PJM Generation Interconnection Request

Queue Z1-087

Seneca Pumped Hydro 34.5kV

Feasibility Study

789826v1
April 2014

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an interconnection customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer is proposing adding 40MW Capacity to existing uprate to an existing 468MW Energy (465.4MW Capacity) pumped hydro facility for a new total of 508MW Energy (505.4MW Capacity) located in Warren, PA interconnecting into the Penelec area. Penelec is a FirstEnergy company. The proposed in-service date is requested for **October 31, 2013** and is currently under review. Impacts on the MISO member transmission systems are not included in this analysis, but they will be included in the Impact Study, which may reveal upgrades needed in the MISO system not identified in this Feasibility Study.

This Generation Interconnection Feasibility Study provides analysis results to aid the Interconnection Customer in assessing the practicality and cost of incorporating the facility into the PJM system. This study was limited to load flow analyses of probable contingencies. If the interconnection customer elects to pursue a System Impact Study, a more comprehensive analysis will be performed.

Direct Connection Cost Estimate

The Z1-087 project is a 40MW Capacity uprate to an existing pumped hydro facility for a new total of 508MW Energy (505.4MW Capacity) connected at the Glade 230kV substation in the Penelec area. To accommodate this interconnection, relaying will need to be replaced at the Glade 230kV substation on the 230kV Seneca line for reliability reasons. This upgrade is estimated to cost approximately **$152,400**, with an extra **$46,000** tax if applicable (**$198,400** total with tax included), to interconnect and take a minimum of **XX months** after the receipt of an executed Construction Service Agreement to complete this work (See **Table 1** below for cost breakdown and details). The single line is shown below in **Figure 1**.

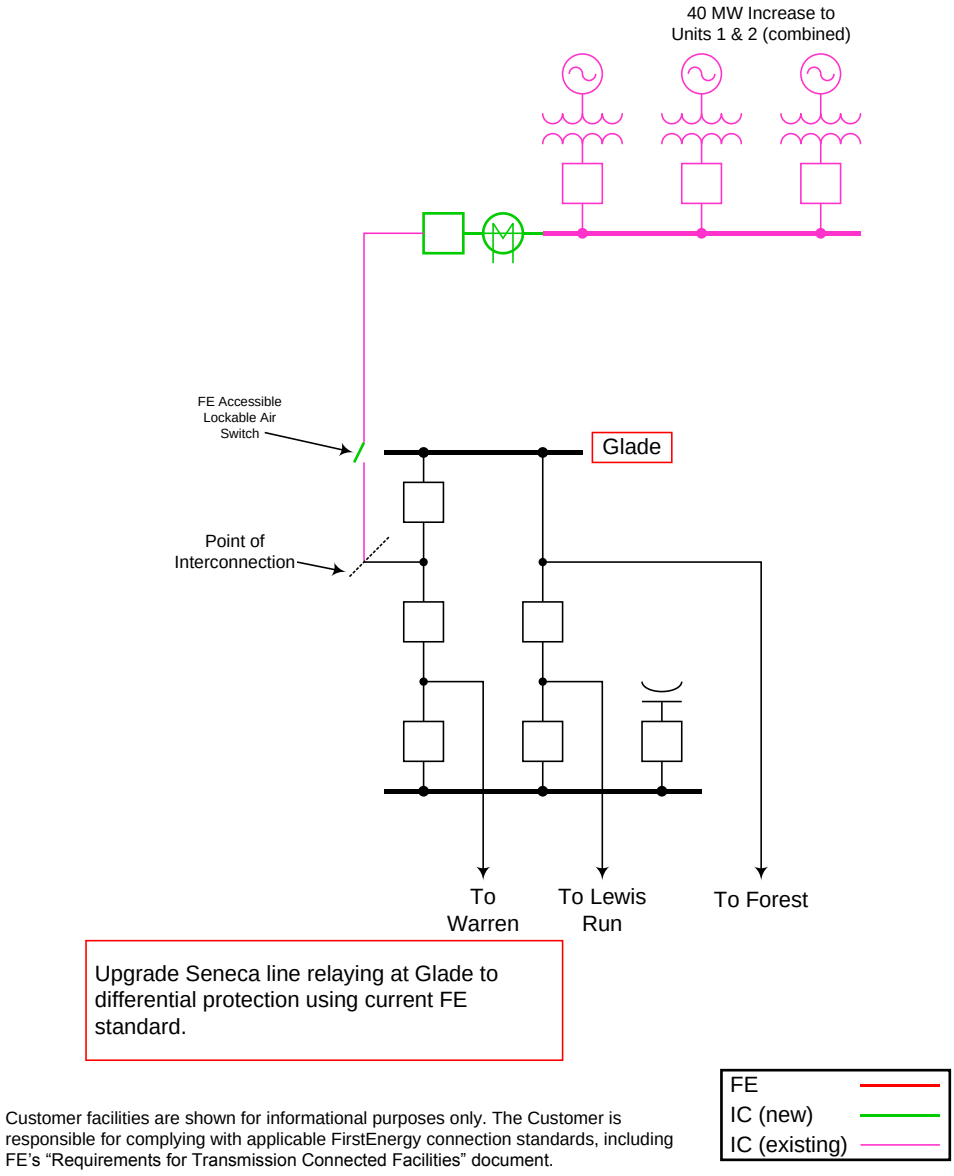
Table 1. Direct Connect Cost Estimate

Description	Total Cost	Tax	Total with Tax
Replace relaying on the 230kV Seneca line at the Glade 230kV substation	$127,300	$38,400	$165,700
Engineering Oversite and Commissioning	$25,100	$7,600	$32,700
Total	**$152,400**	**$46,000**	**$198,400**

Revenue Metering and SCADA Requirements

For PJM: IC will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

For Penelec: The Interconnection Customer will be required to comply with all FE Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "FirstEnergy Requirements for Transmission Connected Facilities" document located at the following links:
www.firstenergycorp.com/feconnect
www.pjm.com/planning/design-engineering/to-tech-standards.aspx



Customer facilities are shown for informational purposes only. The Customer is responsible for complying with applicable FirstEnergy connection standards, including FE's "Requirements for Transmission Connected Facilities" document.

