Generation Interconnection

Feasibility Study Report

for

Queue Project AF1-003

HAWKINS GATE-BILLINGSLEY RD 69 KV

20 MW Capacity / 9.5 MW Energy

February, 2020

I. Background

The Interconnection Customer (IC) is proposing a 20.0 MW Energy (9.5 MW Capacity) solar generating facility to be located in White Plains, Maryland. The facility proposes to interconnect to the Southern Maryland Electric Cooperative (SMECO) electric system.

SMECO studied the proposed project's primary POI local area impacts using the local SMECO 2019 model build seasonal year 2023 PSSE power flow model. PJM studied the broader regional area impacts using the PJM 2017 series RTEP model build summer 2022 case at 69 kV bus #227005 "HAWK 69". The proposed IC project in-service date is July 30, 2021. The proposed in-service date may be unattainable due to the required PJM studies and proposed SMECO construction schedules provided in section VII.

II. Point of Interconnection

The generating facility is proposing a primary and a secondary interconnection option to the local SMECO electric system. The primary interconnection location is SMECO 69 kV line #6716 approximate structure #37 at GPS coordinates 38.5756 latitude and -76.9272 longitude. The secondary interconnection location is SMECO 69 kV line #6726 approximate structure #46 at GPS coordinates 38.5589 latitude and -76.9516 longitude.

Both the primary and the secondary interconnection locations require SMECO to construct a new 69 kV ring bus switching station to act as the defined point of interconnection (POI) between SMECO and the generating facility.

III. Interconnection Customer Project Information

The proposed generating facility is interconnecting to the 69 kV SMECO electric system. The proposed facility consists of PV solar panels mounted to a 15 degree fixed tilt racking system with ten 2450 KVA rated DC-to–AC inverters. Major equipment information is as follows:

Solar Panels (71,739)	Jinko JKM 395M-72V modules, 15-degree fixed tilt orientation
UL1741 Compliant Inverters (10)	SMA Sunny Central 2500-EV
Distribution Transformers (5)	SMA Manufacturer, 4900 KVA, 3-winding, 34.5 kV wye : 550V delta : 550V delta, 5.75% Z, X/R = TBD
Power Transformer (1)	TBD manufacturer, 16.5/22/27.5 MVA, 69 KV wye : 34.5 KV wye : 12.47 kV delta tertiary, 8.5% Z.
Sectionalizing cabinet (x)	N/A
Breakers (2)	One at 69 kV, 600-amp and one at 34.5 kV, 1200-amp
Protection Relays (3)	Two at SEL-351 and one at SEL-387
CT / PT Combo metering unit (1)	69 kV, outdoor rated 500:5 CT ratio and 350:1 PT ratio
Gen Tie Line conductor	TBD size and type, length estimated to be between 0.8 and 1.25 miles depending on selected route.

IC Reactive capacity: Estimated inverter capacity at 95% power factor is ~7.6 MVar leading (absorbing) or lagging (supplying) based on 24.5 MVA inverter nameplate rating. Provisions for additional capacitor rack is not apparent.

IC facilities Sequence of Operation not specified at this time, TBD.

IC engineering, permitting, and construction schedule not specified at this time, TBD.

IV. Analysis

The Interconnection Feasibility Study analysis scope includes preliminary identification of:

1. Over-duty circuit breaker short circuit capability limits,
2. Line or equipment thermal overload issues,
3. Bus voltage limit violations,
4. Protective sectionalizing issues, and
5. Power Flow issues.

The Feasibility Study analysis includes a preliminary scope of work and non-binding cost estimate for interconnection facilities or upgrades required to interconnect the proposed project to the local area electric system in a safe and reliable manner. Neither transient stability analysis or adjacent circuit and substation contingency switching analysis is included within the Feasibility analysis scope; but, such analysis may be included as part of a future System Impact Study scope if determined to be necessary at that time.

SMECO utilizes a DNV-GL vendor software product called ***Synergi Electric*** to analyze potential generation impacts to the local area 15 kV electric system. A similar Siemens vendor product called ***PSS/E*** and Aspen vendor product called ***OneLiner*** are used to analyze potential generation impacts to the local area 69 kV and 230 kV electric system. PJM uses these same two products to evaluate potential generation impacts to the broader regional electric system.

These products create a study area circuit software model that includes the proposed project interconnection. In addition to traditional power flow and short circuit analysis, the model(s) may be used to determine the time-of-day impact of proposed intermittent generation (i.e. solar or battery ESS are two such examples) on the local electric system. Several different time-of-day model simulations may be systematically applied to determine what types of voltage and demand variations occur as random intermittent generator outputs change and how specific individual intermittent generators affect the local area electric system. The time-of-day model simulations consider: seasonal light and peak load conditions, hourly time-of-day impacts, generation output fluctuations, and the operational randomness of other pre-existing intermittent generation sources.

