is associated solely with the single feed to the generating facilities. The project's Attachment Facilities include some 500 KV bus work required to create the new line position and one span of 500 kV transmission line from the substation to a structure outside the substation. Metering equipment, including metering accuracy CT's and metering accuracy CCVT's, will be installed

in the Chickahominy substation. The equipment associated with the Attachment Facilities includes the following:

Purchase and install substation and line material:

Purchase and install substation material at Chickahominy substation:

1. Three (3), 500 kV, 2000/5 current transformers, metering class
2. Three (3), 500 kV, coupling capacitor voltage transformers, metering class
3. Three (3), 396 kV, MO, 318 kV MCOV station class lightning arresters
4. One (1), 500 kV, 5000A double break disconnect switch (outside Chickahominy substation)
5. Conductor, connectors, conduit, control cable, foundations, steel structures and grounding material as per engineering standards
6. One (1) 500kV engineered 3-pole structure with foundations outside the Chickahominy substation fence
7. Three (3) 500kV deadend assemblies and two static deadend assemblies on the existing backbone inside Chickahominy substation.
8. One (1) span (approximately 0.12 miles) of 3-phase 3-1351.5 ACSR 45/7 conductor and two 7#7 ALWD shield wires from the backbone structure inside the substation and the proposed 3-pole structure outside the fence. This shall include the installation of spacers, dampers, two sets of 3-phase tee connectors (one set at each station) for the customer/substation installed risers, and OPGW splices.

Purchase and install relay material at Chickahominy substation:

1. One (1), 1808 – 28” Dual SEL-311L Line Diff. w/ Lockouts Panel
2. One (1), 1808 – 24” Dual SEL-311L Line Diff. w/ Lockouts Panel (Note: This panel to be installed on opposite end of line and owned by the developer).
3. One (1), 1425 – Dual SEL-735 Transmission & G. I. Metering
4. One (1), 4524 – Revenue Metering C.T. M.U. Box
5. One (1), 4506 – 3 phase CCVT Potential M.U. Box
6. One (1), 1323 – Dual SEL-487E/735 PMU & PQ

2. Transmission Line – Upgrades

None

3. New Substation/Switchyard Facilities

None

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n6075 – Expand Chickahominy 500kV substation. Add a 500 kV circuit breaker in the ring bus at Chickahominy substation. Costs include the following:

Purchase and install substation material at Chickahominy Substation:

1. One (1), 500 kV, 5000A dead tank circuit breakers
2. Two (2), 500 kV, 5000A double break disconnect switches

3. Conductor, connectors, conduit, control cable, foundations, steel structures and grounding material as per engineering standards
4. Remove – 500 kV bus section to install breaker and switches

Purchase and install relay material at Chickahominy Substation:

1. One (1), 4510 - SEL-2411 breaker annunciator
2. One (1), 1515 – 28” Dual SEL-351 500kV transmission breaker w/ reclosing panel
3. One (1), Axion 500kV breaker condition monitor
4. One (1), 4526_D – C.B. w/ BCM fiber optic M.U. box

PJM Network Upgrade #n6063 - Line #568 Ladysmith – Possum Point 500kV: Replace wave trap at both Ladysmith and Possum Point Substations for the Ladysmith – Possum Pt 500kV line #568. Estimated to take 14-16 months to engineer and construct. Costs include the following:

Purchase and install at Ladysmith Substation:

1. One (1), 500 kV, 5000 amp wave trap
2. One (1), line tuner, downlead and conduits
3. Conductor, connectors, steel structures, foundations and grounding material according to current engineering standards.

Purchase and install at Possum Point Substation:

1. One (1), 500 kV, 5000 amp wave trap
2. One (1), line tuner, downlead and conduits
3. Conductor, connectors, steel structures, foundations and grounding material according to current engineering standards.

PJM Network Upgrade #n5464 – Line #557 Chickahominy – Elmont: Replace wave traps at Chickahominy substation on line #557 to Elmont. Estimated to take 14-16 months to engineer and construct. Costs include the following:

Purchase and install at Chickahominy:

1. Two (2), 500 kV, 5000 amp wave traps
2. Two (2), line tuners, downloads and conduits
3. Conductor, connectors, steel structures, foundations and grounding material according to current engineering standards.

PJM Network Upgrade #n5466 – Line #567 Chickahominy – Surry: Replace wave traps at Chickahominy and Surry substations on the #567 line. Estimated to take 14-16 months to engineer and construct. Costs include the following:

Purchase and install at Chickahominy:

1. Two (2), 500 kV, 5000 amp wave traps

2. Two (2), line tuners, downloads and conduits
3. Conductor, connectors, steel structures, foundations and grounding material according to current engineering standards.

Purchase and install at Surry:

1. Two (2), 500 kV, 5000 amp wave traps
2. Two (2), line tuners, downloads and conduits
3. Conductor, connectors, steel structures, foundations and grounding material according to current engineering standards.

PJM Network Upgrade #n5483 – Line #574 Ladysmith – Elmont: Replace wave traps at Ladysmith and Elmont substations on the #574 line. Estimated to take 14-16 months to engineer and construct. Costs include the following:

Purchase and install at Ladysmith:

1. Two (2), 500 kV, 5000 amp wave traps
2. Two (2), line tuners, downloads and conduits
3. Conductor, connectors, steel structures, foundations and grounding material according to current engineering standards.

Purchase and install at Elmont:

1. Two (2), 500 kV, 5000 amp wave traps
2. Two (2), line tuners, downloads and conduits
3. Conductor, connectors, steel structures, foundations and grounding material according to current engineering standards.

