Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AC1-098/AC1-099

Dawson – South Justice 115kV
50.2 MW Capacity / 80 MW Energy

January 2020

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 American Beech Solar LLC, (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider (TP)). IC has proposed a solar generating facility located in Halifax County, North Carolina. Queue project AC1-098 will have an installed capability of 60 MW (37.6 MW Capacity) and AC1-099 will have an installed capability of 20 MW (12.6 MW Capacity). The AC1-098 and AC1-099 projects will share the same point of interconnection and were evaluated as a single combined project. The installed AC1-098_099 facilities will have a total capability of 80 MW, with 50.2 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 11/1/2022. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC1-098_099 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on transmission line 1015 between Scotland Neck and South Justice Branch 115kV substations.

Cost Summary

The AC1-098_099 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 587,538
Direct Connection Network Upgrades	$ 5,211,706
Non Direct Connection Network Upgrades	$ 1,283,203
Allocation for New System Upgrades	$ 14,802
Contribution for Previously Identified Upgrades	$ 18,831
Total Costs	**$ 7,116,080**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AC1-098_099 is a request to interconnect an 80 MW new solar generating facility to be located in Halifax County, North Carolina. The proposed generating facility will interconnect with the ITO's Transmission System via a new AC1-098-099 115kV three breaker ring-bus switching station. The requested in-service date is November 01, 2022. Attachment Facility and Network upgrade construction is estimated to be 24 – 30 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 November 1, 2021
- Permits – state level Permit By Rule and county level Final Site Plan approval complete December 31, 2020
- Substantial site work completed April 30, 2022
- Delivery of major electrical equipment June 30, 2022
- Back Feed Power October 15, 2022
- Commercial Operation November 1, 2022

4. Scope of Customer's Work

IC will build a solar generating facility in Halifax County, North Carolina. The generating facility (American Beech Solar) will be comprised of solar arrays. AC1-098 consists of 25 TMEIC Solar Ware PHV-L2700GR Utility Inverters being collected by 2 by 34.5 kv, 1200 A feeder breakers to a step-up substation. AC1-099 consists of 9 TMEIC Solar Ware PHV-L2700GR Utility inverters being collected by 1 by 34.5 kv, 1200 A feeder breakers to the American Beech step-up substation. The 34 2.7MVA 34.5 / 0.60 kV grounded wye delta step-up transformers will connect the solar inverters to the 34.5 kV collector system. The 34.5 kV collector system will connect to the Point of Interconnection (POI) via a 115/34.5 kV wye ground/wye ground main power transformer with a rating of 107/142/178 MVA. The AC1-098_099 POI will be at a tap of the transmission line 1015 between South Justice Branch – Scotland Neck 115kV line.

5. Description of Facilities Included in the Facilities Study

The ITO will connect the proposed generator lead via Attachment Facilities to a new AC1-098_099 ring bus switching station adjacent to the transmission right of way. The site is located along the ITO's 115kV Line 1015 between existing South Justice Branch and Scotland Neck 115 kV substations. The line will be cut between the structures 1015/90 and 1015/91 and diverted to the backbone structure located in the new substation. The risers will be dropped to the bus sections directly underneath the line. The lines will consume two of the three positions in the ring bus. The third position will be for the 115 kV feed from the solar farm collector station.

Metering equipment will be installed in the ITO Switching Station. The grounding systems for both the stations will be tied together. The IC will provide the property and access to the switching station. All substation permitting, site preparation and grading activity will be performed by the IC. There will be transmission line protection and anti-islanding work required at the remote lines terminals in Scotland Neck and South Justice Branch Substations. Site plan (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	$304,096	$210,111	$52,581	$20,751	$587,538
Total Attachment Facilities Cost	$304,096	$210,111	$52,581	$20,751	$587,538
AC1-098_099 115 kV Switching Station (n6281)	$2,407,746	$2,175,789	$394,720	$233,450	$5,211,706
Line 1015 Transmission work (n6282)	$453,127	$546,028	$77,419	$54,639	$1,131,213
Remote relay (n6283)	$67,465	$55,621	$19,666	$9,240	$151,990
Total Network Upgrades	**$2,928,338**	**$2,777,438**	$491,805	$297,329	$6,494,909
Total Project Costs	**$3,232,434**	**$2,987,549**	**$544,386**	**$318,080**	**$7,082,447**

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

Facilities are estimated to take 14 - 24 months to construct and this is based on the ability to obtain outages to construct and test the proposed facilities.

