Facilities Study Report

For

Physical Interconnection of

PJM Generation Interconnection Request

Project ID AG1-494

"Mainspring Grid"

Amherst County, Virginia

Revision 0: December 2024

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 Appalachian Power Company to be abbreviated in the remainder of this report as APCo.

A. Transmission Owner Facilities Study Summary

1. PROJECT DESCRIPTION

The Project Developer has proposed a Storage Generating Facility located in Amherst County, Virginia. The installed facilities for AG1-494 will have a total Maximum Facility Output (MFO) of 50 MW with 20 MW of this output being recognized by PJM as Capacity.

2. POINTS OF INTERCONNECTION AND CHANGE IN OWNERSHIP

The Generating Facility will interconnect with the American Electric Power (AEP) transmission system via a newly constructed APCo owned 138 kV station (name TBD) tapping the Boxwood – Amherst section of the Boxwood - Riverville 138 kV Circuit, approximately 0.57 miles from Boxwood 138 kV Station and 8.61 miles from Riverville 138 kV Station.

The Point of Interconnection (POI) is the point where the risers connect the generation lead circuit to the APCo AG1-494 138 kV Station generation lead circuit termination point.

The Point of Change in Ownership (PCO) will be located at the first structure in the generation lead circuit outside of the proposed APCo AG1-494 138 kV Station fence. APCo will own the span from the proposed APCo AG1-494 138 kV Station to the APCo constructed and owned dead end PCO structure, including the jumpers. The Project Developer will own the other span connecting to the PCO structure, along with the remainder of the 138 kV generation lead transmission line and associated structures back to the AG1-494 generation collector substation.

The construction of the new interconnection substation will split the existing Boxwood - Riverville 138 kV circuit into two lines on the transmission system.

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

3. SCOPE OF PROJECT DEVELOPER FACILITIES

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

- Main Power Transformer(s) (MPT(s))
- Circuit breakers and associated equipment located between the high side of the MPT(s) and the Point of Change in Ownership

- Generation lead circuit line conductors from the Generating Facility to the Point of Change in Ownership
- Protective relays and associated equipment for the generator lead
- Telecommunications Equipment including 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 Transmission Owner facilities required for physical interconnection of the proposed AG1-494 project to the AEP transmission system. These facilities shall be designed according to AEP standards. Once built, AEP will own, operate, and maintain these Facilities.

1. INTERCONNECTION SUBSTATION (NEW) (Stand Alone Network Upgrade)

APCo will construct a new 138 kV ring bus station, initially populated with three (3) circuit breakers, expandable to four (4) circuit breakers. This typical arrangement is planned to be designed to accommodate 3000A of continuous current. The station will be constructed to the southwest of the Boxwood - Riverville circuit to interconnect the project with the AEP transmission system. **Major equipment is expected to include:**

- Three (3) 138 kV 40 kA circuit breakers with associated control relaying.
- Seven (7) breaker disconnect switches.
- Three (3) line disconnect motor operated air breaker (MOAB) switches with associated control relaying.
- Six (6) single phase coupling capacitor voltage transformers (CCVT), three (3) each on the line exits to the Boxwood and Amherst 138 kV Stations.
- Two (2) single phase station service voltage transformers (SSVT).
- Two (2) H-Frame line exit structures, one (1) each for the line exits to the Boxwood and Amherst 138 kV Stations.
- One (1) 16' x 27' Drop-In Control Module (DICM) control building.
- Associated conductors (buswork, ground grid, jumpers), telecom terminal equipment, insulators, arresters, foundations, and structures.
- A dual fiber-based Integrated Communications Optical Network Multiplexor (ICON MUX) current differential line protection relay scheme for the line to the Boxwood 138 kV Station.
- A dual fiber-based ICON MUX current differential line protection relay scheme for the line to the Amherst 138 kV Station.

The civil work required to develop a site that accommodates the installation of the above station includes grading of a 230' x 190' pad with an assumed fall across the pad of 6' and a minimum of 550' x 20' of access road.

2. TRANSMISSION LINE TIE-IN

APCo will tie the proposed 138 kV station into the existing Boxwood - Riverville 138 kV Circuit by completing the following construction tasks:

- Replacement of existing structure #271-11 with one (1) 90 ft. single pole, single circuit, steel davit arms, tangent structure.
- Replacement of existing structure #271-12 with one (1) 85 ft. single pole, single circuit, steel davit arms, tangent structure.
- Installation of one (1) new steel, double circuit, single pole dead end structure on concrete pier foundation with an anchor bolt cage.
- Installation of five (5) spans of aluminum conductor steel-reinforced (ACSR) 795 26/7 (Drake) transmission line conductor with 7#8 Alumoweld shield wire in the existing Boxwood – Amherst section of the Boxwood - Riverville 138 kV Right of Way, cutting in the proposed 138 kV station in an in-and-out arrangement.

