

INFO-2021-2

Informational Study Report

9/1/2021

Table of Contents

1.0	Summary	3
2.0	Introduction.....	3
3.0	Study Scope	4
3.1	Study Pocket Determination.....	4
3.2	Study Criteria	4
3.3	Study Methodology	5
3.4	Study Area.....	5
4.0	Modeling Assumptions.....	5
4.1	Benchmark Case	8
4.2	Study Case Modeling.....	10
5.0	Steady State Analysis Results	10
6.0	Summary of Results.....	12

1.0 Summary

This report is an informational evaluation of a 200MW Solar PV Generating Facility interconnection with POI at the Green Valley 230kV Substation. The expected Commercial Operation Date of the Generating Facility is June 1, 2024 and request was studied for NRIS.

The study identified the following violations:

- Barr Lake – Reunion 230kV line overloads upto 500MVA. This overload can be mitigated by fixing the line termination equipment which can increase the line rating upto 560MVA.

The study did not identify any impacts to the Affected Systems.

Network Resource Interconnection Service of INFO-2021-2 is 200MW.

Note – This report is an informational study and does not grant any Interconnection Service or Transmission Service. The results are based on the modeling assumptions and study scope specified by the Customer, which may or may not reflect the standard modeling assumptions followed for the LGIP studies.

2.0 Introduction

This report is the informational study for a 200MW Solar Photovoltaic (PV) Generating Facility. The Point of Interconnection (POI) is the Green Valley 230kV Substation. The Customer did not provide generator configuration, since this is an informational study, the study modeled a generic 200MW Generating Facility.

The proposed Commercial Operation Date (COD) of INFO-2021-2 is June 1, 2024. The geographical location of the Transmission System near the POI is shown in Figure 1 below.

The request is referred to as “INFO-2021-2” and requested Network Resource Interconnection Service (NRIS)¹.

¹ Network Resource Interconnection Service shall mean an Interconnection Service that allows the Interconnection Customer to integrate its Large Generating Facility with the Transmission Provider’s Transmission system (1) in a manner comparable to that in which the Transmission Provider integrates its generating facilities to serve native load customers; or (2) in an RTO or ISO with market based congestion management, in the same manner as all other Network Resources. Network Resource Interconnection Service in and of itself does not convey transmission service.

3.0 Study Scope

The study was performed using the modeling assumptions specified by the Interconnection Customer. The study scope requested by the Customer includes power flow analysis to evaluate the steady state thermal and voltage limit violations only. Cost estimates for Interconnection Facilities, Station Upgrades and Network Upgrades are not part of the requested study scope. Per the Study Request, the 200 MW rated output of INFO-2021-2 is assumed to be delivered to PSCo native load, so existing PSCo generation is used to sink the generator output.

The study analyzed impacts to the PSCo Transmission System and the Affected Systems, while mitigations to PSCo system impacts are identified, mitigations to Affected System impacts are not identified.

3.1 Study Pocket Determination

As shown in Figure 1, the POI of the request is located in northern Colorado. Hence the study analysis is based on the Northern Colorado study pocket analysis.

3.2 Study Criteria

The following steady state Criteria is used to identify violations on the PSCo system and the Affected Systems.

P0 - System Intact conditions:

Thermal Loading: $\leq 100\%$ Normal facility rating

Voltage range: 0.95 to 1.05 per unit

P1 & P2-1 – Single Contingencies:

Thermal Loading: $\leq 100\%$ Normal facility rating

Voltage range: 0.90 to 1.10 per unit

Voltage deviation: $\leq 8\%$

P2 (except P2-1), P4, P5 & P7 – Multiple Contingencies:

Thermal Loading: $\leq 100\%$ Emergency facility rating

Voltage range: 0.90 to 1.10 per unit

Voltage deviation: $\leq 8\%$

3.3 Study Methodology

The steady state assessment is performed using PSSE V33 and the TARA AC tool.

Thermal violations are identified if a facility (i) resulted in a thermal loading >100% in the Study Case after the study generator addition and (ii) contributed to an incremental loading increase of 1% or more to the benchmark case loading.

Voltage violations are identified if a bus voltage has a further variation of 0.01p.u.

3.4 Study Area

The Study Area includes WECC designated zones 700, 704, and 706. The Affected System included in the analysis is the Tri-State Generation and Transmission Inc. (TSGT) system in the study area.

