

## **Interconnection Feasibility Study Report**

**Request # GI-2013-5**

**Preliminary Draft**

200 MW Wind Generator  
Missile Site 345 kV Substation, Colorado

Public Service Company of Colorado  
Transmission Planning  
**October 18, 2013**

### **Executive Summary**

Public Service Company of Colorado (PSCo) received an interconnection request (GI-2013-5) for a 200 MW wind facility on July 16, 2013. The facility will consist of one hundred and eighteen GE 1.7 MW wind turbines. This facility will be an extension of the existing wind plant at Limon windpark located approximately 35 miles from the Missile Site Substation. GI-2013-5 will be located 9.5 miles east of the existing Limon II wind plant and connect to the Missile Site 345 kV Substation using the existing 345 kV tie line and the existing point of interconnection (POI).

The existing POI at Missile Site 345 kV Substation was requested to be studied as the primary POI; no secondary POI has been specified. The proposed facility is planned to be in-service in October 2014. A Back feed date doesn't apply to this GI as the POI is existing and already backfed. PSCo only evaluated the system beyond the POI, it is the responsibility of the Customer to make sure the tie line is rated for the extended capacity. The GI was requested to be studied as both a Network Resource and Energy Resource. Studies were performed using a 2015 heavy summer power flow case. The study includes steady state power flow and short circuit analyses. The case has been stressed to simulate heavy wind generation in the Pawnee and Missile Site area, and heavy North-South flows in the system. The TOT3 path flow has been set at 896 MW.

The steady state power flow studies included several single and double contingency outages. This request was studied as a stand-alone project only, with no evaluations made of other potential new generation requests that may exist in the Generator Interconnection Request queue, other than the generation projects that are already approved and planned to be in service by July 2015. The main purpose of this Feasibility Study was to evaluate the potential impact on the PSCo transmission infrastructure as well as that of neighboring utilities when an additional 200 MW of generation is injected into the Missile Site 345 kV Substation, and delivering the additional generation to native PSCo loads. There are no affected parties for this study.



## Energy Resource (ER)

N-1 analysis: The proposed generation interconnection caused increased overloads on the Buckley – Smoky 230 kV Line (overload increased from 100% to 106%), Buckley – Tollgate 230 kV Line (overload increased from 100% to 105%), Smoky hill 230/345 kV transformer # 4 (overload increased from 99% to 115%), Smoky hill 230/345 kV transformer # 5 (overload increased from 99% to 115%) and Clark – Jordan 230 kV line (overload increased from 89% to 103%) for certain single contingency outage conditions.

The study simulated wind percentages of 80% and higher in the Pawnee-Missile site area to study a worst case scenario. Considering the heavy generation in the study area, PSCo expects to see these overloads. Typically PSCo has seen high wind percentages in the winter season and these conditions would simulate extremely stressed scenario for the study area in a summer case. Since the summer wind speeds are lower, generation would be lower and the overloads are not likely to be caused in summer conditions.

The Buckley – Smoky Hill 230 KV and Buckley – Tollgate 230 kV lines have been temporarily derated to 386 MVA, PSCo expects the rating to increase to 506 MVA in fourth quarter of 2013 which should mitigate the overloads on these lines. The Smoky Hill 230/345 kV # T4 and # T5 transformers have an 8 hour emergency rating of 644 MVA, PSCo intends to operate these transformers at emergency rating if the overload occurs; at 644 MVA rating these transformers are not overloaded. The Clark - Jordan 230 kV line loading is within the emergency rating of the line.

The proposed generation addition caused no new Voltage range violations or Voltage deviations. With the addition of GI-2013-5, none of the existing voltage range violations exceeded the 0.9-1.05 p.u. range and none of the existing voltage deviations increased by more than 5%.

N-2 analysis: The proposed generation caused increased overloads on the Buckley – Smoky Hill 230 kV line (overload increased from 100% to 106%), Buckley – Tollgate 230 kV line (overload increased from 100% to 106%), Clark – Greenwood 230 kV line (overload increased from 86% to 100%), Clark – Jordan 230 kV line (worst case contingency overload increased from 113% to 130%), Coors – Ft. Lupton 115 kV line (worst case overload increased from 103% to 105%), Meadow – Smoky Hill 230 kV line (overload increased from 96% to 104%), Pawnee – Story 230 kV line (104% to 121%), Smoky Hill – Peakview 115 kV line (overload increased from 105% to 108%).

The Buckley – Smoky Hill 230 KV and Buckley – Tollgate 230 kV lines have been temporarily derated to 386 MVA, PSCo expects the rating to increase to 506 MVA in fourth quarter of 2013 which should mitigate the overloads on these lines. Overload on the Clark – Greenwood 230 kV line is 100% of the normal rating so no mitigation plan is needed for this line. Overload on the Coors – Ft.Lupton 115 kV line is within the



emergency rating (144 MVA) on this line, so no mitigation plan is needed. Overload on the Smoky Hill – Meadow 230 kV line is within the emergency rating (625 MVA) on this line so no mitigation plan is needed.

The proposed generation addition caused no new Voltage range violations or Voltage deviations. With the addition of GI-2013-5, none of the existing voltage range violations exceeded the 0.9-1.05 p.u. range and none of the existing voltage deviations increased by more than 5%.

The proposed GI caused no voltage violations on PSCo system and the thermal violations can be mitigated, so Energy resource capability of the proposed generation is 200 MW and Network Resource capability of the proposed generation is 200 MW

**ER = 200 MW (at Missile Site 345 kV POI)**

**NR = 200 MW (at Missile Site 345 kV POI)**

### Short Circuit

The short circuit study results showed no new circuit breakers overdutied due to the proposed solar generation facility.

**Table 1 – Short Circuit Parameters at the Missile Site 345 kV POI**

System Condition	Three-Phase Fault Level (Amps)	Single-Line-to-Ground Fault Level (Amps)	SLG X/R	3 Phase X/R
Fault Currents for 2014	10,911	11,347	11.216	13.850
Fault Currents with GI2013-5	11,311	11,881	110.744	13.341

### Cost Estimates

The cost for the transmission interconnection (in 2013 dollars):

#### **Transmission Proposal**

The total estimated cost of the recommended system improvements to interconnect the project is approximately **\$0.15 Million** and includes:

- \$ 0.15 million for PSCo-Owned, Customer-Funded Interconnection Facilities
- \$ 0 million for PSCo-Owned, PSCo-Funded Network Upgrades for Interconnection
- \$ 0 million for PSCo Network Upgrades for Delivery to PSCo Loads



This work can be completed in 6 months following receipt of authorization to proceed.

The Interconnection Agreement (IA) requires that certain conditions be met, as follows:

- 1 The conditions of the Large Generator Interconnection Guidelines (LGIG) are met.
- 2 PSCO will require testing of the full range of 0 MW to 200 MW operational capability of the facility to verify that the facility can safely and reliably operate within required power factor and voltage ranges.
- 3 A single point of contact needs to be provided to PSCo Operations to facilitate reliable management of the transmission system.

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