Transmission Interconnection Facilities Study Report

For

PJM Transmission Interconnection Request Queue Position AE1-115

"Churchtown 69kV"

December 2021
Revised: February 2022

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A. Transmission Owner Facilities Study Summary

1. Description of Project

Churchtown Battery Storage LLC, the Interconnection Customer (IC), has proposed a 20 MW Energy (10 MW Capacity) battery storage facility to be located at Latitude: 39.6736010 Longitude: -75.5034740 in Salem County, New Jersey. PJM studied the AE1-115 project as an injection into the Atlantic City Electric Company (ACE) transmission system at the Churchtown 69kV Substation (PSSE bus #228319) and evaluated it for compliance with reliability criteria for summer peak conditions in 2022. The project was studied at a commercial probability of 100%.

A new terminal will be established on the 69kV ring bus at the Churchtown substation. The new terminal will be constructed at the open position between Breakers "N" and "AW". This terminal will require a 69kV circuit breaker (herein referred to as CB "BV") with two 69kV disconnect switches, a 69kV motor-operated line disconnect switch, surge arresters, CVT's, and a 69kV cable termination riser structure.

A 69kV underground transmission line must be constructed from this new terminal to the IC's interface station. This line will exit Churchtown Substation to the northwest using underground construction, where it will transition to overhead construction for the final span into the IC's interface station. This interface station will be constructed and owned by the IC and must be in a location which enables an IC owned circuit breaker to be located within 500 feet of Churchtown Substation. The Point of Interconnection (POI) and required revenue metering equipment will be located within this newly established station. See Attachment #1.

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

The scope of the project as stated in the System Impact Study, dated September 2019, has changed. The proposed transmission line for the IC interface station will leave Churchtown Substation underground. In addition, the estimates herein provided were performed in more detail than those provided in the Impact Study. The project schedule has also changed due to anticipated start date and project lifecycle schedule.

3. Interconnection Customer's Milestone Schedule

The planned in-service date, as requested by the IC is November 1, 2021. This date is not attainable due to the need for additional studies, the Transmission Owner's construction schedule, and the required permitting process.

ACE's portion of the project is projected to be completed approximately 18-24 months following an executed Interconnection Service Agreement (ISA) and Construction Service Agreement (CSA). This is assuming a standard land use and environmental permitting and approval process.

4. Customer's Scope of Work

The Interconnection Customer (IC) is responsible for all design and construction related to activities on their side of the Point of Interconnection (POI). Site preparation, including clearing, grading and an access road, as necessary, is assumed to be by the IC. The access road design must be approved by ACE to ensure it provides adequate access to the substation to support construction and maintenance activities. Route

selection, line design, and right-of-way acquisition for the IC's facilities are not included in this report and are the responsibility of the IC. Protective relaying and metering design and installation must comply with ACE's applicable standards. The IC is also required to provide revenue metering and real-time telemetering data to PJM in conformance with the requirements contained in PJM Manuals M-01 and M-14 and the PJM Tariff.

ACE Interconnection Customer Scope of Direct Connection Work Requirements:

- ACE requires that an IC circuit breaker is located within 500 feet of the ACE substation to facilitate the relay protection scheme between ACE and the IC at the Point of Interconnection (POI).

Special Operating Requirements

1. ACE will require the capability to remotely disconnect the battery storage facility from the grid by communication from its System Operations facility. Such disconnection may be facilitated by a generator breaker or other method depending upon the specific circumstances and the evaluation by ACE.
2. ACE reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including but not limited to metering and telecommunications facilities, owned by ACE.

Additional Interconnection Customer Responsibilities:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

5. Description of Facilities Included in the Facilities Study (ACE's Scope of Work)

Substation Interconnection Estimate

Scope: Establish a new position on Churchtown Substation's 69kV ring bus between the existing breaker "N" and "AW" positions. This new terminal will require the installation of a new 69kV circuit breaker with associated disconnects, a 69kV 3-phase motor operated line disconnect switch, surge arresters, and a 69kV cable termination structure. The bus section for this terminal will be equipped with a new three-phase bank of 69kV CVTs as well as protective relaying. Establishing the new terminal will require installation of new rigid and flexible bus on ACE's existing steel box structure. The 69kV cable termination and CVTs will be installed with associated support structures and foundations.

