INFO-2022-4

Informational Study Report

06/12/2023

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1.0 Summary

This report is an informational evaluation of a 200 MW Battery Energy Storage System (BESS) Generating Facility with a Point of Interconnection (POI) at a new 230 kV switching station on the Rifle Ute – Rifle 230 kV line. The expected Commercial Operation Date (COD) of the Generating Facility is September 30, 2024. The following study was performed in this informational study:

1. Generating Facility as a 200 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-2022-4 NRIS Results

The total cost of the upgrades required to interconnect INFO-2022-4 on the Rifle Ute – Rifle 230 kV line for NRIS is $20.257 million (Table 6 and Table 7)

2.0 Introduction

This report is an informational evaluation of a 200 MW BESS Generating Facility connecting on the Rifle Ute – Rifle 230 kV line. Since this is an informational study, the study modeled a generic 200 MW Generating Facility that can maintain ±0.95 power factor at the POI.

A summary and description of the request for INFO-2022-4 as an NRIS are shown in Table 1.

Table 1 – Summary of Request for INFO-2022-4 as an NRIS

INFO#	Resource Type	Service (MW)	Service Type	COD	POI	Location
INFO-2022-4	BESS	200	NRIS	09/30/2024	Rifle Ute – Rifle 230 kV line	Garfield County, CO

