PI-2025-6 Provisional Interconnection Study Report

Xcel Energy
May 19, 2026

Prepared by: Mitsubishi Electric Power Products, Inc on behalf of Public Service Company of Colorado

Peer Review by: James Nguyen, Principal Engineer

Approved by: Kevin Pera, OATT Program Manager

Table of Contents

List of Figures

List of Tables

1.0 Executive Summary

This Provisional Interconnection Service (PIS)[1] Study has been prepared in accordance with the Xcel Energy Open Access Transmission Tariff and the executed Provisional Interconnection Study Agreement between the Interconnection Customer (IC) and the Transmission Provider (TP) – Public Service Company of Colorado (PSCo). This PI request has been given the queue number as PI-2025-6 and it is associated with the 5RSC-2024-27 Generation Interconnection Request (GIR).

The PI request is for a 250 MW (255 MW gross) Photovoltaic (PV) and a 210.6 MW Battery Energy Storage System (BESS), with a Point of Interconnection (POI) at the Canal Crossing 345 kV switching station.

Based on the Power Flow, Stability and Short-Circuit analyses, the maximum permissible output allowed for the Generating Facility is 0 MW (Grid Discharging) and 0 MW (Grid Charging). The Short-Circuit analysis (breaker duty) on the PSCo transmission system identified a total of eight circuit breakers as being over-dutied because of adding PI-2025-6. The output amount of the Generating Facility in the PLGIA[2] will be reviewed quarterly and updated if there are changes to the system conditions assumed in this analysis.

The total estimated cost of the PSCo transmission system improvements required for PI-2025-6 to receive Provisional Interconnection service is estimated to be **$7.652 million**.

Security: PI-2025-6 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.

The Interconnection Customer assumes all risks and liabilities with respect to changes between the PLGIA and the LGIA[3], including changes in output limits and Interconnection Facilities, Network Upgrades, Distribution Upgrades, and/or System Protection Facilities

[1] **Provisional Interconnection Service (PIS)** shall mean an Interconnection Service provided by Transmission Provider associated with interconnecting the Interconnection Customer's Generating Facility to Transmission Provider's Transmission System and enabling that Transmission System to receive electric energy and capacity from the Generating Facility at the Point of Interconnection, pursuant to the terms of the Provisional Large Generator Interconnection Agreement and, if applicable, the Tariff.

[2] **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 14 and takes the form of the Standard Large Generator Interconnection Agreement, modified for provisional purposes.

[3] **Standard 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.

cost responsibility. This Provisional Interconnection Service in and of itself does not convey transmission service.

2.0 Introduction

This PI request is for a 250 MW (255 MW gross) Photovoltaic and 210.6 MW BESS Generating Facility located in Morgan County, Colorado. The study evaluated the impacts on the PSCo transmission system and Affected Systems by modeling the Generating Facility at the nameplate rating, adjusted for losses associated with the interconnection facilities.

- The Generating Facility is expected to deliver 250 MW to the POI using both PV and BESS.
- The POI of this project is at the Canal Crossing 345 kV switching station.
- The Commercial Operation Date (COD) to be studied for PI-2025-6 is 12/28/2027.

The geographical location of the transmission system near the POI is shown in Figure 1.

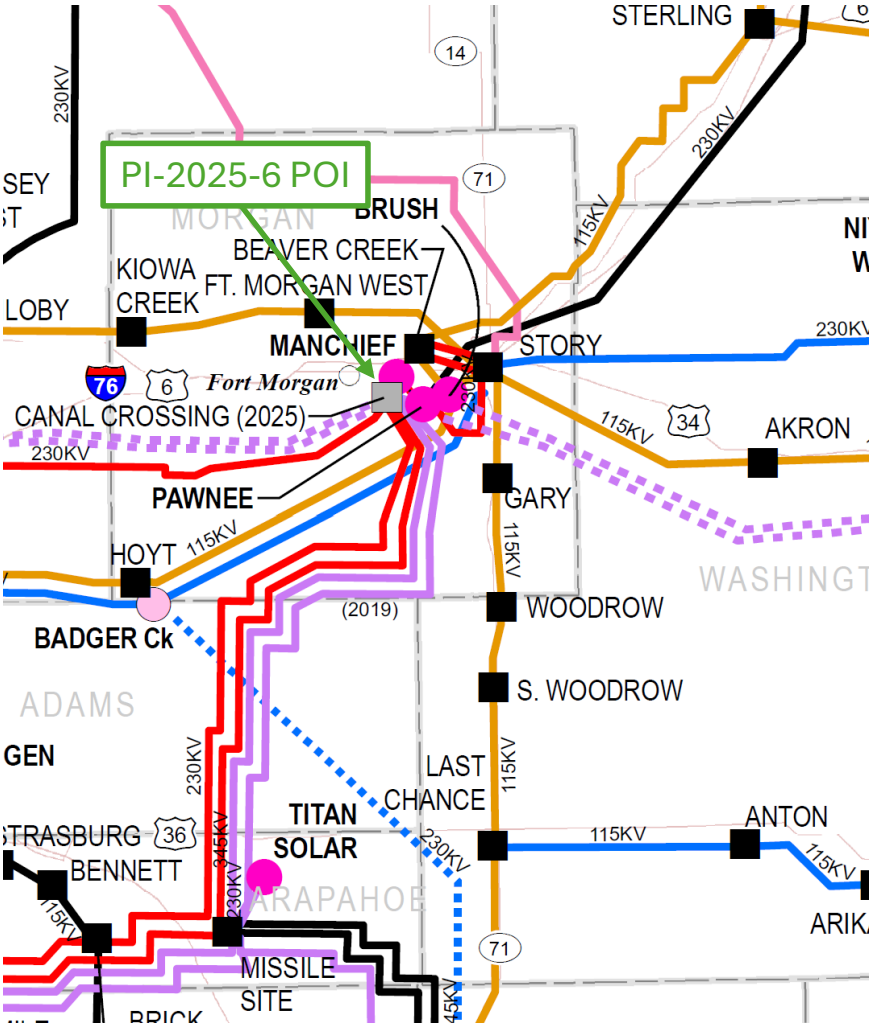

Figure 1: Point of Interconnection of PI-2025-6.