Proposed Schedule

- Detailed design: 6-12 months
- Permitting: 6-12 months (Timeline runs concurrent with design)
- Construction 8 to 12 months

ITO requires the site to be fully graded and permitted site so they can start construction by August 2021.

B. Transmission Owner Facilities Study Results

1. Attachment Facilities

The Attachment Facilities include the portion of the interconnecting switching station which is associated solely with the single feed to the generating facilities collector station. The Point of

Interconnection with the generator will be the 4-hole pad on the ITO disconnect switch. The IC will bring its bus to the demarcation point. Metering equipment will be installed in the ITO Switching Station. The equipment associated with the Attachment Facilities include the metering accuracy CCVT's, metering accuracy CT's, disconnect switch, conductors and connectors.

Purchase and install substation material:

1. One (1) 115 kV, 2000A, 3-phase Center Break Gang Operated Switches
2. Three (3) 115 kV metering accuracy CCVT's
3. Three (3) 115 kV metering accuracy CT's
4. Conductors, connectors, conduits, control cables, foundations, steel structures and grounding material as per engineering standards

Purchase and install relay material:

1. One (1), 1109 – 28" Dual SEL-587Z Transmission Bus Panel
2. One (1), 4200 – Bus Differential C.T. M.U. Box
3. One (1), 1425 – 28" Dual SEL-735 Metering Panel (Transmission & Generation Interconnect)
4. One (1), 4524 – Revenue Metering C.T. M.U. Box
5. One (1), 4531 – Generator Interconnect CCVT Potential M.U. Box
6. One (1), 1323 – 28" SEL-487E/735 PMU & PQ Monitoring Panel
7. One (1), 5603 – Station Network Panel 2
8. Two (2), 4541 - Control Cable M.U. Box

2. Transmission Line – Upgrades

PJM Network Upgrade #n6282 – Construction of new substation connection on Transmission Line 1015 between South Justice Branch and Scotland Neck Substation into the new AC1-098_099 three breaker ring bus. The line connection will require the installation of one (1) backbone structure, two (2) Static pole structures, and two (2) DDE hframe structures. The conceptual design and estimate includes costs for the following:

ESTIMATE – FACILITIES TO BE INSTALLED:

1. Install one (1) 115kV SC steel DDE backbone structure with foundations.
2. Install two (2) steel static poles with foundations.
3. Install two (2) weathering steel Hframe DDE structures.
4. Cut and transfer existing 3-Phase conductor to the proposed DDE Hframs and new backbone structure
5. Cut and transfer existing opgw and shield wire to the proposed DDE Hframs and new backbone structure.

ESTIMATE – FACILITIES TO BE REMOVED:

1. Remove two (2) weathering steel suspension structures

ESTIMATE – MISCELLANEOUS:

1. Obtain additional R/W from proposed Str. 1015/90 - 1015/91

2. Split and renumber Line 1015 from proposed substation to Scotland Neck Substation.

3. New Substation/Switchyard Facilities

PJM Network Upgrade #n6281- Build a three breaker AC1-098_099 115 kV switching station. The site is located along the ITO's 115kV Line #1015 from Scotland Neck to South Justice Branch substation. The line will be cut between the structures 1015/90 and 1015/91 and diverted to the backbone structure located in the new substation. The risers will be dropped to the bus sections directly underneath the line. The lines will consume two of the three positions in the ring bus. The third position will be for the 115 kV feed from the solar farm collector station. The demarcation point between the switching station and the collector station will be the 4-hole pads on the ITO disconnect switch. Metering equipment will be installed in the ITO Switching Station. The grounding systems for both the stations will be tied together. The developer will provide the property and access to the switching station. All substation permitting, site preparation and grading activity will be performed by the IC.