Figure 1. Proposed Point of Interconnection Single Line

Network Impacts

Queue project Z1-087 was studied as a 40.0MW (40.0MW Capacity) injection at the Seneca 230kV substation in the Penelec area. Project Z1-087 was evaluated for compliance with reliability criteria for summer peak conditions in 2017. Potential network impacts were as follows:

Generator Deliverability

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

No problems were identified.

Multiple Facility Contingency

(Double Circuit Tower Line contingencies were studied for the full energy output. The contingencies of Line with Failed Breaker and Bus Fault will be performed for the Impact Study.)

No problems were identified.

Short Circuit

(Summary of impacted circuit breakers)

Not required.

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)

Item 1a. (AP - AP) The ELKO-CARBON C JCT 138 kV line (from bus 235174 to bus 235159 ckt 1) loads from 154.17% to 155.35% (**DC power flow**) of its emergency rating (132 MVA) for the bus fault outage of 'AP_C1_57'. This project contributes approximately 3.46 MW to the thermal violation.

CONTINGENCY 'AP_C1_57' /ELKO_230_1
OPEN BRANCH FROM BUS 235175 TO BUS 235971 CKT 1
OPEN BRANCH FROM BUS 235175 TO BUS 235174 CKT 1
END

Please refer to Appendix 1 for a table containing the generators having contribution to this flowgate.

Item 1b. (AP - AP) The ELKO-CARBON C JCT 138 kV line (from bus 235174 to bus 235159 ckt 1) loads from 154.17% to 155.35% (**DC power flow**) of its emergency rating (132 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_442'. This project contributes approximately 3.46 MW to the thermal violation.

CONTINGENCY 'AP_SB_442' / ELKO230-FOREST230
STK BKR AT ELKO230 #1
OPEN BRANCH FROM BUS 235175 TO BUS 235971 CKT 1
OPEN BRANCH FROM BUS 235175 TO BUS 235174 CKT 1
END

Please refer to Appendix 2 for a table containing the generators having contribution to this flowgate.

Steady-State Voltage Requirements
(Summary of the VAR requirements based upon the results of the steady-state voltage studies)

To be determined in the System Impact Study.

Light Load Reliability Analysis
(Summary of any reinforcements required to mitigate system reliability issues during light load periods.)

To be determined in the System Impact Study.

Stability and Reactive Power Requirement
(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined in the System Impact Study.

New System Reinforcements
(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

None.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)

For Items 1a and 1b, the overloads of the ELKO-CARBON C JCT 138 kV line can be mitigated by the following upgrades and cost estimates listed in **Table 1** below:

Table 1. ELKO-CARBON Upgrade Cost Estimates

Description	Total Cost	Tax	Total with Tax
Construct new 230 kV double circuit line, approx. 1 mile in length. Reconfigure loop at Elko to create two Elko – Squab Hollow 230 kV lines and Squab Hollow - Shawville 230 kV line.	$2,545,000	$767,100	$3,312,100
At Squab Hollow substation, install three 230 kV breakers and associated facilities to create two new line terminals.	$2,244,700	$664,500	$2,909,200
Remote Terminal Upgrades (RTUs)	$26,400	$7,900	$34,300
Total	**$4,816,100**	**$1,439,500**	**$6,255,600**

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.

As a result of the aggregate energy resources in the area, there were no violations identified.

Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(AP - AP) The ELKO-CARBON C JCT 138 kV line (from bus 235174 to bus 235159 ckt 1) loads from 154.17% to 155.35% (**DC power flow**) of its emergency rating (132 MVA) for the bus fault outage of 'AP_C1_57'. This project contributes approximately 3.46 MW to the thermal violation.

CONTINGENCY 'AP_C1_57' /ELKO_230_1
OPEN BRANCH FROM BUS 235175 TO BUS 235971 CKT 1
OPEN BRANCH FROM BUS 235175 TO BUS 235174 CKT 1
END

Bus Number	Bus Name	Full Contribution
200649	PENNTECH	0.17
290086	Q-036 E	-2.79
904762	V4-077 E	-0.46
914131	Y2-055	3.09
Y2-068	Y2-068	15.73
916381	Z1-087	3.46

Appendix 2

(AP - AP) The ELKO-CARBON C JCT 138 kV line (from bus 235174 to bus 235159 ckt 1) loads from 154.17% to 155.35% (**DC power flow**) of its emergency rating (132 MVA) for the line fault with failed breaker contingency outage of 'AP_SB_442'. This project contributes approximately 3.46 MW to the thermal violation.

CONTINGENCY 'AP_SB_442' / ELKO230-FOREST230 STK BKR AT ELKO230 #1
OPEN BRANCH FROM BUS 235175 TO BUS 235971 CKT 1
OPEN BRANCH FROM BUS 235175 TO BUS 235174 CKT 1
END

Bus Number	Bus Name	Full Contribution
200649	PENNTECH	0.17
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