4.0 Modeling Assumptions

The 2026HS2a WECC case released on July 21, 2020 was selected as the starting case. The Base Case was created from the Starting Case by including the following modeling changes. The following approved transmission projects in PSCo's 10-year transmission plan, with in-service date before summer 2026 were modeled:

http://www.oasis.oati.com/woa/docs/PSCO/PSCOdocs/FERC_890_Q1_2020_Transmission_Plan_Presentation.pdf

- Cloverly 115kV Substation – ISD 2021
- Graham Creek 115kV Substation – ISD 2022
- Husky 230/115kV Substation – ISD 2022
- Mirasol 230kV Substation – ISD 2022
- Avery Substation – ISD 2021
- Barker Substation – Bank1 ISD: 2021, Bank 2 ISD: 2022
- High Point Substation – ISD 2022
- Titan Substation – ISD 2022
- Dove Valley Substation – ISD 2023
- Monument – Flying Horse 115kV Series Reactor – ISD 2022
- Ault – Husky 230kV line – ISD 2022

- Husky – Graham Creek – Cloverly 115kV line – ISD 2022
- Gilman – Avon 115kV line – ISD 2022
- Climax – Robinson Rack – Gilman 115kV – ISD 2022
- Greenwood – Arapahoe – Denver Terminal 230kV – ISD 2022
- Upgrade Villa Grove – Poncha 69kV Line to 73MVA – ISD 2021
- Upgrade Poncha – Sargent - San Luis Valley 115kV line to 120MVA – ISD 2021
- Upgrade Antonito – Romeo – Old40Tap – Alamosa Terminal – Alamosa Switchyard 69kV line to 143MVA – ISD 2022/2023

All transmission facilities were modeled at their expected ratings for 2023 Summer season. Also, the following facility uprate projects were modeled at their planned future ratings:

- Upgrade Allison – SodaLakes 115kV line to 318MVA – ISD 2021
- Upgrade Buckley34 – Smokyhill 230kV line to 506MVA – ISD 2021
- Upgrade Daniels Park – Priarie1 230kV line to 756MVA. This project– ISD to be determined
- Upgrade Greenwood – Priarie1 230kV line to 576MVA – ISD 2021
- Upgrade Daniels Park – Priarie3 230kV line to 756MVA – ISD to be determined
- Upgrade Greenwood – Priarie3 230kV line to 576MVA – ISD 2021
- Upgrade Midway 230kV bus tie to 576MVA – ISD 2023
- Upgrade Waterton – Martin2 tap 115kV line to 189MVA – ISD 2021
- Upgrade Daniels Park 345/230kV # T4 to 560MVA – ISD 2021
- Upgrade Leetsdale – Monaco 230kV line to 560MVA – ISD 2021
- Upgrade Greenwood – Monaco 230kV line to 560MVA – ISD 2021
- Upgrade Waterton – Martin1 tap 115kV line to 189MVA – ISD 2023

The following additional changes were made to the TSGT model in the Base Case per further review and comment from TSGT:

- Fuller – Vollmer – Black Squirrel 115 kV line modeled at 173 MVA – ISD 2022
- Fuller 230/115kV, 100MVA #2 transformer – ISD 2023

The following additional changes were made to the BHE model in the Base Case per further review and comment from BHE:

- Pueblo West substation – ISD 4/13/2021

- Pueblo Reservoir – Burnt Mill 115kV Rebuild – ISD 8/31/2021
- Boone - South Fowler 115kV Project – ISD 10/1/2021
- North Penrose Substation – ISD 1/31/2022
- West Station – Pueblo Res 115kV Rebuild – ISD 1/31/2022

The following additional changes were made to the CSU model in the Base Case per further review and comment from CSU:

- The Cottonwood – Tesla 34.5kV line is modeled open and Kettle Creek – Tesla 34.5kV line is modeled closed on the CSU system – ISD 2023
- Briargate South 115/230kV transformer project tapping the Cottonwood – Fuller 230kV line – ISD 2023

The Base Case model includes the existing PSCo generation resources and all Affected System's existing resources. In addition, the following higher-queued generation from PSCo's queue were modeled in the Base Case: GI-2014-6, GI-2014-9, GI-2014-13, GI-2016-15, Transitional Cluster (GI-2018-24 , GI-2018-25, and GI-2019-6), 1RSC-2020 (1RSC-2020-1 and 1RSC-2020-2), DISIS-2020-001 (GI-2020-1, GI-2020-3, GI-2020-4, GI-2020-5, GI-2020-6, GI-2020-7, and GI-2020-10), 2RSC-2020, DISIS-2020-002 (GI-2020-12, GI-2020-13, GI-2020-14, GI-2020-15 and GI-2020-16) and 3DISIS-2021-001 (GI-2021-1, GI-2021-2, GI-2021-3, GI-2021-4, GI-2021-6, GI-2021-8 and GI-2021-9). While the higher-queued NRIS requests were dispatched at 100%, the higher-queued ERIS requests were modeled offline.