3.0 Study Scope

The Study Scope included Power Flow (thermal and voltage) analysis, Stability analysis, Voltage and Reactive Capability analysis, Short-Circuit analysis, and Cost Estimates for Interconnection Facilities and Station Network Upgrades. The study also identified the Contingent Facilities associated with the Provisional Interconnection service.

3.1 Power Flow and Stability Analysis Criteria

The Power Flow and Stability Analysis criteria used for this study follow the guidelines set forth in the TPL-001-WECC-CRT-4 under requirement WR1.

3.2 Short-Circuit Analysis Criteria (Breaker Duty)

Fault Current after PI addition should not exceed 100% of the Breaker Duty rating. PSCo can only perform breaker duty analysis on the PSCo Transmission 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.

3.3 Benchmark Case Modeling

The Benchmark Case was created from the Base Case (2029HS) as described in Chapter 3 of the BPM, by modifying the study pocket generation dispatch to reflect heavy generation in the East study pocket.

3.4 Study Case and Short-Circuit Modeling

PI-2025-6 is a 255 MW gross PV plus 210.6 MW gross BESS Generating Facility. Grid discharging was studied as 250 MW of generation to the POI. Grid charging was studied as 210.6 MW of load at the generator terminal.

- Solar PV Machine model – Sixty-seven (67) inverters, Sungrow SG4400UD, rated for 4.4 MVA
- BESS Machine model – One-thousand one hundred and fifty-two (1,152) inverters, Sungrow SC210HX-US, rated for 0.21 MVA
    - BESS capacity is 200MW/800MWh, 4-hour duration, Li-Ion battery, AC-Coupled
- Main step-up transformers – Two (2) main step-up transformers. The voltage and rating for both GSU #1 and GSU #2 are 345/34.5/13.8 kV, 94/125.3/156.7 MVA
- Length of Gen-Tie – 0.16 mile

The Study Case was created from the Benchmark Case by turning on the PI-2025-6 generation and balanced against PSCo generation outside of the Eastern Colorado study pocket. The facility's diagram in PSLF is presented in Figure 2, and modeling data (.epc and .dyd files) are attached in Appendix A.

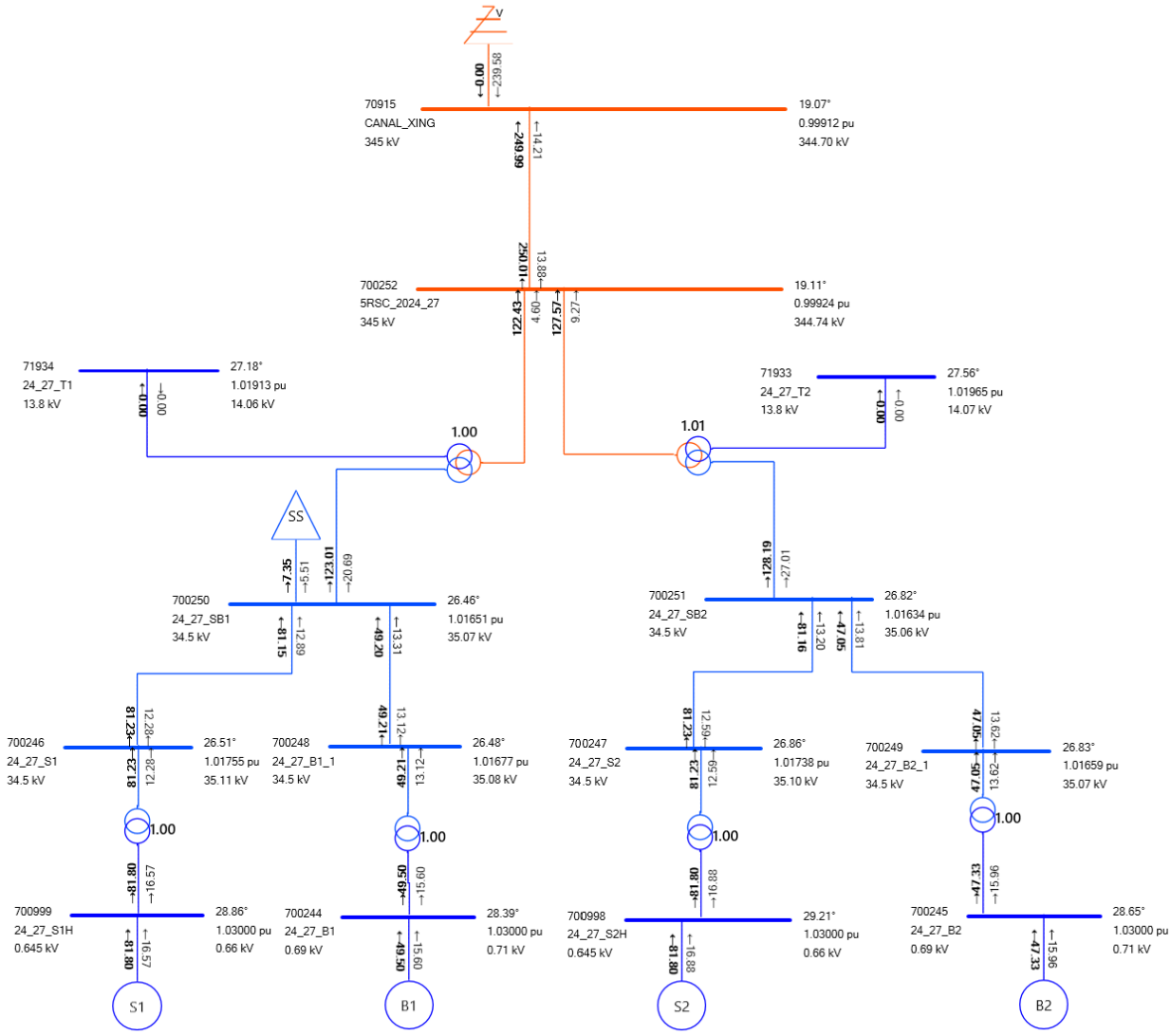

Figure 2: PSLF Model representation of PI-2025-6.

