Facilities Study Report

For

Physical Interconnection of

PJM Generation Interconnection Request

Project ID AE2-291

Grit DP-Perth 115 kV

December 2024

Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff Part VII, and, if applicable, the Application and Studies Agreement between the Project Developer and PJM Interconnection, LLC (PJM or Transmission Provider (TP)). The Transmission Owner (TO) is Virginia Electric and Power Company (VEPCO or Dominion).

A. Transmission Owner Facilities Study Summary

1. PROJECT DESCRIPTION

The Project Developer (PD) has proposed a Solar Generating Facility located in Pittsylvania, VA with a designated PJM Project ID of AE2-291. The installed facilities will have a total Maximum Facility Output (MFO) of 102 MW with 61.2 MW of this output being recognized by PJM as Capacity.

2. POINT OF INTERCONNECTION (POI)

AE2-291 is a new service request project that will interconnect with the Dominion transmission system via a newly constructed 115 kV three breaker ring bus switching station.

AE2-291 will be tapping the Altavista–Perth 115 kV line 31, approximately 13.51 miles from Altavista and 6.52 miles from Perth. The construction of the new interconnection substation will result in the splitting of the existing Altavista–Perth 115 kV line 31 into two lines on the transmission system. The line is to be cut-in between existing structures 31/202 and 31/203. Line 31 is being renumbered to 1XXX between AE2-291 (called Hillandale substation) and Perth substation.

The proposed generation interconnection is shown on the single line diagram in Attachment #1.

3. POINT OF CHANGE IN OWNERSHIP

The Point of Change in Ownership will be the 115kV disconnect switch 4-hole pad inside the Dominion station by the common fence.

4. SCOPE OF PROJECT DEVELOPER INTERCONNECTION FACILITIES

Project Developer will design, build, own, operate and maintain the Project Developer Interconnection Facilities on Project Developer's side of the Point of Change in Ownership (PCO). This includes, but is not limited to:

- Circuit breakers and associated equipment located between the high side of the MPT(s) or GSU(s) and the Point of Change in Ownership.
- Generator lead line from the Generating Facility to the Point of Change in Ownership.
- Relay and protective equipment, telecommunications equipment, and Supervisory Control and Data Acquisition (SCADA) to comply with the TO's Applicable Technical Requirements and Standards.

B. Transmission Owner Facilities Study Results

The following is a description of the planned Transmission Owner facilities for the physical interconnection of the proposed AE2-291 project to the Dominion transmission system. These facilities shall be designed according to Dominion Applicable Technical Requirements and Standards. Once built, Dominion will own, operate, and maintain these Facilities.

1. TRANSMISSION OWNER INTERCONNECTION FACILITIES:

The Transmission Owner Interconnection Facilities will include, but not be limited to, the following:

A 115 kV backbone structure and foundation within the fence of the Interconnection Substation, to terminate the Project Developer's generator lead line.

Line conductor from the backbone structure to the bus position in the switchyard of the interconnection substation.

Purchase and install substation material – Transmission Owner Interconnection Facilities:

1. One (1), 115kV, 2000A, 3-phase center break gang operated switch
2. Three (3), 115kV, metering accuracy CCVT
3. Three (3), 115kV, 500:5 metering accuracy CT
4. Conductor, connectors, conduits, control cables, foundations, steel structures and grounding material as per engineering standards

Purchase and install relay material – Transmission Owner Interconnection Facilities:

1. One (1), 1110 – 24" dual SEL-587Z/351A transmission bus panel
2. One (1), 4200_W1 – bus differential CT make-up box
3. One (1), 1425 – 24" dual SEL-735 transmission and generator interconnect metering panel
4. One (1), 4524 – revenue metering CT make-up box
5. One (1), 4506 – 3-phase CCVT potential make-up box with metering (P4)
6. One (1), 1323 – 24" SEL-487E/735 PMU and PQ monitoring panel
7. Two (2), 4541 – control cable make-up box
8. Two (2), 4528A – generation fiber make-up box

The Project Developer has the option to select 'Option to Build' as is their right under the PJM Generator Interconnection Agreement.

If "Option to Build" is selected, the Project Developer becomes responsible for the purchase and install of the TOIF facilities listed above, as well as the oversight costs included in 4. OTHER SCOPE OF WORK.

