Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AB2-077 / 078 / 079

Buggs Island – Chase City 115kV
36 MW Capacity / 60 MW Energy

June / 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 Otter Creek Solar LLC, (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider (TP)). IC has proposed a solar generating facility located in Chase City, VA (Mecklenburg County). The installed facilities will have a total capability of 60 MW with 36 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is December 15, 2020. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AB2-077 / AB2-078 / AB2-079 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Buggs Island - Chase City 115kV line.

Cost Summary

The AB2-077 / 078 / 079 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$ 488,920
Direct Connection Network Upgrades	$5,174,866
Non Direct Connection Network Upgrades	$1,713,234
Allocation for New System Upgrades	$0
Contribution for Previously Identified Upgrades	$0
Total Costs	**$7,377,020**

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AB2-077 / 078 / 079 is a request to interconnect 60 MW (Capacity 36 MW) of energy from a new solar facility to be located near Chase City, VA in Mecklenburg County. The proposed facility will interconnect with ITO's Buggs Island – Chase City 115kV line #36 via a new three breaker switching station. The requested in-service date is December 15, 2020. Attachment Facility and Direct Connection Network upgrade construction is estimated to be 14-24 months.

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

No changes

3. Interconnection Customer's Submitted Milestone Schedule

- Plan to break ground October 15, 2019
- Permits – state level CPCN and county level Final Site Plan approval complete by August 1, 2019
- Turn over flat, graded site with 1 inch gravel to ITO for new switching station November 1, 2019
- Substantial site work completed May 1, 2020
- Delivery of major electrical equipment August 15, 2020
- Back Feed Power early to November 15, 2020
- Commercial Operation December 15, 2020

4. Scope of Customer's Work

IC will build a solar generating facility in Mecklenburg County, Virginia. The generating facility will be comprised of solar arrays. AB2-077 / 078 / 079 consists of 18 x 3.333 MW HEC-US-FS3000CU15 inverters. The 18 x 34.5/0.690 kV generator step up (GSU) transformers with a rating of 3.0 MVA will connect the solar inverters to the 34.5 kV collector system. The generating facility will connect to the Point of Interconnection (POI) via a 115/34.5 kV wye grounded wye grounded main power transformer with a rating of 38/48/60 MVA. The AB2-077 / 078 / 079 POI will be at a new Interconnection switching station.

5. Description of Facilities Included in the Facilities Study

The ITO will connect the proposed generator lead via Attachment Facilities to a new AB2-077 / 078 / 079 115kV switching station adjacent to the 115kV transmission right of way on a property provided by the IC. The position of the switching station will be adjacent to the right of way of the existing 115 kV Transmission Line #36, on a property provided and rough graded by the IC. The station will be positioned in such a way that the two 115 kV Light Duty Backbones will be installed perpendicular with the existing transmission line. The line will be cut at Structure #36/1040 and routed into the proposed New Three Breaker Ring Substation. The lines will consume two of the three positions in the ring bus. The third position will be for the 115-kV feed from IC's collector station, located adjacent to the New Three Breaker Ring Substation. The demarcation point between the New Three Breaker Ring Substation and the collector station will

be the 4-hole pads on the collector station disconnect switch. The ITO will bring its bus to the demarcation point. Metering equipment will be required between the ITO bus and the generator collector substation. The grounding systems for both the stations will be tied together. All substation permitting, site preparation and grading activity will be performed by the IC.
Remote relay work will include installing Islanding Transfer Trip schemes at Buggs Island NUG and Chase City Substations.

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

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Substation	$275,616	$149,022	$47,584	$16,698	$488,920
Total Attachment Facilities Cost	$275,616	$149,022	$47,584	$16,698	$488,920
Queue AB2-077 / 078 / 079 switching station (n5665)	$2,286,719	$2,057,338	$560,591	$270,218	$5,174,866
Transmission line relocation (n5664)	$662,279	$637,723	$118,941	$62,968	$1,481,911
Remote relay (n5666)	$115,330	$74,961	$29,949	$11,083	$231,323
Total Network Upgrades	$3,064,328	$2,770,022	$709,481	$344,269	$6,888,100
Total Project Costs	$3,064,328	$2,919,044	$757,065	$360,967	$7,377,020

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 - 12 months

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 substation. The equipment associated with the Attachment Facilities include the bus, structures, disconnect switch, metering accuracy CCVT's, metering accuracy CT's, metering and associated protection equipment.