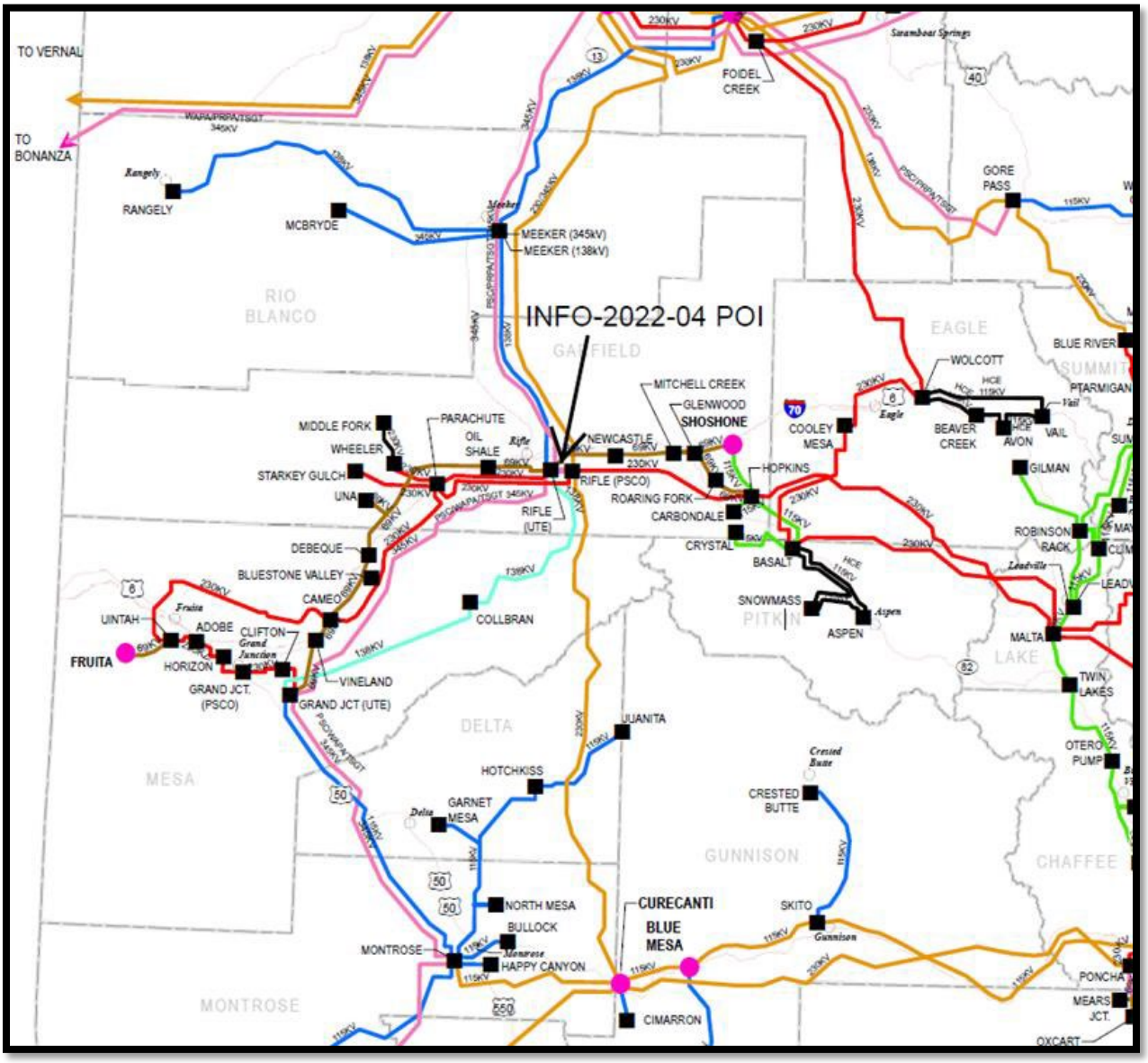

Figure 1: Approximate Location of INFO-2022-4 POI

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-2022-4 was analyzed as NRIS. Grid Charging capability for INFO-2022-4 was also analyzed.

3.1 Study Pockets

The POI of INFO-2022-4 is located within the Western Slope study pocket.

3.2 Study Areas

The study area for the Western Slope study pocket includes the WECC base case zone 708. The Affected Systems included in the analysis is Western Area Power Administration (WAPA) transmission system in the study area.

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 PowerGEM TARA software. The generation redispatch for ERIS is identified using TARA's Security Constrained Redispatch (SCRD) tool.

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.

Distribution Factor(s) (DFAX) criteria for identifying contribution to thermal overloads is ≥1%. DFAX criteria for identifying contribution to the voltage violations is 0.005 p.u.

When the study pocket has a mix of NRIS and ERIS requests, it is studied by first modeling the NRIS GIRs at their full requested amount and modeling the ERIS GIRs offline. Network Upgrades required to mitigate the thermal and/or voltage violations are only allocated to NRIS requests because other GIR's output is modeled at zero.

The NRIS GIRs and their associated Network Upgrades are then modeled in the NRIS Study Case, and ERIS GIRs are dispatched at 100% to study the system impact. Violations are identified and the study evaluates if a generation redispatch combination eliminates the violation. If generation redispatch is unable to eliminate the violation, upgrades will be identified.

The resources included in the Optimal Power Flow (OPF) redispatch are:

- All PSCo and Non-PSCo resources connected to the PSCo Transmission System.
- Higher-queued NRIS generation in the PSCo queue.
- Generation connected to an Affected System Transmission System if that generation is a designated network resource to serve load connected to PSCo.
- All other generation connected to an Affected System Transmission System and stressed in the Study Case may be dispatched to the Base Case level.

Maximum allowable ERIS generation is calculated for each GIR using its DFAX for overloads identified at full output, such that all identified overloads are eliminated.

3.5 Western Colorado WECC Power Transfer Paths

The western Colorado transmission system is bounded by three WECC Power Transfer Paths – TOT5, TOT2A, and TOT1A. TOT5 consists of a group of transmission lines that connect western Colorado and eastern Colorado across the Continental Divide of Colorado. TOT2A is a group of transmission lines that connect southwest Colorado and northwest New Mexico. TOT1A consists of transmission lines that connect northwest Colorado to northeast Utah. PSCo has partial ownership in TOT5 and TOT2A but not in TOT1A. Western Area Power Administration – Rocky Mountain Region (WAPA-RMR) is the path operator for all three paths. The study assumed reasonable flows across TOT5 as identified by WAPA-RMR. This includes a TOT5 west-to-east flow of 1200 MW (for studies with "PSCo Eastern Colorado loads" as the off-taker).

Delivery of power from generation in western Colorado to loads in eastern Colorado will require transmission service across the TOT5 power transfer path. This study did not address that issue. Network Resource Interconnection Service (NRIS) is an interconnection service that allows the Interconnection Customer to integrate its generating facility with the Transmission Provider's transmission system in a manner comparable to how the Transmission Provider integrates its generating facilities to serve native load customers. At present, if generation is added in Western Colorado to serve network loads in Eastern Colorado, transmission service would need to be procured from the TOT5 capacity owners from west-to-east across TOT5. If the entities do not have available transfer capability for this transmission service, a transmission service study would be required because "NRIS" does not convey transmission service. The TOT5 west-to-east total transfer capability (TTC) is 1680 MW and transfers west-to-east across TOT5 above the 1680 MW TTC to serve PSCo native loads in Eastern Colorado could require significant transmission upgrades across the Continental Divide of Colorado. These network upgrades would be developed as part of transmission service request study followed by a WECC path rating process and a path allocation process with the other owners of TOT5.