2. STAND ALONE NETWORK UPGRADES

The Stand Alone Network Upgrades will include, but not be limited to, the following:

For new interconnection substation:

AE2-291 Interconnection Substation (NXXXX)

A new 115 kV three breaker ring bus switching station will be constructed along the Altavista–Perth 115 kV transmission line 31 to interconnect the project with the Dominion transmission system.

The objective of this project is to build a 115kV three breaker ring bus to support the new solar farm built by Project Developer. The site is located along Dominion's existing 115kV, line #31 from Altavista Substation to Perth Substation. The cut line will consume two of the positions in the ring bus. The third position will be for the 115kV feed from Project Developer's Collector Station for the new solar farm.

The Project Developer will provide the property and access to the switching station. The grounding systems for each station will be tied together. All substation permitting, site preparation and grading activity will be performed by the Project Developer. All permits are the responsibility of the developer.

Substation design and relay protection are based on Dominion's Facility Interconnection Requirements, NERC Compliance Procedure FAC-001 (version 23), that is posted on PJM's website. This standard meets or exceeds the PJM Transmission and Substation Design Subcommittee Technical Requirements and the PJM Protection Standards (PJM Manual 7).

The scope of work includes the following:

Purchase and Install - Stand Alone Network Physical Facilities:

1. Approximate station fence line dimensions of 330' x 250'. At a minimum, site preparation and grading will be required to extend 15' beyond these dimensions for station grounding. Additional property and site prep may be required for proper grading and stormwater management, etc.
2. Approximately 1,160 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), 115kV, 3000A, 40kAIC, SF-6 circuit breaker
4. Six (6), 115kV, 2000A, 3-phase center break gang operated switch
5. Six (6), 115kV, relay accuracy CCVT
6. Two (2), 115kV, 2000A wave trap
7. Two (2), line tuner
8. Nine (9), 90kV, 74kV MCOV surge arrester
9. Two (2), 115kV, 2000A, 2-phase center break switch (for PVT's)
10. Two (2), 115kV, 100KVA power PT's for station service
11. Two (2), 115kV, 10 in-lb., 125VDC motor operator
12. One (1), 24' x 40' control enclosure
13. One (1), 125 VDC, 300 Ah station battery and 50 Amp charger (size to be verified during detail engineering)
14. Approximately 220 ft of cable trough with a 20 ft road crossing section
15. Two (2), 38" x 38" x 42" precast yard pull box
16. Station stone as required
17. Station lighting as required
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 - Stand Alone Network Relay Protection Equipment:

1. Three (3), 1510 – 24” dual SEL-351-7 transmission breaker with reclosing panel
2. Three (3), 4510 – SEL-2411 breaker annunciator
3. Two (2), 1340 – 24” dual SEL-411L DCB/PLC line panel
4. Two (2), 4506 – 3-phase CCVT potential make-up box
5. One (1), 1603 – 24” SEL-451 islanding control scheme panel
6. Two (2), 4000 – station service potential make-up box
7. Two (2), 4548 – non-earthing switch MOAB control box
8. One (1), 4103 – non-earthing switch MOAB AC/DC distribution box
9. Two (2), 4018 – 500A station service AC distribution panel
10. Two (2), 4007 – 225A outdoor transmission yard AC NQOD
11. Two (2), 4019 – 225A 3-phase throw over switch
12. Two (2), 4016 – 600A PVT disconnect switch
13. One (1), 4153c – wall mount station battery monitor
14. One (1), 5618 – SEL-3555 communications panel
15. One (1), 1255 – station annunciator panel
16. One (1), 5021 – SEL-2411 RTU panel
17. One (1), 5609 – fiber optic management panel
18. Three (3), 4526_A – circuit breaker fiber optic make-up box
19. One (1), 5202 – 26” APP 601 digital fault recorder
20. Six (6), 4040 – security fiber/power make-up box
21. One (1), 5603 – station network panel no. 1
22. One (1), 5603 – station network panel no. 2
23. One (1), 4051 – power block
24. One (1), 4042_D1B – security utility – utility ATS
25. One (1), 4044 – 225A 1Ø outdoor main security AC NQOD
26. Two (2), 4040 – 100A 1Ø outdoor security AC NQOD
27. One (1), 5616 – station security panel
28. One (1), 5616 – station security fence panel
29. Two (2), 4018 – 225A station service AC distribution panel branch breaker
30. One (1), high voltage protection (HVP) box (provided by IT) (to be verified during detail engineering)
31. One (1), telephone interface box (to be verified during detail engineering)

The Project Developer has the option to select ‘Option to Build’ as is their right under the PJM Generator Interconnection Agreement.

