Generation Interconnection
Facility Study Report

For

PJM Generation Interconnection Request
Queue Position AC2-012

Grassfield - Great Bridge 115 kV
57 MW Capacity / 150 MW Energy

December, 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 NextEra Energy Resources LLC, (Interconnection Customer (IC)) and PJM Interconnection, LLC (Transmission Provider (TP)). Virginia Electric and Power Company is the Interconnected Transmission Owner (ITO) and provided the input to develop this study.

The IC has proposed a solar generating facility located in Chesapeake, Virginia (City of Chesapeake). The installed facilities will have a total capability of 150 MW with 57 MW of this output being recognized by PJM as capacity. The proposed in-service date for this project is 12/13/2022. **This study does not imply an ITO commitment to this in-service date.**

Point of Interconnection

AC2-012 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Grassfield – Great Bridge 115 kV line (line 74).

Cost Summary

The AC2-012 project will be responsible for the following costs:

Description	Total Cost
Attachment Facilities	$539,349
Direct Connection Network Upgrades	$5,642,602
Non Direct Connection Network Upgrades	$2,196,541
Allocation for New System Upgrades	$0
Contribution for Previously Identified Upgrades	$0
Total Costs	**$8,378,492**

© PJM Interconnection 2020. All rights reserved.

A. Transmission Owner Facilities Study Summary

1. Description of Project

Queue AC2-012 is a request to interconnect a 150 MW new solar generating facility to be located in Chesapeake, Virginia (City of Chesapeake). AC2-012 will interconnect with the ITO transmission system via a new three breaker ring bus switching station that connects on the Grassfield – Great Bridge 115 kV line (line #74).

Attachment Facility and Network Upgrade construction is estimated to be 18 - 28 months.

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

None

3. Interconnection Customer's Milestone Schedule

- Plan to break ground October 15, 2021
- Permits – state level Permit By Rule and county level final site plan approval complete October 15, 2021
- Substantial site work completed November 15, 2022
- Delivery of major electrical equipment June 15, 2022
- Back Feed Power November 18, 2022
- Commercial Operation December 13, 2022

4. Scope of Customer's Work

Generator Interconnection Request AC2-012 is for a 150 MW Maximum Facility Output (MFO) solar powered generation facility. AC2-012 consists of 146 × 1.046233 MW GE 1500V LV5 Solar Inverters and 73 x 34.5/0.6 kV GSU transformers connected to the Point of Interconnection (POI) at a tap of the Great Bridge – Grassfield 115 kV circuit. The project will connect to Dominion Virginia Power (DVP) transmission system in City of Chesapeake County, Virginia.

5. Description of Facilities Included in the Facilities Study

The ITO will connect the proposed generator lead via Attachment Facilities to a new AC2-012 three-breaker ring bus switching station. The site is located along Dominion Energy's existing 115 kV, #74 Line from Great Bridge to Grassfield substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 115kV feed from the IC's Collector Station for the new 150MW Solar Farm.

The new 115kV Three Breaker Ring Substation will share a common foot print and fence line with the IC's Collector Station. The demarcation point between the two stations will be the 115kV Breaker Disconnect Switch 4-hole pad in the IC's Collector Station by the common fence. Dominion will bring its bus to the demarcation point. The bus, structures, disconnect switch, metering accuracy CCVT's, metering accuracy CT's, protection and metering equipment will be Attachment Facilities. The grounding systems for each station will be tied together. All substation permitting, site preparation and grading activity will be performed by the IC.

© PJM Interconnection 2020. All rights reserved.

The line segment between the new Three Breaker Ring Substation and Great Bridge Substation will be renumbered. The line segment between the new Three Breaker Ring Substation and Chesapeake Substation shall remain Line #74.

Non-Direct Connection Upgrades include installing islanding transfer trip schemes at Chesapeake station and drawing updates at the Commonwealth Natural Gas, Grassfield and Great Bridge 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	$314,271	$154,821	$52,921	$17,336	$539,349
Total Attachment Facilities Cost	$314,271	$154,821	$52,921	$17,336	$539,349
AC2-012 115 kV 3-Breaker Ring Bus (n6903)	$2,675,016	$2,322,371	$403,659	$241,556	$5,642,602
Trans line #23 (n6904)	$1,212,676	$491,685	$179,059	$68,698	$1,952,118
Remote station work (n6905)	$164,050	$37,046	$37,580	$5,747	$244,423
Total Network Upgrades	$4,051,742	$2,851,102	$620,298	$316,001	$7,839,143
Total Project Costs	$4,366,013	$3,005,923	$673,219	$333,337	$8,378,492

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

Facilities are estimated to take 18 - 28 months from ISA execution and is based on the ability to obtain outages to construct and test the proposed facilities.