4.0 Base Case Modeling Assumptions

The 2026HS2a1 WECC case released on July 31, 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 2026 were modeled:

- Cloverly 115 kV Substation – ISD 2021
- Collins Street 115 kV Substation – ISD 2025
- Husky 230/115 kV Substation – ISD 2025
- Mirasol 230 kV Substation – ISD 2022
- Avery Substation – ISD 2021
- Barker Substation – ISD 2025
- High Point Substation – ISD 2023
- Titan Substation – ISD 2024
- Dove Valley Substation – ISD 2023
- Stock Show – ISD 2026
- Monument – Flying Horse 115 kV Series Reactor – ISD 2024
- Ault – Husky 230 kV line – ISD 2025
- Husky – Graham Creek – Cloverly 115 kV line – ISD 2025
- Gilman – Avon 115 kV line – ISD 2025
- Climax – Robinson Rack – Gilman 115 kV – ISD 2026
- Greenwood – Arapahoe – Denver Terminal 230 kV – ISD 2023
- Upgrade Villa Grove – Poncha 69 kV Line to 73 MVA – ISD 2021
- Upgrade Poncha – Sargent - San Luis Valley 115 kV line to 120 MVA – ISD 2024
- Upgrade Antonito – Romeo – Old40 Tap – Alamosa Terminal – Alamosa Switchyard 69 kV line to 143 MVA – ISD 2023
- Tundra Switching Station 230 kV – ISD 2022
- Upgrade Allison – Soda Lakes 115 kV line to 318 MVA – ISD 2022

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

- Fuller – Vollmer 115 kV line modeled at 173 MVA – ISD 2022
- Black Squirrel – Vollmer 115 kV line modeled at 144 MVA – ISD 2022
- Black Squirrel – Black Forest Tap 115 kV line modeled at 144 MVA – ISD 2022
- Beaver Creek – Adena 115 kV line modeled at 114 MVA
- Fuller 230/115 kV, 150 MVA #2 transformer – ISD 2023
- Paddock – Shaw Ranch – Calhan Tap – Santa Fe Springs 115 kV Loop modeled open

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

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

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 offline in the Base Case along with any System Network Upgrades identified in their corresponding studies.

- Individual GIRs (GI-2014-5, GI-2014-6, GI-2014-7, GI-2014-9, GI-2014-13, GI-2014-14, GI-2016-4, and GI-2016-15)
- Transitional Cluster (GI-2018-24, and GI-2019-6)
- DISIS-2020-001 Cluster
- 2RSC-2020-05 Cluster
- DISIS-2020-002 Cluster
- DISIS-2021-003 Cluster
- DISIS-2021-004 Cluster
- DISIS-2022-005 Cluster

While the higher-queued NRIS requests in the study pocket were dispatched at 100% while performing each study pocket's analysis, the higher-queued ERIS requests were modeled offline.

5.0 Western Slope Pocket Analysis

5.1 Benchmark Cases Modeling

5.1.1 Generation Scenario

The Benchmark Case for the Generation scenario (the BESS facility operating as a 200 MW generator) was created from the Base Case by adopting the generation dispatch in Table 2 to reflect heavy generation in the Western Slope study pocket and scheduling the 200 MW of BESS generation to PSCo loads in the Denver Metro Area. The WECC TOT5 Path flow in the Benchmark Case was set to 1200 MW.

Table 2 – Generation Dispatch Used to Create the Western Slope Generation Scenario Benchmark Case (MW is Gross Capacity)

Bus Number	Bus Name	Voltage (kV)	ID	Status	Pgen (MW)	Pmax (MW)
70180	FRUITA	13.80	G1	1	18.00	20.00
79015	CRAIG 1	22.00	1	1	442.46	470.00
79016	CRAIG 2	22.00	1	1	442.46	470.00
79017	CRAIG 3	22.00	1	1	478.00	478.00
79040	HAYDEN1	18.00	1	1	207.92	212.00
79041	HAYDEN2	22.00	1	1	278.70	285.0
Total					1867.54	1935.00

5.1.2 Grid Charging Scenario

The Benchmark Case for the Grid Charging scenario was created from the Base Case by adopting the generation dispatch in Table 3 to reflect heavy generation in the Western Slope study pocket. The BESS was operating as a 200 MW load and this load was served from generation in Area 10 (New Mexico) and Area 65 (PacifiCorp). The WECC TOT5 Path flow in the Benchmark Case was set to 1200 MW.

