Facilities Study Report

For

Physical Interconnection of

PJM Generation Interconnection Request

Project ID AE2-185

Gladys DP-Stone Mill 69 kV

Revision 1

Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff, as well as 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 Campbell, VA with a designated PJM Project ID of AE2-185. The installed facilities will have a total Maximum Facility Output (MFO) of 60 MW with 36 MW of this output being recognized by PJM as Capacity.

2. POINT OF INTERCONNECTION (POI)

AE2-185 is a project sharing a Common Use Upgrade that will interconnect with the Dominion transmission system via a newly constructed 69 kV single breaker tap. This new tap will serve as the interconnection location for AE2-185 & AF2-404.

AE2-185 will be tapping the Gladys DP–Stone Mill 69 kV line 35, approximately 0.38 miles from Gladys DP and 11.92 miles from Stone Mill, between structure 35/408 and 35/409.

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

3. POINT OF CHANGE IN OWNERSHIP

The Point in Change of Ownership will be the 69kV 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:

- Main Power Transformer (s) (MPT), Generation step-up (GSU) transformer(s) or final transformation, as applicable.
- 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.

5. Supplemental Dominion Project

- A Dominion supplemental project has been proposed to construct a 3-breaker ring bus on the #35 line at the tap point near structure 35/302, approximately 8.7 miles from AE2-185/AF2-404. Relay protection scheme and equipment at AE2-185/AF2-404 may be modified from what is identified in this Facility Study Report. Coordination of construction and outages for these projects will be required.

B. Transmission Owner Facilities Study Results

The following is a description of the planned Transmission Owner facilities for the physical interconnection of the proposed AE2-185 & AF2-404 projects 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:

For new interconnection transmission:

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

A 69 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), 69kV, 2000A, 3-phase center break gang operated switch
2. Three (3), 69kV, metering accuracy CCVT
3. Three (3), 69kV, 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

For new interconnection substation:

AE2-185 & AF2-404 Interconnection Substation (NXXXX)

A new 69 kV single breaker tap will be constructed along the Gladys DP–Stone Mill 69 kV transmission line 35 to interconnect the project with the Dominion transmission system.

The objective of this project is to build a new 69kV single breaker tap switching station. The site is located along Dominion’s existing 69kV line 35 between structures 35/408 and 35/409 in Campbell County, Virginia. The station will be positioned in such a way that the 69kV backbone will accept the new line tap and terminate into this structure. A new 69kV circuit breaker will be installed at this terminal along with disconnect switches, arresters, and potential transformers.

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 – Transmission Owner Interconnection Facilities:

1. Approximate station fence line dimensions of 290’ x 160’. 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 900 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. One (1), 69kV, 3000A, 40kAIC, SF-6 circuit breaker
4. One (1), 69kV, 2000A, 3-phase center break gang operated switch
5. Three (3), 69kV, relay accuracy CCVT
6. One (1), 69kV, 2000A wave trap
7. One (1), line tuner
8. Six (6), 60kV, 48kV MCOV surge arrester
9. One (1), 69kV, 2000A, 1-phase center break switch (for PVT’s)
10. One (1), 69kV, 100KVA power PT's for station service
11. Two (2), 69kV, 10 in-lb., 125VDC motor operator

12. One (1), 100KW, 1PHS, 240/120VAC Generator
13. One (1), 600A, 240VAC Station Service ATS
14. One (1), 24’ x 40’ control enclosure (with provisions for secondary station service generator connection)
15. One (1), 125 VDC, 200 Ah station battery and 50 Amp charger (size to be verified during detail engineering)
16. Approximately 100 ft of cable trough
17. Two (2), 38” x 38” x 42” precast yard pull box
18. Station stone as required
19. Station lighting as required
20. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
21. Foundations as required including control house, equipment, and bus support stands
22. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as per engineering standards

Purchase and Install - Transmission Owner Interconnection Facilities Relay Protection Equipment:

1. One (1), 1510 – 24” dual SEL-351-7 transmission breaker with reclosing panel
2. One (1), 4510 – SEL-2411 breaker annunciator
3. One (1), 1340 – 24” dual SEL-411L DCB/PLC line panel
4. One (1), 4506 – 3-phase CCVT potential make-up box
5. One (1), 1603 – 24” SEL-451 islanding control scheme panel
6. One (1), 4000 – station service potential make-up box
7. One (1), 4548 – non-earthing switch MOAB control box
8. One (1), 4103 – non-earthing switch MOAB AC/DC distribution box
9. One (1), 4018 – 500A station service AC distribution panel
10. Two (2), 4007 – 225A outdoor transmission yard AC NQOD
11. One (1), 4019 – 225A 3-phase throw over switch
12. One (1), 4016 – 600A PVT disconnect switch
13. One (1), 4153c – wall mount station battery monitor
14. One (1), 5613 – annunciator / RTU / communication panel
15. One (1), 5609 – fiber optic management panel
16. One (1), 4526_A – circuit breaker fiber optic make-up box
17. One (1), 5202 – 26” APP 601 digital fault recorder
18. Six (6), 4040 – security fiber/power make-up box
19. One (1), 5603 – station network panel no. 1
20. One (1), 5603 – station network panel no. 2
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. One (1), 5616 – station security panel
26. One (1), 5616 – station security fence panel
27. Two (2), 4018 – 225A station service AC distribution panel branch breaker
28. One (1), high voltage protection (HVP) box (provided by IT) (to be verified during detail engineering)
29. 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 Interconnection Service 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.

The Project Developer has the option to select 'Option to Build' as is their right under the PJM Interconnection Service 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:

No Stand Alone Network Upgrades have been identified in this facility studies report.

For new interconnection substation:

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

Option to Build, Transmission Owner Interconnection Facilities – Project Developer:

1. Approximate station fence line dimensions of 290' x 160'. 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 900 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. One (1), 69kV, 3000A, 40kAIC, SF-6 circuit breaker
4. One (1), 69kV, 2000A, 3-phase center break gang operated switch
5. Three (3), 69kV, relay accuracy CCVT
6. One (1), 69kV, 2000A wave trap
7. One (1), line tuner
8. Six (6), 60kV, 48kV MCOV surge arrester
9. One (1), 69kV, 2000A, 1-phase center break switch (for PVT's)
10. One (1), 69kV, 100KVA power PT's for station service
11. Two (2), 69kV, 10 in-lb., 125VDC motor operator
12. One (1), 100KW, 1PHS, 240/120VAC Generator
13. One (1), 600A, 240VAC Station Service ATS

14. One (1), 24’ x 40’ control enclosure (with provisions for secondary station service generator connection)
15. One (1), 125 VDC, 200 Ah station battery and 50 Amp charger (size to be verified during detail engineering)
16. Approximately 100 ft of cable trough
17. Two (2), 38” x 38” x 42” precast yard pull box
18. Station stone as required
19. Station lighting as required
20. Steel structures as required including switch stands, bus supports, station service transformers, CCVT and wave trap supports
21. Foundations as required including control house, equipment, and bus support stands
22. Conductors, connectors, conduits, control cables, cable trough, and grounding materials as per engineering standards

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

1. One (1), 1510 – 24” dual SEL-351-7 transmission breaker with reclosing panel
2. One (1), 4510 – SEL-2411 breaker annunciator
3. One (1), 1340 – 24” dual SEL-411L DCB/PLC line panel
4. One (1), 4506 – 3-phase CCVT potential make-up box
5. One (1), 1603 – 24” SEL-451 islanding control scheme panel
6. One (1), 4000 – station service potential make-up box
7. One (1), 4548 – non-earthing switch MOAB control box
8. One (1), 4103 – non-earthing switch MOAB AC/DC distribution box
9. One (1), 4018 – 500A station service AC distribution panel
10. Two (2), 4007 – 225A outdoor transmission yard AC NQOD
11. One (1), 4019 – 225A 3-phase throw over switch
12. One (1), 4016 – 600A PVT disconnect switch
13. One (1), 4153c – wall mount station battery monitor
14. One (1), 5613 – annunciator / RTU / communication panel
15. One (1), 5609 – fiber optic management panel
16. One (1), 4526_A – circuit breaker fiber optic make-up box
17. One (1), 5202 – 26” APP 601 digital fault recorder
18. Six (6), 4040 – security fiber/power make-up box
19. One (1), 4051 – power block
20. One (1), 4042_D1B – security utility – utility ATS
21. One (1), 4044 – 225A 1Ø outdoor main security AC NQOD
22. Two (2), 4040 – 100A 1Ø outdoor security AC NQOD
23. 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:

The objective of the following estimate is to tap existing 69kV Line #35 in order to incorporate the new AE2-185 & AF2-404 interconnect substation onto Dominion’s System. Line #35 will be dead-

ended between existing Structures 35/408 and 35/409 on one (1) standard backbone structure. The proposed interconnect substation will also consist of two (2) steel static poles to provide static protection over AE2-185 & AF2-404.

