

Facilities Study Report

For

Physical Interconnection of

PJM Generation Interconnection Request

Project ID AF2-441

Burnham 138kV

Revision 1: December 2024

Introduction

This Facilities Study has been prepared in accordance with the PJM Open Access Transmission Tariff Part VII. The Transmission Owner (TO) is ComEd.

A. Transmission Owner Facilities Study Summary

1. PROJECT DESCRIPTION

The Project Developer has proposed a Battery Storage Generating Facility located in Cook County, Illinois with a designated PJM Project ID of AF2-441. The installed facilities will have a total Maximum Facility Output (MFO) of 200 MW with 80 MW of this output being recognized by PJM as Capacity.

2. POINT OF INTERCONNECTION (POI)

The Generating Facility will interconnect with the ComEd transmission system via a direct connection into the TSS 177 Burnham 138kV 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 is located at the first dead-end structure of L.17710 inside the TSS 177 Burnham interconnection substation fence line.

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:

- One (1) 3-Phase Main Power Transformers (MPT)- 130/170/225 ONAN/ONAF/ONAF, 138kV Y- grounded, 34.5kV Y-grounded with a 13.8kV Delta tertiary. The Z% = 5.8% on a 130 MVA base with X/R=55.38 (High side to low side).
- One (1) 138kV circuit breaker.
- One (1) 3-pole 138kV disconnect switch.
- One (1) 138kV generator lead line, 138kV L.17710, from the Generating Facility to the Point of Interconnection.
- Relaying at project developer facility to send a Transfer Trip to TSS 177 Burnham for 138kV CB Breaker Failure. Ability to isolate 87L and DTT functions is required. Example scheme/settings can be provided by ComEd.
- Install three (3) 1200:1 CCVTs on 138kV side of power transformer to be used for System 1 and System 2 relay protection.
- New gas circuit breaker control for loss of SF6 gas condition should be as follows (See Engineering Practice EP-5206E and relay specifications):
 - For an open circuit breaker, when SF6 gas drops to the critical level, the close circuit of breaker shall be opened and line and both CB motor operated disconnects shall be opened.
 - For a closed SF6 gas circuit breaker, when SF6 gas drops to the critical level, the

circuit breaker shall be opened and both CB motor operated disconnects shall be opened.

- Project Developer to provide transformer test reports for 138kV-34.5kV-13.8kV step up transformers. Test reports must include %Z impedance and load loss, including type of Inverter/s used for ComEd short circuit modeling.
- In general, Project Developer relaying, etc. to follow section 6.2 (Design E) of latest version of EED interconnection guidelines (for Generator Greater than 10MW) Rev 2: Effective 12/16/21, with the following project specific notes:
 - New 138kV gas circuit breakers to auto trip and isolate for critical gas level.
 - New 138kV Tie Line terminal relay types to be the same as ComEd terminal relays. This includes firmware versions.
 - Project Developer to ensure proper current contributions from the new Transformer high side breaker CTs to the 138kV line relaying. New 138kV Tie Line relays to account for tripping the new transformer high side breaker.
 - ComEd Protection and Control Engineering must review all Project Developer relay protection design drawings and relay settings.
 - Project Developer equipment impedance and/or test data must be provided to ComEd Protection and Control Engineering for all lines, transformers, and inverters to model in a short circuit program.
 - Project Developer to include Over/Under frequency and voltage protection at Battery Storage collector bus. Under-frequency settings are to comply with MAIN Guide 1B.
 - Dual bus protection for 34.5kV bus.
 - Dual TRFM protection and site protection must be compliant with NERC & PJM requirements.
 - Metering is required to be installed per ComEd & PJM standards. See Section 7.
 - SCADA interface to ComEd will be required, which will most likely require a 3rd party TelCo or wireless connection (to be determined by UCOMM during detailed Engineering phase).
 - Witness testing by ComEd or a DA will be required and must be pre-scheduled at least 90 days in advance.
- All changes to topology, including generation, must be modeled during the Phase 1 study for PRC-027 compliance. A protection system coordination study is required for new BES buses or when there is a 15% (or greater) change in fault current for an existing BES bus. Setting changes may be required per the outcome of this coordination study.
- Project Developer to provide final lead length of 138kV L.17710, electrical characteristics, construction configuration, size of conductors, and impedance characteristics.
- Project Developer to provide limiting Transmission Facility ratings for their portion of 138kV L.17710, in accordance with NERC FAC-008, FERC Order 881 and PJM Operational requirements for normal and emergency ratings from -55F to 130F in 5F increments.

