



**DRAFT Addendum to Feasibility Study for Generation Interconnection  
Request GI-2017-31**

**NRIS FEASIBILITY ASSESSMENT**

**XCEL ENERGY – PSCO TRANSMISSION PLANNING WEST**

**April 13, 2018**

## **A. Introduction**

Public Service Company of Colorado (PSCo) as Transmission Provider<sup>1</sup> is required to perform the Interconnection Studies for each large Generator Interconnection Request<sup>2</sup> (GIR) in accordance with Attachment N – Standard Large Generator Interconnection Procedures (LGIP) included in the Xcel Energy Open Access Transmission Tariff (OATT).

Section 4.1 of PSCo's LGIP provides that the queue position of each GIR must be used to determine the order of performing the Interconnection Studies and determine cost responsibility for the facilities necessary to accommodate the GIR. A higher queued Interconnection Request is one that has been placed "earlier" in the queue in relation to another Interconnection Request that is lower queued.

Section 6.2 of PSCo's LGIP provides that the Interconnection Feasibility Study shall evaluate the feasibility of the proposed interconnection using the Base Case,<sup>3</sup> and additionally generating facilities (and with respect to (iii), any identified Network Upgrades) that: (i) are directly interconnected to the Transmission System; (ii) are interconnected to Affected Systems and may have an impact on the Interconnection Request; (iii) have a pending higher queued Interconnection Request to interconnect to the Transmission System; and (iv) have no Queue Position but have executed an LGIA or requested that an unexecuted LGIA be filed with FERC. Section 7.3 provides similar stipulations for the Interconnection System Impact Study.

This study evaluated maximum NRIS feasibility and so only evaluated those GIRs in the PSCo queue that have requested Network Resource Interconnection Service (NRIS).<sup>4</sup> Although the study evaluated NRIS feasibility, it did not determine the transmission upgrades required for NRIS. The study did not include any higher-queued GIRs that had or requested only Energy

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<sup>1</sup> **Transmission Provider** shall mean the public utility (or its designated agent) that owns, controls, or operates transmission or distribution facilities used for the transmission of electricity in interstate commerce and provides transmission service under the Tariff. The term Transmission Provider should be read to include the Transmission Owner when the Transmission Owner is separate from the Transmission Provider.

<sup>2</sup> **Generator Interconnection Request** shall mean an Interconnection Customer's request, in the form of Appendix 1 to the Standard Large Generator Interconnection Procedures, in accordance with the Tariff, to interconnect a new Generating Facility, or to increase the capacity of, or make a Material Modification to the operating characteristics of, an existing Generating Facility that is interconnected with the Transmission Provider's Transmission System.

<sup>3</sup> **Section 2.3 of the LGIP states:** Such databases and lists, hereinafter referred to as Base Cases, shall include all (1) generation projects and (ii) transmission projects, including merchant transmission projects that are proposed for the Transmission System for which a transmission expansion plan has been submitted and approved by the applicable authority.

<sup>4</sup> **Network Resource Interconnection Service (NRIS)** allows Interconnection Customer's Large Generating Facility to be designated as a Network Resource, up to the Large Generating Facility's full output, on the same basis as existing Network Resources interconnected to Transmission Provider's Transmission System, and to be studied as a Network Resource on the assumption that such a designation will occur. (See *Section 3.2.2 of Attachment N in Xcel Energy OATT*)

Resource Interconnection Service (ERIS).<sup>5</sup> Additionally, GIRs withdrawn from the queue were not included in the model. GIRs that requested the use of the Rush Creek Gen-Tie for interconnection but would have resulted in exceedance of the Rush Creek Gen-Tie's facility rating were similarly not included in the model.

This NRIS Feasibility Assessment is based on steady-state (power flow) analyses performed using a system intact 2023HS summer peak load Base Case compiled by the Western Electricity Coordinating Council (WECC), which models the following forecasted load:

**PSCo Obligation Load<sup>6</sup> + System Losses = ~7350 MW**

**PSCo BAA Load = ~8700 MW**

## **B. Cumulative NRIS Feasibility Assessment Study Scope/Limitations**

PSCo studied progressively interconnecting and cumulatively dispatching the rated MW output of eligible NRIS GIRs in PSCo's queue until the power flow simulation/analysis performed for the resulting model crosses the maximum limit of engineering feasibility and/or practicality.