For Short-Circuit modeling, all connected generating facilities were assumed capable of producing maximum fault current. Accordingly, all generators were modeled at full capacity, regardless of whether NRIS or ERIS was requested. Generation was modeled as a separate generating resource in CAPE and included at full capacity in the short circuit study, independent of any operating limitations that would otherwise be imposed.

3.5 Voltage and Reactive Power Capability Evaluation

Per Section 4.1.1.1 of the BPM, the following voltage regulation and reactive power capability requirements are applicable to non-synchronous generators:

- Xcel Energy's OATT requires all non-synchronous generator Interconnection Customers to provide dynamic reactive power within the power factor range of 0.95 leading to 0.95 lagging at the high side of the generator substation. Furthermore, Xcel Energy requires every Generating Facility to have dynamic voltage control capability to assist in maintaining the POI voltage schedule specified by the Transmission Operator.
- It is the responsibility of the Interconnection Customer to determine the type (switched shunt capacitors and/or switched shunt reactors, etc.), the size (Mvar), and the locations (on the Interconnection Customer's facility) of any additional static reactive power compensation needed within the generating plant in order to have adequate reactive capability to meet the +/- 0.95 power factor at the high side of the main step-up transformer.
- It is the responsibility of the Interconnection Customer to compensate their generation tie-line to ensure minimal reactive power flow under no load conditions.

All the summary tables representing the GIR's Voltage and Reactive Power Capability tests adhere to the following color formatting representing the different aspects of the tests:

- Values highlighted in red indicate a failed reactive power requirement.
- Voltages outside the range of 0.95 p.u. to 1.05 p.u. are highlighted in yellow to provide additional information.

The PI-2025-6 GIR is modeled as follows:

PV: Pmax = 255.0 MW, Pmin = 0.00 MW, Qmax = 147.9 Mvar, Qmin= -147.9 Mvar

BESS: Pmax = 210.6 MW, Pmin = -210.6 MW, Qmax = 119.1 Mvar, Qmin= -119.1Mvar

The summary for the Voltage and Reactive Power Capability Evaluation for PI-2025-6 is:

- The GIR is capable of meeting ±0.95 pf at the high side of the main step-up transformer while maintaining a normal operating voltage at the POI.
- The GIR is capable of meeting ±0.95 pf at its terminals while meeting the interconnection service request.
- The reactive power exchange and voltage change across the gen-tie are acceptable under no load conditions.

The Voltage and Reactive Power Capability tests performed for PI-2025-6 are summarized in Table 1.

Table 1 – Reactive Capability Evaluation for PI-2025-6

PV Generator Terminals					BESS Generator Terminals					High Side of Main Transformer				POI			
Pgen (MW)	Qgen (Mvar)	Qmax (Mvar)	Qmin (Mvar)	V (p.u.)	Pgen (MW)	Qgen (Mvar)	Qmax (Mvar)	Qmin (Mvar)	V (p.u.)	P (MW)	Q (Mvar)	V (p.u.)	PF	P (MW)	Q (Mvar)	V (p.u.)	PF
163.6	80.6	147.9	-147.9	1.03	96.8	67.1	119.1	-119.1	1.03	250.0	85.5	1.01	0.946	250.0	85.8	1.01	0.946
163.6	-29.1	147.9	-147.9	0.99	96.8	-2.2	119.1	-119.1	1.00	250.0	-84.4	1.00	-0.947	249.9	-84.1	1.00	-0.948
255.0	147.9	147.9	-147.9	1.05	OFFLINE					242.7	80.2	1.01	0.949	242.7	80.6	1.01	0.949
OFFLINE					210.6	119.1	119.1	-119.1	1.01	199.9	65.9	1.01	0.950	199.9	66.3	1.01	0.949
210.6	119.1	119.1	-119.1	1.04	OFFLINE					243.6	-84.2	1.00	-0.945	243.6	-83.9	1.00	-0.946
OFFLINE					210.6	-24.6	119.1	-119.1	1.00	200.3	-69.9	1.01	-0.944	200.3	-69.6	1.01	-0.945
0.0	41.8	147.9	-147.9	1.03	0.0	31.4	119.1	-119.1	1.03	-8.3	63.5	1.01	-0.129	-8.3	64.0	1.01	-0.128

3.6 Power Flow Analysis Results

Contingency analysis was performed on the East Colorado study pocket Study Case.

- System intact contingency analysis showed no thermal or voltage violations attributable to PI-2025-6.
- Results of the single contingency analysis are shown in Table 2. Single contingency analysis illustrated voltage violations attributable to PI-2025-6 and are shown in Table 3.
- Results of the multiple contingency analysis are shown in Table 5.

All single contingency overloads identified in Table 2 were alleviated through generation redispatch, as reflected in the Redispatch Study Case results presented in the last column of the table.

All single contingency voltage violations identified in Table 3 were alleviated through generation redispatch.

The redispatch to solve the single contingency overloads and voltage violations is shown in Table 4.

Multiple contingency overloads are mitigated using system adjustments, including generation redispatch (includes GIRs under study) and/or operator actions.

