INFO-2023-2

Informational Study Report

09/05/2023

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1.0 Summary

This report is an informational evaluation of a 330 MW Solar Photovoltaic (PV) plus 330 MW Battery Energy Storage System (BESS) Hybrid Generating Facility requesting 330 MW of interconnection service with a Point of Interconnection (POI) at the Tundra 345 kV substation. The expected Commercial Operation Date (COD) of the Generating Facility is December 15, 2025. The following studies were performed in this informational study:

1. Generating Facility as 330 MW of Network Resource Interconnection Service (NRIS)

This report is an informational evaluation 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.

1.1 INFO-2023-2 NRIS Results

The total cost of the upgrades required to interconnect INFO-2023-2 at the Tundra 345 kV substation for NRIS is $13.10 million (Tables 3 and 5)

2.0 Introduction

This report is an informational evaluation of a 330 MW Solar (PV) plus 330 MW BESS Hybrid Generating Facility connecting at the Tundra 345 kV substation. The study included a modeled Generating Facility supplied by the customer.

A summary and description of the request for INFO-2023-2 as an NRIS are shown in Table 1.

Table 1 – Summary of Request for INFO-2023-2 as an NRIS

INFO#	Resource Type	Service (MW)	Service Type	COD	POI	Location
INFO-2023-2	PV + BESS	330	NRIS	12/15/2025	Tundra 345 kV substation	Pueblo County, CO

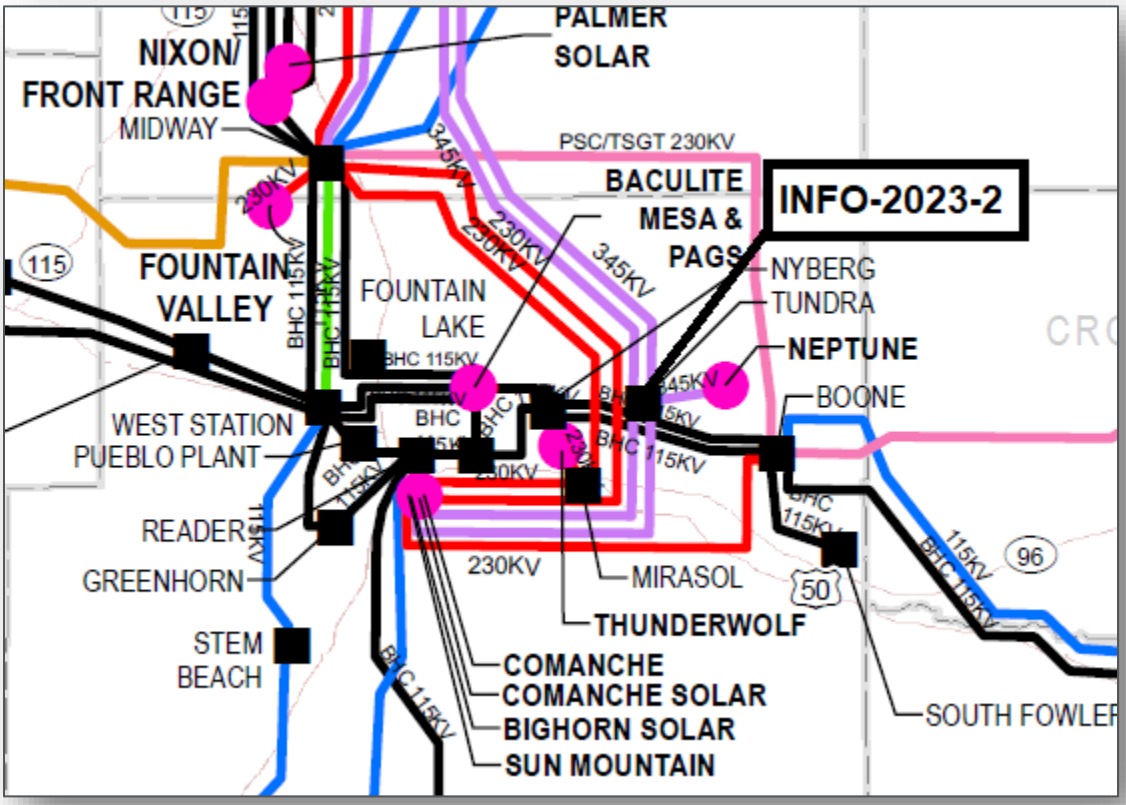

Figure 1: Location of INFO-2023-2 POI

3.0 Study Scope

The study was performed using the modeling assumptions specified by the Interconnection Customer (IC).

The scope of the study includes steady-state (thermal and voltage) analysis and cost estimates. The non-binding cost estimates provide total cost responsibility for Transmission Provider Interconnection Facilities (TPIF), Station Network Upgrades, and System Network Upgrades.