Table 3 – Generation Dispatch Used to Create the Western Slope Grid Charging Scenario Benchmark Case (MW is Gross Capacity)

Bus Number	Bus Name	Voltage (kV)	ID	Status	Pgen (MW)	Pmax (MW)
70180	FRUITA	13.80	G1	1	18.00	20.00
79015	CRAIG 1	22.00	1	1	442.46	470.00
79016	CRAIG 2	22.00	1	1	442.46	470.00
79017	CRAIG 3	22.00	1	1	478.00	478.00
79040	HAYDEN1	18.00	1	1	207.92	212.00
79041	HAYDEN2	22.00	1	1	278.70	285.0
Total					1867.54	1935.00

5.2 INFO-2022-4 – NRIS

5.2.1 Study Cases Modeling

An NRIS Study Case was developed from the Generation scenario Benchmark Case by modeling INFO-2022-4 with a POI at a new 230 kV switching station on the Rifle Ute – Rifle 230 kV line. The 200 MW NRIS output of INFO-2022-4 is balanced against all PSCo generation connected to the PSCo Transmission System outside the study pocket on a pro-rata basis.

5.2.2 Steady-State Analysis

Contingency analysis was performed on the Western Slope study pocket NRIS Study Case. System intact or single contingency overloads were mitigated using established TOT5 operating practices and procedures. No system intact overloads or single contingency overloads appear to be attributable to INFO-2022-4.

Table 4 shows the multiple contingency analysis on the NRIS Study Case (the GI-2022-4 facility operating as a 200 MW generator serving PSCo loads in the Denver Metro Area). Per TPL-001-4, this table is provided for information only. Multiple contingency overloads may be mitigated using system adjustments, including generation redispatch (includes GIRs under study) and/or system operator actions; however, these multiple contingency overloads were not mitigated in the study..

Single contingency and multiple contingency analysis showed no voltage violations attributed to the INFO-2022-4 as NRIS.

Table 4 – Western Slope Study Pocket NRIS Results – Multiple Contingency Analysis

Overloaded Facility	Type	Owner	Emergency Rating (MVA)	Benchmark Case		NRIS Study Case		Loading % Change Due to Study GIR	Contingency Name[1]
				MVA Flow	% Loading	MVA Flow	% Loading		
EAST PORTAL (73000) - WEST PORTAL (73001) 69 kV CKT #1	Line	WAPA	30.00	64.35	214.50	66.81	222.70	8.20	P7_020a
MARY'S LAKE 115 kV (78066) - MARY'S LAKE 69 kV (73436) Transformer #1	Xfmr	WAPA	30.00	62.93	209.78	65.38	217.94	8.16	P7_020a
EAST PORTAL (73000) - 73436 MARY'S LAKE (73436) 69 kV CKT #1	Line	WAPA	30.00	62.63	208.79	65.14	217.16	8.37	P7_020a
WEST PORTAL (73001) - MCKENZIE (73132) 69 kV CKT #1	Line	WAPA	36.00	64.74	179.84	67.18	186.63	6.79	P7_020a
HOPKINS (70231) - BASALT (79003) 115 kV CKT #1	Line	PSCo	95.00	113.03	118.98	122.27	128.71	9.73	BF_135
CABINCRK (70072) - LOOKOUT (70266) 230 kV CKT #1	Line	PSCo	473.00	530.61	112.18	545.22	115.27	3.09	BF_195
IDAHOSPG (70237) - LOOKOUT (70266) 230 kV CKT #1	Line	PSCo	473.00	521.86	110.33	537.04	113.54	3.21	BF_194
MCKENZIE (73132) - STILLWATER TAP (73573) 69 kV CKT #1	Line	WAPA	69.00	70.10	101.60	72.56	105.17	3.57	P7_020a
MALTA (70274) - HARTSELT (70927) 230 kV CKT #1	Line	PSCo	473.00	458.85	97.01	479.57	101.39	4.38	P7_077
TARRYALL (70427) - HARTSELT (70927) 230 kV CKT #1	Line	PSCo	473.00	455.64	96.33	476.35	100.71	4.38	P7_077

[1] Contingency Definitions corresponding to Contingency Names are given in Appendix A.

