Revised
Generation Interconnection
System Impact Study Report

For

PJM Generation Interconnection Request Queue
Position Z1-035

Lake Road North 11.5 kV

October 2020

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.

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 System Impact Study is performed.

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.

General

The Interconnection Customer (IC) is proposing an 18MW (2.34MW Capacity) wind facility to be interconnected to the Cleveland Public Power transmission system near Cleveland, OH. The proposed in-service date for this project is **December 31, 2025**.

The intent of the System Impact Study is to determine system reinforcements and associated costs and construction time estimates required to facilitate the addition of the new generating plant to the transmission system. The reinforcements include the direct connection of the generator to the system and any network upgrades necessary to maintain the reliability of the transmission system.

Point of Interconnection

Z1-035 will interconnect with the Cleveland Public Power (CPP) transmission system via taps to the Lake Road North 11.5 kV substation, which connects to the ATSI transmission system.

Facilities to Accommodate the Interconnection

Scope of Direct Connection Work

The Z1-035 project will tap the Lake Road North 11.5 kV bus owned by Cleveland Public Power (CPP), which connects to the ATSI transmission system. Z1-035 is an offshore wind project with six 3MW wind turbines to be located in Lake Erie approximately 8 miles offshore northwest of downtown Cleveland, OH in the Cleveland Public Power (CPP) area.

Final attachment facilities and local upgrades (if required) along with terms and conditions to interconnect Z1-035 will be specified in a separate two party Interconnection Agreement (IA) between CPP and the Interconnection Customer as this project is considered FERC non-jurisdictional per the PJM Open Access Transmission Tariff (OATT).

From the transmission perspective, no network impacts were identified as detailed in the "Network Impacts" section below.

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.

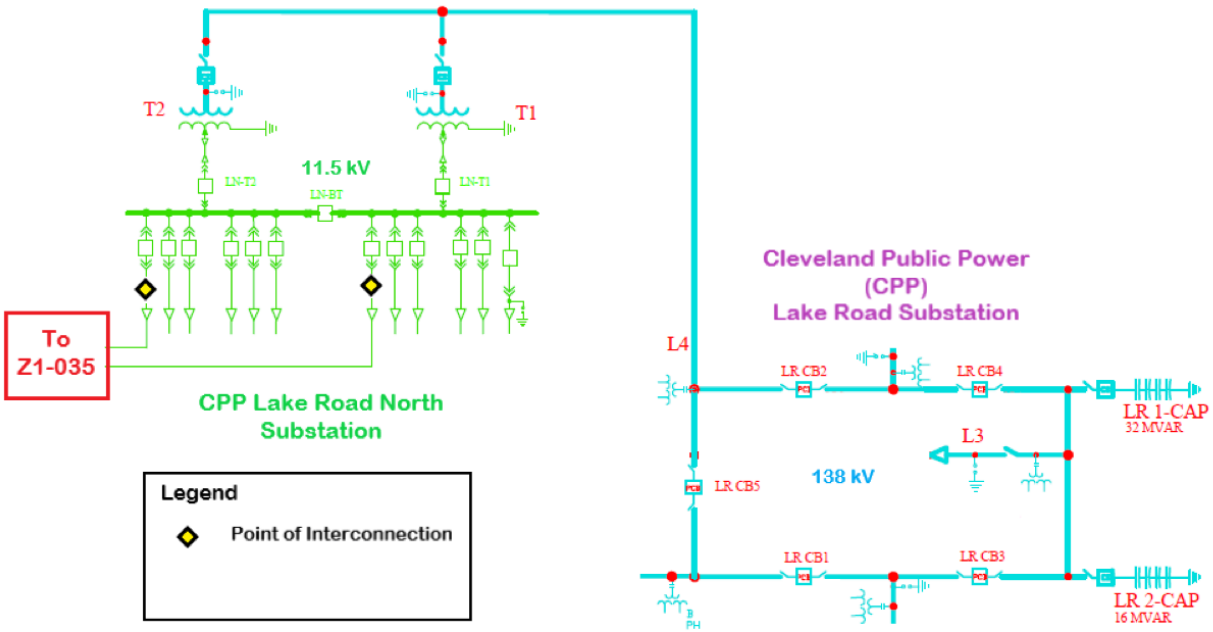

Figure 1. Single Line Diagram

Network Impacts

The Queue Project Z1-035 was studied as a 18.0 MW (2.3 MW Capacity) injection CPP Lake Road North 11.5 kV bus. Project Z1-035 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project Z1-035 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis - 2017

Generator Deliverability

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

No violations were identified.