Table 2 – East Colorado – Single Contingency Thermal Overloads

Ref. No.	Monitored Facility	Contingency Name	Area	Owner	Rate (MVA)	BM Case AC Loading (%)	Study Case		Redispatch Study Case	
							AC Loading (%)	Loading Diff. (%)	AC Loading (%)	Loading Diff. (%)
1	70599 SMOKY_HL 345 70396 SMOKY_HL 230 T4 1	LoTC_151: Harvest Mile - Smoky Hill 345 kV CKT 2	70	PSCo	560	100.6	103.9	3.3	99.7	-0.9
2	70599 SMOKY_HL 345 70396 SMOKY_HL 230 T5 1	LoTC_151: Harvest Mile - Smoky Hill 345 kV CKT 2	70	PSCo	560	100.6	103.9	3.3	99.7	-0.9
3	73192 STORY 230 70311 PAWNEE 230 1 1	P21From: 70915 CANAL_XING 345 70916 FT_ST_VRAIN 345 1 1	70/73	PSCo	581	95.7	106.5	10.8	96.1	0.4

Table 3 – East Colorado – Single Contingency Voltage Violations

Ref. No.	Bus #	Bus Name	Base kV	Area	Cont. Name	BM Voltage	Study Voltage	Voltage Dff.	Notes
1	72024	HENRYLAK	115	73	72024 HENRYLAK 115 70605 HENRYLAK 230 T1 1	0.906	0.890	-0.016	Fixed with redispatch.
2	72019	BROMLEY	115	73	72024 HENRYLAK 115 70605 HENRYLAK 230 T1 1	0.909	0.893	-0.016	Fixed with redispatch.
3	72208	DELCAMIN	69	73	72107 SLATERTS 115 73049 DELCAMIN 115 1 1	0.884	0.869	-0.015	Fixed with redispatch.
4	73049	DELCAMIN	115	73	72107 SLATERTS 115 73049 DELCAMIN 115 1 1	0.906	0.891	-0.015	Fixed with redispatch.
5	73377	EXCEL	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.868	0.850	-0.018	Fixed with redispatch.
6	73310	FME	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.869	0.851	-0.018	Fixed with redispatch.
7	73309	HENDERSON	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.870	0.852	-0.018	Fixed with redispatch.
8	73031	BRUSHTAP	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.870	0.852	-0.018	Fixed with redispatch.
9	73378	FMN	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.871	0.852	-0.018	Fixed with redispatch.
10	73305	EFMORGTP	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.871	0.852	-0.018	Fixed with redispatch.
11	73311	FMS	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.873	0.854	-0.018	Fixed with redispatch.
12	73379	FMWEST	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.873	0.854	-0.018	Fixed with redispatch.
13	73023	BIJOUTAP	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.884	0.866	-0.018	Fixed with redispatch.
14	73147	ORCHARD	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.901	0.884	-0.017	Fixed with redispatch.
15	73097	KIOWA CK	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.901	0.884	-0.017	Fixed with redispatch.
16	73213	WIGGINS TAP	115	73	73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.908	0.892	-0.017	Fixed with redispatch.
17	72107	SLATERTS	115	73	P21From: 72107 SLATERTS 115 73049 DELCAMIN 115 1 1	0.907	0.892	-0.015	Fixed with redispatch.
18	73020	BEAVERCK	115	73	P21From: 73020 BEAVERCK 115 73031 BRUSHTAP 115 1 1	0.871	0.853	-0.018	Fixed with redispatch.

Table 4 – East Colorado – Single Contingency Redispatch Mitigation

Ref. No.	Bus Number	Bus Name	ID	Original Status	Original Pgen (MW)	Modified Status	Modified Pgen (MW)
1	70069	CABCRKA	HA	0	0.0	1	150.0
2	70070	CABCRKB	HB	0	0.0	1	150.0
3	70710	PTZLOGN1	W1	1	160.0	1	20.0
4	70712	PTZLOGN2	W2	1	96.2	1	20.0
5	70767	RUSHCK_1_W1	W1	1	161.6	1	100.0
6	70770	RUSHCK_1_W2	W2	1	142.4	1	120.0

Table 5 – East Colorado – Multiple Contingency Thermal Overloads

Ref. No.	Monitored Facility	Contingency Name	Area	Owner	Rate (MVA)	BM Case AC Loading (%)	Study Case AC Loading (%)	Loading Diff. (%)
1	70599 SMOKY_HL 345 70396 SMOKY_HL 230 T4 1	BF_129d: Smoky Hill 7082 Stuck	70	PSCo	756	126.4	130.8	4.4
2	70599 SMOKY_HL 345 70396 SMOKY_HL 230 T5 1	BF_129c: Smoky Hill 7084 Stuck	70	PSCo	756	124.4	130.8	6.4
3	73192 STORY 230 70311 PAWNEE 230 1 1	P7_136: Pawnee to Brick CTR 230 kV, Smoky Hill to Missile Site 345 kV	70/73	PSCo	589	110.7	118.6	7.9
4	70599 SMOKY_HL 345 70624 MISS_SITE 345 1 1	P7_61: Daniels Park to Missile Site 345 kV CKTs 1 and 2	70	PSCo	1775	99.2	103.6	4.4
5	70192 FT_LUPTON 230 70311 PAWNEE 230 1 1	P7_136: Pawnee to Brick CTR 230 kV, Smoky Hill to Missile Site 345 kV	70	PSCo	478	97.2	102.4	5.2

3.7 Stability Analysis Results

Prior to the start of the Stability Analysis, unstable results were observed for the Benchmark case in simulations for the contingencies at Canal Crossing 345 kV (Ref. Nos. 2, 3, 4, and 5) and at Shortgrass 345 kV (Ref. No. 9). The issue was investigated, and the addition of two 350 MVar Synchronous Condensers (SCs), one at Waterton 345 kV and one at Daniels Park 345 kV has been proposed as a provisory solution. The addition of the two SCs was verified to produce stable results in Benchmark cases. The Stability Analysis was then conducted with the addition of the SCs.

The results of the transient stability analysis are summarized in Table 6 (Grid Discharging) and Table 7 (Grid Charging).

All contingencies presented the following:

- ✓ No machines lost synchronism with the system.
- ✓ No voltage drop violations were observed.
- ✓ Machine rotor angles displayed positive damping.

The stability plots for are shown in Appendix B and C in Section 8.0 of this report.

