Generation Interconnection
System Impact Study Report

For

PJM Generation Interconnection Request Queue
Position AB1-089

Byron-Wayne 345kV

Revision 0: September 2018
Revision 1: October 2021

Preface

The intent of the System Impact Study is to determine a plan, with approximate 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.

For Local and Network Upgrades which are required due to overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost less than $5,000,000, the cost of the Local and Network Upgrades will be shared by all proposed projects which have been assigned a Queue Position in the New Services Queue in which the need for the Local and Network Upgrades was identified. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

For Local and Network Upgrades which are required due to the overloads associated with the System Impact Studies of an individual New Services Queue, and have a cost of $5,000,000 or greater, the cost of the Local and Network Upgrades will be allocated according to the order of the New Service Requests in the New Services Queue and the MW contribution of each individual Interconnection Request for those projects which cause or contribute to the need for the Local or Network Upgrades. The Load Flow Cost Allocation methods discussed in this manual, including cutoffs, still apply to the individual projects.

Cost allocation rules can be found in PJM Manual 14A, Attachment B.

The System Impact 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.

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.

General

Invenergy Nelson LLC (Interconnection Customer or IC) is proposing to install a 1x1 combined cycle combustion unit in Lee County. This is a request for an MFO of 575 MWs, 550 MWs to be considered as a Capacity resource. The IC has proposed an in service date of June 1, 2019 and is currently under review. The study year for the AB1 queue is 2019.

Revision History:

Revision 1: The October 2021 revised study is to update the load flow results. Load flow retool results indicate that the Stillwell-Dumont 345 kV line violation in the Revision 0 report is no longer valid for AB1-089. The violation and associated reinforcement have been deleted.

Point of Interconnection

The Interconnection Customer proposes to interconnect with the ComEd transmission system at the 345kV transmission line between Byron and Wayne via a 35 mile line, interconnecting approximately 10 miles east of Byron Station.

Attachment Facilities

The AB1-089 generator lead will interconnect to a new 345kV Interconnection Substation. This interconnection would require one 345kV line MOD, line relaying, a dead-end structure and revenue metering as shown in the one line diagram.

The cost for the attachment facilities is estimated at $1M.

Scope of Work	Cost Estimate
Installation of one 345kV line MOD, line relaying, one dead-end structures and one set of revenue metering (see notes below on cost estimate)	$1.0M

Direct Connection Network Upgrades

In order to accommodate interconnection of AB1-089, a new 345kV Interconnection Substation on the 345kV transmission line, between Byron and Wayne, would be built to interconnect developer's generator lead. The scope of work includes installation of three 345kV circuit breakers in a "breaker-and-a-half" bus configuration and tie in the Interconnection Substation as shown in the one line diagram below.

The Interconnection Customer is responsible for constructing all of the facilities on the Interconnection Customer side of the point of interconnection outside of the substation. It is assumed for the purposes of this report that the Interconnection Customer will obtain the site for the Interconnection Substation and right-of-way between the Interconnection Substation and the transmission line.

In the event that the IC exercises the option to build the interconnecting substation, the IC will be required to construct all interconnection facilities that will be turned over to ComEd in accordance with ComEd published standards and the PJM Tariff. ComEd would design, engineer and construct the tie in of the Interconnection Substation to the 345kV transmission line between Byron and Wayne.

The preliminary cost estimate for Direct Connection Network Upgrade is given in the following tables.

For Option to Build Direct Connection cost estimates:

Scope of Work	Cost Estimate
Installation of a new 345kV substation as described above	N/A
Transmission line tie in work (foundations, structures, conductors)	$3,000,000
ComEd oversight and testing	$1,500,000
Total Cost Estimate (see notes below on cost estimate)	$4,500,000

For ComEd building the interconnecting substation cost estimates:

Scope of Work	Cost Estimate
Installation of a new 345kV substation as described above	$18,000,000
Transmission line tie in work (foundations, structures, conductors)	$3,000,000
Total Cost Estimate (see notes below on cost estimate)	$21,000,000

ComEd would take approximately 24-months to construct after the ISA / ICSA are signed.

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following table below:

Scope of Work	Cost Estimate
Relay/communications/SCADA upgrades at Byron Station	$1,000,000
Relay/communications/SCADA upgrades at Wayne	$1,000,000
Total Cost Estimate (see notes below on cost estimate)	$2,000,000