Per the Study Request, INFO-2023-2 was analyzed as NRIS.

3.1 Study Pockets

The POI of INFO-2023-2 is located within the Southern Colorado study pocket. The generation was sunk into the Denver Metro study pocket.

3.2 Study Areas

The study area for the Southern Colorado study pocket includes the WECC base case zone 704. The generation sink is in zone 700.

3.3 Study Criteria

The following steady-state analysis criteria is used to identify violations on the PSCo system and the Affected Systems:

P0 - System Intact conditions:
Thermal Loading: ≤ 100% of the normal facility rating
Voltage range: 0.95 to 1.05 per unit

P1 & P2-1 – Single Contingencies:
Thermal Loading: ≤ 100% normal facility rating
Voltage range: 0.90 to 1.10 per unit
Voltage deviation: ≤ 8% of pre-contingency voltage

P2 (except P2-1), P4, P5 & P7 – Multiple Contingencies:
Thermal Loading: ≤ 100% emergency facility rating
Voltage range: 0.90 to 1.10 per unit
Voltage deviation: ≤ 8% of pre-contingency voltage

3.4 Study Methodology

The steady-state power flow assessment is performed using the PSLF software.

Thermal violations are identified if a facility (i) resulted in a thermal loading >100% in the Study Case after the study pocket GIR cluster 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 (i) resulted in a bus voltage >1.1 p.u. (or <0.9 p.u.) in the Study Case after the study pocket GIR cluster addition and (ii) contributed to an adverse impact of +0.005 p.u. (or -0.005 p.u.) compared to the Benchmark Case voltage.

DFAX criteria for identifying contribution to thermal overloads is ≥1%. DFAX criteria for identifying contribution to the voltage violations is 0.005 p.u.

4.0 Base Case Modeling Assumptions

The 2026HS2a1 WECC case released on Oct. 10, 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 an in-service date before summer 2028 were modeled: (https://www.oasis.oati.com/woa/docs/PSCO/PSCOdocs/FERC_890_Q1_3-23-2023_Final.pdf)

- Colorado Power Pathway Project, Segments 1-5:
    - Missile Site – Canal Crossing 1 & 2, 345 kV
    - Pawnee – Canal Crossing 1 & 2, 345 kV
    - Fort St. Vrain – Canal Crossing 1 & 2, 345 kV
    - Canal Crossing – Goose Creek 1 & 2, 345 kV
    - Goose Creek – Shortgrass 345 kV
    - Goose Creek – Cheyenne Ridge 345 kV
    - May Valley – Tundra 1 & 2, 345 kV
    - Goose Creek – May Valley 1 & 2, 345 kV

The Base Case model includes the existing PSCo generation resources and all Affected Systems' existing resources.

In addition, the following higher-queued generation from PSCo's queue were modeled online in the Base Case along with any System Network Upgrades identified in their corresponding studies.

- Individual GIRs (GI-2014-6, GI-2020-01, GI-2020-03, GI-2020-04, GI-2020-05, GI-2020-10, GI-2020-13, GI-2021-2, GI-2021-3, GI-2021-6)

5.0 Southern Colorado Study Pocket Analysis

5.1 Benchmark Cases Modeling

The Benchmark Case was created from the Starting Case with updates to conform to the latest FAC-008 facility ratings.

5.1.1 Generation Scenario

The Benchmark Case for Generation scenario was created from the Base Case by adopting the generation dispatch in Table 2 to reflect heavy generation in the Southern Colorado pocket.

Table 2 – Generation Dispatch Used to Create the Southern Colorado Generation Benchmark Case (MW is Gross Capacity)

Bus Number	Name	ID	Status	PGEN (MW)	PMAX (MW)
70553	ARAP5&6	G5	1	35	40
70553	ARAP5&6	G6	1	35	40.7
70554	ARAP7	ST	1	44	45
70878	BIGHORN_S1	S1	1	156	240
70753	BRONCO_W1	W1	1	120	300
70069	CABCRKA	HA	1	160	162
70070	CABCRKB	HB	1	160	162
70825	CEDAR2_W1	W1	1	50	125
70826	CEDAR2_W2	W2	1	40.3	100.8
70827	CEDAR2_W3	W3	1	5.3	25
70823	CEDARCK_1A	W1	1	88	220
70824	CEDARCK_1B	W2	1	32	80
70670	CEDARPT_W1	W1	1	49.7	124.2
70671	CEDARPT_W2	W2	1	50.4	126
70761	CEP5_B1	B1	1	25	50
70763	CEP5_S1	S1	1	130	200
70756	CEP6_B1	B1	1	60	125
70758	CEP6_S1	S1	1	162.8	250.5
70914	CEP7_S1	S1	1	50.2	77.2
70104	CHEROK2	SC	1	0	0
70106	CHEROK4	G4	0	0	383
70145	CHEROKEE5	G5	1	150	184.6
70146	CHEROKEE6	G6	1	150	185.4
70147	CHEROKEE7	ST	1	227	228