By selecting this construction process method, the Project Developer shall secure all required real estate, obtain all necessary permits, perform site work including site preparation and grading, furnish equipment, construction personnel and ancillary materials as found in the facility study for construction of the switching station in compliance with Dominion Energy Substation Engineering Standards.

If the Project Developer selects “Option to Build”, the work required is as follows:

Option to Build, Stand Alone Network Upgrade Physical Facilities – Project Developer:

1. Approximate station fence line dimensions of 330’ x 250’. At a minimum, site preparation and grading will be required to extend 15’ beyond these dimensions for station grounding. Additional property and site prep may be required for proper grading and stormwater management, etc.
2. Approximately 1,160 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), 115kV, 3000A, 40kAIC, SF-6 circuit breaker
4. Six (6), 115kV, 2000A, 3-phase center break gang operated switch
5. Six (6), 115kV, relay accuracy CCVT
6. Two (2), 115kV, 2000A wave trap
7. Two (2), line tuner
8. Nine (9), 90kV, 74kV MCOV surge arrester
9. Two (2), 115kV, 2000A, 2-phase center break switch (for PVT’s)
10. Two (2), 115kV, 100KVA power PT's for station service
11. Two (2), 115kV, 10 in-lb., 125VDC motor operator
12. One (1), 24’ x 40’ control enclosure
13. One (1), 125 VDC, 300 Ah station battery and 50 Amp charger (size to be verified during detail engineering)
14. Approximately 220 ft of cable trough with a 20 ft road crossing station
15. Two (2), 38” x 38” x 42” precast yard pull box
16. Station stone as required
17. Station lighting as required
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

Option to Build, Stand Alone Network Upgrade Relay Protection Equipment – Project Developer:

1. Three (3), 1510 – 24” dual SEL-351-7 transmission breaker with reclosing panel
2. Three (3), 4510 – SEL-2411 breaker annunciator
3. Two (2), 1340 – 24” dual SEL-411L DCB/PLC line panel
4. Two (2), 4506 – 3-phase CCVT potential make-up box
5. One (1), 1603 – 24” SEL-451 islanding control scheme panel
6. Two (2), 4000 – station service potential make-up box
7. Two (2), 4548 – non-earthing switch MOAB control box
8. One (1), 4103 – non-earthing switch MOAB AC/DC distribution box
9. Two (2), 4018 – 500A station service AC distribution panel
10. Two (2), 4007 – 225A outdoor transmission yard AC NQOD
11. Two (2), 4019 – 225A three phase throw over switch
12. Two (2), 4016 – 600A PVT disconnect switch
13. One (1), 4153c – wall mount station battery monitor
14. One (1), 5618 – SEL-3555 communications panel
15. One (1), 1255 – station annunciator panel

16. One (1), 5021 – SEL-2411 RTU panel
17. One (1), 5609 – fiber optic management panel
18. Three (3), 4526_A – circuit breaker fiber optic make-up box
19. One (1), 5202 – 26" APP 601 digital fault recorder
20. Six (6), 4040 – security fiber/power make-up box
21. One (1), 4051 – power block
22. One (1), 4042_D1B – security utility – utility ATS
23. One (1), 4044 – 225A 1Ø outdoor main security AC NQOD
24. Two (2), 4040 – 100A 1Ø outdoor security AC NQOD
25. Two (2), 4018 – 225A station service AC distribution panel branch breaker

3. NETWORK UPGRADES

The Network Upgrades will include, but not be limited to, the following:

Transmission Line Tie-in for new interconnection substation:

Line 31, 115 kV, will be cut and looped into the new interconnection substation.

This project serves to cut-in 115 kV line 31 into a new substation called Hillandale, which is to be located in Halifax County, VA. The line is to be cut-in between existing structures 31/202 and 31/203. Line 31 is being renumbered to 1XXX between Hillandale substation and Perth substation.

The proposed structures to be installed are two (2) 115 kV single circuit engineered steel 3-Pole double deadend structures, two (2) 115 kV single circuit steel backbones, and two (2) steel static poles. The new conductor and shield wire to be used for both lines will be single (1) 768.2 ACSS/TW "Maumee" conductor, and dual (2) DNO-11410 OPGW, respectively. 7#7 Alumoweld will be utilized for shielding within Hillandale Substation.