Switching station

Purchase and install substation material :

1. One (1), 115kV, 2000A Center Break Switch
2. Three (3), 115kV, Metering Accuracy CCVT's
3. Three (3), 115kV, Metering Accuracy CT's
4. Conductors, connectors, conduits, control cables, foundations, steel structures and grounding material

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. Two (2), 4541 - Control Cable M.U. Box

2. Transmission Line – Upgrades

PJM Network Upgrade #n5664 - Re-arrange Bugs Island – Chase City 115kV line #36 to loop into and out of the new three breaker AB2-077 / 078 / 079 115 kV switching station at structure 36/1040.

Constructed in 2009 on Dom-pole monopoles, the 36 line is an existing 115 kV line that runs from Chase City Substation to Buggs Island NUG. The ITO will split the 36 line at the proposed Queue AB2-077 / 078 / 079 Substation which will include a three breaker ring-bus that will provide a connection point for this queue's generation interconnection.

The following work scope is for the construction of a new substation connection on Transmission Line 36 between Chase City Substation and Buggs Island NUG. In addition to the work on the 36 line, OPGW and static wire will be brought into the station from the adjacent 33 line. The line connection will require the installation of (2) backbone structures, one (1) static pole structure, one Engineered DDE structure, and the installation and transferring of several spans of conductor, fiber, and static wire.

ITO to renumber structures between the New Queue AB2-077 / 078 / 079 Switching station and Chase City Substation.

The conceptual design and estimate includes costs for the following:

ESTIMATE – FACILITIES TO BE INSTALLED/MODIFIED – 36 LINE:

1. Install two (2) 75' Single Circuit Heavy-Duty Steel DDE Backbone structures (no switches) with foundations (Str. 36/1040A and XX/1040B).
2. Install one (1) 75' Galvanized Steel Static Pole with foundation (Str. 33/603A).
3. Install one (1) 90' Double-Circuit DDE Galvanized Steel Engineered Monopole with foundation (Str. 36/1040).

4. Modify Ex. Dom-pole Str. 36/1041. This structure is currently a Suspension structure and is to be converted into an in-line DDE structure. New Deadend Assemblies and associated hardware will be installed.
5. Cut and Transfer two (2) existing spans of 3-Phase 636 ACSR conductor to new DDE Monopole structure 36/1040.
6. Cut and Transfer two (2) existing spans of 3#6 ALWD static wire to new DDE Monopole structure 36/1040.
7. Install two (2) new spans of 3-Phase 636 ACSR from Str. 36/1040 to Backbone Structures 36/1040A and XXXX/1040B.
8. Install four (4) new spans of single 7#7 ALWD static wire from Str. 36/1040 to Backbone Structures 36/1040A and XXXX/1040B.
9. Renumber approximately 43 structures with new line number XXXX between AB2-079 Substation and Chase City Substation.

ESTIMATE – FACILITIES TO BE INSTALLED/MODIFIED – 33 LINE:

1. Modify Ex. Str. 33/603. This is an existing suspension structure that will require the installation of one (1) Steel X-brace, along with two OPGW deadend assemblies and two Static deadend assemblies.
2. Deadend the Existing 3#6 ALWD Static wire at Strs. 33/604 and 33/603, respectively. The span between Str. 33/603 – 33/604 is to be removed.
3. Install one (1) new 7#7 ALWD Static wire (approx. 486') from Ex. Str. 33/603 to new Static Pole Str. 33/603A.
4. Install one (1) new 7#7 ALWD Static wire (approx. 337') from Ex. Str. 33/604 to new Static Pole Str. 33/603A.
5. Transfer the existing OPGW on the 33 line such that the existing OPGW runs from Ex. Str. 33/603 to new Backbone Str. 36/1040A.
6. Install one (1) span of new OPGW from Ex. Str. 33/604 to new Backbone Str. XX/1040A.
    a. Install one (1) new OPGW strain assembly at Ex. Str. 36/604
    b. Train OPGW down Ex. Str. 212/102 and connect at new Splice box

ESTIMATE – FACILITIES TO BE REMOVED – 36 LINE:

1. Remove existing Dom-pole Suspension Str. 36/1040.

ESTIMATE – FACILITIES TO BE REMOVED – 33 LINE:

1. Remove one (1) span (approximately 680') of 3#6 ALWD Static wire between Ex. Strs. 33/603 – 33/604.

ESTIMATE – MISCELLANEOUS:

1. Obtain additional R/W from Str. 33/603 – 33/604.

NOTE:

1. Queue AB2-077 / 078 / 079 Substation is positioned such that the 33 line is outside the horizontal clearance buffer to the substation fence. As such, the only vertical clearance to fence that should need to be considered is where the 36 line enters the station.
2. The existing 33 and 36 line structures were not originally designed to withstand broken wire loads. Therefore, the modified existing structures on the 33 and 36 lines will be designed to their original criteria.