Major Equipment Included in Estimate:

- Control Panel, 69kV Circuit Breaker (24'') Qty. 1
- Relay Panel, Bus Differential, Pri/BU (24") Qty. 1
- 69kV Gas Circuit Breaker, 2000A, 40kA Qty. 1
- CVT, 69kV class, single-phase, dual windings Qty. 3
- Disconnect Switch, 3-Phase Group operated, 69kV, 2000A, Manual Worm gear,

Center Break Qty. 2

- Disconnect Switch, 3-Phase Group operated w/ motor operator, 69kV, 2000A, Vertical Break with Quick Break Whips Qty. 1
- Surge Arrester, 69kV Station Class, Polymer Qty. 3
- Revenue Grade Meter Qty. 2
- Cable Termination Riser, 69kV Qty. 1

Substation Estimate Assumptions:

- Based on a review of the drawings, the ground grid is sufficiently robust and does not need to be upgraded. However, a study will be done during detailed design to verify this assumption.
- No additional yard lights will be added.
- No additional lightning protection will be added.

Required Relaying:

New protective relays are required for the new IC terminal. Two (2) differential relays will be required for primary and back-up protection. These relays will wrap the IC's breaker and the two breakers for the IC's line position at Churchtown Substation. A new relay will also be required for the control and breaker failure protection of the new 69kV circuit breaker. Modifications must also be made to the existing protection schemes involving CB "AW", CB "N", CB "LM", and CB "IO" to accommodate the new circuit breaker in the ring.

ACE reserves the right to review the electrical protection design and relay settings for interconnecting customer facilities to ensure that the protective relaying equipment will be compatible with that installed at the remote substations. All interface settings and protection equipment shall be reviewed and approved by ACE. ACE personnel must be present at the time of commissioning to witness proper function of the protection schemes and related coordination.

Transmission Line Estimate

Scope: An underground 69kV getaway will be constructed between the cable termination structure installed as part of the substation portion of this project and the cable transition structure to be located between the IC's interface station and the Churchtown Substation fence line. The line will enter the substation in an ACE standard concrete-encased duct before sweeping up to the cable termination structure installed as part of the substation scope. Each phase of conductor will be routed through separate 6" schedule 40 PVC conduit

Major Equipment Included in Estimate:

- 69kV cable transition structure, galvanized steel construction Qty. 1
- 69kV Cable Terminators Qty. 6
- 69kV Dead-End Insulator Assemblies, Toughened Glass Qty. 6
- 69kV Surge Arresters Qty. 3
- 69kV aerial conductor (795 ACSR Drake 45/7 or equivalent) Qty. 750 lf

- 69kV 2500 kcmil XLPE CU cable Qty. 1200 lf
- 69kV 500 kcmil XLPE CU cable Qty. 400 lf
- OPGW (type unknown at this time) Qty. 250 lf
- Static wire (type unknown at this time) Qty. 250 lf

Transmission Line Estimate Assumptions:

- This estimate is based on the assumed work scope and materials described in this document. This estimate may change based on the actual location of the POI station and the resulting line length and routing.
- The IC will construct the generator tie line up to the cable transition structure outside of ACE's substation
- The cable transition structure outside of the ACE substation fence may be located on ACE property assuming necessary rights are acquired by the IC.
- The IC is responsible for obtaining any new ROW and permits for routing the transmission line between Churchtown Substation and the IC's POI station. Tree / vegetation clearing is anticipated for this new line and will also be the responsibility of the IC.
- The IC is responsible for constructing the 69kV line between their interface station and their generation facilities, including obtaining all necessary permitting and rights-of-way.
- Based on the ACE UG Transmission design process, an Underground Interference Study is required to approve this route relative to existing subsurface installations
- Due to excavation required to establish the UG transmission path, minor site work will be necessary to dispose of waste soil and restore the disturbed area. The amount of restoration will vary based on construction methodology.

