Provisional Interconnection Study Report for PI-2024-21 (Modified PI-2024-10)

4/15/2025

Table of Contents

List of Figures

List of Tables

1.0 Executive Summary

The PI-2024-21 (modified PI-2024-10) project is a Provisional Interconnection Service (PIS) request for a 199 MW Battery Energy Storage System (BESS) Generating Facility with a Point of Interconnection (POI) at the Spindle 230 kV switching station. This PIS request is associated with Generation Interconnection Request 5RSC-2024-13 in the 5RSC cluster.

In addition to changing the location of the Generating Facility to a different site, the customer has also requested the following changes to PI-2024-10 request. The first one is the length of the gen-tie line that changed from 0.80 miles, in PI-2024-10, to 0.197 miles, in PI-2024-21. This change impacts the impedance in the gen-tie line connecting the project to the POI and minor impact to the power flow. The second change is the COD that moved from 11/1/2026, in PI-2024-10, to 1/15/2027, in PI-2024-21. This change does not impact the Base Case year selection since in both instances the 2027 Heavy Summer is the appropriate choice for the study. The power flow and stability analyses were not repeated as the changes were immaterial. Summary of the previous study is shown below and details can be found in the PI-2024-10 report.

The revised total estimated cost of the transmission system improvements required for PI-2024-21 to qualify for Provisional Interconnection Service is **$8.222** million (Table 1 and Table 2).

The initial maximum permissible output of PI-2024-21 Generating Facility is 199 MW. Additionally, the 199 MW of requested Grid Charging will be permitted since no upgrades were identified during the analysis.

The maximum permissible output of the Generating Facility in the PLGIA[1] would be reviewed quarterly and updated, if there are changes to the system conditions assumed in this analysis, to determine the maximum permissible output.

Security: PI-2024-21 is a request for Energy Resource Interconnection Service (ERIS). For ERIS requests, security shall estimate the risk associated with the Network Upgrades and the Interconnection Facilities and is assumed to be a minimum of $5 million.

[1] **Provisional Large Generator Interconnection Agreement (PLGIA)** shall mean the interconnection agreement for Provisional Interconnection Service established between Transmission Provider and/or the Transmission Owner and the Interconnection Customer. The pro forma agreement is provided in Appendix 8 and takes the form of the Large Generator Interconnection Agreement, modified for provisional purposes.

In addition, the Interconnection Customer would assume all risk and liabilities with respect to changes between the PLGIA and the LGIA[2], including changes in output limits and Interconnection Facilities, Network Upgrades, Distribution Upgrades, and/or System Protection Facilities cost responsibility.

The Provisional Interconnection Service in and of itself does not convey transmission service.

2.0 Breaker Duty Analysis Criteria

Fault Current after PI addition should not exceed 100% of the Breaker Duty rating. PSCo can only perform breaker duty analysis on the PSCo system. Before the PI goes in-service the Affected Systems may choose to perform a breaker duty analysis to identify breaker duty violations on their system.

2.1 Short-Circuit Modeling

This request is for the interconnection of a 199 MW BESS Generating Facility (PI-2024-21) to the Spindle 230 kV switching station. The output will not exceed 199 MW at the POI.

This facility will consist of sixty-four (64) Power Electronics FREEMAQ PCSM 660 V FP4200M inverters rated at 4.20 MVA at 40°C, feeding sixty-four (64) 34.5 kV/660 V pad-mounted transformers rated at 4.20 MVA at 65°C. A 34.5 kV collector system will combine five (5) ESS feeders at the 34.5 kV switchgear and one (1) 230 kV/34.5 kV/13.8 kV main GSU transformer rated at 165/220/275 MVA with one (1) high side breakers will step up the voltage to the interconnection voltage level. An approximately 0.197-mile-long generation tie line connects the project to the Spindle 230 kV switching station.

All connected generating facilities were assumed capable of producing maximum fault current. As such, all generation was modeled at full capacity, whether Network Resource Interconnection Service (NRIS) or ERIS is requested. Generation is modeled as a separate generating resource in PSS CAPE software and included at full capacity in the short circuit study, regardless of any limitations to the output that would be imposed otherwise.