Table 6 – Transient Stability Analysis Results (Grid Discharging)

Ref. No.	Contingency Name	Fault Category	Outage(s)	Clearing Time (Cycles)	Post-Fault Voltage Recovery	Angular Stability
1	Flat Run	P0	-	-	Stable	Stable
2	Gen PI-2025-6	P1	PI-2025-6 Units	4	Stable	Stable
3	Missile Site - Canal Crossing	P1	Missile Site - Canal Crossing 345 kV CKT 1	4	Stable	Stable
4	Canal Crossing - Pawnee	P1	Canal Crossing - Pawnee 345 kV CKT 1	4	Stable	Stable
5	FSV - Canal Crossing	P1	Fort St Vrain - Canal Crossing 345 kV CKT 1	4	Stable	Stable
6	Goose Creek - Canal Crossing	P1	Goose Creek - Canal Crossing 345 kV CKT 1	4	Stable	Stable
7	Goose Creek - May Valley	P1	Goose Creek - May Valley 345 kV CKT 1	4	Stable	Stable
8	Goose Creek - Shortgrass	P1	Goose Creek - Shortgrass 345 kV CKT 1 Loss of Shortgrass Shunt	4	Stable	Stable
9	Shortgrass - Pronghorn	P1	Shortgrass - Pronghorn 345 kV CKT 1	4	Stable	Stable
10	Shortgrass - Bronco Plains	P1	Shortgrass - Bronco Plains 345 kV CKT 1	4	Stable	Stable
11	May Valley - Sandstone	P1	May Valley - Sandstone 345 kV CKT 1	4	Stable	Stable
12	Goose Creek - Cheyenne Ridge	P4	Goose Creek - Cheyenne Ridge W 345 kV CKT 1 Cheyenne Ridge W - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge E - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge W1 345/34.5 kV Transformer 1 Cheyenne Ridge W2 345/34.5 kV Transformer 1 Cheyenne Ridge East W13 345/34.5 kV Transformer 1 Cheyenne Ridge East W2 345/34.5 kV Transformer 1	12	Stable	Stable
13	Canal Crossing - Goose Creek	P7	Goose Creek - Canal Crossing 345 kV CKT 1 Goose Creek - Canal Crossing 345 kV CKT 2 Loss of Canal Crossing Shunt	4	Stable	Stable

Ref. No.	Contingency Name	Fault Category	Outage(s)	Clearing Time (Cycles)	Post-Fault Voltage Recovery	Angular Stability
14	May Valley - Goose Creek	P7	Goose Creek - May Valley 345 kV CKT 1 Goose Creek - May Valley 345 kV CKT 2 Loss of May Valley Shunt	4	Stable	Stable
15	Goose Creek - Shortgrass - Cheyenne Ridge	P7	Goose Creek - Shortgrass 345 kV CKT 1 Goose Creek - Cheyenne Ridge W 345 kV CKT 1 Loss of Cheyenne Ridge East Shunt Cheyenne Ridge W - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge E - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge W1 345/34.5 kV Transformer 1 Cheyenne Ridge W2 345/34.5 kV Transformer 1 Cheyenne Ridge East W13 345/34.5 kV Transformer 1 Cheyenne Ridge East W2 345/34.5 kV Transformer 1	4	Stable	Stable

Ref. No.	Contingency Name	Fault Category	Outage(s)	Clearing Time (Cycles)	Post-Fault Voltage Recovery	Angular Stability
1	Flat Run	P0	-	-	Stable	Stable
2	Gen PI-2025-6	P1	PI-2025-6 Units	4	Stable	Stable
3	Missile Site - Canal Crossing	P1	Missile Site - Canal Crossing 345 kV CKT 1	4	Stable	Stable
4	Canal Crossing - Pawnee	P1	Canal Crossing - Pawnee 345 kV CKT 1	4	Stable	Stable
5	FSV - Canal Crossing	P1	Fort St Vrain - Canal Crossing 345 kV CKT 1	4	Stable	Stable
6	Goose Creek - Canal Crossing	P1	Goose Creek - Canal Crossing 345 kV CKT 1	4	Stable	Stable
7	Goose Creek - May Valley	P1	Goose Creek - May Valley 345 kV CKT 1	4	Stable	Stable

Ref. No.	Contingency Name	Fault Category	Outage(s)	Clearing Time (Cycles)	Post-Fault Voltage Recovery	Angular Stability
8	Goose Creek - Shortgrass	P1	Goose Creek - Shortgrass 345 kV CKT 1 Loss of Shortgrass Shunt	4	Stable	Stable
9	Shortgrass - Pronghorn	P1	Shortgrass - Pronghorn 345 kV CKT 1	4	Stable	Stable
10	Shortgrass - Bronco Plains	P1	Shortgrass - Bronco Plains 345 kV CKT 1	4	Stable	Stable
11	May Valley - Sandstone	P1	May Valley - Sandstone 345 kV CKT 1	4	Stable	Stable
12	Goose Creek - Cheyenne Ridge	P4	Goose Creek - Cheyenne Ridge W 345 kV CKT 1 Cheyenne Ridge W - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge E - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge W1 345/34.5 kV Transformer 1 Cheyenne Ridge W2 345/34.5 kV Transformer 1 Cheyenne Ridge East W13 345/34.5 kV Transformer 1 Cheyenne Ridge East W2 345/34.5 kV Transformer 1	12	Stable	Stable
13	Canal Crossing - Goose Creek	P7	Goose Creek - Canal Crossing 345 kV CKT 1 Goose Creek - Canal Crossing 345 kV CKT 2 Loss of Canal Crossing Shunt	4	Stable	Stable
14	May Valley - Goose Creek	P7	Goose Creek - May Valley 345 kV CKT 1 Goose Creek - May Valley 345 kV CKT 2 Loss of May Valley Shunt	4	Stable	Stable
15	Goose Creek - Shortgrass - Cheyenne Ridge	P7	Goose Creek - Shortgrass 345 kV CKT 1 Goose Creek - Cheyenne Ridge W 345 kV CKT 1 Loss of Cheyenne Ridge East Shunt Cheyenne Ridge W - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge E - Cheyenne Ridge Control 345 kV CKT 1	4	Stable	Stable