6. Total Cost of Transmission Owner Facilities Included in the Facilities Study

Item	*Total Cost*
Substation Attachment Facilities	$1,902,742
Transmission Line Attachment Facilities	$1,548,995
Total Cost	**$3,451,737**

7. Summary of the Schedule for Completion of Work for the Facilities Study

Attachment Facility	*Timeframe*
Engineering, Procurement, and Construction	18-24 months

B. Transmission Owner Facilities Study Results

This section describes facilities identified to be installed (attachment facilities), replaced, and/or upgraded (upgrade facilities) by ACE to accommodate the project. During detailed design and analysis other components may be identified for installation or replacement due to this interconnection.

1. Transmission Lines –New

Transmission Line between Churchtown Substation and IC's POI Station

- Install one (1) drilled pier, estimated to be 7 feet in diameter and 30 feet long for the cable transition structure.
- Install one (1) galvanized steel monopole cable transition structure, of tapered tube construction. The precise location for this structure will be determined based on the final location of the IC's interface station.
- Install 350' of concrete encased duct bank, with a schedule 40 PVC eight-conduit arrangement
- Install all required transmission insulator assemblies and hardware
- Install phase conductors and static wire between the cable transition structure and the take-off tower at the IC's POI station.

2. Transmission Lines – Upgrade

No direct connect scope.

3. New Substation/Switchyard Facilities

No direct connect scope.

4. Substation/Switchyard Facility Upgrades

Additions / Modifications at ACE's Churchtown Substation

- Install substation equipment grounding in areas of equipment additions
- Install cable and conduit as required
- Install one (1) disconnect switch, 69kV, 2000A, three-phase, group operated w/ motor operator, vertical break, horizontally mounted w/ quick-break whips
- Install four (4) drilled piers for surge arrester, CVT & cable termination structures
- Install one (1) 69kV breaker foundation, pad
- Install one (1) 69kV gas circuit breaker, 2000A, 40kA
- Install two (2) disconnect switches, 69kV, 2000A, three-phase, group operated w/ manual worm gear, center break
- Install one (1) cable termination structure, 69kV, three-phase, two-leg

- Install one (1) surge arrester support structure, three-phase, 1-leg
- Install three (3) surge arresters, 69kV station class, polymer
- Install one (1) CVT support structure, three-phase, 1-leg.
- Install three (3) CVTs, 69kV class, single phase, dual-windings
- Install three (3) microprocessor-based relay & control panels
- Install 69kV substation bus, insulators, connectors, etc. as required
- Test and commission all new relay, control, and communications configurations

5. Telecommunications Facilities – Upgrades

No direct connect scope.

6. Metering & Communications

A three-phase 69kV revenue metering point will need to be established within the IC's facility at the POI. The IC will purchase and install all metering instrument transformers (including one spare to be kept on site) as well as construct a metering structure per ACE's specifications. The secondary wiring connections both at the instrument transformers and at the metering enclosure will be completed by ACE's metering technicians. The metering control cable and meter cabinets will be supplied by ACE and installed by the IC's contractors. The IC will install conduit for the control cable between the instrument transformers and the metering enclosure. The location of the metering enclosure will be determined in the construction phase. The IC will provide 120V power to the meter cabinet. ACE will provide both the Primary and Backup meters. ACE's meter technicians will program and install the Primary & Backup solid state multi-function meters for the new metering position.

The Primary meter will be equipped with load profile, telemetry, and DNP outputs. The IC will be provided with the Primary meter's DNP output via RS-485. Transmission Owner will supply a wireless modem for MV90 interrogation. In the event that a wireless modem is unable to reliably communicate, the IC will be required to make provisions for a POTS (Plain Old Telephone Service) line or equivalent technology approved by DPL within approximately three feet of the DPL metering position to facilitate remote interrogation and data collection. It is the IC's responsibility to send the data that PJM and ACE require directly to PJM. The IC will grant permission for PJM to send ACE the following telemetry that the IC sends to PJM: real time MW, MVAR, volts, amperes, generator status, and interval MWH and MVARH.