5.2.3 Affected Systems

The INFO-2022-4 facility would interconnect to the Rifle-Rifle Ute 230 kV transmission line. PSCo, Tri-State, and Platte River Power Authority jointly own the Rifle Ute-Rifle 230 kV line. WAPA facilities were identified for potential overloads under multiple contingency scenarios and these multiple contingency overloads of their facilities are listed in Table 4 for information only.

5.2.4 Summary

NRIS identified for INFO-2022-4 is 200 MW.

The NRIS study did not identify any single contingency overloads (that may be mitigated by established TOT5 operating practices and procedures) caused by INFO-2022-4 as a NRIS GIR and, therefore, did not identify System Network Upgrades attributed to INFO-2022-4.

5.3 INFO-2022-4 – Grid Charging

5.3.1 Study Cases Modeling

A Grid Charging Study Case was developed from the Grid Charging scenario Benchmark Case by modeling INFO-2022-4 with a POI at a new 230 kV switching station on the Rifle Ute – Rifle 230 kV line. The 200 MW load of INFO-2022-4, while charging, was balanced with generation in Area 10 (New Mexico) and Area 65 (PacifiCorp) with 1200 MW west-to-east across TOT5 maintained. .

5.3.2 Steady-State Analysis

Contingency analysis was performed on the Western Slope study pocket Grid Charging Study Case. System intact or single contingency overloads were mitigated using established TOT5 operating practices and procedures. No system intact overloads or single contingency overloads appear to be attributable to INFO-2022-4.

Table 5 shows the multiple contingency analysis on the Grid Charging Study Case. This involves the GI-2022-4 facility operating as a 200 MW load served from generation in Area 10 (New Mexico) and Area 65 (PacifiCorp) with the TOT5 flow at 1200 MW west-to-east. Per TPL-001-4, this table was provided for information only. Multiple contingency overloads may be mitigated using system adjustments, including generation redispatch (includes GIRs under study) and/or system operator actions; however, these multiple contingency overloads were not mitigated in the study .

Single contingency and multiple contingency analysis showed no voltage violations attributed to the INFO-2022-4.

Table 5 – Western Slope Study Pocket Grid Charging Results – Multiple Contingency Analysis

Overloaded Facility	Type	Owner	Emergency Rating (MVA)	Benchmark Case		NRIS Study Case		Loading % Change Due to Study GIR	Contingency Name[1]
				MVA Flow	% Loading	MVA Flow	% Loading		
EAST PORTAL (73000) - WEST PORTAL (73001) 69 kV CKT #1	Line	WAPA	30.00	64.35	214.50	64.68	215.60	1.10	P7_020a
MARY'S LAKE 115 kV (78066) - MARY'S LAKE 69 kV (73436) Transformer #1	Xfmr	WAPA	30.00	62.93	209.78	63.30	211.02	1.24	P7_020a
EAST PORTAL (73000) - 73436 MARY'S LAKE (73436) 69 kV CKT #1	Line	WAPA	30.00	62.63	208.79	63.01	210.04	1.25	P7_020a

5.3.3 Affected Systems

WAPA was identified as an impacted Affected System as result of overloads on their facilities as listed in Table 5.

5.3.4 Summary

Grid Charging study was performed for INFO-2022-4. The study did not identify any voltage violations or thermal overloads attributed to INFO-2022-4. Grid Charging capability without any additional System Network Upgrades for:

- INFO-2022-4 is 200 MW.

6.0 Cost Estimates and Assumptions

There are three 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 each GIR connecting to that station on a per-capita basis per Section 4.2.4(a) of the LGIP.
3. All System Network Upgrades which are allocated by the proportional impact per Section 4.2.4(b) of the LGIP:
    - o System Network Upgrades allocated to INFO-2022-4 as an NRIS.

6.1 Total Cost of Transmission Provider's Interconnecting Facilities

Table 6 specifies the INFO-2022-4 project's Transmission Provider's Interconnection Facilities and the corresponding costs.