The following future generation connected to the Affected Systems are modeled in the Base Case:

IREA:

- 80MW Pioneer Solar PV Generating Facility interconnecting on the Victory – Brick Center 115kV line – COD 12/31/2020
- 45MW Hunter Solar PV Generating Facility interconnecting at Brick Center 115kV Substation – COD 2/1/2022
- 54.5MW Kiowa Solar PV Generating Facility interconnecting at Victory 115kV Substation – COD 4/1/2023

TSGT:

- TI-18-0809, 100MW NRIS/ERIS Solar, Walsenburg-Gladstone 230kV line
- TI-19-1016, 40MW NRIS/ERIS Solar, Walsenburg-Gladstone 230kV line

4.1 Benchmark Case

The Benchmark Case was created from the Base Case by adopting the generation dispatch in Table 1.

**Table 1 – Generation Dispatch Used to Create the Benchmark Case
(MW is Gross Capacity)**

Bus Name	ID	Status	PGen (MW)	PMax (MW)
CEDAR2_W1 0.66	W1	1	100	125
CEDAR2_W2 0.69	W2	1	80.6	100.8
CEDAR2_W3 0.66	W3	1	20	25
CEDARCK_1A 34.50	W1	1	176	220
CEDARCK_1B 34.50	W2	1	64	80
FTLUP1-2 13.80	G1	1	45	50
FTLUP1-2 13.80	G2	1	45	50
JMSHAFR1 13.80	G1	1	32.2	35.8
JMSHAFR1 13.80	G2	1	31.5	35
JMSHAFR2 13.80	ST	1	45.6	50.7
JMSHAFR3 13.80	G3	1	32.5	36.1
JMSHAFR3 13.80	ST	1	45	50
JMSHAFR4 13.80	G4	1	31.3	34.8
JMSHAFR4 13.80	G5	1	29.7	33
KNUTSON1 13.80	G1	1	65.3	72.5
KNUTSON2 13.80	G2	1	65.3	72.5
PAWNEE 22.00	C1	1	535	535
MANCHEF1 16.00	G1	0	0	140
MANCHEF2 16.00	G2	0	0	140
PLNENDG1_1 13.80	G0	1	4.9	5.4
PLNENDG1_1 13.80	G1	1	4.9	5.4
PLNENDG1_1 13.80	G2	1	4.9	5.4
PLNENDG1_1 13.80	G3	1	4.9	5.4
PLNENDG1_1 13.80	G4	1	4.9	5.4
PLNENDG1_1 13.80	G5	1	4.9	5.4
PLNENDG1_1 13.80	G6	1	4.9	5.4
PLNENDG1_1 13.80	G7	1	4.9	5.4
PLNENDG1_1 13.80	G8	1	4.9	5.4
PLNENDG1_1 13.80	G9	1	4.9	5.4
PLNENDG1_2 13.80	G0	1	4.9	5.4
PLNENDG1_2 13.80	G1	1	4.9	5.4