The work required is as follows:

Purchase and install substation material (Direct Network):

1. Approximately 285' X 260' site preparation and grading as required for installation of the switching station (by the developer)
2. Approximately 1050 linear FT of 5/8" Chain Link, 12 FT tall, perimeter fence around the station along with the security cameras and integrators as per Design 4 fence standards
3. Full substation ground grid as per engineering standards
4. One (1), 115 kV, Heavy Duty Steel Backbone (by Transmission)
5. Two (2), shield wire poles and three span of shield wires (by Transmission)
6. Three (3), 115 kV, 3000A, 40 kA SF6 Circuit Breakers
7. Six (6), 115 kV, 2000A, 3-phase Center Break Gang Operated Switches
8. Nine (9), 90 kV MO, 74 kV MCOV Station Class Arresters
9. Six (6), 115 kV CCVTs, Relay Accuracy
10. Two (2), 115 kV, 2000 Amps Wave Traps and Line Tuners
11. One (1), 24' X 40' Control Enclosure
12. One (1), 125 VDC, 200 Ah Station Battery and 50 Amp Charger
13. Approximately 240 FT of Cable Trough, with a 20 FT road crossing section
14. Four (4), 100 KVA Power Potential Transformers for station service
15. Two (2), 115 kV, 2000A, 2-phase Center Break Gang Operated Switches
16. Oil Containment system for the 115 kV PVTs.
17. High Voltage Protection Cabinet
18. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
19. Foundations as required including control house, equipment and bus support stands
20. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as per engineering standards

Purchase and install relay material (Direct Network):

1. Three (3), 1510 – 28" Dual SEL-351-7 Transmission Breaker w/ Reclosing Panel

2. Three (3), 4510 - SEL-2411 Breaker Annunciator
3. Two (2), 1320 – 28" Dual SEL-421-5 DCB Line Panel
4. Two (2), 4506 – 3 Phase CCVT Potential M.U. Box
5. One (1), 1603 – 28" SEL-451 Islanding Control Scheme Panel
6. Two (2), 4000 – Station Service Potential M.U. Box
7. Two (2), 4018 – 500A Station Service AC Distribution Panel
8. Two (2), 4007 – 225A Outdoor Transmission Yard AC NQOD
9. Two (2), 4019 – 225A Three Phase Throwover Switch
10. Two (2), 4016 – 600A PVT Disconnect Switch
11. One (1), 4153 – Wall Mount Station Battery Monitor
12. One (1), 5612 - SEL-3530 Data Concentrator Panel
13. One (1), 1255 – Station Annunciator Panel
14. One (1), 5021 – SEL-2411 RTU Panel
15. One (1), 5609 – Fiber Optic Management Panel
16. Three (3), 4526_A – Circuit Breaker Fiber Optic M.U. Box
17. One (1), 5202 – 26" APP 601 Digital Fault Recorder
18. One (1), 5603 – Station Network Panel 1
19. One (1), 5616 – Station Security Panel
20. One (1), Telephone Interface Box
21. One (1), High Voltage Protection (HVP) Box (Provided by IT)

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n6283- 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 Earleys, Scotland Neck, and South Justice Branch 115 kV substations. These costs include the following:

Earleys 115 kV Substation

Project Summary

Install Islanding Transfer Trip Scheme on Line 126. The estimated cost of this scope is $39,582.

Purchase and install relay material:

1. One (1), CT-51C Islanding Transfer Trip Set
2. One (1), SEL-2411 Maintenance Switch

Scotland Neck 115 kV Substation

Project Summary

Change Line 1015 Destination & install Islanding Transfer Trip Scheme. The estimated cost of this scope is $71,147.

Purchase and install relay material:

1. One (1), 1604 – 28" Transmission Islanding Transfer Trip Panel

South Justice Branch 115 kV Substation

Project Summary

Change Line 1015 Destination & install Islanding Transfer Trip Scheme. The estimated cost of this scope is $41,261.

Purchase and install relay material:
1. One (1), CT-51C Islanding Transfer Trip Set
2. One (1), SEL-2411 Maintenance Switch

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Earleys	$17,830	$14,077	$5,368	$2,308	$39,582
Scotland Neck	$30,582	$27,467	$8,475	$4,624	$71,147
South Justice Branch	$19,053	$14,077	$5,823	$2,308	$41,261
Total Remote Relay Upgrades	$67,465	$55,621	$19,666	$9,240	$151,990

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 IC would be responsible for the following expectations in the area of Environmental, Real Estate and Permitting:

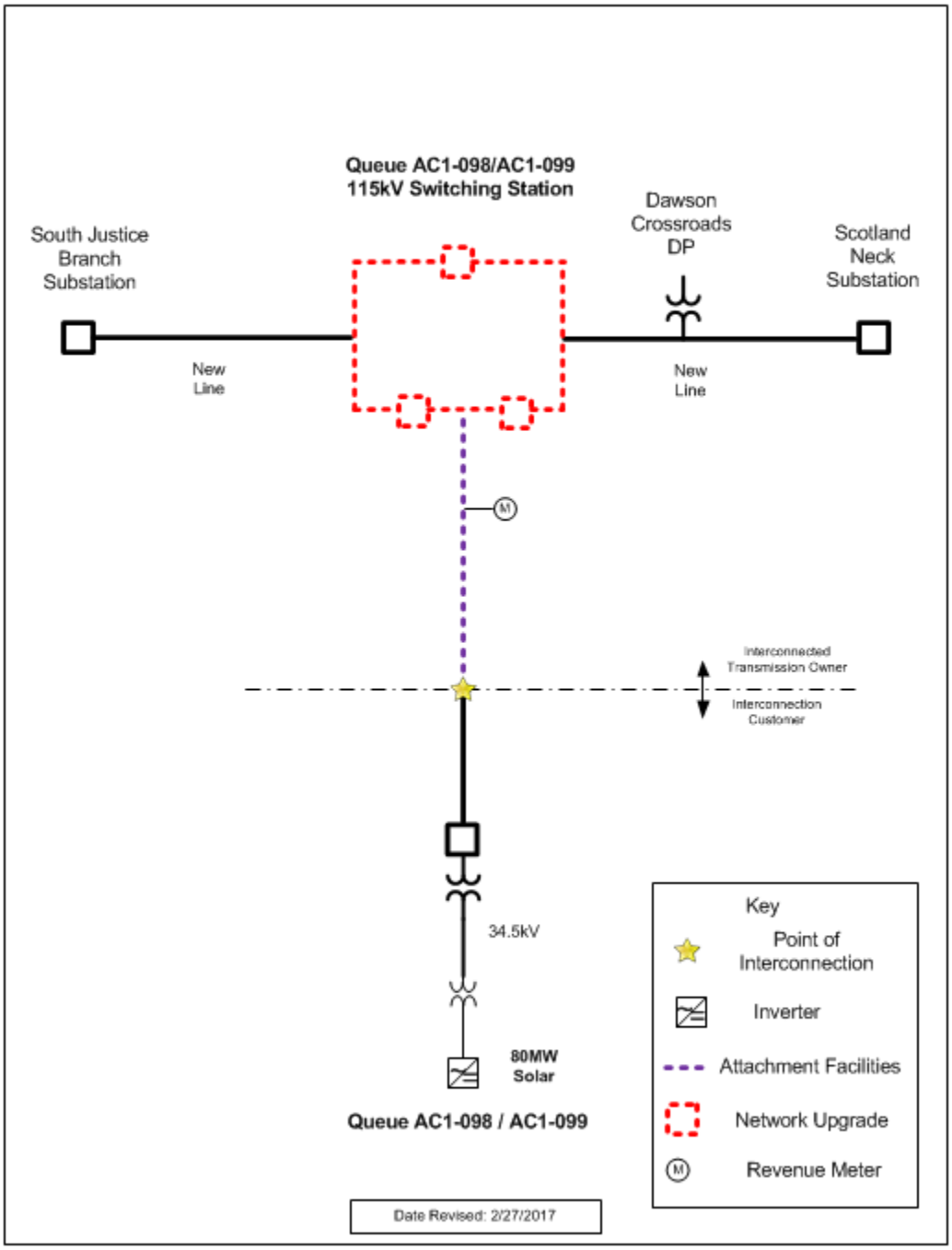
- Suitable Access Road from Substation to a North Carolina State Maintained Roadway.
- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation.
- Conditional Use Permit for Substation.
- Any other Land/Permitting requirements required by the Substation.

ITO Real Estate Needs:

- The substation layout is complete and ITO requires a 285'x 260' piece of property (title in fee) to build the substation. The property includes the piece of property between the substation and collector station for the strain bus.
    - ITO requires ownership transfer of the substation site before they start construction. Target for the deed by November 2021.
    - The size of the station assumes ITO will not need a separate storm water management system for the substation. If the county rules differently then the ITO will need to revisit the land requirements.
- ITO will need a letter similar to the zoning letter from the county stating that if the solar farm is retired and / or decommissioned the substation will remain.