Table 6 – INFO-2022-4 Transmission Provider's Interconnection Facilities

Element	Description	Cost Est. (Million)
New 230 kV Switching Station (Approximately halfway between UteRifle - Rifle Substations)	Interconnect INFO-2022-4 at a new 230 kV Switching Station on the UteRifle - Rifle 230 kV line (3007). The new equipment includes: • (1) 230 kV deadend structure • (3) 230 kV surge arresters • (1) 230 kV disconnect switch • (3) CT/PTs • Fiber communication equipment • Station controls • Associated electrical equipment, bus, wiring and grounding • Associated foundations and structures • Associated transmission line communications, fiber, relaying and testing	$1.613
Total Cost Estimate for Interconnection Customer-Funded, PSCo-Owned Interconnection Facilities		**$1.613**

6.2 Total Cost of Station Network Upgrades

The details of the Station Network Upgrades required at the new 230 kV Switching Station on the Rifle Ute – Rifle 230 kV line are shown in Table 7.

Table 7 – Station Network Upgrades – INFO-2022-4 230 kV Switching Station

Element	Description	Cost Est. (million)
New 230 kV Switching Station (Approximately halfway between UteRifle - Rifle Substations)	Install new 230 kV Switching Station tapping the UteRifle - Rifle 230 kV line (3007). The new equipment includes: • (2) 230 kV deadend structures • (3) 230 kV circuit breakers • (8) 230 kV disconnect switches • (6) CCVTs • (2) SSVTs • (6) 230kV Surge Arresters • (1) Electrical Equipment Enclosure • (2) wave traps • Site grading and fencing • Station controls and wiring • Associated foundations and structures • Station permitting	$14.757
New 230 kV Switching Station (Approximately halfway between UteRifle - Rifle Substations)	Install required communication equipment in the EEE at the new 230 kV Switching Station	$0.439
UteRifle - Rifle 230 kV Line (3007)	Remote End Line Protection	$0.509
UteRifle - Rifle 230 kV Line (3007)	Line connection East side of new 230 kV Switching Station	$1.163
UteRifle - Rifle 230 kV Line (3007)	Line connection West side of new 230 kV Switching Station	$1.176
	Siting and Land Rights Land Acquisition and Permitting	$0.600
Total Cost Estimate for PSCo-Funded, PSCo-Owned Interconnection Facilities		**$18.644**

6.3 Total Cost of System Network Upgrades

6.3.1 INFO-2022-4

Steady-state analysis for INFO-2022-4 as an NRIS did not discover any System Network Upgrades in the Western Slope study pocket. There are no System Network Upgrade costs associated with INFO-2022-4 studied as an NRIS.

Additionally, there are no System Network Upgrade costs associated with INFO-2022-5 studied in a Grid Charging scenario.

6.4 Summary of Costs assigned to INFO-2022-4 as NRIS

The total cost of the required upgrades for INFO-2022-4 to interconnect at a new INFO-2022-4 230 kV Switching Station on the Rifle Ute – Rifle 230 kV line as NRIS is $20.257 million.

- **Cost of Transmission Provider's Interconnection Facilities is $1.613 million (**Table 6**)**
- **Cost of Station Network Upgrades is $18.644 million (**Table 7**)**
- **Cost of System Network Upgrades is $0 million**

The list of improvements required to accommodate the interconnection of INFO-2022-4 are given in Table 6 and Table 7. System improvements are subject to revision as a more detailed and refined design is produced.

6.5 Cost Estimate Assumptions

The cost estimates are in 2023 dollars with escalation and contingencies applied. Allowances for Funds Used During Construction (AFUDC) is not included. These estimated costs include all applicable labor and overheads associated with the siting, engineering, design, and construction of these new PSCo facilities. This estimate does not include the cost for any Interconnection Customer owned equipment and associated design and engineering. A level of accuracy is not specified for the estimates.

1. Labor is estimated for straight time only – no overtime included.
2. No costs for retail load metering are included in these estimates.
3. PSCo (or it's Contractor) crews will perform all construction, wiring, testing, and commissioning for PSCo owned and maintained facilities.
4. Customer will install two (2) redundant fiber optics circuits into the Transmission provider's substation as part of its interconnection facilities construction scope.
5. Line outages will be necessary during the construction period. Outage availability could potentially be problematic and extend back-feed date.
6. Power Quality Metering (PQM) will be required on the Customer's generation tie-line terminating into the POI.
7. 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 / Xcel will need indications, readings, and data from the LFAGC RTU.

7.0 Appendices

Appendix A: Multiple Contingency Definitions	Appendix A - Multiple Contingency Def.pdf