[2] Large Generator Interconnection Agreement (LGIA): Shall mean the form of interconnection agreement applicable to an Interconnection Request pertaining to a Large Generating Facility that is included in the Transmission Provider's Tariff.

2.2 Short-Circuit and Breaker Duty Analysis Results

A study was completed to determine whether any overstressed breakers resulted when several Provisional Interconnections (PIs) were added to the PSCo transmission system in the order of their Commercial Operation Date (COD). If the addition of the interconnection resulted in a requirement that one or more breakers be replaced in the PSCo transmission system, it was considered that that customer would not be able to connect under a Provisional Interconnection agreement and it was removed from the study.

Taken into consideration were any existing plans for breaker replacement by PSCo. Breakers that had already been assigned to projects were not considered as needing replacement by the interconnection customer.

The breaker duty study on the PSCo transmission system did not identify any circuit breakers that became over-dutied because of adding the PI-2024-21. Should any circuit breakers become overdue, the fault currents at the POI for three-phase and phase-to-ground will be provided in this report. Conversely, the fault currents can be made available upon request by the customer.

3.0 Cost Estimates

The revised total estimated cost of the required upgrades for PI-2024-21 to interconnect for Provisional Interconnection Service at the Spindle 230 kV switching station is **$8.222 million**.

- **Cost of Transmission Provider's Interconnection Facilities (TPIF) is $3.098 million** (Table 1)
- **Cost of Station Network Upgrades is $5.124 million** (Table 2)
- **Cost of System Network Upgrades is $0**

The list of improvements required to accommodate the Provisional Interconnection Service of PI-2024-21 are given in Table 1, and Table 2.

Table 1 – Transmission Provider's Interconnection Facilities

Element	Description	Cost Est. (Million)
PSCo's Spindle 230 kV switching station	Interconnection of 5RSC-2024-13 (PI-2024-21) at the Spindle 230 kV Switching Station. The new equipment includes: • (1) 230 kV single bay dead end structure • (1) 230 kV single bay dead end extension structure • (1) 230 kV 3-phase arrester • (1) 230 kV 3000 A disconnect switch • (3) 230 kV 1-phase CT's for metering • (3) 230 kV CCVTs • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures • Associated transmission line communications, fiber, relaying	$2.463
PSCo's Spindle 230 kV switching station	Transmission Provider's dead-end structure at the Point of Change of Ownership (PCO) outside the switching station fence line and transmission line into new switching station from the PCO. Single span, dead end structure, 3 conductors, insulators, hardware, jumpers and labor.	$0.635
Total Cost Estimate for Interconnection Customer-Funded, PSCo-Owned Interconnection Facilities		**$3.098**

Table 2 – Station Network Upgrades

Element	Description	Cost Est. (Million)
PSCo's Spindle 230 kV switching station	Interconnection of 5RSC-2024-13 (PI-2024-21) at the Spindle 230 kV Switching Station. The new equipment includes: • (1) 230 kV 3000 A Circuit Breaker • (2) 230 kV 3000 A Gang Switches • Associated electrical equipment, bus, wiring and grounding • Station controls and wiring • Associated foundations and structures	$4.236
PSCo's Spindle 230 kV switching station	Install required communication in the EEE at the Spindle 230 kV Switching Station	$0.838
PSCo's Spindle 230 kV switching station	Siting and Land Rights permitting, no land purchase costs included	$0.050
Total Cost Estimate for PSCo-Funded, PSCo-Owned Interconnection Facilities		**$5.124**

PSCo has developed cost estimates for Interconnection Facilities and Network/Infrastructure Upgrades required for the interconnection of PI-2024-21 for Provisional Interconnection Service. The estimated costs provided in this report are based upon the following assumptions:

- The estimated costs are in 2025 dollars with escalation and contingencies applied.
- Allowances for Funds Used During Construction (AFUDC) is not included.
- The estimated costs include all applicable labor and overheads associated with the siting, engineering, design, and construction of these new PSCo facilities.
- The estimated costs do not include the cost for any Customer owned equipment and associated design and engineering.
- Labor is estimated for straight time only—no overtime included.
- PSCo (or its Contractor) will perform all construction, wiring, testing, and commissioning for PSCo owned and maintained facilities.