Bus Number	Name	ID	Status	PGEN (MW)	PMAX (MW)
70733	CHEYRGE_W1	W1	1	49.6	124
70736	CHEYRGE_W2	W2	1	50.4	126
70739	CHEYRGW_W1	W1	1	49.6	124
70742	CHEYRGW_W2	W2	1	50.4	126
70933	COGENTRIX_PV	S3	1	19.5	30
70120	COMAN_2	C2	1	340	365
70777	COMAN_3	C3	1	780	804
70934	COMAN_S1	S1	1	81.3	125
70701	CO_GRN_E	W1	1	32.4	81
70702	CO_GRN_W	W2	1	32.4	81
70665	GLDNWST_W1	W1	1	49.6	124.1
70666	GLDNWST_W2	W2	1	50	125
70931	GSANDHIL_PV	S1	1	12.4	19
70932	HOOPER_PV	S2	1	19.5	30
70495	JMSHAFR1	G2	1	35	35
70495	JMSHAFR1	G1	1	35.8	35.8
70493	JMSHAFR2	ST	1	7.4	50.7
70490	JMSHAFR3	ST	1	15.8	50
70490	JMSHAFR3	G3	1	35	36.1
70487	JMSHAFR4	G5	1	15	33
70487	JMSHAFR4	G4	1	12.8	34.8
70565	KNUTSON1	G1	1	40.5	72.5
70566	KNUTSON2	G2	1	40.5	72.5
70635	LIMON1_W	W1	1	80.4	201
70636	LIMON2_W	W2	1	80.4	201
70637	LIMON3_W	W3	1	80.4	201
15	LV-PV	1	1	150	180.6
70314	MANCHEF1	G1	1	130	140
70315	MANCHEF2	G2	1	130	140
70818	MTNBRZ_W1	W1	1	67.6	169
70310	PAWNEE	C1	1	534.5	536
71016	PEAKVIEWLO	W1	1	60	60
70710	PTZLOGN1	W1	1	80.4	201
70712	PTZLOGN2	W2	1	48	120
70713	PTZLOGN3	W3	1	31.8	79.5
70714	PTZLOGN4	W4	1	74	175
70499	QF_B4-4T	G5	1	12	25
70499	QF_B4-4T	G4	1	12	24

Bus Number	Name	ID	Status	PGEN (MW)	PMAX (MW)
70556	QF_B4D4T	ST	1	24	70
70498	QF_BCP2T	G3	1	30	34.1
70498	QF_BCP2T	ST	1	35	36
70500	QF_CPP1T	G2	1	20	24
70500	QF_CPP1T	G1	1	20	24
70501	QF_CPP3T	ST	1	26	27
78024	RPS_PV_GEN	PV	1	5	32.4
70629	RUSHCK1_W1	W1	1	80.8	202
70771	RUSHCK1_W3	W3	1	71.2	178
70631	RUSHCK2_W2	W2	1	88	220
70593	SPNDLE1	G1	1	120	143.1
70594	SPNDLE2	G2	1	120	140.6
70721	SPRNGCAN1_W1	W1	1	25.9	64.8
70715	SPRNGCAN2_W2	W2	1	13.6	64.8
70562	SPRUCE1	G1	1	120	136.5
70563	SPRUCE2	G2	1	120	135.5
70409	ST.VRAIN	ST	1	283	317.8
70406	ST.VR_2	G2	1	96	133.4
70407	ST.VR_3	G3	1	110	171.5
70408	ST.VR_4	G4	1	120	173.6
70950	ST.VR_5	G5	1	122	162
70951	ST.VR_6	G6	1	150	162
70935	SUNPOWER	S1	1	33.8	52
70010	TBII_GEN	W	1	65	76
70703	TWNBUTTE	W1	1	16.7	41.8

5.2 INFO-2023-2 – NRIS

5.2.1 Study Cases Modeling

An NRIS Study Case was developed from the Generation scenario Benchmark Case by modeling INFO-2023-2 high-side GSU connected to the Tundra 345 kV bus. The 330 MW NRIS output of INFO-2023-2 is balanced against all PSCo generation connected to the PSCo Transmission System outside the study pocket on a pro-rata basis. Generation is sunk into the Denver Metro Area, per requested study assumptions.

5.2.2 Steady-State Analysis

Contingency analysis was performed on the entire PSCo network.

Contingency analysis resulted in no new overloads or voltage concerns.

The multiple contingency analysis on the NRIS Study Case did not show any thermal violations.

