Transmission Interconnection Facilities Study Report

For

PJM Transmission Interconnection Request Queue Position AE1-062

"Silver Lake 69kV"

January 2022

Table of Contents

A. Transmission Owner Facilities Study Summary

1. Description of Project

Silver Lake Battery Storage, LLC, the Interconnection Customer (IC), has proposed a 20MW Energy (10MW Capacity) battery storage facility to be located at Latitude: 39.8095600 Longitude: -74.9519540 in Camden County, NJ. PJM studied the AE1-062 project as an injection into the Atlantic City Electric Company (ACE) transmission system at the Silver Lake 69kV Substation and evaluated it for compliance with reliability criteria for summer peak conditions in 2022. The project was studied at a commercial probability of 100%.

The substation work required to accommodate this interconnection consists of establishing a new 69kV line terminal position at Silver Lake substation by converting the existing straight bus into a 69kV ring bus configuration. This new terminal will require the relocation of two (2) 69kV circuit breakers and their associated disconnects, installation of a new 69kV motor operated line disconnect switch, new surge arresters, one (1) 69kV CVT installation, and a 69kV box structure. Reconfiguring the 69kV yard will require the relocation of a third 69kV circuit breaker and associated disconnects, installation of a second new 69kV box structure, three (3) new 69kV circuit breakers with disconnects, two (2) 69kV cable termination riser structures, five (5) 69kV CVT installations, and four (4) 69kV motor operated disconnects. During this reconfiguration, the existing 69kV Lindenwold Line (TSOM #0744) will be relocated to a new position. Construction of these upgrades will require temporary expansion of the substation yard to allow for a mobile transformer unit to be placed in service during construction.

The transmission work required to accommodate this interconnection consists of relocating the existing 69kV Lindenwold Line (TSOM#0744) takeoff to its proposed position in the new Silver Lake 69kV ring bus and establishing temporary sources for feeding the mobile unit required for the substation portion of this project. A new overhead 69kV line will also be established from the proposed IC position at the Silver Lake 69kV Substation to 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 Silver Lake 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 ring bus configuration will require the relocation of the existing 69kV Lindenwold Line to a new takeoff position, as well as temporary expansion of the yard to house mobile transformation. The inclusion of mobile transformation will require upgrades and temporary additions to existing nearby 69kV infrastructure. 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 determined by ACE's schedule is January 31, 2026.

ACE's portion of the project is projected to be completed approximately 36-48 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. The Interconnection Customer shall design its non-synchronous generation facility with the ability to maintain a power factor of at least 0.95 leading to 0.95 lagging measured at the Point of Interconnection

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: Reconfigure the existing 69kV line bus at Silver Lake Substation into a standard ACE ring bus configuration and establish a new terminal position for the IC.

Creating the ring bus will require the relocation of the existing 69kV Lindenwold Line along with an existing 69kV breaker and associated disconnects. Three new 69kV circuit breakers, four motor operated disconnects, and five three-phase CVT installations along with foundations and support structures will be installed throughout the 69kV yard. Two 69kV box structures will also be required along with two 69kV cable termination riser structures. These structures will be connected by 69kV cables run in concrete-encased duct bank to close the ring. The existing battery system will be replaced, and a DC distribution panel will be installed in the Silver Lake control enclosure and new cable trench will be installed throughout the yard.

Establishing the IC's terminal position will require the installation of a new 69kV box structure, a three-phase motor operated line disconnect switch, surge arresters, and the relocation of two existing 69kV circuit breakers. The bus section for this terminal will be equipped with a new three-phase bank of 69kV CVTs as well as protective relaying. All new equipment will be installed with associated support structures and foundations.

The existing Silver Lake Substation will also be temporarily expanded in order to house a mobile transformation unit that is required to serve load during construction. The ground grid and substation fence will need to be extended to enclose this new area.

Major Equipment Included in Estimate:

- 69kV Gas Circuit Breaker, 2000A, 40kA — Qty. 3
- Relay Panel, Bus Differential, Pri/BU (24") — Qty. 1
- Control Panel, 69kV Circuit Breaker – Dual Breaker (24") — Qty. 3
- DC Distribution Panel — Qty. 1
- 125V Battery System, 60 cells — Qty. 1
- 125V Battery Charger — Qty. 2
- CVT, 69kV Station Class, single-phase, dual windings — Qty. 18
- Cable Trench, H-20 Rated — Qty. 300 ft.
- Disconnect Switch, 3-Phase Group operated w/ manual worm gear, 69kV, 2000A, Center Break — Qty. 7
- Disconnect Switch, 3-Phase Group operated w/ Motor Operator, 69kV, 2000A, Vertical Break with Quick Break Whips — Qty. 4
- Disconnect Switch, 3-Phase Group operated w/ Motor Operator, 69kV, 3000A, Vertical Break with Quick Break Whips — Qty. 1
- 69kV 2500kcmil CU cable terminators — Qty. 12
- Surge Arrester, 69kV Station Class, Polymer — Qty. 9
- Revenue Grade Meter — Qty. 2