Ref. No.	Contingency Name	Fault Category	Outage(s)	Clearing Time (Cycles)	Post-Fault Voltage Recovery	Angular Stability
			Cheyenne Ridge W1 345/34.5 kV Transformer 1 Cheyenne Ridge W2 345/34.5 kV Transformer 1 Cheyenne Ridge East W13 345/34.5 kV Transformer 1 Cheyenne Ridge East W2 345/34.5 kV Transformer 1			

Table 7 – Transient Stability Analysis Results (Grid Charging)

Ref. No.	Contingency Name	Fault Category	Outage(s)	Clearing Time (Cycles)	Post-Fault Voltage Recovery	Angular Stability
1	Flat Run	P0	-	-	Stable	Stable
2	Gen PI-2025-6	P1	PI-2025-6 Units	4	Stable	Stable
3	Missile Site - Canal Crossing	P1	Missile Site - Canal Crossing 345 kV CKT 1	4	Stable	Stable
4	Canal Crossing - Pawnee	P1	Canal Crossing - Pawnee 345 kV CKT 1	4	Stable	Stable
5	FSV - Canal Crossing	P1	Fort St Vrain - Canal Crossing 345 kV CKT 1	4	Stable	Stable
6	Goose Creek - Canal Crossing	P1	Goose Creek - Canal Crossing 345 kV CKT 1	4	Stable	Stable
7	Goose Creek - May Valley	P1	Goose Creek - May Valley 345 kV CKT 1	4	Stable	Stable
8	Goose Creek - Shortgrass	P1	Goose Creek - Shortgrass 345 kV CKT 1 Loss of Shortgrass Shunt	4	Stable	Stable
9	Shortgrass - Pronghorn	P1	Shortgrass - Pronghorn 345 kV CKT 1	4	Stable	Stable
10	Shortgrass - Bronco Plains	P1	Shortgrass - Bronco Plains 345 kV CKT 1	4	Stable	Stable
11	May Valley - Sandstone	P1	May Valley - Sandstone 345 kV CKT 1	4	Stable	Stable
12	Goose Creek - Cheyenne Ridge	P4	Goose Creek - Cheyenne Ridge W 345 kV CKT 1 Cheyenne Ridge W - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge E - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge W1 345/34.5 kV Transformer 1 Cheyenne Ridge W2 345/34.5 kV Transformer 1 Cheyenne Ridge East W13 345/34.5 kV Transformer 1 Cheyenne Ridge East W2 345/34.5 kV Transformer 1	12	Stable	Stable
13	Canal Crossing - Goose Creek	P7	Goose Creek - Canal Crossing 345 kV CKT 1 Goose Creek - Canal Crossing 345 kV CKT 2 Loss of Canal Crossing Shunt	4	Stable	Stable

Ref. No.	Contingency Name	Fault Category	Outage(s)	Clearing Time (Cycles)	Post-Fault Voltage Recovery	Angular Stability
14	May Valley - Goose Creek	P7	Goose Creek - May Valley 345 kV CKT 1 Goose Creek - May Valley 345 kV CKT 2 Loss of May Valley Shunt	4	Stable	Stable
15	Goose Creek - Shortgrass - Cheyenne Ridge	P7	Goose Creek - Shortgrass 345 kV CKT 1 Goose Creek - Cheyenne Ridge W 345 kV CKT 1 Loss of Cheyenne Ridge East Shunt Cheyenne Ridge W - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge E - Cheyenne Ridge Control 345 kV CKT 1 Cheyenne Ridge W1 345/34.5 kV Transformer 1 Cheyenne Ridge W2 345/34.5 kV Transformer 1 Cheyenne Ridge East W13 345/34.5 kV Transformer 1 Cheyenne Ridge East W2 345/34.5 kV Transformer 1	4	Stable	Stable

3.8 Short-Circuit (Breaker Duty) Analysis Results

A study was completed to determine whether any over-dutied 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 Short-Circuit analysis (breaker duty) on the PSCo transmission system identified a total of eight circuit breakers as being over-dutied because of adding PI-2025-6. The fault currents at the POI for can be made available upon request by the Customer.

Table 8 - Overstressed Breakers Due to PI-2025-6 Addition

SUBSTATION	BASE KV	BREAKER NAME
DANIELS PARK	230	5100
DANIELS PARK	230	5103
DANIELS PARK	230	5107
DANIELS PARK	230	5111
DANIELS PARK	230	5115
DANIELS PARK	230	5113
DANIELS PARK	230	5104
DANIELS PARK	230	5116

3.9 Affected Systems

No Affected Systems were identified.

4.0 Cost Estimates

The total estimated cost of the required Upgrades for PI-2025-6 to interconnect for Provisional Interconnection Service at the Canal Crossing 345 kV switching station **$7.652 million**.

- **Cost of Transmission Provider's Interconnection Facilities (TPIF) is $3.585 million** (Table 9)
- **Cost of Station Network Upgrades is $4.067 million** (Table 10)
- **Cost of System Network Upgrades is $0**

The list of improvements required to accommodate the Provisional Interconnection of PI-2025-6 are given in Table 8, and Table 9.