- Project Developer shall provide shunt reactive compensation as required by the PJM Interconnection studies.
- Power output from the Project Developer site shall be in accordance with the power quality standards contained in the IEEE Standard 519. The generating units and all associated equipment at the Project Developer site shall not introduce any distortion of ComEd's waveform or telephone or carrier interference that is inconsistent or conflicts with such standard.
- Relay and protective equipment, telecommunications equipment, and Supervisory Control and Data Acquisition (SCADA) to comply with the ComEd's Applicable Technical Requirements and Standards. 138KV L.17710 will require two Single Mode Fiber paths from TSS 177 Burnham to the developer substation control building approximately 0.17 miles. One fiber path will be dedicated for System 1 Relay/schemes, and the other will be dedicated for System 2 Relays/schemes. These Fiber paths will need to be physically diverse from each other, and each should contain a minimum of 48 Single Mode Fibers. Both Fiber cables will be owned and maintained by the Project Developer, and the demarcation of ownership will be in an FDP within the TSS 177 Burnham control building.
- For any new equipment connected to the BES (Bulk Electric System rated at 100kV or above) the associated primary/System 1 and secondary/System 2 protective schemes to have a minimum redundant:
 - Connected CTs (where available)
 - PT secondary (where available)
 - DC control circuits
 - Auxiliary trip relays
 - Circuit breaker trip coils (where available)
 - Communication circuitry.

B. Transmission Owner Facilities Study Results

The following is a description of the planned Transmission Owner facilities for the physical interconnection of the proposed AF2-441 project to ComEd transmission system. These facilities shall be designed according to ComEd Applicable Technical Requirements and Standards. Once built, ComEd will own, operate, and maintain these Facilities.

1. TRANSMISSION OWNER INTERCONNECTION FACILITIES:

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

- A 138kV dead-end structure and foundation within the fence of the Interconnection Substation, to terminate the Project Developer's generator lead line.
- Line conductor from the dead-end structure to the bus position in the switchyard of the interconnection substation.
- One (1) 138kV circuit breaker (CB) with a minimum nameplate capability 3126/3366/4023/4806 A (747/805/962/1149 MVA) SN/SLTE/SSTE/SLD continuous, and interrupting capability of 63kA at -40°F.

- Two (2) Motor Operated Disconnect (MOD) switches with a minimum nameplate capability 3126/3366/4023/4806 A (747/805/962/1149 MVA) SN/SLTE/SSTE/SLD continuous.
- Three (3) metering CTs, three (3) metering PTs, or a combination unit, meters, and associated equipment to meter L.17710.
 - Install equipment necessary to provide bi-directional revenue metering (kWH, kVARH) and real time data (kW, kVAR, and circuit breaker status and 138kV voltage) for 138kV L.17710, on the ComEd side of the POI per ComEd applicable standards.
- Three (3) 1200:1 CCVTs with dual windings on the line side to be used for primary/System 1 and secondary/ System 2 relay protection.
- Three (3) surge arrestors.
- Foundations and structures.
- Two separate Single Mode Fiber paths will be required between TSS 177 Burnham and the AF2-441 substation building. One fiber path will be dedicated for Primary Relay/schemes, and the other will be dedicated for Secondary Relays/schemes. These Fiber paths will need to be physically diverse from each other, and each should contain a minimum of 48 Single Mode Fibers. Both of these Fiber cables will be owned and maintained by the Project Developer, and the demarcation of ownership will be in an FDP within the TSS 177 Burnham control building. In addition, install load rejection logic such that transfer trip is initiated on both Primary and Secondary relaying to GIC site if L.17710 CB at TSS177 Burnham is opened (referred to GDD 4003 for load rejection design).

2. STAND ALONE NETWORK UPGRADES

This section is not applicable.

3. NETWORK UPGRADES

TSS 177 Burnham Upgrade (NXXXX)

The existing substation, TSS 177 Burnham 138kV, will be upgraded to interconnect the project with the ComEd transmission system.