The customer requirements include:

- Customer will install two (2) redundant fiber optic circuits (one primary circuit with a redundant backup) into the Transmission Provider's substation as part of its interconnection facilities construction scope.
- Power Quality Metering (PQM) will be required on the Customer's generation tie-line terminating into the POI.

- The Customer will be required to design, procure, install, own, operate and maintain a Load Frequency/Automated Generation Control (LF/AGC) RTU at their Customer substation. PSCo will be provided with indications, readings, and data from the LF/AGC RTU.
- The Interconnection Customer will comply with the most current version of the *Interconnection Guidelines for Transmission Interconnected Producer-Owned Generation Greater Than 20 MW*, as amended from time to time, and available at: Interconnection | Transmission | Corporate | Xcel Energy

4.0 Schedule

This section provides proposed milestones for the interconnection of PI-2024-21 to the Transmission Provider's transmission system. The customer requested a back-feed date (In-Service Date for Transmission Provider's Interconnection Facilities and Station Network Upgrades required for interconnection) for the Provisional Interconnection of June 19, 2026. This is attainable by the Transmission Provider, based upon the current schedule developed for this interconnection request. The Transmission Provider proposes the milestones provided below in Table 3.

Table 3 – Proposed Milestones for PI-2024-21

Milestone	Responsible Party	Estimated Completion Date
LGIA Execution	Interconnection Customer and Transmission Provider	June 2025
In-Service Date for Transmission Provider Interconnection Facilities and Station Network Upgrades required for interconnection	Transmission Provider	June 19, 2026
In-Service Date & Energization of Interconnection Customer's Interconnection Facilities	Interconnection Customer	June 19, 2026
Initial Synchronization Date	Interconnection Customer	July 1, 2026
Begin trial operation & testing	Interconnection Customer and Transmission Provider	July 19, 2026
Commercial Operation Date	Interconnection Customer	January 15, 2027

Some schedule elements are outside of the Transmission Provider's control and could impact the overall schedule. The following schedule assumptions provide the basis for the schedule milestones:

- Construction permitting (if required) for new facilities will be completed within 12 months of LGIA execution.
- The Transmission Provider is currently experiencing continued increases to material lead times which could impact the schedule milestones. The schedule milestones are based upon material lead times known at this time.
- Availability of line outages to interconnect new facilities to the transmission system.
- A Certificate of Public Convenience and Necessity (CPCN) may be required for the construction of the Interconnection Facilities and Station Network Upgrades. The expected time to obtain a CPCN approval is 18 months, which could impact the start of construction for the interconnection facilities.

5.0 Summary of Provisional Interconnection Service Analysis

The power flow and stability analyses were not repeated for PI-2024-21 as the changes were immaterial.

The breaker duty study on the PSCo transmission system did not identify any circuit breakers that became over-dutied because of adding the PI-2024-21.

The revised total estimated cost of the PSCo transmission system improvements required for PI-2024-21 to qualify for Provisional Interconnection Service is **$8.222** million.

The initial maximum permissible output of PI-2024-21 Generating Facility is 199 MW. Additionally, the 199 MW of requested Grid Charging will be permitted since no upgrades were identified during the analysis. The maximum permissible output of the Generating Facility in the PLGIA would be reviewed quarterly and updated if there are changes to system conditions compared to the system conditions previously used to determine the maximum permissible output.

Security: Based on 5RSC-2024-13 in the 5RSC selection of Energy Resource Interconnection Service (ERIS), the security associated with the Network Upgrades that might be identified at the conclusion of the 5RSC-2024-13 Large Generation Interconnection Procedure (LGIP) in the 5RSC cluster is $5 million.

The Provisional Interconnection Service in and of itself does not convey transmission service.