Table 9 – Transmission Provider's Interconnection Facilities

Element	Description	Cost Est. (Million)
PSCo's Canal Crossing 345 kV switching station	Interconnection of 5RSC-2024-27 (PI-2025-6) at Canal Crossing 345 kV switching station. The new equipment includes: • (1) 345 kV 3-phase arrester • (1) 345 kV 3000 A line disconnect switch • (3) 345 kV 1-phase CTs for metering • (3) 345 kV 1-phase CCVTs • Dual fiber communication equipment • Associated electrical equipment, wiring and grounding • Associated foundations and structures • Associated transmission line communications, fiber, relaying and testing • Testing and commissioning	$2.153
PSCo's Canal Crossing 345 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. Dead end structure, single span, 3 conductors, insulators, hardware, jumpers and labor	$1.432
Total Cost Estimate for Interconnection Customer-Funded, PSCo-Owned Interconnection Facilities		**$3.585**

Table 10 – Station Network Upgrades

Element	Description	Cost Est. (Million)
PSCo's Canal Crossing 345 kV switching station	Interconnection of 5RSC-2024-27 (PI-2025-6) at Canal Crossing 345 kV switching station. The new equipment includes: • (1) 345 kV 3000 A SF6 circuit breaker • (2) 345 kV 3000 A disconnect switches • Permitting • Associated electrical equipment, bus, wiring and grounding • Station controls and wiring • Associated foundations and structures	$3.371
PSCo's Canal Crossing 345 kV switching station	Install required communication in the EEE at the Canal Crossing 345 kV switching station	$0.696
Total Cost Estimate for PSCo-Funded, PSCo-Owned Interconnection Facilities		**$4.067**

PSCo has developed cost estimates for Transmission Provider's Interconnection Facilities and Network/Infrastructure Upgrades required for the interconnection of PI-2025-6 for Provisional Interconnection Service. The estimated costs provided in this report are based upon the following assumptions:

- The estimated costs are in 2026 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:

- Interconnection Customer will install two (2) redundant fiber optic circuits (one primary circuit with a redundant backup) into the Transmission Provider's switching station 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 Remote Terminal Unit (RTU) at their Customer substation. PSCo will be provided with indications, readings and data from the 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

4.1 Schedule

This section provides proposed milestones for the interconnection of PI-2025-6 to the Transmission Provider's Transmission System. The customer requested a back-feed date (In-Service Date for Transmission Provider Interconnection Facilities and Station Network Upgrades required for interconnection) for the Provisional Interconnection is February 28, 2027. This is not 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 11.

Table 11 – Proposed Milestones for PI-2025-6

Milestone	Responsible Party	Estimated Completion Date
PLGIA Execution	Interconnection Customer and Transmission Provider	July 2026
In-Service Date for Transmission Provider Interconnection Facilities and Station Network Upgrades required for interconnection	Transmission Provider	July 30, 2027
In-Service Date & Energization of Interconnection Customer's Interconnection Facilities	Interconnection Customer	August 24,2027
Initial Synchronization Date	Interconnection Customer	August 25, 2027
Begin trial operation & testing	Interconnection Customer and Transmission Provider	August 25, 2027
Commercial Operation Date	Interconnection Customer	December 28, 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 PLGIA 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.

5.0 Conclusion

The total estimated cost of the PSCo transmission system improvements required for PI-2025-6 to qualify for Provisional Interconnection Service would be **$7.652 million**.

Based on the Power Flow, Stability and Short Circuit analyses, the maximum permissible output allowed for the Generating Facility is 0 MW (Grid Discharging) and 0 MW (Grid Charging). The Short-Circuit analysis (breaker duty) on the PSCo transmission system identified a total of eight circuit breakers as being over-dutied because of adding PI-2025-6. The output amount of the Generating Facility in the PLGIA will be reviewed quarterly and updated if there are changes to the system conditions assumed in this analysis.

Security: PI-2025-6 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.

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

6.0 Contingent Facilities

The Contingent Facilities identified for PI-2025-6 include the over-dutied breakers, TPIF and Station Network Upgrades identified in Table 8, Table 9 and Table 10, respectively.