PJM Network Upgrade #n6055 – Line #576 Midlothian – North Anna: Replace wave trap at North Anna substation on the #576 line. Estimated to take 14-16 months to engineer and construct. Costs include the following:

Purchase and install at North Anna:

1. One (1), 500 kV, 5000 amp wave trap
2. One (1), line tuner, download and conduits
3. Conductor, connectors, steel structures, foundations and grounding material according to current engineering standards.

PJM Network Upgrade #n6122 – Chickahominy SC122 circuit breaker: Replace the Chickahominy SC122 50kA 230kV breaker with a 63kA device. Estimated to take 8 months to engineer and construct. Costs include the following:

Purchase and install at Chickahominy:

1. One (1), 230 kV, 3000A, 63 kA, Synchronous Close, SF6 Circuit Breaker
2. Conductor, connectors, foundations, conduits, control cable and grounding material as per current engineering standards.

Remove the existing 50 kA, SF6 Circuit Breaker. Foundation and accessories

Purchase and install relay material at Chickahominy Substation:

1. One (1), 4510 - SEL-2411 Breaker Annunciator
2. One (1), 4521 – Synchronous Breaker Monitor
3. One (1), 4526_B – Sync. Breaker Fiber 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 Section 8 of Attachment O Appendix 2.

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.

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.

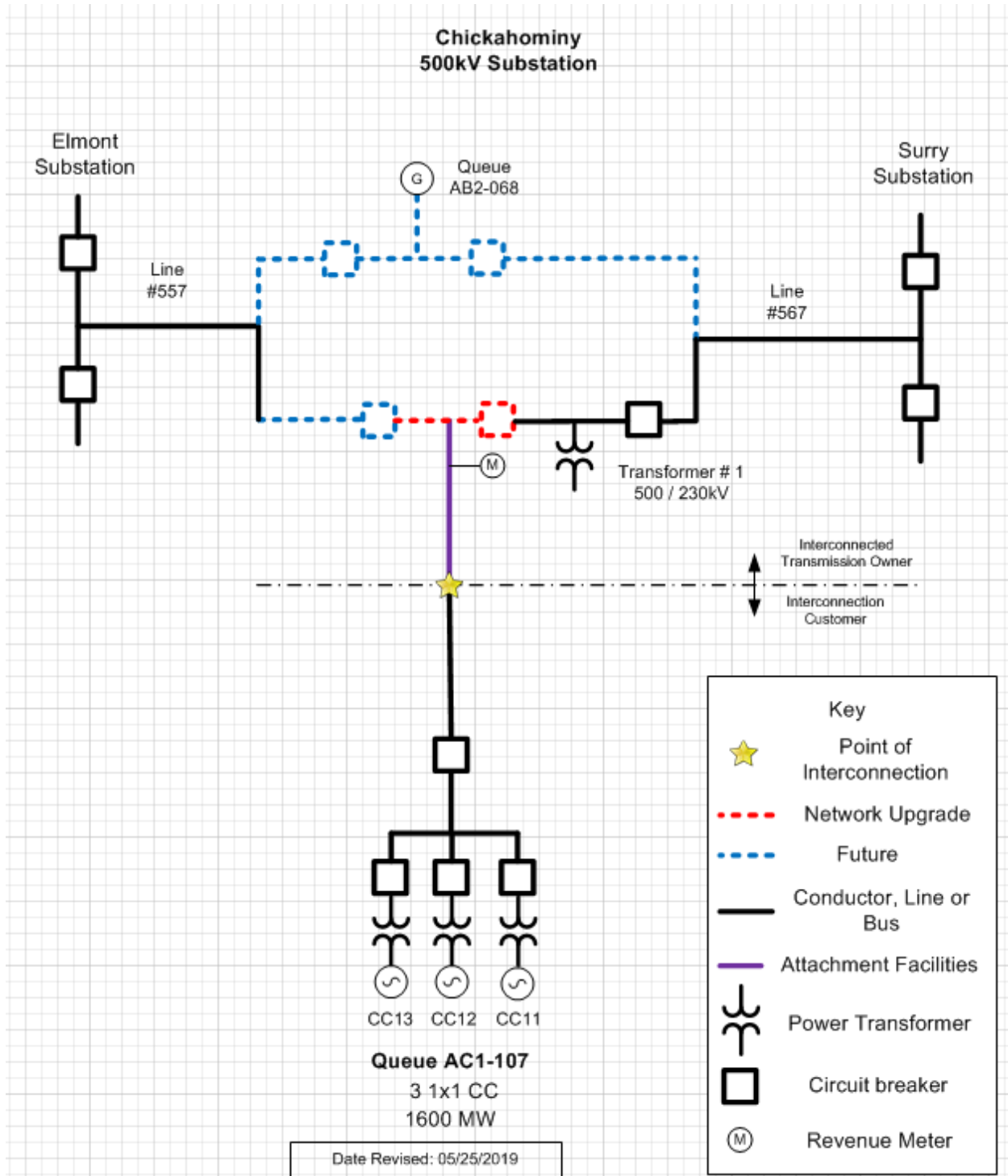
The IC will supply and own metering equipment that will provide Instantaneous net MW and MVar per unit values in accordance with PJM Manuals M-01 and M-14D, and Sections 8.1 through 8.5 of Appendix 2 to the ISA;

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

The project will require permitting for the transmission line construction as well as the substation work. The actual permits required for the project will not be known until the permitting team engages with the local and state agencies upon execution of the ISA.

Attachment 1. Single Line



Attachment 2. AC1-107 Chickahominy 500kV Substation General Arrangement