Substation Estimate Assumptions:

- 69kV circuit breakers "L", "D", and "E" can be reused at their newly proposed locations.
- Due to the extensive reconfiguration of the Silver Lake 69kV bus, it is likely that much of the load served from Silver Lake will need to be firmed externally during construction. A mobile transformer will need to be installed at Silver Lake and tied directly to the 12kV bus. It is assumed that the mobile unit can be placed adjacent to Silver Lake's southwest fence line.
- 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 Silver Lake Substation. Three new relays will also be required for the control and breaker failure protection of the new 69kV circuit breakers. Modifications must also be made to the existing protection schemes at Silver Lake to accommodate the new bus configuration.

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: A 69kV path will be established between the new terminal position installed as part of the substation portion of this project and the dead-end structure located in the IC's interface station. The line will be of overhead construction.

In order to support the creation of a new 69kV ring bus at Silver Lake Substation, the nearby 69kV transmission lines Atco (TSOM# 0706) and Lindenwold (TSOM# 0744) will be reconfigured to establish sources to the required mobile transformation unit. Temporary poles will be placed with one-way line switches to facilitate a second source, and a 3-pole dead end structure will be installed to create drops to the mobile unit.

Additionally, the existing 69kV Lindenwold Line will be rerouted to its new takeoff position within Silver Lake Substation.

Major Equipment Included in Estimate:

- 69kV angle structure, galvanized steel, tapered tube construction Qty. 2
- 69kV dead-end monopole structure, galvanized steel, tapered tube construction Qty. 7
- 69kV 3-pole dead-end structure, wood pole construction, heavy class Qty. 1
- 69kV tangent structure, wood pole construction, heavy class Qty. 3
- 69kV Line Switch, 2000A, one-way, manual operator Qty. 3
- 69kV Dead-End Insulator Assemblies, Toughened Glass Qty. 42

- 69kV Dead-End Insulator Assemblies, Polymer Qty. 27
- 69kV Suspension Insulators, Polymer Qty. 6
- 69kV aerial conductor (795 ACSR Drake 26/7 or equivalent) Qty. 3250 lf
- OPGW (type unknown at this time) Qty. 500 lf
- Static wire (type unknown at this time) Qty. 1000 lf

Transmission Line Estimate Assumptions:

- Since the exact location of the IC's POI station is not known, it has been assumed that it will be located to the West and North of Silver Lake Substation (within 500 feet of the substation). 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 new 69kV line between Silver Lake Substation and the IC's POI station will be overhead construction. It is assumed that water and public road crossings are not necessary.
- The IC is responsible for obtaining any new ROW and permits for routing the transmission line between Silver Lake 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.
- The relocated Lindenwold 69kV line will exit Silver Lake Substation to the West from its proposed new takeoff. It has been assumed that one 69kV angle structure, and two 69kV dead-end monopole structures will be required to relocate this line.
- The temporary mobile unit feed will require the installation of a new 3-pole dead-end structure and three new tangent structures with one-way line switches. Three existing 69kV poles will be spot replaced with updated framing.

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

Item	*Total Cost*
Substation Attachment Facilities	$6,918,458
Transmission Line Attachment Facilities	$3,736,468
Total Cost	**$10,654,926**

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

Attachment Facility	*Timeframe*
Engineering, Procurement, and Construction	36-48 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 Silver Lake Substation and IC's POI Station

- Install two (2) drilled piers, estimated to be 7 feet in diameter and 30 feet long for the steel dead-end structures.
- Install two (2) galvanized steel monopole dead-end structures, of tapered tube construction. The precise location for these structures will be determined based on the final location of the IC's interface station.
- Install all required transmission insulator assemblies and hardware.
- Install phase conductors and static wire between ACE's take-off structure and the take-off tower at the IC's POI station.