Multiple Facility Contingency

(Double Circuit Tower Line(DCTL), Line with Failed Breaker(LFFB) and Bus Fault(Bus) contingencies for the full energy output)

No violations were identified.

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)

No violations were identified.

Short Circuit

(Summary of impacted circuit breakers)

PJM has completed the short circuit analysis of the Z1-035 queue project. One option was considered during this study: the primary option was a direct connection to the Lake Road 11.5 kV bus. PJM analysis found **no breakers** to be overdutied.

Steady-State Voltage Requirements

(Summary of VAR requirements based upon the results of the steady-state voltage studies)

None.

Stability and Reactive Power Requirement

(Summary of VAR requirements based upon the results of the dynamic studies.)

Executive Summary of Analysis

Generator Interconnection Request Z1-035 is for an 18 MW Maximum Facility Output (MFO) offshore wind generating facility, which consists of 6 Vestas V126-3.45 MW 50/60 Hz wind turbines. Project Z1-035 will directly connect into the existing Cleveland Public Power (CPP) Lake Road substation via approximately 0.08 miles 11.5 kV line. The Point of Interconnection (POI) will be where the Interconnection Customer 11.5 kV line terminates at the structure inside the CPP Lake Road substation in the CPP/American Transmission Systems, Inc. (ATSI). The Z1-035 offshore wind generating facility will be located in Cuyahoga County, Ohio.

This report describes a dynamic simulation analysis of Z1-035 as part of the overall system impact study. The load flow scenario for the analysis was based on the RTEP 2021 peak load case, modified to include applicable queue projects. Z1-035 has been dispatched online at maximum power output, with unity power factor and approximately 1.0 pu voltage at the generator terminals.

Z1-035 was tested for compliance with NERC, PJM, Transmission Owner and other applicable criteria. 24 contingencies were studied, each with a 20 second simulation time period (with 0.5 second initial run prior to any events). Studied faults included:

a) Steady state operation (Category P0);

b) Three phase faults with normal clearing time on the intact network (Category P1);

c) Single phase to ground faults with delayed clearing due to a stuck breaker (Category P4);

d) Single phase to ground faults with delayed clearing as a result of protection failure (Category P5).

For all simulations, the queue project under study along with the rest of the PJM system were required to maintain synchronism and with all states returning to an acceptable new condition following the disturbance.

For all 25 fault contingencies tested on the 2021 peak load case:

a) Z1-035 was able to ride through the faults (except for faults where protective action trips a generator(s)).

b) Post-contingency oscillations were positively damped with a damping margin of at least 3%.

c) Following fault clearing, all bus voltages recover to a minimum of 0.7 per unit after 2.5 seconds (except where protective action isolates that bus).

d) No transmission element trips, other than those either directly connected or designed to trip as a consequence of that fault.

No mitigations were found to be required for the studied project. The post-contingency voltage at Lake Road 69 kV bus following the contingencies involving loss of the Lake Road 138/69 kV transformer was approximately at 0.84 pu. This low voltage was observed with or without the project Z1-035. With the low terminal voltage of Z1-035, the reduced active power output of Z1-035 may be observed as shown in P4.1B1.04, and P4.1B1.05. It is suggested to check the low voltage power reduction logic of the project Z1-035.

The studied project meets the 0.95 leading and lagging reactive power requirement at the POI.

Light Load Analysis - 2017

*(Summary of any reinforcements required to mitigate system reliability issues during light load periods. This light load study was evaluated for compliance with reliability criteria for **Light Load conditions** in 2017.)*

No impacts.

System 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)

None.

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.

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