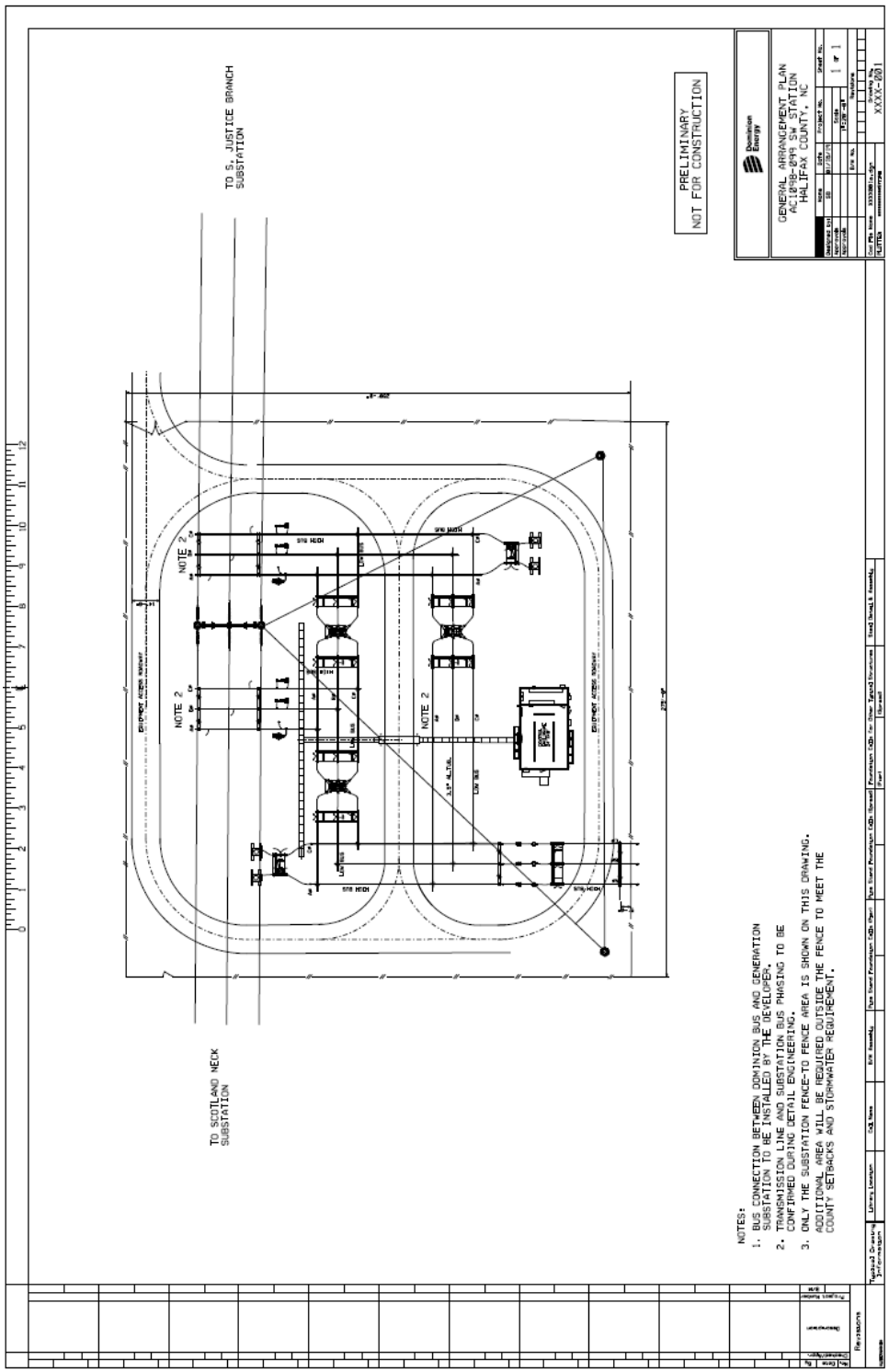
Attachment 1.

Single Line



Attachment 2.

AC1-098_099 Switching Station General Arrangement



AC1-098_099 Switching Station Plan