6.0 Preliminary One-Line Diagram and General Arrangement for PI-2024-21

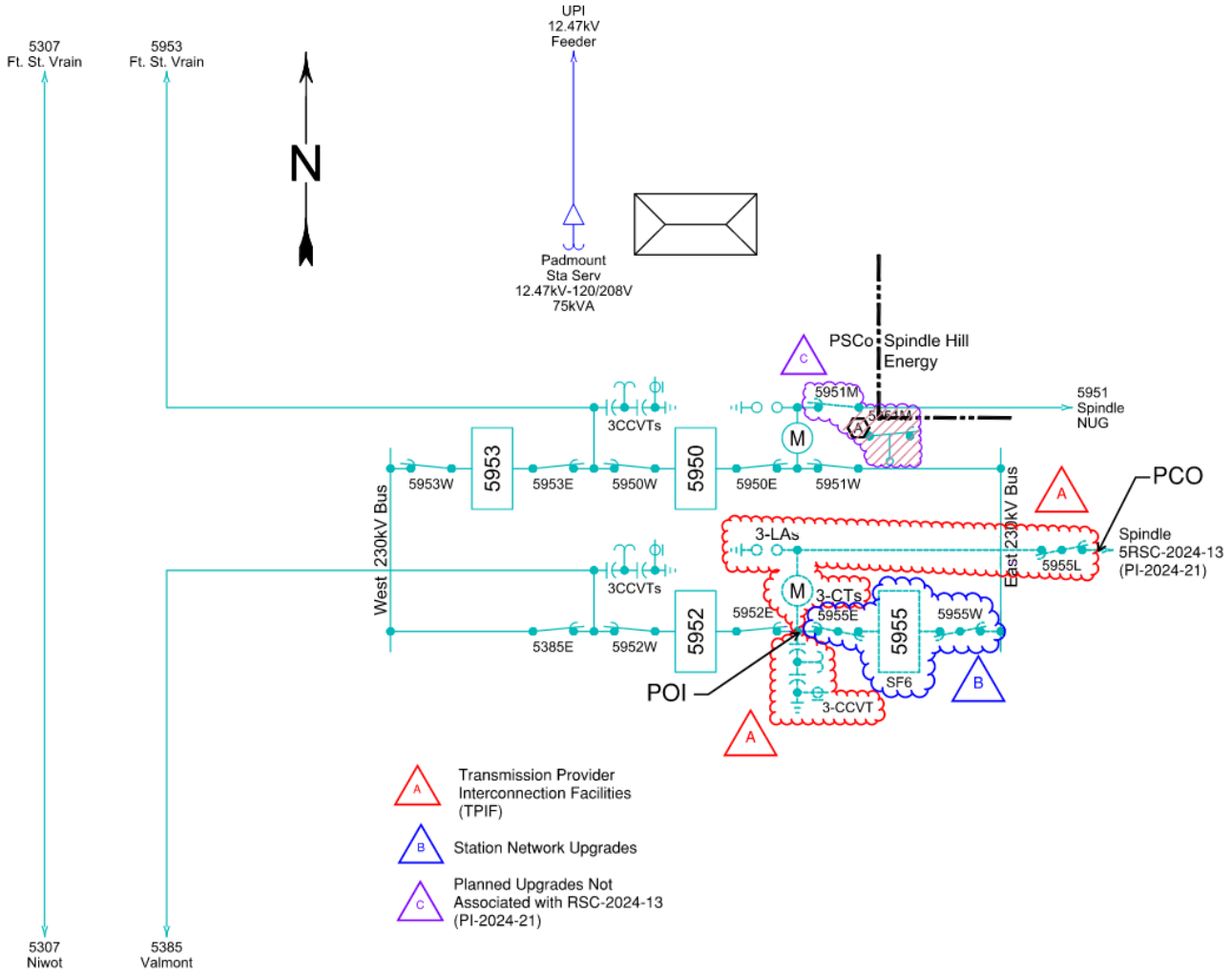

Figure 1: Preliminary One-Line for PI-2024-21 at the Spindle 230 kV switching station