7.0 Conceptual One-Line Diagram and General Arrangement for PI-2025-6

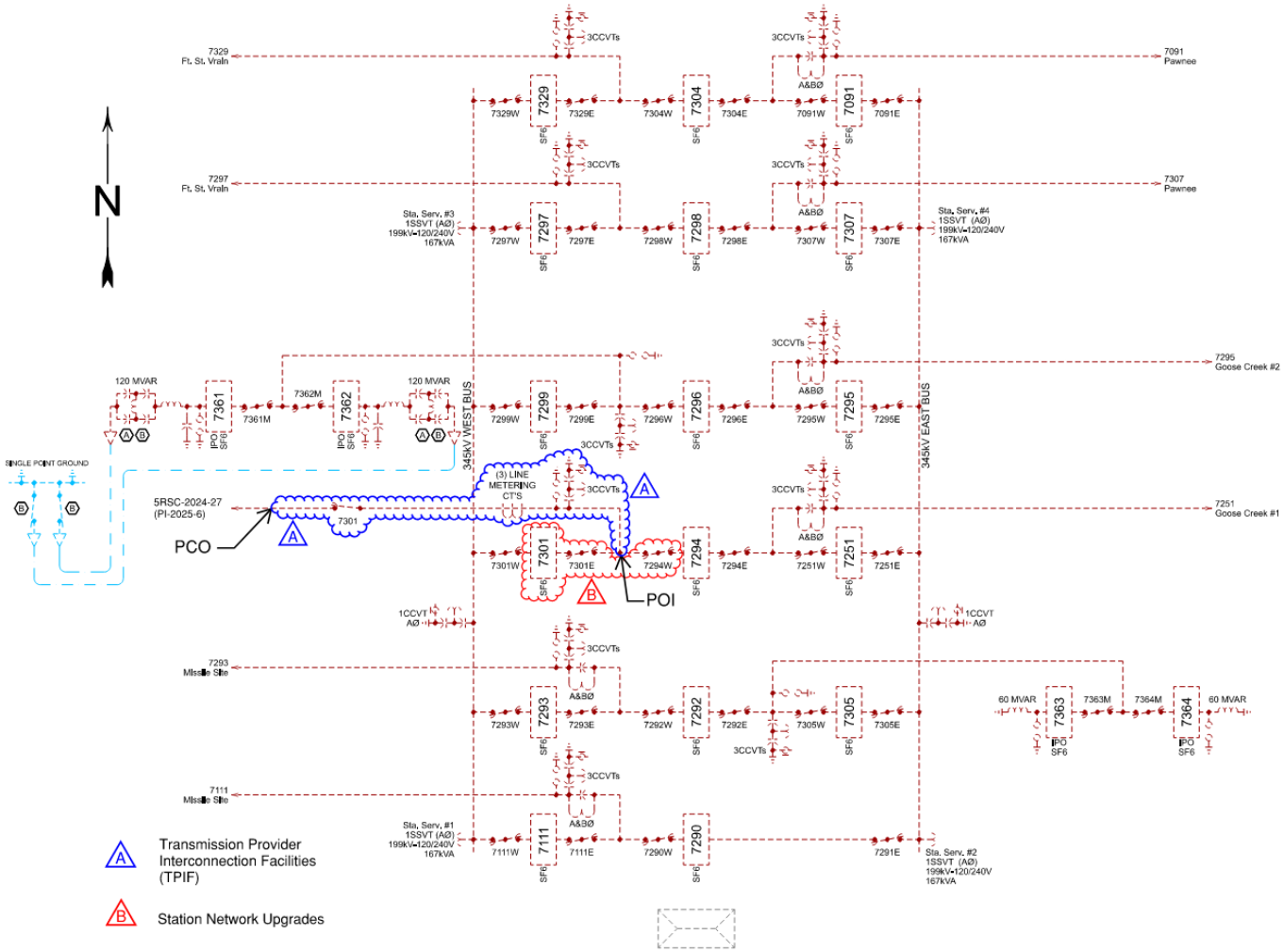

Figure 3: Preliminary One-Line of PI-2025-6 at the Canal Crossing 345 kV Switching Station

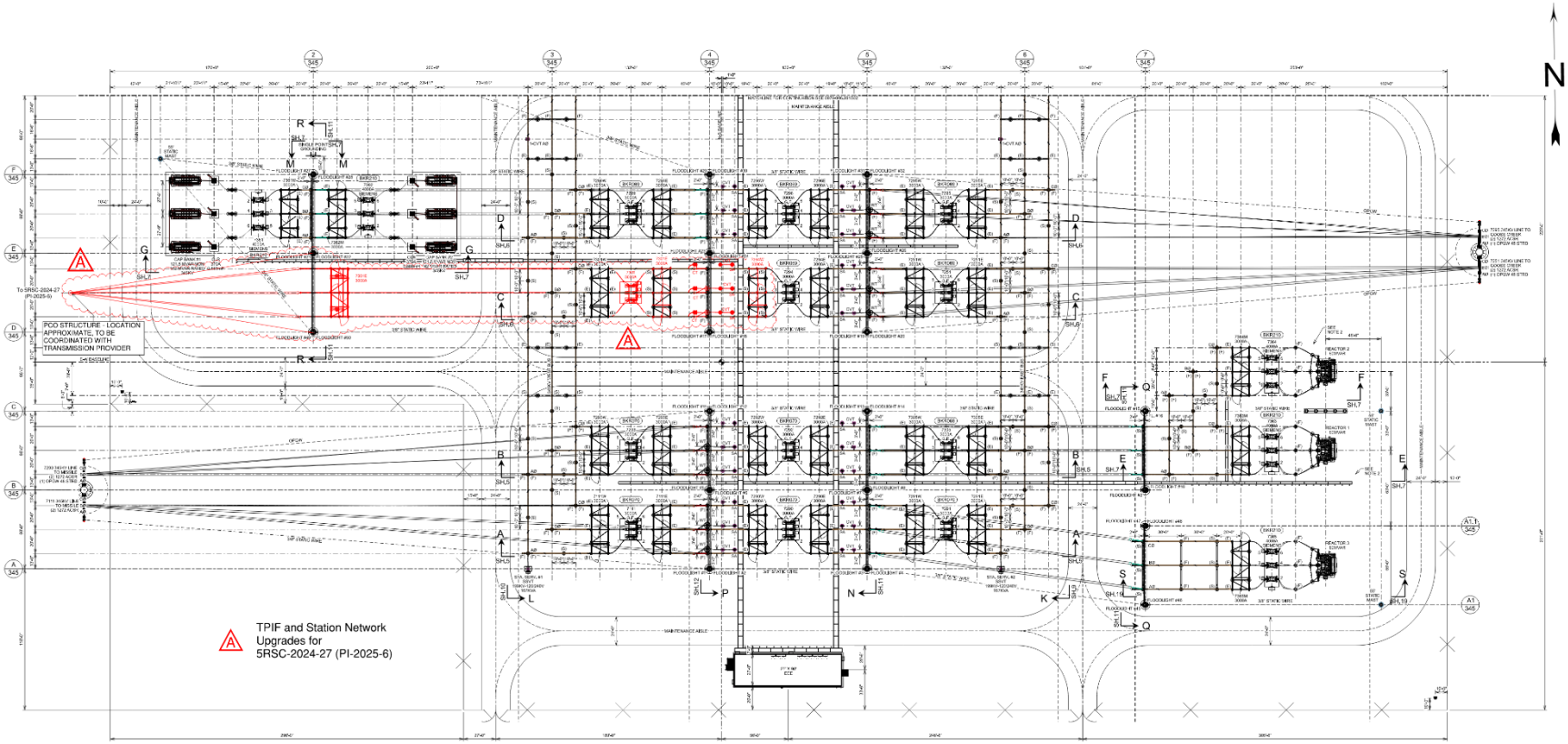

Figure 4: Preliminary General Arrangement of PI-2025-6 at the Canal Crossing 345 kV Switching Station

8.0 Appendices

Appendix A: Modeling Files	PI-2025-06_only.epc PI-2025-06_only.dyd
Appendix B: Stability Plots (Grid Discharging)	PI-2025-6_Transient _Stability_Plots_GD.p
Appendix C: Stability Plots (Grid Charging)	PI-2025-6_Transient_ Stability_Plots_GC