Proposed Schedule

- Detailed design: 6-12 months
- Permitting: 10-16 months (Timeline runs concurrent with design)
- Construction 8-12 months

ITO requires the site to be fully graded and permitted site so they can start construction by January 2022.

© PJM Interconnection 2020. All rights reserved.

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 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), 115kV, 2000A, 3-Phase Center Break Gang Operated Switch.
2. Three (3), 115kV, Metering Accuracy CCVT's.
3. Three (3), 115kV, 500:5 Metering Accuracy CT's.
4. Conductor, connectors, conduits, control cables, foundations, steel structures and grounding material as required per engineering standards

Purchase and install relay material:

1. One (1), 1109 – 28" Dual SEL-587Z Transmission Bus Panel
2. One (1), 4200_W1 – Bus Differential C.T. M.U. Box
3. One (1), 1425 – 28" Dual SEL-735 Transmission & Generator Interconnect Metering Panel
4. One (1), 4524 – Revenue Metering C.T. M.U. Box
5. One (1), 4506 – 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
8. Two (2), 4528A – Generation Fiber MU Box

2. Transmission Line – Upgrades

PJM Network Upgrade #n6904 - Re-arrange line #74 to loop into and out of the new three breaker AC2-012 115 kV switching station

This project will include a new solar generation interconnect on the 74 line between existing stations Grassfield and Great Bridge. An approximately 0.17 mile tap line will run to the new substation off the main line between structures 74/658 and 74/659A in Chesapeake, Virginia.

The project work summary is described below:

STRUCTURE INSTALLATIONS:

1. Install two (2) 115kV Single Circuit Direct Embedded DDE steel 3-Pole Structures with Foundations.
2. Install two (2) 115kV Double Circuit DDE Steel Monopoles with Foundations.
3. Install two (2) 115kV Single Circuit Backbones (31'-6" Spacing) with Foundations.
4. Install two (2) Static Poles with Foundations.

© PJM Interconnection 2020. All rights reserved.

CONDUCTOR/SHIELD WIRE INSTALLATIONS:

1. Install approximately 0.38 mi (8 spans) of 3-phase 768.2 ACSS/TW/HS conductor to proposed structures.
2. Install approximately 0.60 mi (12 spans) of 7#7 Alumoweld shield wire to proposed structures.

CONDUCTOR/SHIELD WIRE REMOVAL:

1. Remove Approximately 0.11 mi (1 span) of 3-phase 336.4 ACSR between existing structures 74/658 and 74/659A.
2. Remove approximately 0.22 mi (2 spans) of 3/8" HS Shield Wire between existing structures 74/658 and 74/659A.

MISCELLANEOUS NOTES:

1. Additional Right of Way will need to be obtained for the spans that leave the mainline and go into the substation.
2. Existing Structures 74/658 and 74/659A were not analyzed and may need structural review.
3. Approximately 19 structures will need renumbered from AC2-012 to Great Bridge Substation.

3. New Substation/Switchyard Facilities

PJM Network Upgrade #n6903 - Build a three breaker AC2-012 115 kV switching station.

The facilities identified provides for the construction of a new 115kV Three Breaker Ring Substation between Transmission Structures 74/658 and 74/659A.

The objective of this project is to build a 115kV, 3-Breaker Ring Bus to support the new 150MW Solar Farm built by the IC. The site is located along Dominion Energy's existing 115kV, #74 Line from Great Bridge to Grassfield substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 115kV feed from the IC's Collector Station for the new 150MW Solar Farm.

The new 115kV Three Breaker Ring Substation will share a common foot print and fence line with the IC's Collector Station. The demarcation point between the two stations will be the 115kV Breaker Disconnect Switch 4-hole pad in the IC's Collector Station by the common fence. Dominion will bring its bus to the demarcation point. The bus, structures, disconnect switch, metering accuracy CCVT's, metering accuracy CT's, protection and metering equipment will be Attachment Facilities. The grounding systems for each station will be tied together. All substation permitting, site preparation and grading activity will be performed by the IC.

Transmission Lines to renumber the existing line segment between the new Three Breaker Ring Substation and Great Bridge Substation. The existing line segment between the new Three Breaker Ring Substation and Chesapeake Substation shall remain Line 74.

Additional Work to be required at Chesapeake, Great Bridge, and Hickory Substations.

© PJM Interconnection 2020. All rights reserved.

Security and Fence Type – Design Level 4.