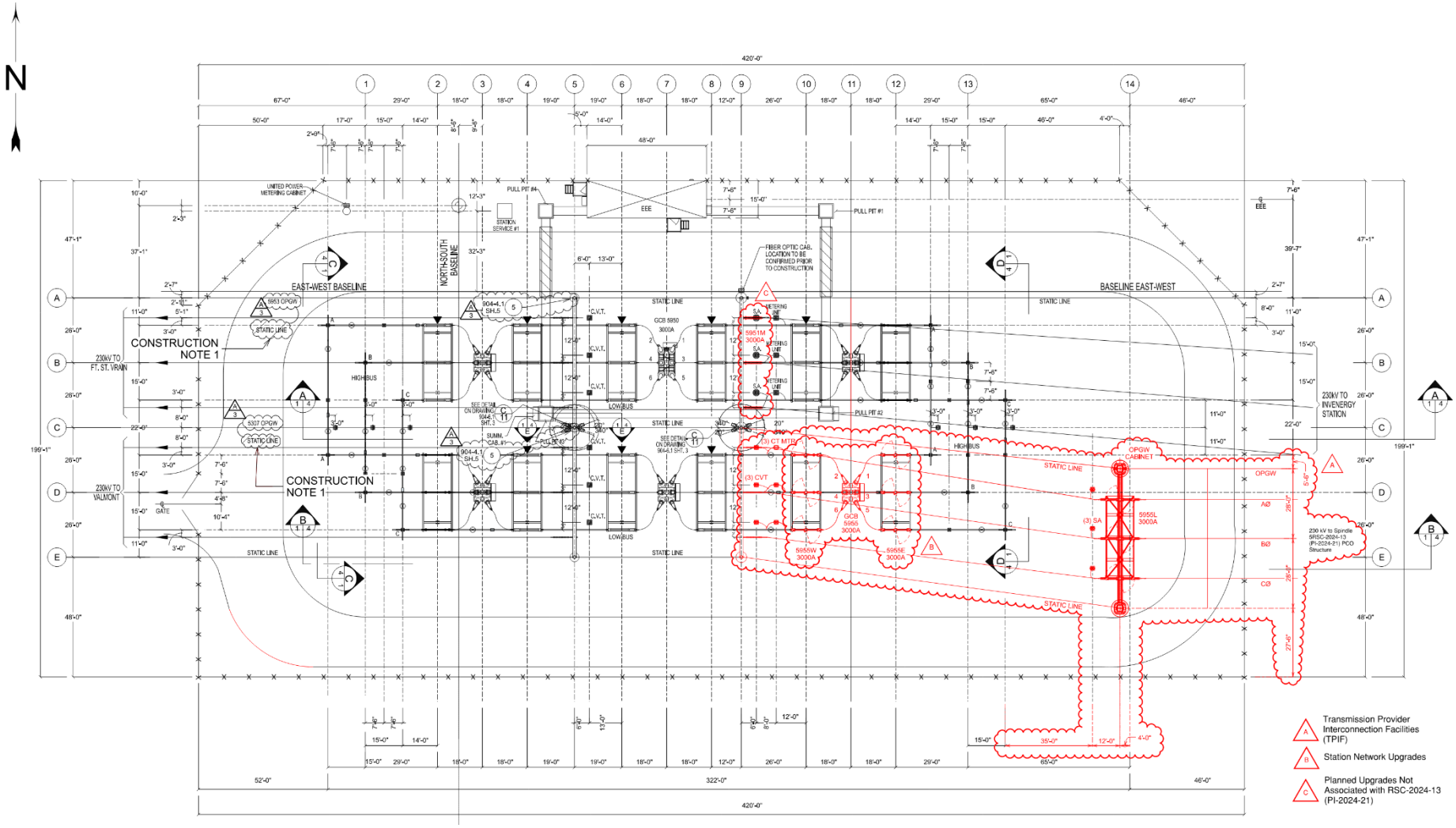

Figure 2: **Preliminary General Arrangement for PI-2024-21 at the Spindle 230 kV switching station**