3. TRANSMISSION OWNER INTERCONNECTION FACILITIES:

The APCo Interconnection Facilities may or may not include the following:

Please see Section 8.1, bullet #4 and Section 9 for submetering requirements.

- Installation of one (1) new steel, single circuit, single pole dead end structure and one span of ACSR 795 (Drake) transmission line conductor with 7#8 Alumoweld shield wire for the generation lead circuit extending from the proposed 138 kV station.
- Extension of two (2) underground 48 count all dielectric loose tube (ADLT) fiber optic cables from the proposed 138 kV station control house to fiber demarcation splice boxes to support direct fiber relaying between the proposed 138 kV and Project Developer's collector stations. The Project Developer will be responsible for the fiber extension from the splice boxes to the collector station.
- Installation of three (3) single phase CCVTs on the generation lead circuit.
- Installation of a standard revenue metering package, including three (3) single phase current transformers (CT), three (3) single phase voltage transformers (VT), associated structures and foundations, one (1) ethernet switch, and one (1) DICM-installed metering panel, for the generation lead circuit at the proposed 138 kV station.
- Installation of a dual, direct fiber, current differential relay protection scheme for the generation lead circuit to the proposed AG1-494 138 kV collector station.

4. UPGRADE TO NEIGHBORING STATIONS

4.1 Boxwood 138 kV

- APCo will reconfigure the ICON at the Boxwood 138 kV station, installing a new Small Form-factor Pluggable (SFP) transceiver.

4.2 Amherst 138 kV

- APCo will reconfigure the ICON at the Amherst 138 kV station, installing a new SFP transceiver.

5. INSTALLATION OF FIBER CABLE CIRCUITS

AEP will install two (2) station exit transitions and two (2) new fiber optic cable paths consisting of 2 miles of 144 count ADSS cable installed on existing AEP structures and associated terminating equipment and devices (transceivers, multiplexors, routers). This installation is required to accommodate fiber-based relaying, supervisory control and data acquisition (SCADA), and carrier ethernet switch (CES) connectivity between the proposed AG1-494, Boxwood, and Amherst Stations.

6. MILESTONE SCHEDULES FOR COMPLETION OF AEP WORK

6.1 STANDARD OPTION:

Activity	Number of Days (See Notes)
Project Engagement*	1
Engineering Start	70
Material Ordering	112
Construction (Grading & Below Grade)	569
Construction (Above Grade)	629
Outage Requests Made By	344
Outage (Structure Foundations)**	709
Outage (Cut-in & Testing)**	760
Ready For Back Feed (ITO In-Service Date)	790

***Day 1 will be determined at the PJM construction project kick off meeting.**
****Scheduled Outages are contingent upon outage availability. Longer duration outages are not available during peak load periods.**

The above schedule is based on typical AEP construction timelines, long lead material availability, and common outage constraints. The facilities outlined in this report, as constructed by AEP, are estimated to take 26 months to complete. Given this construction timeline, the timeline for the phase 3 study, and a typical period for agreement processing, AEP can support a backfeed date of October 28, 2027, subject to change during the tariff defined Final Agreement Negotiation Phase. The Project Developer is expected to have the interconnection facilities constructed and ready to accept backfeed by the business day prior to the final negotiated backfeed date.

6.2 OPTION TO BUILD:

Activity	Dates (See Notes)
Project Engagement*	1
Engineering Start	70
Material Ordering	140
Construction (Grading & Below Grade)	540
Construction (Above Grade)	570
Outage Requests Made By	275
Outage (Structure Foundations)**	590
Outage (Cut-in & Testing)**	640
Ready For Back Feed (ITO In-Service Date)	670

***Day 1 will be determined at the PJM construction project kick off meeting. Scheduled Outages are contingent upon outage availability. Longer duration outages are not available during peak load periods.**

****Coordination with the Project Developer will be required 90 days prior to the start of this task.**

The above schedule is based on typical AEP construction timelines, long lead material availability, and common outage constraints. The facilities related to the cut-in and remote end stations outlined in this report, as constructed by AEP, are estimated to take 22 months to complete. Given this construction timeline, the timeline for the phase 3 study, and a typical period for agreement processing, AEP can support a backfeed date of October 28, 2027, subject to change during the tariff defined Final Agreement Negotiation Phase. The Project Developer is expected to have the interconnection facilities, including the interconnection station, ready to accept backfeed by the business day prior.

7. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

Note - Any materials purchased, or design decisions made by the Project Developer (relative to any facilities to be owned by AEP) prior to coordination with and approval by the executing AEP team (pursuant to an Engineering and Procurement or Generation Interconnection Agreement) are at the developer's risk and may not meet the specifications required for interconnection with the AEP transmission system.

7.1 SCOPE ASSUMPTIONS:

- Equipment specifications (Breaker ratings, conductor size, etc.) are a result of the desktop functional scoping process observed while conducting this facilities study. These specifications are subject to change based on the results of the detailed scoping efforts that will take place post-interconnection or engineering and procurement agreements.
- Protection and Control (P&C) coordination with the Project Developer will be needed throughout the project. The Project Developer will be required to install an AEP-compatible line relaying protection panel at the collector substation using AEP standards to ensure relay coordination and adequate line protection. The AEP design team will ensure that the firmware at the collector station terminal matches the approved firmware at the AEP terminal. Failure to accept the cost of a matching line relay protection panel may change scoping.
- Scopes provided are based on a table-top process without the benefit of the results of site-specific engineering studies (e.g., soil borings, environmental survey, ground grid, etc.), unless otherwise provided by the Project Developer.
- The Project Developer will obtain, at its cost, all necessary provisions for the AEP direct connection facilities.
- The Project Developer will provide a site acceptable to AEP (for transfer in Fee Simple) and any required easements for the proposed 138 kV station and associated line work to enable access to all facilities and structures.
- The proposed 138 kV station interconnecting AG1-494 will be located in close proximity to the existing Boxwood - Riverville Transmission Line Right of Way.
- The Project Developer will have their construction and required checkout completed prior to the start of the interconnection to the proposed 138 kV station and any required testing outages.
- The existing structures intended to support the installation of new fiber optic ADSS cable are assumed to be capable of the additional burden. As such, this scope is subject to change as result of the detailed engineering processes that take place after execution of a Generation Interconnection Agreement.

7.2 SCHEDULE ASSUMPTIONS:

- All transmission outages are subject to PJM and AEP Operations outage scheduling requirements.
- Significant scope of work changes will impact the schedule.

- The above schedule reflects only the work required to interconnect the AG1-494 project. The schedules regarding network upgrades associated with this project, if any, are detailed in the documentation related to the specific network upgrade.
- Slippage by the Project Developer in executing the Generation Interconnection Agreement (GIA) does not equate to a "day for day" slippage in the scheduled back feed and in service dates. Depending on the time of year, planned outages, neighboring projects and maintenance of the grid, outage availability has the potential to shift by weeks or months depending on conditions at the time of the fully executed agreement.

7.3 ESTIMATE ASSUMPTIONS:

- Estimates provided are based on a table-top process without the benefit of the results of site-specific engineering studies (e.g., soil borings, environmental survey, ground grid, etc.), unless otherwise provided by the Project Developer.

7.4 OPTION TO BUILD ASSUMPTIONS:

- The Project Developer will use firms from the AEP approved list that have experience in the transmission region where the POI is located.
- The Project Developer follows the requirements specified in "Independent Power Producers Option to Build Guidelines", available at:

https://www.aep.com/requiredpostings/AEPTransmissionStudies

8. METERING REQUIREMENTS

All metering needed for this interconnection project must meet the metering requirements stated in Appendix 2, section 8 of the AG1-494 GIA, and in PJM Manuals M01 and M14D. The details of applicable metering requirements are provided in the "Connection Requirements for the AEP Transmission System" document, found at:
https://www.aep.com/requiredpostings/AEPTransmissionStudies

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

Any additional generation proposed behind an originating project's PCO that differs in either fuel type or corporate entity from the originating project will require the installation of additional submetering for both the originating project and the uprate for the purpose of settlement. Submetering will require additional space within the originating project's facilities. The meters, routers, Ethernet to fiber converters, and telecom switch will be procured and owned by AEP. The revenue quality instrument transformers, fiber-optic cable connecting the submeters, and any other additional hardware for the required submetering will be procured, installed, owned, and maintained by the Project Developer.

9. LAND REQUIREMENTS FOR INTERCONNECTION SUBSTATION

Land requirements for the Interconnection Substation needed for this interconnection project must meet the requirements in the https://www.aep.com/requiredpostings/AEPTransmissionStudies posted on AEP website.