3. New Substation/Switchyard Facilities

PJM Network Upgrade #n5665 - Build a three breaker AB2-077 / 078 / 079 115 kV switching station. The site is located along the ITO's existing right of way for the Black Branch – Chase City 115kV line #36. The work required is as follows:

Purchase and install substation material

1. Approximately 300' X 230' site preparation and grading as required for installation of the switching station (by Otter Creek Solar, LLC) not including any added land as required for SWM, etc
2. Approximately 1060 linear FT of 5/8" Chain Link, 12 FT tall, perimeter fence around the station along with the security cameras and integrators (Design 4 Standard).
3. Full substation ground grid
4. Two (2), Single Circuit Backbones (by Transmission)
5. One (1), Shield wire pole and two span of shield wires (by Transmission)
6. Three (3), 115kV, 3000A, 40 kA, SF6 Circuit Breakers
7. Six (6), 115kV, 2000A Center Break Switches
8. Six (6), 115kV, CCVT's, relay accuracy
9. One (1), 2000A, Vertically Mounted, Wave Trap along with one (1), Line Tuner
10. Nine (9), 90kV MO, 74kV MCOV Station Class Arresters
11. Four (4), 115kV, 100 KVA Power PT's for Station Service
12. Two (2), 115kV, 2000A, 2-Pole Center Break Switches (for PVT's)
13. One (1), 24' x 40' Control Enclosure
14. One (1), 135VDC, 577Ah Batteries and 50A Charger
15. Oil Containment system for the 115kV PVT's.
16. Cable Trough, concrete w/cover, 2' 6'' wide, approximately 250 FT, with a 20 FT road crossing section.
17. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
18. Foundations as required including control house, equipment and bus support stands
19. Conductors, connectors, conduits, control cables and grounding materials

Purchase and install relay material

1. Three (3), 1510 – 28" Dual SEL-351-7 Transmission Breaker w/ Reclosing Panel
2. Three (3), 4510 - SEL-2411 Breaker Annunciator
3. One (1), 1320 – 28" Dual SEL-421-5 DCB Line Panel
4. One (1), XXXX – 28" Dual SEL-421-5 DCB Mirrored Bit Line Panel
5. Two (2), 4506 – 3 Phase CCVT Potential M.U. Box
6. One (1), 1603 – 28" SEL-451 Islanding Control Scheme Panel
7. Two (2), 4000 – Station Service Potential M.U. Box
8. Two (2), 4018 – 500A Station Service AC Distribution Panel
9. Two (2), 4007 – 225A Outdoor Transmission Yard AC NQOD
10. Two (2), 4019 – 225A Three Phase Throwover Switch
11. Two (2), 4016 – 600A PVT Disconnect Switch
12. One (1), 4153 – Wall Mount Station Battery Monitor
13. One (1), 5612 - SEL-3530 Data Concentrator Panel
14. One (1), 1255 – Station Annunciator Panel

15. One (1), 5021 – SEL-2411 RTU Panel
16. One (1), 5609 – Fiber Optic Management Panel
17. Three (3), 4526_A – Circuit Breaker Fiber Optic M.U. Box
18. One (1), 5202 – 26" APP 601 Digital Fault Recorder
19. One (1), 5603 – Station Network Panel 1
20. One (1), 5603 – Station Network Panel 2
21. One (1), 5616 – Station Security Panel
22. One (1), Telephone Interface Box
23. One (1), High Voltage Protection (HVP) Box

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n5666 - 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 Buggs Island and Chase City 115kV substations. These costs include the following:

Buggs Island 115 kV Substation

Project Summary
At Buggs Island substation drawing work, relay resets, and field support necessary to change the Line 36 destination from Chase City to the new Queue AB2-077 / 078 / 079 Interconnect Substation. Install Breaker Failure & Islanding Transfer Trip schemes.

Purchase and install relay material:
1. One (1), 1604 – 24" Transmission Islanding Transfer Trip Panel
2. One (1), CS-51C Breaker Failure Transfer Trip Transmitter/Receiver

Chase City 115kV Substation

Project Summary
At Chase City substation replace Transmission Line #36 Straight Bus Line/Breaker Panel with a Dual SEL-421 DCB (Mirrored Bit) Straight Bus Panel. Also, install a Breaker Failure & Islanding Transfer Trip scheme. Due to the short line between Chase City and this Queue, fiber will be required between the two stations for line protection. Due to protection over fiber, the Line 36 Wave Trap will be removed.