Permanent Facilities to be Installed:

1. Install one (1) 115kV SC 55' Backbone Structures with Foundations (Structures 408A).
2. Install two (2) Steel Static Poles with foundations (Structures 408B & 408C)
3. Cut existing 3-phase 1-336.4 kcmil 26/7 ACSR "Linnet" (Line 35) between existing Structures 35/408 and 35/409. Transfer and dead-end the new sections onto new standard backbone structure 35/408A.
4. Cut existing 7#7 Alumoweld (Line 35) between existing Structures 35/408 and 35/409. Transfer and dead-end the new sections onto new standard backbone structure 35/408A.
5. Install approximately two hundred feet (200') of 7#7 Alumoweld from proposed Backbone Structure 35/408A to proposed Steel Static Pole 35/408B.
6. Install approximately ninety feet (90') of 7#7 Alumoweld from proposed Steel Static Pole 35/408B to proposed Steel Static Pole 35/408C.
7. Install approximately one hundred and eighty feet (180') of 7#7 Alumoweld from proposed Steel Static Pole 35/408C to proposed Backbone Structure 35/408A.

Upgrades to neighboring facilities:

Additional work is required at Stone Mill Substation.

Stone Mill Substation

This project provides for drawing work, relay resets, and field support necessary to change line 35 destination from Gladys DP to AE2-185/AF2-404 Generator Interconnect. This project is the Non-Direct Connect for the AE2-185/AF2-404 Generator Interconnect project.

Purchase and install relay material:

1. One (1), 1603 – 24" SEL-451 islanding control panel
2. One (1), 1340 – 24" dual SEL411L DCB/PLC line panel
3. One (1), panel retirement (Panel 5)

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, Transmission Owner Interconnection 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, 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
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

5. MILESTONE SCHEDULE FOR COMPLETION OF [TO] WORK

Facilities outlined in this report are estimated to take 42 months to construct, from the time the Generation 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	8
Permitting	3	34
Construction	32	42

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 collector station and switchyard will share a fence line.
4. The Dominion supplemental project (SXXXX) will require a islanding scheme. The protections scheme will be developed during the detailed design and is not included as part of the AE2-185 and AF2-404 Facility Study Report.
5. Proposed Generation Interconnection project AE2-283 is connection to the Gladys DP line. Outage and construction coordination may be required.

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 Assumptions:

1. The physical condition of existing Line #35 structures are adequate for the construction items contained in this estimate.
2. The approximate location of the AE2-185/AF2-404 generation interconnect Substation was mutually agreed upon at the time of this estimate by the Dominion & Kiewit project teams based on multiple variables. These variables included, but were not limited to: the developer’s input and plans, environmental concerns, and general overhead transmission design concerns. LiDAR data was used to estimate the elevation of the proposed substation at the backbone structure location, and was assumed to be approximately 769’. Final foundation cost, structure cost, and locations may vary from this estimate as a result of these assumptions.
3. No new Right-of-Way will be required for this project under the assumption the developer will own the property surrounding the existing Right-of-Way in the vicinity of the affected project area.
4. No foundation analysis was performed as part of this estimate and is outside the current scope of this project.
5. All necessary outages to allow for the installation of the AE2-185/AF2-404 project are assumed to be obtainable, and a temporary line is not considered necessary. This design has accounted for temporary energization using phase jumpers on Structure 35/408C to facilitate construction operations and outage schedule(s).
6. Assuming developer project fence line will not be crossing Line 35 Right-of-Way. Therefore, if the developer designs for the fence to cross under Line #35 it will be their responsibility to ensure that they have the appropriate clearances.
7. There is an existing ground clearance violation between structures 35/407 & 35/408 when checking under 115kV clearance requirements, it is unclear if this portion of the line was originally designed for 115kV or 69kV. It is not part of AE2-185/AF2-404 scope to remediate this potential violation.