Note: Currently, the scope and estimate assumes DVP standard spread footer foundations. Once the soil information is received and if it is decided to change that to "pile foundations" then DVP team should be informed at the earliest to adjust the project estimate.

The work required is as follows:

Purchase and install substation material – Direct Network Upgrade:

1. Approximately 274' x 248' site preparation and grading as required for installation of the switching station (by the developer).
2. Approximately 1044 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. Three (3), 115 kV, 3000A, 40kAIC, SF-6 Circuit Breakers.
4. Six (6), 115 kV, 2000A, 3-Phase Center Break Gang Operated Switches.
5. Six (6), 115kV, Relay Accuracy CCVTs.
6. Nine (9), 90 kV, 74 kV MCOV surge arresters.
7. Two (2), 115kV, 2000A, 2-Phase Switches (for PVT's).
8. Two (2), 115kV, 100KVA Power PT's for Station Service.
9. One (1), 24' x 40' control enclosure.
10. One (1), 125 VDC, 300 Ah Station Battery and 50 Amp Charger (size to be verified during detail engineering).
11. Approximately 220 FT of Cable Trough, with a 20FT road crossing section.
12. Station Stone as required.
13. Station Lighting as required.
14. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports.
15. One (1), 225A Single Phase Auto Throw-Over Switch (Security Station Service)
16. Foundations as required including control house, equipment and bus support stands.
17. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as per engineering standards.

Purchase and install relay material – Direct Network Upgrade:

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), 1340 – 28" Dual SEL-411L 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 Disconnect Switch Fused @ 500A
11. One (1), 4153c – Wall Mount Station Battery Monitor
12. One (1), 5618 - SEL-3555 Communications Panel

© PJM Interconnection 2020. All rights reserved.

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), 5603 – Station Network Panel 2
20. One (1), 4523 – Security Camera Interface Box
21. One (1), 5616 – Station Security Panel
22. One (1), High Voltage Protection (HVP) Box (Provided by IT)
23. One (1), Telephone Interface Box
24. One (1), 5616 - Security Fence Panel
25. Two (2), 4018 – 225A Station Service AC Distribution Panel Branch Breaker

4. Upgrades to Substation / Switchyard Facilities

PJM Network Upgrade #n6905 - Remote protection and communication work.

ITO protection requirements to reliably interconnect the proposed generating facility with the transmission system have been determined. As a result, drawing updates, transmission line protection and anti-islanding work required at the remote line terminals at the Chesapeake, Commonwealth Natural Gas, Grassfield, and Great Bridge. These costs include the following:

Chesapeake 115 kV Substation

Project Summary:
AC2-012 provides for the drawing work, relay resets, and field support necessary to change the Line 74 destination at Chesapeake Substation. Install Islanding Transfer Trip to work with AC2-012. This project is the Non-Direct Connect for the AC2-012 Generator Interconnect project.

Purchase and install relay material:

1. 1. One (1), 1603 – 24" SEL-451 Islanding Control Scheme Panel
2. 2. Remove Panel no. 33

Commonwealth Natural Gas 115 kV Substation

Project Summary:
AC2-012 provides for the drawing work, relay resets, and field support necessary to change the Line 74 destination(s) at Commonwealth Natural Gas, Grassfield and Great Bridge Substation(s). This project is the Non-Direct Connect for the AC2-012 Generator Interconnect project.

Purchase and install relay material:

1. No Relay Material

© PJM Interconnection 2020. All rights reserved.

Grassfield 115 kV Substation

Project Summary:
AC2-012 provides for the drawing work, relay resets, and field support necessary to change the Line 74 destination(s) at Commonwealth Natural Gas, Grassfield and Great Bridge Substation(s). This project is the Non-Direct Connect for the AC2-012 Generator Interconnect project.

Purchase and install relay material:
1. No Relay Material

Great Bridge 115 kV Substation

Project Summary:
AC2-012 provides for the drawing work, relay resets, and field support necessary to change the Line 74 destination(s) at Commonwealth Natural Gas, Grassfield and Great Bridge Substation(s). This project is the Non-Direct Connect for the AC2-012 Generator Interconnect project.

Purchase and install relay material:
1. No Relay Material

Work Description	Direct		Indirect		Total Cost
	Labor	Material	Labor	Material	
Chesapeake Station	$39,589	$37,046	$8,246	$5,747	$90,628
Commonwealth Natural Gas Station	$41,487	$0	$9,778	$0	$51,265
Grassfield Station	$41,487	$0	$9,778	$0	$51,265
Great Bridge Station	$41,487	$0	$9,778	$0	$51,265
Total Remote Relay Upgrades	$164,050	$37,046	$37,580	$5,747	$244,423

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 publicly 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:

© PJM Interconnection 2020. All rights reserved.