V. Results

Local Area Power Flow Analysis: SMECO evaluated local area power flow for summer, winter, and minimum light load seasonal conditions based on year 2023 area configuration and forecasted loads. Area PJM solar generation projects AC2-101 Shugart and AC2-120 Ripley are assumed to be in-service. The proposed AF1-003 Willets Crossing generation is assumed to use a volt-var control strategy to maintain the POI bus voltage at 1.0 per unit. Maximum assumed AF1-003 Willets Crossing generation reactive capacity is 7.6 MVar at 95% power factor based on the project's stated 24.5 MVA inverter nameplate rating.

No apparent adverse bus voltage or facility thermal loading conditions are evident on the SMECO electric system based on this analysis; however, notable findings include:

1. The proposed solar generation results in both bus #227005 Hawkins Gate 230 kV: 69 kV power transformers being nearly unloaded during light load daytime demand periods. This issue is further exasperated to where reverse power can flow back into the Pepco electric system when PJM interconnection queue project AF1-005 Pisgah is included.

Local Area Short-Circuit Analysis: SMECO evaluated local area fault current contributions based on the year 2023 local SMECO area configuration and the regional PJM 2019 series Aspen short-circuit model "PJMSC_2021_03142019" connected generation sources. No adverse fault current contribution issues are evident.

Description	Breaker Rating (A)	Existing *		Proposed	
		SLG (A)	TPH (A)	SLG (A)	TPH (A)
Hawkins Gate switching station 69 kV bus	40,000	31,763	26615	31,778	26,631
Westlake #2 substation 69 kV bus	40,000	6,078	9,734	6,078	9,741
Westlake #2 substation 12.47 kV bus	20,000	13,678	12,611	13,680	12,614
Wooded Glen substation 69 kV bus	40,000	8,775	11,280	8,778	11,302
Wooded Glen substation 12.47 kV bus	25,000	9,618	9,149	9,621	9,152

* Existing conditions include the fault current contribution for PJM Queue project #AC2-101 Shugart and AC2-120 Ripley solar farms.

VI. Scope of Work

The proposed POI and physical demarcation between SMECO and the IC is a SMECO owned and installed self-supporting dead-end structure within the confines of a new SMECO owned 69 kV ring bus switching station. The physical connection between the switching station and the POI dead-end structure is overhead line conductor jumpers.

The 69 kV ring bus switching station is a low-profile design with three breakers, disconnect switches, bus work, revenue metering, and protective relaying / control circuits with associated communications in a climate controlled building. Additional land is required to physically permit and build the new SMECO switching station.

The primary POI option already has 69 kV breaker line current differential protective relaying at the associated SMECO line #6716 up-stream Hawkins Gate switching station and down-stream Westlake substation terminal locations. Similarly, the secondary POI option also has 69 kV breaker line current differential protective relaying at the associated SMECO line #6726 up-stream Hawkins Gate switching station and down-stream Dorchester substation terminal locations.

SMECO Scope of Work Clarifications:

1. Cost estimate includes: a) site design and grading for SMECO owned facilities, b) existing 69 kV SMECO line modifications, and c) switching station site work including associated foundations, steel and equipment, bus work, control house, relays, construction, testing and commissioning.
2. Cost estimate does not include any associated new right-of-way, land acquisition, or real estate related costs. Associated permitting costs will be determined at a future date once the new switching station site location is finalized. Permitting costs are in addition to estimated project costs.
3. SMECO will coordinate necessary 69 kV planned line outages and existing 69 kV line modifications to facilitate SMECO switching station construction activities.
4. SMECO will engineer, specify, permit, procure, construct, manage, and maintain all aspects of the proposed new switching station and all other associated facilities on its side of the POI.
5. SMECO is responsible for the OH conductor, equipment, and associated jumpers from the dead end structure to the switching station 69 kV bus.
6. Protective relaying and associated monitoring and control communications will be installed within a new SMECO switching station control building.

IC Scope of Work Clarifications:

1. The IC is responsible for installing and terminating the generation tap line on the dead end structure.
2. Due to the distance between the SMECO switching station and IC collector substation locations, the IC is required to install separate 69 kV line disconnect switches near the POI switching station dead end structure and at the IC collector substation.
3. The IC is responsible for all aspects of the new 69 kV generation tap line and collector substation facilities including but not limited to the isolation step-up transformer, substation protection, and associated solar distribution feeder circuits. All such facilities are subject to SMECO review and approval.
4. The IC is responsible for securing all permits, right-of-way easements, and any other associated real estate needs for the 69 kV generation tap line.
5. The IC is responsible for conveying suitable land to SMECO to accommodate the

proposed SMECO switching station POI. A SMECO approved environmental assessment is to accompany the land conveyance prior to SMECO accepting the land conveyance and proceeding with the new switching station site work. Physical switching station site dimensions and actual location are subject to change dependent on future detailed engineering design specifications and permitting requirements. The conveyed land is to be adjoining with the existing SMECO 69 kV line easement area and have direct immediate access to a main paved County or State road.