The maximum limit is reached when the cumulative MW output of modeled generation interconnected as NRIS equals PSCo's Obligation Load. To accommodate this analysis, this study assumes that all new generation is at 100% output, while the existing generation is decremented.<sup>7</sup> A point of infeasibility must be reached when the cumulative total of new generation exceeds the PSCo Obligation Load plus system losses in the Base Case power flow model. I.e.:

**Maximum Feasibility Limit for PSCo NRIS = PSCo Obligation Load + System Losses**

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<sup>5</sup> Energy Resource Interconnection Service (ERIS) allows Interconnection Customer to connect the Large Generating Facility to the Transmission System and be eligible to deliver the Large Generating Facility's output using the existing firm or non-firm capacity of the Transmission System on an "as available" basis. Energy Resource Interconnection Service does not in and of itself convey any right to deliver electricity to any specific customer or Point of Delivery. (See *Section 3.2.1 of Attachment N in Xcel Energy OATT*)

<sup>6</sup> PSCo's Obligation Load is PSCo's Network Load which includes PSCo's retail and wholesale customers.

<sup>7</sup> Only the generating resources designated to serve PSCo's Obligation Load, i.e. the PSCo Designated Network Resources (DNRs) are decremented.

### Limitations

The actual engineering NRIS feasibility limit may very likely be encountered at a much lower MW level than the maximum limit. This actual/lower feasibility limit may be encountered when a successful power flow simulation is no longer achievable (*i.e.*, the model will not solve) – it manifests itself as the power flow model’s failure to converge on a mathematical solution.

Note that this study used power flow simulation/analysis to determine the NRIS maximum feasibility limit. Results of short circuit, stability or other additional analyses may identify other limits or constraints for interconnecting generation.

Note that Interconnection Service does not convey Transmission Service. Consequently, it is possible that even GIRs deemed feasible for NRIS in this study will require additional upgrades to attain Network Integration Transmission Service (NITS) and qualify as DNRs.

### Description of Steps in the Cumulative NRIS Feasibility Assessment Study:

- The study evaluates the PSCo GIR queue using a top down (sequential) cumulative approach. It starts with a Base Case model that includes all (*i.e.* existing and planned) generation resources and transmission facilities.
- The first GIR (*i.e.*, Project 1) is added to the above study model and existing/planned generation is decremented. Power flow analysis is run on the resulting “cumulative GIR-1” study model. The next GIR (Project 2) is then added, and the power flow analysis is then run on the resulting “cumulative GIR-2” study model.
- The above process is repeated for each GIR until the power flow analysis fails to solve for the resulting stressed “cumulative GIR” study model, or until the aggregate/cumulative MW output of all the GIRs interconnected in the model becomes equal to PSCo’s obligation load. At this point, adding any new lower-queued GIR would require replacing a higher-queued GIR in the model, which is impermissible under the PSCo Tariff LGIPs. This indicates that the study’s maximum feasibility limit has been encountered and no additional GIR can be studied.

### **C. Results and Conclusion**

PSCo's Designated Network Resource generators dispatched in the 2023HS Base Case were progressively dispatched down to accommodate the progressive addition of NRIS GIR's in queue order and a power flow solution was obtained after each GIR addition. PSCo was able to successfully complete power flow simulations for ~7350 MW cumulative rated MW output of the interconnected NRIS GIR's, which are listed in the Appendix. This NRIS maximum GIR addition equals the PSCo Obligation Load plus Losses in the 2023HS model and is the maximum feasibility limit for newly interconnecting generators.

Therefore, for the PSCo GIR queue existing at the completion of this cumulative assessment:

1. Only the higher queued GIRs up to and including GI-2017-30 (see the Appendix) are determined to be potentially feasible for NRIS.
2. That is, all lower-queued GIRs starting from GI-2017-31 are **not** feasible for NRIS.

## Appendix – NRIS Feasible Generator Interconnection Requests

Queue No.	POI Station/Line	POI Voltage (kV)	Generator Rated MW	Fuel Source	Requested Service
GI-2008-33	Pawnee Substation	230	270	Gas	Energy Resource only
GI-2014-2	San Luis Valley Substation	230	35	Solar	Energy Resource only
GI-2014-9	Comanche-Midway Line	230	70	Solar	Network+Energy Resource
GI-2014-11	San Luis Valley Substation	230	50	Solar	Network+Energy Resource
GI-2014-13	San Luis Valley Substation	230	53	Solar	Energy Resource only
GI-2015-1	Comanche-Daniels Park	345	250	Wind	Network+Energy Resource
GI-2016-4	Missile Site Substation	345	300	Wind	Network+Energy Resource
GI-2016-5	Midway Substation	115	200	Solar	Network+Energy Resource (Withdrawn 3/7/2018)
GI-2016-6	Missile Site Substation	230	600	Wind	Network+Energy Resource
GI-2016-7	Boone Substation	230	240	Solar	Network+Energy Resource
GI-2016-9	San Luis Valley Substation	230	480	Solar	Network+Energy Resource
GI-2016-12	Boone Substation	115	80	Solar	Network+Energy Resource
GI-2016-13	Comanche-Boone Line	230	200	Solar	Network+Energy Resource
GI-2016-14	Missile Site Substation	345	500	Wind	Network+Energy Resource
GI-2016-15	Missile Site Substation	345	299	Wind	Network+Energy Resource (Excluded due to Rush Creek Gen-Tie Rating Limit)
GI-2016-18	Comanche Substation	230	120	Solar	Network+Energy Resource
GI-2016-19	Missile Site Substation	345	150	Wind	Network+Energy Resource (Excluded due to Rush Creek Gen-Tie Rating Limit)