2. Transmission Lines – Upgrade

Transmission Line #0744 Lindenwold Relocation

- Install two (2) drilled piers, estimated to be 7 feet in diameter and 30 feet long for the steel dead-end structures.
- Install two (2) galvanized steel monopole dead-end structures, of tapered tube construction. The precise location for these structures will be determined during detailed engineering design.
- Install two (2) galvanized steel angle structures, of tapered tube construction with caisson foundations.
- Install all required transmission insulator assemblies and hardware.
- Install phase conductors and static wire between the new 69kV Lindenwold terminal position and the existing line.

Transmission Lines #0744 & #0706 Upgrades for Mobile Transformation Service

- Install three (3) drilled piers, estimated to be 7 feet in diameter and 30 feet long for the steel dead-end structures.
- Install three (3) galvanized steel monopole dead-end structures, of tapered tube construction. The precise location for these structures will be determined during detailed engineering design.
- Install three (3) tangent structures of wood pole construction, heavy class.
- Install three (3) single-phase 69kV Line Switches, one-way with manual operators.
- Install one (1) 3-pole dead-end structure of wood pole construction, heavy class.
- Install all required transmission insulator assemblies and hardware.

- Install phase conductors and static wire between ACE's 69kV infrastructure and the mobile transformation unit.

3. New Substation/Switchyard Facilities

No direct connect scope.

4. Substation/Switchyard Facility Upgrades

Additions / Modifications at ACE's Silver Lake Substation

- Install substation equipment grounding in areas of equipment addition and yard extension
- Upgrade 125V battery and DC distribution systems in the Silver Lake Substation control enclosure.
- Install four (4) disconnect switches, 69kV, 2000A, three-phase, group operated w/ motor operator, vertical break, horizontally mounted w/ quick-break whips
- Install one (1) disconnect switch, 69kV, 3000A, three-phase, group operated w/ motor operator, vertical break, horizontally mounted w/ quick-break whips
- Install eighteen (18) drilled piers for box structures, surge arresters, CVTs & cable termination structures
- Install six (6) 69kV breaker foundations, pad
- Install three (3) 69kV gas circuit breakers, 2000A, 40kA
- Relocate three (3) existing 69kV gas circuit breakers "L", "D", & "E" along with their associated disconnects
- Install seven (7) disconnect switches, 69kV, 2000A, three-phase, group operated w/ manual worm gear, center break
- Install two (2) cable termination structures, 69kV, three-phase, two-leg
- Install two (2) 69kV box structures, 28' x 28'
- Install one (1) 69kV low bus support structure, 1-leg
- Install nine (9) surge arresters, 69kV station class, polymer
- Install five (5) CVT support structure, three-phase, 1-leg
- Install eighteen (18) CVTs, 69kV class, single phase, dual-windings
- Install four (4) microprocessor-based relay & control panels
- Install 300' of H-20 rated cable trench
- Install 69kV substation bus, insulators, connectors, etc. as required
- Install cable and conduit 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 ACE within approximately three feet of the ACE 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 transmission line will require environmental permitting and tree clearing. The extent of clearing required can be determined once the location of the IC's 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 Silver Lake 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 AE1-062 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: AE1-062 Silver Lake 69kV Substation Attachment Estimate	**Indirect Cost ($)**		**Direct Cost ($)**		**Total Cost ($)**
Direct Connect Facilities	**Material**	**Labor/Fees/Equip.**	**Material**	**Labor/Fees/Equip.**	
Project Planning, Permits, Approvals, Post-Construction & Close-Out				$345,831	$345,831
Detailed Engineering & Design, Material Procurement				$566,835	$566,835
Construction Planning, Prep, and Oversight				$627,398	$627,398
Substation Construction			$1,079,286	$2,730,814	$3,810,100
Test & Energization				$204,000	$204,000
Project Oversight & Overhead Costs		$735,369			$735,369
Contingency			$200,000	$429,025	$629,025
Total Cost		$735,369	$1,279,286	$4,903,803	$6,918,458

Project Name: AE1-062 Silver Lake 69kV Transmission Attachment Estimate	**Indirect Cost ($)**		**Direct Cost ($)**		**Total Cost ($)**
Direct Connect Facilities	**Material**	**Labor/Fees/Equip.**	**Material**	**Labor/Fees/Equip.**	
Project Planning, Permits, Approvals, Post-Construction & Close-Out				$137,601	$137,601
Detailed Engineering & Design, Material Procurement				$325,080	$325,080
Construction Planning, Prep, and Oversight				$237,127	$237,127
Transmission Construction			$911,629	$1,394,166	$2,305,795
Project Oversight & Overhead Costs		$317,237			$317,237
Contingency			$100,000	$313,628	$413,628
Total Cost		$317,237	$1,011,629	$2,407,602	$3,736,468

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 36-48 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