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:

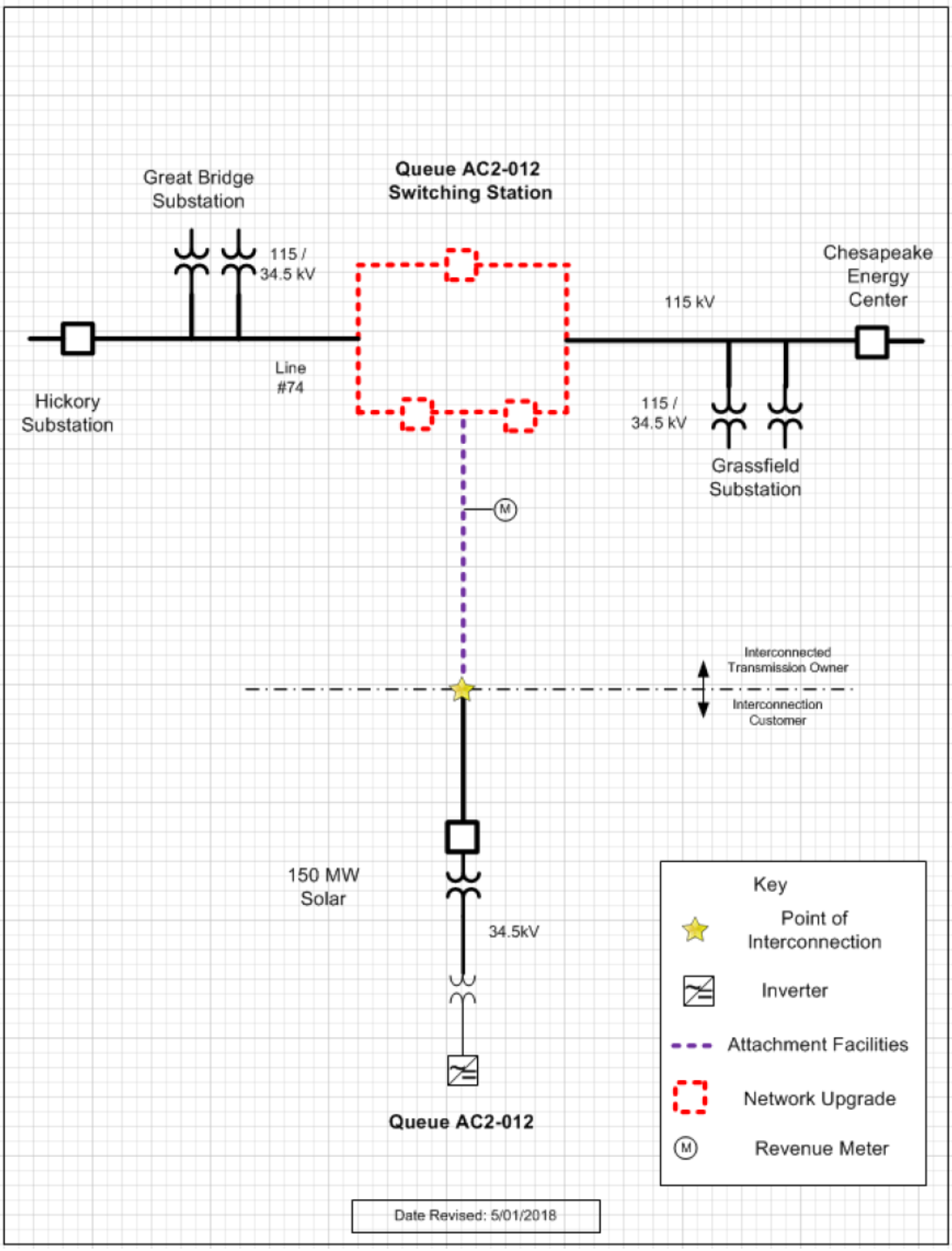
- Suitable Access Road from Substation to a Virginia State Maintained Roadway.
- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation.
- Conditional Use Permit for Substation.
- Any other Land/Permitting requirements required by the Substation.

ITO Real Estate Needs:

- The substation layout is complete and ITO requires a 274'x 248' 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 January 2022.
    - 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.

© PJM Interconnection 2020. All rights reserved.

Attachment 1.
Single Line



© PJM Interconnection 2020. All rights reserved.

Attachment 2.
AC2-012 Switching Station General Arrangement