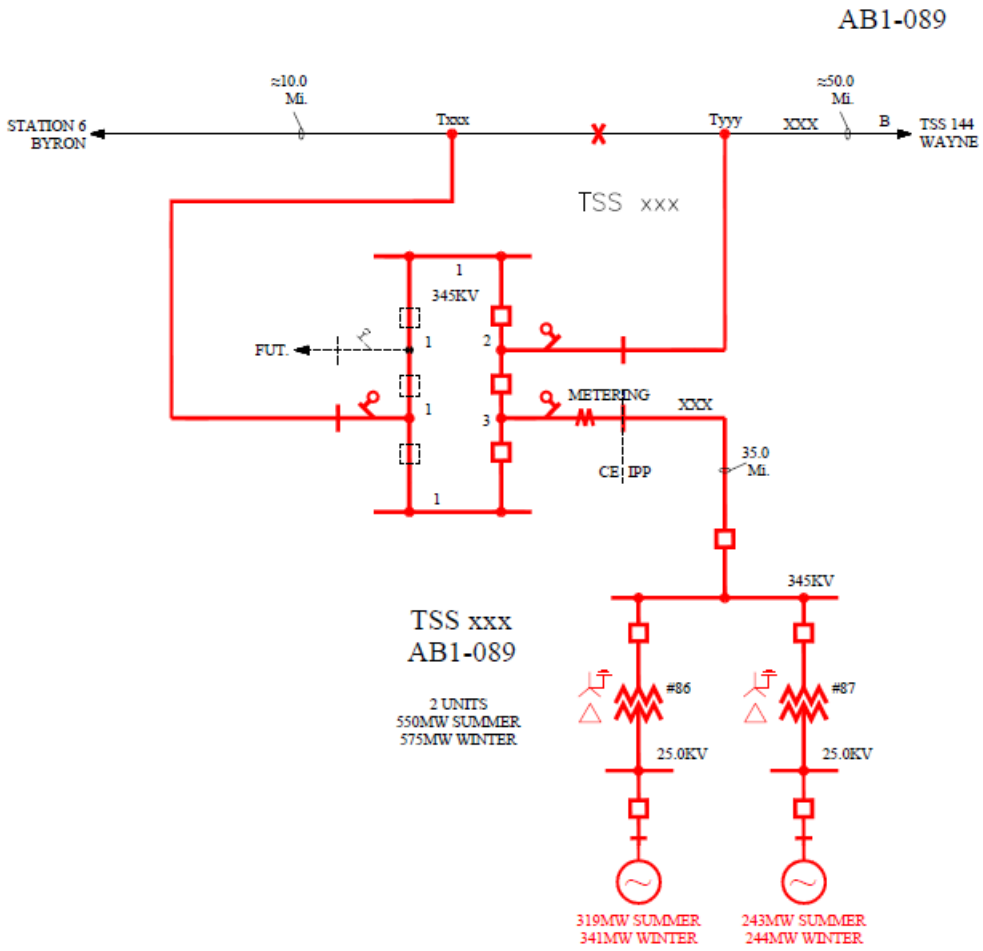

Figure 1. Single Line Diagram

Note on Timeline:

Normally it takes about 24-months to engineer, design, procure material and construct 345kV facilities. However, Byron Station is a nuclear station, and it is anticipated that the construction would need to be coordinated and scheduled with Byron Station per NERC Standard NUC-001 requirements – for the yet to be built 345kV Byron-Wayne transmission line that will be in the Byron switchyard – this may prolong this construction.

Notes on Cost Estimate:

1) These estimates are Order-of-Magnitude estimates of the costs that ComEd would bill to the customer for this interconnection. These estimates are based on a one-line electrical diagram of the project and the information provided by the Interconnection Customer.

2) These cost estimates do not include cost of acquiring right-of-way for the transmission line and purchasing any additional land, if needed, for the line terminations. The need and cost of acquiring property and associated legal costs will be investigated during Facilities Study for this project.

3) There were no site visits performed for these estimates. There may be costs related to specific site related issues that are not identified in these estimates. The site reviews will be performed during the Facilities Study or during detailed engineering.

4) These estimates are not a guarantee of the maximum amount payable by the Interconnection Customer and the actual costs of ComEd's work may differ significantly from these estimates. Per the PJM Tariff, Interconnection Customer will be responsible for paying all actual costs of ComEd's work.

5) The Interconnection Customer is responsible for all engineering, procurement, testing and construction of all equipment on the Interconnection Customer’s side of the Point of Interconnection (POI).

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 Section 8 of Attachment O to the PJM Open Access Transmission Tariff.

For ComEd:

The IC will be required to comply with all ComEd Revenue Metering Requirements. The Revenue Metering Requirements may be found on the ComEd website.

Network Impacts

The Queue Project AB1-089 was evaluated as a 550.0 MW (Capacity 550.0 MW) injection into a tap of the Byron – Wayne 'B' 345 kV line in the ComEd area. Project AB1-089 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AB1-089 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis - 2019

Generator 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

Steady-State Voltage Requirements

No issues identified.

Short Circuit
(Summary of impacted circuit breakers)

None.

Affected System Analysis & Mitigation

MISO Impacts:

None. See PJM October 2016 Queue Generation Affected System Impact Study dated March 15, 2017 available on the MISO website.

Delivery of Energy Portion of Interconnection Request
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.
Only the most severely overloaded conditions are listed. 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 will study all overload conditions associated with the overloaded element(s) identified.

Not Applicable

Light Load Analysis - 2019

No violations identified.

System Reinforcements

Short Circuit
(Summary form of Cost allocation for breakers will be inserted here if any)

None

Stability and Reactive Power Requirement
(Results of the dynamic studies should be inserted here)

None.

Summer Peak Load Flow Analysis Reinforcements

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)

(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None.

Light Load Load Flow Analysis Reinforcements

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)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None