Bus Name	ID	Status	PGen (MW)	PMax (MW)
PLNENDG1_2 13.80	G2	1	4.9	5.4
PLNENDG1_2 13.80	G3	1	4.9	5.4
PLNENDG1_2 13.80	G4	1	4.9	5.4
PLNENDG1_2 13.80	G5	1	4.9	5.4
PLNENDG1_2 13.80	G6	1	4.9	5.4
PLNENDG1_2 13.80	G7	1	4.9	5.4
PLNENDG1_2 13.80	G8	1	4.9	5.4
PLNENDG1_2 13.80	G9	1	4.9	5.4
PLNENDG2_1 13.80	G1	1	7.3	8.1
PLNENDG2_1 13.80	G2	1	7.3	8.1
PLNENDG2_1 13.80	G3	1	7.3	8.1
PLNENDG2_1 13.80	G4	1	7.3	8.1
PLNENDG2_1 13.80	G5	1	7.3	8.1
PLNENDG2_1 13.80	G6	1	7.3	8.1
PLNENDG2_1 13.80	G7	1	7.3	8.1
PLNENDG2_2 13.80	G1	1	7.3	8.1
PLNENDG2_2 13.80	G2	1	7.3	8.1
PLNENDG2_2 13.80	G3	1	7.3	8.1
PLNENDG2_2 13.80	G4	1	7.3	8.1
PLNENDG2_2 13.80	G5	1	7.3	8.1
PLNENDG2_2 13.80	G6	1	7.3	8.1
PLNENDG2_2 13.80	G7	1	7.3	8.1
PLNENDG2_2 13.80	G1	1	7.3	8.1
RMEC1 15.00	G1	1	139.5	155
RMEC2 15.00	G2	1	139.5	155
RMEC3 23.00	ST	1	309.6	344
SPNDLE1 18.00	G1	1	141.3	157
SPNDLE2 18.00	G2	1	141.3	157
ST.VRAIN 22.00	ST	1	279	310
ST.VR_2 18.00	G2	1	146	146
ST.VR_3 18.00	G3	1	133.2	148
ST.VR_4 18.00	G4	1	137.7	153
ST.VR_5 18.00	G5	1	164.7	183
ST.VR_6 18.00	G6	1	164.7	183
VALMONT6 13.80	G6	0	0	53
VALMNT7 13.80	G7	0	0	44.3
VALMNT8 13.80	G8	0	0	44.3

Bus Name	ID	Status	PGen (MW)	PMax (MW)
MTNBRZ_W1 34.50	W1	1	135.2	169
SPRUCE1	G1	1	130.5	145
SPRUCE2	G2	1	130.5	145

4.2 Study Case Modeling

A Study case was created from the Benchmark Case by modeling INFO-2021-2 at the Green Valley 230kV Substation. The 200MW output is balanced by reducing Comanche 3.

5.0 Steady State Analysis Results

The results of the single contingency analysis are shown in Table 2.

The addition of INFO-2021-2 caused a new overload on the Barr Lake – Reunion 230kV line. The overload can be mitigated by fixing the terminal equipment limitations which may increase the line rating upto 560MVA.

The results of the multiple contingency analysis are given in Table 3. Per TPL1-4, multiple contingency overloads on the PSCo facilities and Affected System facilities can be mitigated using system adjustments, including generation redispatch (including GI under study) and/or operator actions.

The study did not identify any single or multiple contingency impacts to the Affected Systems.

Table 2 – Overloads identified in Single Contingency Analysis

Overloaded Facility	Type	Owner	Normal Rating (MVA)	Facility Loading in Benchmark Case		Facility Loading in Study Case		% Change due to INFO-2021-2	Single Contingency Definition
				MVA Flow	% Line Loading	MVA Flow	% Line Loading		
Barr Lake – Reunion 230kV	Line	PSCo	478	471.3	98.6%	500.0	104.6%	6.0%	Ft. Lupton – JL Green 230kV line

Table 3 – Overloads identified in Multiple Contingency Analysis

Overloaded Facility	Type	Owner	Emergency Rating (MVA)	Facility Loading in Benchmark Case		Facility Loading in Study Case		Change due to INFO-2021-2	Multiple Contingency Definition
				MVA Flow	% Line Loading	MVA Flow	% Line Loading		
Barr Lake – Reunion 230kV	Line	PSCo	478	569.8	119.2%	618.1	129.3%	10.1%	Spruce – Smoky Hill 230kV & Spruce – Powhaton 230kV
Clark – Jordan 230kV	Line	PSCo	364	371.7	102.1%	396.5	108.9%	6.8%	Smoky Hill – Sullivan/Leetsdale 230kV

6.0 Summary of Results

Network Resource Interconnection Service of INFO-2021-2 is 200MW.

The COD of INFO-2021-2 is dependent of the construction of the GI-2020-06 230kV Switching Station, which is expected to require a CPCN. The total estimated time frame for regulatory activities (CPCN) and to site, design, procure and construct the switching station at the POI is approximately 36 months after authorization to proceed has been obtained.

Note – This report is an informational study and does not grant any Interconnection Service or Transmission Service. The results are based on the modeling assumptions and study scope specified by the Customer, which may or may not reflect the standard modeling assumptions followed for the LGIP studies.