- Replace manual disconnect switch with a 138kV circuit breaker for Bus-Tie 1-2 and two (2) motor operated disconnect switches (one switch on each side of the circuit breaker). The circuit breaker and switches shall have a minimum thermal capability of 3126/3366/4023/4806 A (747/805/962/1149 MVA) SN/SLTE/SSTE/SLD.
- For 138kV L.17710 install standard ComEd 138kV GIC interface relaying consisting of a Primary 87L-1/SEL-411L (with standard 1300nm 87L port) current differential scheme and a Secondary 87L-2/SEL-311L-1 current differential scheme. Utilize full 2000:5 CT ratio for both systems of line relaying.
- Install three (3) 1200:1 CCVTs with dual windings on 138kV Bus 2 to be used for Primary and Secondary relay protection.
- Install 50BF/79 SEL-451-5 relay and associated LOR per GDD 1930 or 1931 on new line 138kV CB and BT1-2 CB. New CB's must have sync check thru the relay for Manual close, SCADA close, and automatic reclosing.

- Install dual SEL-487Bs and LORs for 138kV Bus 2 per GDD 1920.
- Replace Bus 1 Bus Differential relaying to dual SEL487 per GDD 1920.
- New CB's will have a SEL-2411 installed for CB Monitoring.
- New CB's will have two sets of 2000:5 CT on each side, C800 accuracy class, and at least a 1.5 times rating factor. CB will have MOD on each side that will be tripped/opened on critical gas.
- Install one (1) SCADA cabinet with two (2) SEL-3350 RTACs and two (2) RST-2228 aux switches.
- Connect ComEd-owned revenue meter to new IP switch architecture.
- Install one (1) 208/120VAC outdoor AC panelboard to provide aux power to new 138kV circuit breakers and MODs.
- Install one (1) 125VDC panelboard for the new relaying and new 138kV circuit breakers.
- Update control panel and signage/labeling.
- Review and reset relay settings on 138kV line L17714 and L17712, including remote terminals.

4. OTHER SCOPE OF WORK

This section is not applicable.

5. MILESTONE SCHEDULE FOR COMPLETION OF COMED WORK

Facilities outlined in this report are estimated to take 17 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 | 10 |
| Permitting | 10 | 11 |
| Construction | 12 | 17 |

6. ASSUMPTIONS IN DEVELOPING SCOPE/COST/SCHEDULE

- ComEd estimate does not include costs of design and construction of AF2-441 Lincoln Reserve Energy substation, and transmission as described in Project Developer scope of work. ComEd estimated schedule is based on the GIA contract being executed by all parties.

- This cost estimates assume that work will be performed during normal weekdays and with no overtime. Transmission line outages for construction have not been identified, but generally are available from September to May. These outages are controlled by PJM.
- Costs are based on 2024 rates and do not reflect a potential increase in Labor or Material costs after 2024.
- ComEd cost estimate is valid for six (6) months after Facilities Study release by PJM.
- The Project Developer will be responsible to request and bear the cost for relocation of existing transmission or distribution lines (including structures and other facilities) that may be required for transmission line crossings, the transport of any large equipment, such as turbines, rotors, turbine structures, cranes, etc. Formal submittal of this request to ComEd's TSO for ultimate review by PJM can be made 7 months prior to back feed request date.
- Foundation design assumes typical soil conditions at locations and will be subject to change after soil boring tests.
- All upgrades to facilities included in this document will be required to meet latest ComEd standards.
- Upgrades are subject to change based on detailed design development.
- ComEd will complete pre-design and post construction survey for the transmission and substation upgrades, as required. This includes, but is not limited to, the LIDAR survey and video imaging for transmission lines. Costs associated with this are at the expense of the Project Developer. Pre-design survey must be completed prior to detailed engineering.
- This study assumes that there will be no additional right-of-way and/or easement work required.
- This Facilities Study is time dependent. If the project is not into construction within one year of the issuance, the study will be void and the project re-studied, requiring the completion of a new Facility Study.
- It is assumed that all associated network upgrades, as listed in the Phase 1 study, are complete prior to this queue being placed in service.