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 AE2-185 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

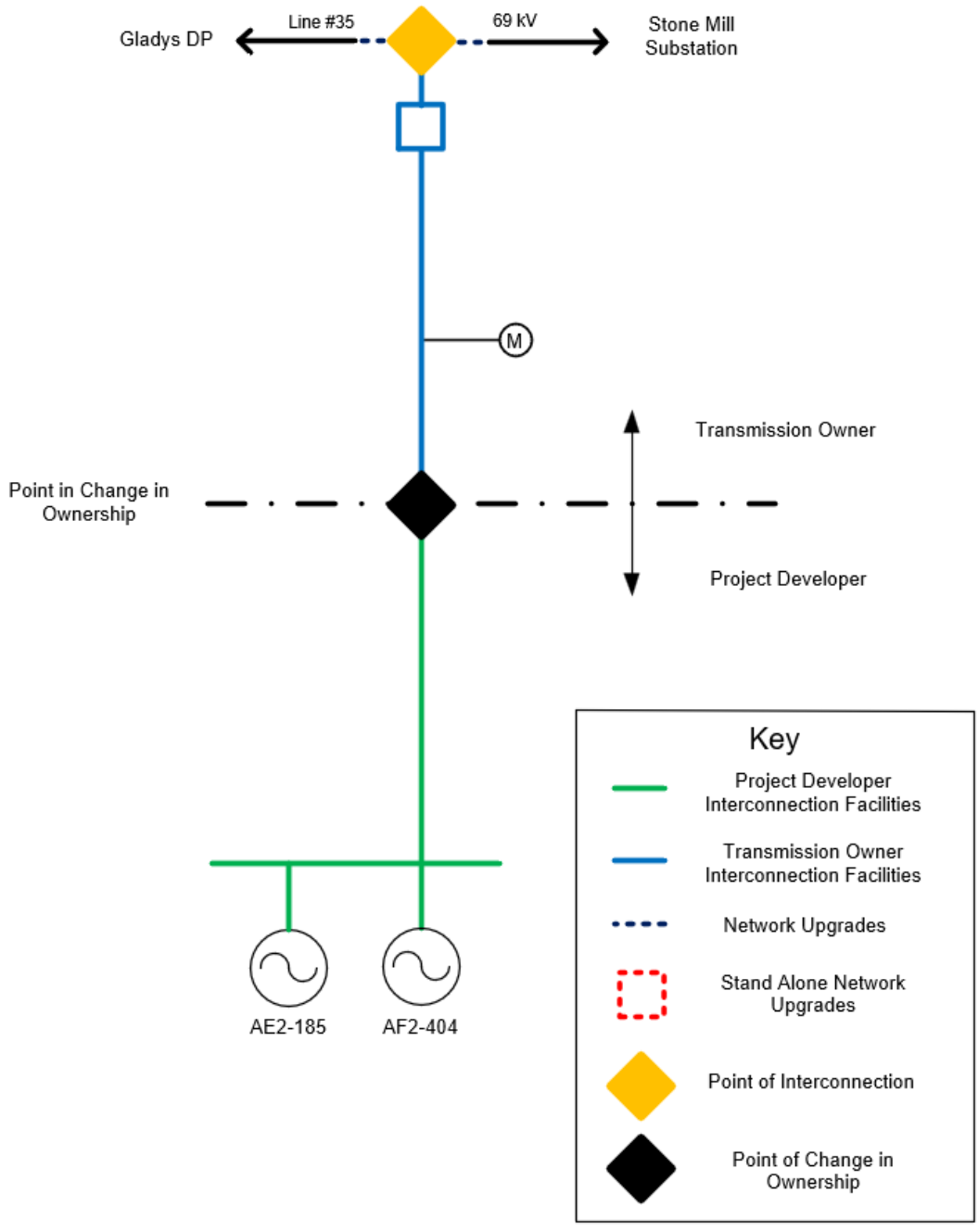
- Dominion will require a stormwater easement for substation specific stormwater design BMP's to allow access to and use of the facilities.

  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