Queue No.	POI Station/Line	POI Voltage (kV)	Generator Rated MW	Fuel Source	Requested Service
GI-2016-21	Missile Site Substation	345	199.92	Solar	Network+Energy Resource (Excluded due to Rush Creek Gen-Tie Rating Limit)
GI-2016-23	Green Valley Substation	230	150	Solar	Network+Energy Resource
GI-2016-25	Missile Site Substation	345	500.25	Wind	Network+Energy Resource (Excluded due to Rush Creek Gen-Tie Rating Limit)
GI-2016-27	Missile Site Substation	345	550	Wind	Network+Energy Resource (Excluded due to Rush Creek Gen-Tie Rating Limit)
GI-2016-28	Collbran Substation	138	51.75	Solar	Network+Energy Resource
GI-2016-31	Pawnee Substation	230	51.75	Solar	Network+Energy Resource
GI-2016-32	Missile Site Substation	230	51.75	Solar	Network+Energy Resource
GI-2017-2	Missile Site Substation	230	150	Solar	Network+Energy Resource
GI-2017-3	Comanche Substation	230	100	Solar	Network+Energy Resource
GI-2017-5	Hartsel Substation	230	54.3	Solar	Network+Energy Resource
GI-2017-6	Barr Lake Substation	230	50	Solar	Network+Energy Resource (Withdrawn 1/30/2018)
GI-2017-9	Midway-West Station Junction Line	115	80	Solar	Network+Energy Resource
GI-2017-10	Pawnee-Brick Center	230	150	Solar	Network+Energy Resource
GI-2017-11	Missile Site Substation	345	500	Solar	Network+Energy Resource (Excluded due to Rush Creek Gen-Tie Rating Limit)
GI-2017-12	Keenesburg Substation	230	170	Wind + Solar	Network+Energy Resource
GI-2017-13	Missile Site Substation	345	400	Solar	Network+Energy Resource (Excluded due to Rush Creek

Queue No.	POI Station/Line	POI Voltage (kV)	Generator Rated MW	Fuel Source	Requested Service
					<b>Gen-Tie Rating Limit)</b>
GI-2017-14	Missile Site Substation	230	201	Wind	Network+Energy Resource
GI-2017-15	Vasquez-Gilcrest Line	115	10.6	Gas	Network+Energy Resource
GI-2017-16	Midway-Boone Line	230	150	Solar	Network+Energy Resource
<b>GI-2017-17</b>	<b>Missile Site Substation</b>	<b>345</b>	<b>300</b>	<b>Wind</b>	<b>Network+Energy Resource (Excluded due to Rush Creek Gen-Tie Rating Limit)</b>
GI-2017-18	Pawnee Substation	230	120	Solar	Network+Energy Resource
GI-2017-19	Missile Site Substation	230	250	Solar	Network+Energy Resource
<b>GI-2017-21</b>	<b>Comanche-Boone Line</b>	<b>230</b>	<b>40</b>	<b>Solar</b>	<b>Energy Resource only</b>
GI-2017-23	Missile Site Substation	230	201	Wind	Network+Energy Resource
GI-2017-24	Pawnee Substation	345	630	Wind	Network+Energy Resource
GI-2017-25	Boone Substation	115	150	Solar	Network+Energy Resource
GI-2017-26	Lamar Substation	230	500	Wind	Network+Energy Resource
GI-2017-27	Comanche-Boone Line	230	200	Solar	Network+Energy Resource
GI-2017-28	Boone Substation	115	100	Solar + BES	Network+Energy Resource
GI-2017-29	Comanche Substation	345	350	Wind	Network+Energy Resource
GI-2017-30	Comanche Substation	345	300	Solar	Network+Energy Resource
		<b>Total NRIS</b>	<b>7325.4 MW</b>		