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 AF2-441 GIA, and in PJM Manuals M01 and M14D. The details of applicable revenue metering requirements are given in the 'ComEd Interconnection Guidelines' posted on PJM website.

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

- **REVENUE METERING FOR PJM AND COMED**
 - The revenue meter measures the wholesale energy output (Hourly compensated net MWH and Hourly compensated net MVARH) of the Generating Facility.

- The metering equipment, including revenue meter and CT/PT shall be installed, at Project Developer's expense, at the interconnection substation on ComEd side of the Point of Interconnection.
- ComEd shall own, operate, maintain, inspect, and test all the metering equipment as set forth in 'Testing of Metering Equipment' section of the PJM Tariff, at the Project Developer's expense.
- REAL-TIME METERING FOR PJM
 - The Project Developer shall install, own, operate, maintain, inspect, and test real-time metering equipment to measure and transmit directly to PJM the real time MW, MVAR, voltage and status of electrical equipment such as circuit breakers and Motor Operated Disconnect switches, in conformance with the requirements listed in PJM Manuals M-01 and M-14D, at the Project Developer's expense.
- RETAIL METERING FOR COMED
 - The AMI Meter measures the energy consumption by the Project Developer at transmission level and hence shall be designed to measure low MW flow.
 - The metering equipment including AMI Meter and CT/PT shall be installed at the interconnection substation on ComEd side of the POI, at the Project Developer's expense.
 - ComEd shall own, operate, maintain, inspect, and test all the metering equipment as set forth in the 'ComEd Interconnection Guidelines'.
- BATTERY TERMINAL AMI METERING FOR COMED
 - FERC Order 841 designates inflow to charge battery storage facility as wholesale power. To separately measure the power inflow to charge the battery and bill it at wholesale rate, the Project Developer needs to install the following equipment.
 - Advanced Metering Infrastructure (AMI) equipment including AMI Meter and Current Transformer/Potential Transformer (CT/PT) at the output terminal of the battery storage facility to measure power flow from transmission system to charge the battery storage facility.
 - Fiber cable to provide communication link to transmit AMI meter data to the ComEd SCADA system.

8. LAND REQUIREMENTS FOR INTERCONNECTION SUBSTATION

No additional easements, access rights, or temporary or permanent real property rights or acquisitions were identified as required for network upgrades to the ComEd system or for the project to interconnect at this location within this study. However, as further needs are assessed in detailed engineering, design and/or construction activities, if it is determined that there is a need for easements, access rights, or temporary or permanent real property rights or acquisitions, the developer is fully responsible for the costs to acquire these required land rights. Also, as necessary, the schedule will be adjusted accordingly to account for the necessary time to obtain these required land rights. All easements, access rights, or temporary or permanent real property rights or

acquisitions shall comply with all ComEd requirements as detailed in “Land requirements for Interconnection Substations”.

9. ENVIRONMENTAL AND PERMITTING

- ComEd will be responsible to obtain all environmental approvals and permitting required. This includes any endangered species studies and monitoring, as required. Costs associated with this permitting are at the expense of the Project Developer.
- The Project Developer will be responsible for site restoration required for substation and transmission upgrades. This includes, but is not limited to road restoration/improvements, wetland restoration, and farm field restoration/crop damage. Costs associated with this are at the expense of the Project Developer.
- The Project Developer will be responsible for the cost to purchase real estate or obtain the necessary right-of-way easement for all upgrades associated with this project. These associated upgrades are not included in the costs listed in this study.
- The Project Developer will be responsible for remediation costs for locations found to have environmental contaminations and remediation. This may require contaminated soil disposal as well as lead paint removal for existing structure work.
- It is assumed that all necessary permits will be obtained in a timely manner to allow engineering and construction to proceed according to the Milestone Schedule.
- It is assumed that conveyance of property and rights will be obtained to support the PJM Transmission Outage Schedule.
- It is assumed that the required Environmental Study will yield no impediments to the development of the site.
- ComEd will complete geotechnical soil borings, resistivity study, and analysis for substation and transmission upgrades. Costs associated with this are at the expense of the Project Developer.

C. APPENDICES

- Attachment #1: Single line Diagram for the Physical Interconnection
Attachment #2: Substation General Arrangement (Attached Separately)

Attachment #1

AF2-441
PRIMARY POI