Modification to Existing Facilities:

1. Cut and transfer the existing 2-545.6 ACAR conductor for line 31 from the from the ahead side of existing structure 31/202 to the back side of proposed structure 1XXX/203.
2. Cut and transfer the existing 2-545.6 ACAR conductor for line 31 from the back side of existing structure 31/203 to the ahead side of proposed structure 31/202.
3. Cut and transfer the existing two (2) 3#6 Alumoweld shield wire for line 31 from the from the ahead side of existing structure 31/202 to the back side of proposed structure 1XXX/203.
4. Cut and transfer the existing two (2) 3#6 Alumoweld shield wire for line 31 from the back side of existing structure 31/203 to the ahead side of proposed structure 31/202.

Permanent Facilities to be Installed:

1. Install two (2) 115 kV engineered single circuit steel double deadend 3-pole structures on foundations as follows:
    a. Structures 31/202 and 1XXX/203
2. Install two (2) 115 kV single circuit steel backbones on foundations as follows:

a. Structures 31/201 and 1XXX/204

3. Install two (2) steel static poles on foundations as follows:
    a. Structures 1XXX/202A and 1XXX/202B
4. Install approximately 0.22 miles of 3-phase single (1) 768 ACSS/TW/HS “Maumee” conductor broken out as follows:
    a. Approximately 0.11 miles from proposed structure 31/202 to proposed backbone 31/201.
    b. Approximately 0.11 miles from proposed structure 1XXX/203 to proposed backbone 1XXX/204.
5. Install approximately 0.22 miles of dual (2) DNO-11410 OPGW broken out as follows:
    a. Approximately 0.11 miles from proposed structure 31/202 to proposed backbone 31/201.
    b. Approximately 0.11 miles from proposed structure 1XXX/203 to proposed backbone 1XXX/204.
    c. This includes the installation of eight (8) of splices as follows:
        i. Two (2) splices, one on both outer poles of proposed structure 31/202.
        ii. Two (2) splices, one on both masts of proposed backbone 31/201.
        iii. Two (2) splices, one on both outer poles of proposed structure 1XXX/203.
        iv. Two (2) splices, one on both masts of proposed backbone 1XXX/204.
6. Install approximately 0.23 miles of one (1) 7#7 Alumoweld shield wire between the static poles and proposed backbones 31/201 and 1XXX/204 inside Hillandale substation.

Upgrades to neighboring facilities:

Additional work is required at Perth Substation, Otter River Substation and Altavista Substation.

Perth Substation

Project AE2-291 provides for drawing work, islanding panel addition, relay resets, and field support necessary to change line 31 destination from Altavista to AE2-291 Generator Interconnect.

Purchase and install relay material:

1. One (1), UPLC II transfer trip TX/RX set

Altavista Substation

Project AE2-291 provides for drawing work, islanding panel addition, relay resets, and field support necessary to change line 31 destination from Perth to AE2-291 Generator Interconnect.

Purchase and install relay material:

1. One (1), 1603 – 24" SEL-451 islanding control scheme panel
2. One (1), panel retirement (Panel 25)

Otter River Substation

Project AE2-291 provides for drawing work, relay resets, and field support necessary to change the line 31 destination at Otter River Substation. The line number may or may not be changed.

4. OTHER SCOPE OF WORK

The Project Developer 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 GIA.

If the Project Developer selects "Option to Build", the oversight required is as follows:

Option to Build, Stand Alone Network Physical Facilities & Oversight – Dominion:

1. All Physical Engineering related oversight and approvals of activities related to equipment procurement, design, construction, and energization of switching station
2. All Real Estate related oversight and approval of activities related to construction of switching station
3. All Permitting related oversight and approval of activities related to construction of switching station
4. All Survey related oversight and approval of activities related to construction of switching station
5. All Construction and Methods oversight and approval of activities related to construction and energization of switching station
6. All Project Management oversight activities related to construction and energization of switching station
7. Review and approve all riser conductor, connectors, spacers, and bolts related to connection of the switching station to the Bulk Electric Transmission System
8. Review and approve all material related to the integration of the security fence software package back to the Corporate Security Fusion Center

Option to Build, Stand Alone Network Relay Protection Equipment – Dominion:

1. All Protection & Controls Engineering oversight and approval of activities related to equipment procurement, design, construction, and energization of switching station
2. All relay panel installation methods oversight and approval of activities related to construction and energization of switching station