Purchase and install:
1. N/A

Remove:
1. One (1), existing 1600A Wave Trap

Purchase and install relay material:
1. One (1), XXXX – 24" Dual SEL-421-5 DCB (Mirrored Bit) Line & Breaker Panel
2. One (1), Panel Retirement (Panel 22)

Work Description	Direct	Indirect	Total Cost

	Labor	Material	Labor	Material	
Buggs Island	$37,921	$44,342	$8,877	$6,718	$97,858
Chase City	$77,409	$30,619	$21,072	$4,365	$133,465
Total Remote Relay Upgrades	$115,330	$74,961	$29,949	$11,083	$231,323

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.

Meteorological Data Reporting Requirement

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Temperature (degrees Fahrenheit)
- Atmospheric pressure (hectopascals)
- Irradiance
- Forced outage data

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

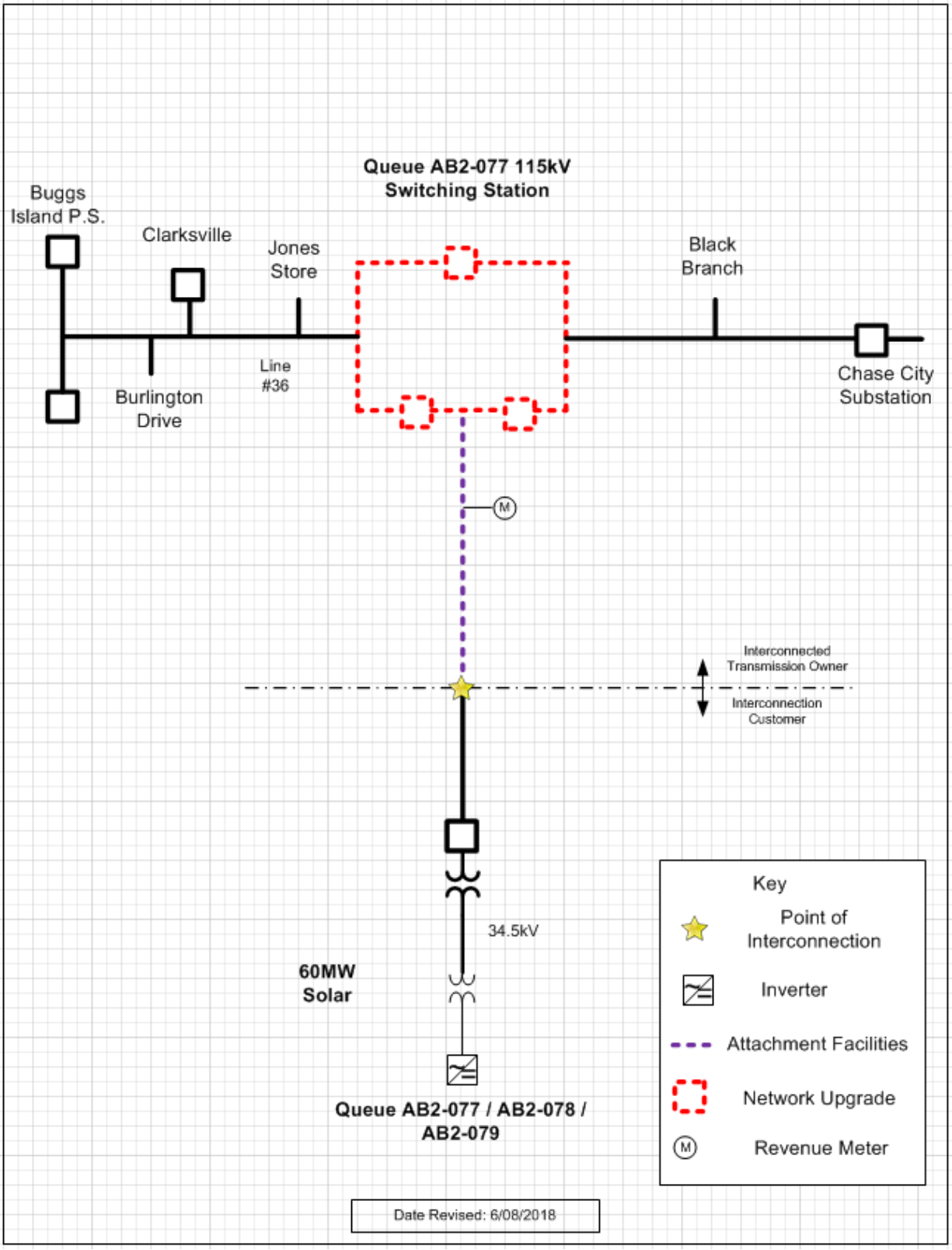
The IC would be responsible for the following expectations in the area of Environmental, Real Estate and Permitting:

- Suitable Access Road from Substation to a Virginia 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 230'x 300' 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 2019.
    - The size of the station assumes ITO will not need a separate storm water management system for the substation. If the county rules differently than 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.
Switching Station Layout