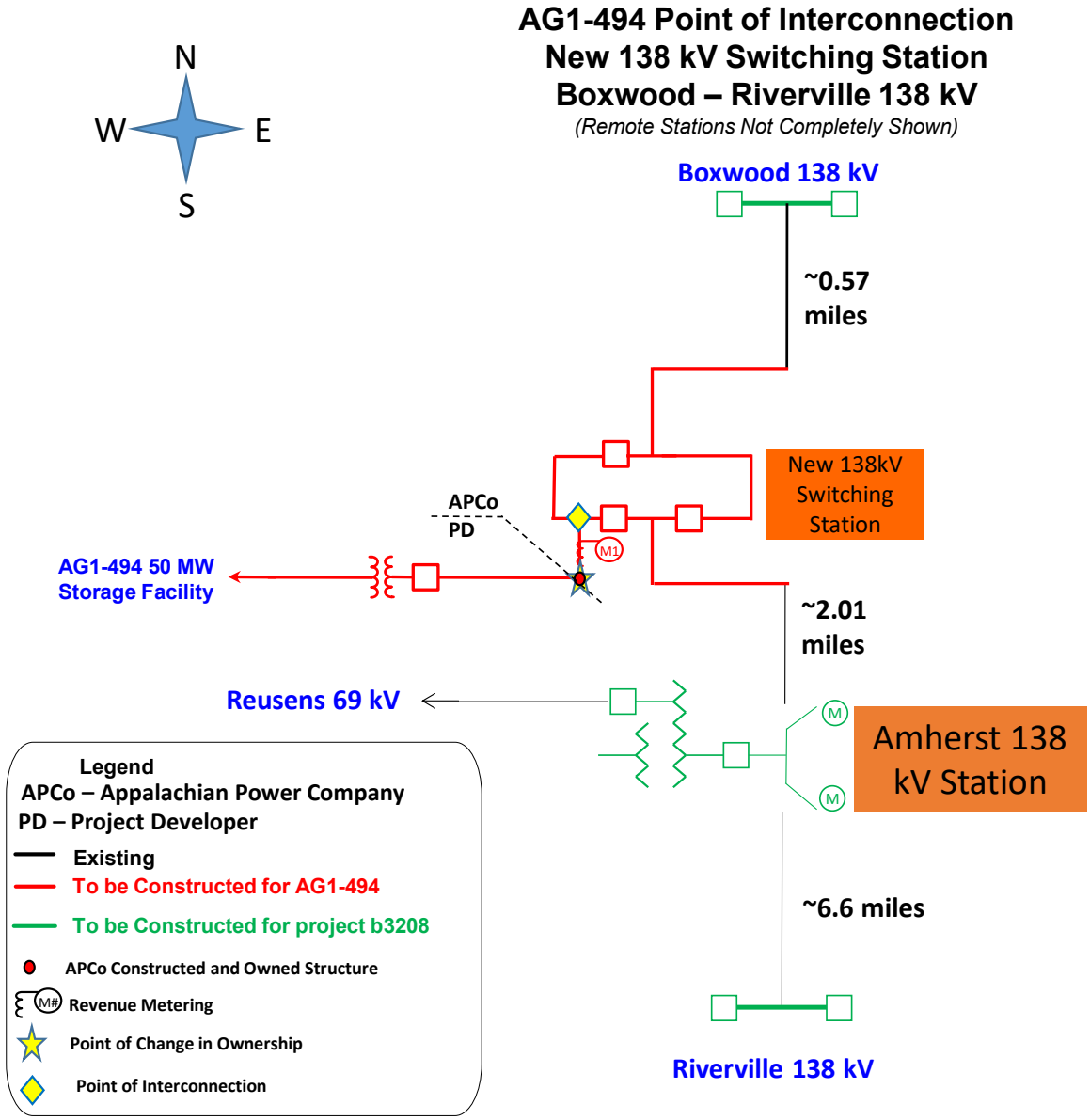
The land footprint required for a typical 138 kV interconnection station is 230' x 190', not accounting for additional retention/detention ponds that may be required. This area is subject to change as result of the detailed engineering processes that take place after interconnection agreement execution.

10. ENVIRONMENTAL AND PERMITTING

The Project Developer is expected to obtain, at its cost, all necessary permits and provisions for the facilities to be constructed for this interconnection. AEP requires that the standards provided in the "Standards and Expectations for Siting, Real Estate, Right-Of-Way, and Environmental Permitting for Transmission Interconnection Projects", found at: https://www.aep.com/requiredpostings/AEPTransmissionStudies be adhered to for all facilities interconnecting with the AEP transmission system.

C APPENDICES

Attachment #1: Single line Diagram for the Physical Interconnection



Attachment #2: POI Map