3. All relay, communications, security settings related to the connection of the switching station to the Bulk Electric Transmission System
4. One (1), 5616 – station security panel
5. One (1), 5616 – station security fence panel
6. One (1), 5603 – station network panel no. 1
7. One (1), 5603 – station network panel no. 2
8. One (1), high voltage protection (HVP) box (Provided by IT) (to be verified during detail engineering)
9. One (1), telephone interface box (to be verified during detail engineering)

Option to Build, Transmission Owner Interconnection Facilities; Physical Facilities & Oversight – Dominion:

1. All Physical Engineering related oversight and approvals of activities related to equipment procurement, design, construction, and energization of switching station
2. All Construction and Methods oversight and approval of activities related to construction and energization of switching station
3. All Project Management oversight activities related to construction and energization of switching station

Option to Build, Transmission Owner Interconnection Facilities Relay Protection Equipment – Dominion:

1. All Protection & Controls Engineering oversight and approval of activities related to equipment procurement, design, construction, and energization of switching station
2. All relay panel installation methods oversight and approval of activities related to construction and energization of switching station
3. All relay, communications, security settings related to the connection of the switching station to the Bulk Electric Transmission System

5. MILESTONE SCHEDULE FOR COMPLETION OF TO WORK

Facilities outlined in this report are estimated to take 39 months to construct, from the time the Generator Interconnection Agreement is fully executed. This schedule may be impacted by the timeline for procurement and installation of long lead items, the ability to obtain outages to construct and test the proposed facilities.

Description	Start month	Finish month
Detailed Design	1	11
Permitting	3	29
Construction	28	39

6. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

General Assumptions:

1. The estimated procurement lead time for breakers is based on current Dominion pre-ordered breaker production slots. These production slots will be assigned after the agreement is executed.
2. The preliminary construction schedule is dependent on outage availability.
3. The project collector station will share a common fence with the generation interconnection switchyard.

TOIF/SANU Conceptual Design Notes:

1. Currently, the scope and estimate assume Dominion standard spread footer foundations. Once the soil information is available and it is prudent to change the design to "helical pile foundations" the Dominion team should be informed to adjust the project estimate at the earliest possible opportunity.
2. Security and fence type – design level 4.

Network Upgrades Conceptual Design Notes:

1. Engineered steel pole costs were determined based off typical wind and weight spans, line angles, and average structure heights for each voltage.
2. Steel pole foundation costs were based off the projects' location and structure type in the regional soil profile map. The regional soil profile map used for this project is Piedmont.
3. Survey costs were determined based on substation proposed location, fiber installation, and impacts on existing line.

7. REVENUE METERING REQUIREMENTS

All revenue metering needed for this interconnection project must meet the metering requirements stated in Appendix 2, section 8 of the AE2-291 GIA, and in PJM Manuals M01 and M14D. The details of applicable revenue metering requirements are given in section 4.1.6 Metering and Telecommunications of Dominion's Facility Interconnection Connection Requirement NERC Standard FAC-001 posted on PJM website.

The revenue metering will be installed on the Transmission Owner side of the Point of Change in Ownership will be installed, owned and maintained by Transmission Owner.

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

The Project Developer will access revenue meter via wireless transceivers or fiber cabling to meter with RS-485 or Ethernet communication port for dial-up reads. Project Developer must provide

revenue and real time data to PJM from Project Developer Market Operations Center per “PJM Telemetry Data Exchange Summary” document available at PJM.com.

8. LAND REQUIREMENTS FOR INTERCONNECTION SUBSTATION

Land requirements for the Interconnection Substation needed for this interconnection project must meet the requirements in Dominion’s Facility Interconnection Requirements, NERC Compliance Procedure FAC-001 (version 23), that is posted on PJM’s website.

The Project Developer would be responsible for the following expectations in the area of Real Estate.

- The land required for Dominion’s substation and project specific areas around must be deeded over title-in-fee.
- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation.
- Dominion Real Estate and Counsel will provide standard real estate checklist word document. Process needs to start at least 6 months prior to closing date.
- Required subdivision plat and associated documentation to be reviewed prior to subdividing parcel with the county.
- Suitable Access Road from Substation to a Virginia/North Carolina State Maintained Roadway.
- Dominion will require access road, transmission line and utilities easement to the Substation.
- Any other Land/Permitting requirements required by the Substation.

9. ENVIRONMENTAL AND PERMITING

The Project Developer would be responsible for the following expectations in the area of Environmental and Permitting.