6. Prior to commencing with any subsequent Facilities Study for this project, the IC is to provide engineering documentation and drawings to SMECO depicting: a) a revised site plan including the proposed new SMECO owned switching station facility, IC collector substation site, and IC generation tap line, b) a revised one-line diagram showing the complete 34.5 kV and 69 kV IC facilities and associated solar AC and DC layout c) any missing or modified preliminary manufacturer specification information for the major equipment identified in section III of the SMECO Feasibility Study document, d) proposed sequence of operation description for the solar inverters including reactive power regulation, and e) available 69 kV generation tap line design and routing information.

7. Informational note only at this time: End-use customer (i.e. energy delivered from SMECO to the customer-owned facilities as measured at the POI) power factor shall be in accordance with the "Power Factor" language found in a future TBD SMECO Tariff Schedule. Generation customers (i.e. energy delivered from the customer-owned facilities to SMECO as measured at the POI) interconnected to the SMECO electric system will operate in accordance with applicable PJM Tariff reactive power requirements. If not subject to PJM Tariff requirements, interconnected customer generation may be required to hold a power factor between 0.95 leading (absorbing MVars) and 0.95 lagging (supplying MVars) as specified by SMECO. SMECO will coordinate and confirm the desired reactive control mode for the IC generation facilities at a later date and may instead request the IC operate its generation using a volt-var control strategy to maintain the POI between 1.0 - 1.02 per unit voltage.

8. Informational note only at this time: Express written authorization from SMECO is required before any IC facilities are installed or associated improvements made within SMECO's existing property and line easement areas. SMECO access to its facilities and any associated easement areas must remain clear at all times. Storing or depositing equipment or materials within the SMECO property and easement areas is prohibited.

VII. Cost and Schedule

PJM AF1 Queue Report and Agreement Schedule	Start Date	End Date
Feasibility Study	November 1, 2019	January 31, 2020
System Impact Study	May 1, 2020	August 31, 2020
Facilities Study	October 1, 2020	March 31, 2021
Wholesale Market Participant Agreement (WMPA)	May 1, 2020	June 30, 2020
Interconnection Agreement (IA)	July 1, 2020	August 31, 2021

Project Schedule: The estimated project schedule is 24 months after receiving the signed interconnection agreement and initial milestone payment. Associated permit or developer delays can affect the proposed project schedule. SMECO prefers that construction be scheduled between March and October if possible to do so.

SMECO Project Schedule	Date
Permitting (12 month)	September 2021
Engineering Begins (6 month)	September 2021
Order Material (6 month)	March 2022
Land expansion deeded to SMECO	May 2022
Switching Station Site Grading (3 month)	September 2022
Physical Construction Begins (9 month)	December 2023
POI In Service	August 2023
Project Complete and Closeout	September 2023
Note: SMECO will make all possible effort to comply with the listed construction schedule; however, SMECO is not liable for inadvertent schedule delays.	

SMECO's estimated POI project cost is $4,500,000 and includes: engineering, project management, labor and materials, construction, and construction management. Associated permitting costs will be determined at a future date and are in addition to estimated project costs. Estimated material and labor costs include 20% contingency. The estimated project cost breakdown is:

Engineering, Company Labor, and Overhead	$ 1,250,000
Material	$ 1,300,000
Construction	$ 1,950,000
Total	$ 4,500,000

VIII. Summary Findings

1. No adverse SMECO system 15 kV or 69 kV local area power flow issues are evident.
2. No adverse 15 kV or 69 kV local area bus voltage issues are evident.
3. No adverse 15 kV or 69 kV local area fault current contribution issues are evident.
4. No apparent baseline or supplemental projects are required to support the proposed generation interconnection project.
5. A local network project is required to support the proposed generation interconnection project. A preliminary scope-of-work, project schedule, and project cost is included within this report.
6. Prior to commencing with any subsequent Facilities Study for this project, the IC is to provide additional and revised engineering documentation and drawings to SMECO as indicated within SMECO Feasibility study report section VI.
7. Due to the multiple number of generation sources within the immediate project area it is recommended that PJM conduct a transient stability analysis for this project in a subsequent System Impact or Facilities Study.
8. The PJM studies and proposed SMECO construction schedules do not support the proposed project July 30, 2021 in-service date.

PJM Transmission Network Impacts

Primary Point of Interconnection

The Primary Point of Interconnection is SMECO's 69 kV line #6716 approximate structure #37 at GPS coordinates 38.5756 latitude and -76.9272 longitude. Potential network impacts were as follows:

Summer Peak Load Flow

Generation Deliverability
(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

Contribution to Previously Identified Overloads
(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None

Potential Congestion due to Local Energy Deliverability
PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

None

System Reinforcements

None

Short Circuit

No violations

Secondary Point of Interconnection

The Secondary Point of Interconnection location is SMECO's 69 kV line #6726 approximate structure #46 at GPS coordinates 38.5589 latitude and -76.9516 longitude. Potential network impacts were as follows:

Summer Peak Load Flow

Generation Deliverability
(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency
(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

Contribution to Previously Identified Overloads
(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

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System Reinforcements

None

Short Circuit

No violations