7. Environmental, Real Estate and Permitting

Construction of the proposed duct bank will require environmental permitting and tree clearing. The extent of clearing required can be determined once the location of the IC' substation has been set.
The IC is responsible for obtaining all permits (such as road crossings, railroad crossings, water crossings, or environmental permits if necessary), so those costs are not included in this estimate; however, permitting must be factored into the project's schedule. Based on a review of the drawings and Google Earth imagery, it does not appear that road crossings, railroad crossings or water crossings

will be needed for the line between Churchtown Substation and the IC's interface station and that matting requirements for this line will not be extensive.

All work to accommodate the interconnection of AE1-115 is dependent upon the IC obtaining all necessary permits. Moreover, the IC shall be responsible for acquiring all necessary real property rights and acquisitions, including but not limited to: rights of way, easements, and fee simple, in a form approved by ACE. Any setbacks in obtaining the necessary real property rights, acquisitions and permits required for this interconnection may delay the construction schedule.

8. Summary of Results of Study

Project Name: AE1-115 Churchtown 69kV	**Indirect Cost ($)**		**Direct Cost ($)**		**Total Cost ($)**
Substation Direct Connect Facilities	**Material**	**Labor/Fees/Equip.**	**Material**	**Labor/Fees/Equip.**	
Project Planning, Permits, Approvals, Post-Construction & Close-Out		$391,070		$142,615	$533,685
Detailed Engineering & Design, Material Procurement		$112,840		$22,265	$135,105
Construction Planning, Prep, and Oversight		$278,520		$69,852	$348,372
Substation Construction		$305,078	$212,195		$517,273
Test & Energization		$33,450		$4,731	$38,181
Project Oversight & Overhead Costs				$330,126	$330,126
Total Cost	$0	$1,120,958	$212,195	$569,589	$1,902,742

Project Name: AE1-115 Churchtown 69kV	**Indirect Cost ($)**		**Direct Cost ($)**		**Total Cost ($)**
Transmission Line Direct Connect Facilities	**Material**	**Labor/Fees/Equip.**	**Material**	**Labor/Fees/Equip.**	
Project Planning, Permits, Approvals, Post-Construction & Close-Out		$262,070		$73,035	$335,105
Detailed Engineering & Design, Material Procurement		$92,430		$32,092	$124,522
Construction Planning, Prep, and Oversight		$95,721		$51,750	$147,471
Transmission Construction		$465,895	$326,910	$7,709	$800,514
Demolition and Salvage		$23,400			$23,400
Project Oversight & Overhead Costs				$117,983	$117,983
Total Cost	$0	$939,516	$326,910	$282,569	$1,548,995

Generation projects meeting IRS "Safe Harbor" provisions generally do not incur "CIAC" (Contribution in Aid to Construction), a tax collected by the utility for the state or federal government. ACE does not expect to collect CIAC for this project. If for any reason, "CIAC" would be required for this project, it would be the responsibility of the party owning the generator to pay this cost.

ACE reserves the right to charge the Interconnection Customer operation and maintenance expenses to maintain the Interconnection Customer attachment facilities, including metering facilities, owned by ACE.

9. Schedules and Assumptions

The overall estimated timeline for ACE to place its direct connect facilities in service for this project is approximately 18-24 months after receipt of a fully executed Interconnection Service Agreement (ISA) and Construction Service Agreement (CSA).

Storm damage and restoration, time of year limitations, permitting issues, outage scheduling, system emergencies, and contractor and equipment availability could also impact the schedule. It is important to note that this project will be incorporated into the existing project work load at ACE at the time of contract execution. If the work load of existing projects is extensive, resource constraints may cause this project to be delayed beyond the projected in-service date.

Attachment #1