- Assessment of environmental impacts related to the Interconnection Facility and/or Network Upgrades including:

  Environmental Impact Study requirements

  Environmental Permitting

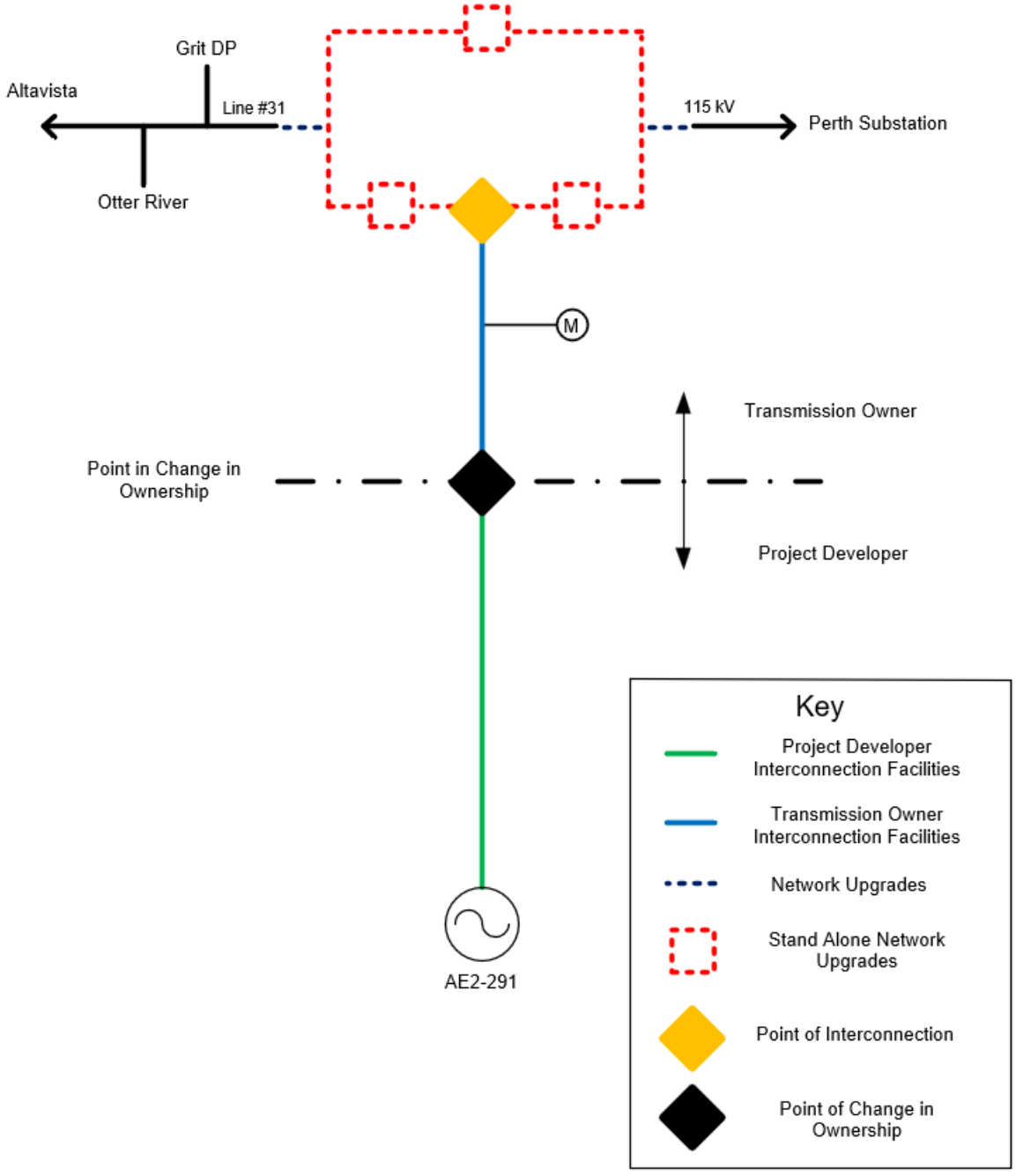
- Dominion will require a stormwater easement for substation specific stormwater design BMP’s to allow access to and use of the facilities.

  A maintenance agreement should be in place in perpetuity for said stormwater facilities.

- Conditional Use Permit for Substation
- Any additional land needed for Storm Water Management, Landscaping, and Wetlands/Wetlands Mitigation
- Any other Permitting requirements required by the Substation

C. APPENDICES

Attachment #1: Single line Diagram for the Physical Interconnection



Attachment #2: Substation General Arrangement