Single contingency and multiple contingency analysis showed no voltage violations attributed to the INFO-2023-2 as NRIS. The contingency list is disclosed with the PSLF cases used to complete this study.

5.2.3 Summary

NRIS identified for INFO-2023-2 is 330 MW.

The NRIS study identified no new overloads caused by the INFO-2023-2 as a NRIS GIR.

6.0 Cost Estimates and Assumptions

There are two types of costs identified in the study:

1. Transmission Provider's Interconnection Facilities (TPIF) which are directly assigned to each GIR
2. Station equipment Network Upgrades, which are allocated to each GIR connecting to that station on a per-capita basis per Section 4.2.4(a) of the LGIP

6.1 Total Cost of Transmission Provider's Interconnecting Facilities

The total cost of Transmission Provider's Interconnection Facilities for each POI and INFO-2023-2's cost assignment is given in Table 3.

Table 3 – Total Cost of Transmission Provider's Interconnection Facilities

GIR	POI	Total Cost (million)
INFO-2023-2	Tundra 345 kV bus	$3.00

Table 4 specifies the INFO-2023-2 project's Transmission Provider's Interconnection Facilities and the corresponding costs.

Table 4: INFO-2023-2 Transmission Provider's Interconnection Facilities

Element	Description	Cost Est. (Million)
PSCo's Tundra 345 kV Switching Station	Interconnect INFO-2023-2 at the existing Tundra 345 kV Switching Station. The new equipment includes: • (1) 345 kV deadend structure • (3) 345 kV surge arresters • (1) 345 kV 3000 A disconnect switch • (3) CVTs • (3) CTs • Fiber communication equipment • Station controls • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures • Associated transmission line communications, fiber, relaying and testing.	$3.00
Total Cost Estimate for Interconnection Customer-Funded, PSCo-Owned Interconnection Facilities		**$3.00**
Time Frame	**Site, design, procure and construct**	**30-36 Months**

6.2 Total Cost of Station Network Upgrades

The total cost of Station Network Upgrades for INFO-2023-2 is given in Table 5.

Table 5 – Total Cost of Station Network Upgrades by GIR

GIR	POI	Total Cost (million)
INFO-2023-2	Tundra 345 kV bus	$10.10

The details of the Station Network Upgrades required at the Tundra 345 kV bus are shown in Table 6.

Table 6: Station Network Upgrades - Tundra 345 kV Switching Station

Element	Description	Cost Est. (Million)
PSCo's Tundra 345 kV Switching Station	Expand the Tundra 345 kV Switching Station to accomodate interconnection of INFO-2023-2. The new equipment includes: • (1) 345 kV deadend structure • (1) 345 kV 3000 A circuit breaker • (4) 345 kV 3000 A disconnect switches • Station controls and wiring • Associated foundations and structures • Grading and surfacing yard expansion area • Fencing around yard expansion	$10.00
	Siting and Land Rights support for facilities permitting	$0.10
Total Cost Estimate for PSCo-Funded, PSCo-Owned Interconnection Facilities		**$10.10**
Time Frame	**Site, design, procure and construct**	**30-36 Months**

6.3 Summary of Costs assigned to INFO-2023-2

The total cost of the required upgrades for INFO-2023-2 to interconnect at a new INFO-2023-2 345 kV Switching Station with a POI at Tundra 345 kV bus as NRIS is $13.10 million.

- **Cost of Transmission Provider's Interconnection Facilities is $3.00 million (Table 3)**
- **Cost of Station Network Upgrades is $10.10 million (Table 5)**

The list of improvements required to accommodate the interconnection of INFO-2023-2 are given in Tables 4 & 6. System improvements are subject to revision as a more detailed and refined design is produced.

6.4 Cost Estimate Assumptions

PSCo (or its Contractor) will perform all construction, wiring, testing and commissioning for PSCo owned and maintained facilities. The cost estimates are in 2023 dollars with an escalation percentage and contingencies applied to the cost estimates. Cost estimates are based upon current site conditions at the Tundra 345 kV Switching Station and currently planned interconnections. Disposition of higher queued interconnection requests and final design of Colorado Power Pathway interconnections at the Tundra 345 kV Switching Station could impact

interconnection availability at the Tundra 345 kV Switching Station and/or have cost implications depending upon the final location of the interconnection position.

The Tundra 345 kV yard will require expansion to accommodate this generation interconnection. This cost estimate assumes no additional land acquisition is required for the yard expansion. Remote end upgrades are not required as a result of the new generation.

The estimated costs include all applicable labor and overheads associated with the siting, engineering, design, and construction of the PSCo facilities to facilitate interconnection. Site grading and aggregate surfacing are also included. The estimated costs do not include the cost for any Customer owned equipment and associated design and engineering. Labor is estimated at straight time only, no overtime work is included.

7.0 Contingency List File

PSLF_CTG_list.otg