

## Chambers 230/115 kV, 280 MVA#2

**Project Name:** Chambers 230/115 kV, 280 MVA auto transformer #2

**Project Construction Start Date:** October 2012

**Project in Service Date:** June 2013

**Project Location:** Aurora, Colorado

**Cost:** \$5.2 million

### **Project Need:**

This project proposes to add a second 230/115 kV, 280 MVA transformer at the existing Chambers Substation located in Aurora, Colorado. Chambers Substation was energized in December 2010 with one 230/115 kV, 280 MVA transformer installed initially. The substation was built to accommodate two 230/115 kV, 280 MVA transformers. PSCo transmission planning is now proposing to add the second 230/115 kV, 280 MVA transformer at this substation. All the project work will be located inside the substation fence. The need for the second transformer arises due to reliability and to avoid thermal overloads on the existing transformer under certain N-2 outages conditions.

The need for the second transformer is studied using a 2012 heavy summer case. Three scenarios cases, including one economic dispatch case and two cases with heavy generation in the Northeast are studied.

Overloads on the transformer mainly depend on the generation in Northeast Denver. PSCo has a major concentration of generation (natural gas, coal fired and wind plants) in the North east Denver area. Table-1 gives the MW value of the generation available in the North east and their dispatch levels for all the three scenarios. All the wind generation is dispatched at 21% of the rated value in all the three scenarios, this % value is obtained from the historical wind generation output in the region. Scenario-1 gives an economic dispatch. Scenario-2 and 3 model heavy generation in the north, with generation dispatched as shown in Table-1. Scenario-2 was obtained by modifying the generation in Scenario-1 as shown in Table-1. In Scenario-2, when Manchief generation is on (260MW), cabin Creek generation is decreased from 160 MW to 0 MW and Lamar DC tie is set to 0 MW from 101MW importing. In Scenario-3 , when the Thermo Cogeneration is on (123 MW), Lamar DC tie is modeled at 101 MW exporting. Scenario-3 is obtained from Scenario-2 by changing the generation dispatch as shown in Table-1.

Table-1 Available generation in Northeast Denver and dispatch levels in the three scenario cases

<b>Generator</b>	<b>Rated MW</b>	<b>Dispatch in MW Scenario-1</b>	<b>Dispatch in MW Scenario-2</b>	<b>Dispatch in MW Scenario-3</b>
Brighton Nug	150	150	150	150
Fort Lupton	100	0	0	0
Manchief	260	0	160	160
Pawnee	530	505	505	505
Brush4	135	135	135	135
Brush2	68	0	0	0
Brush 1&3	79	79	79	79
Thermo Cogen	150	0	0	123
Thermo Fort Lupton	122	110	110	110
RMEC	600	600	600	600
Spindle	260	260	260	260
Spruce	260	260	260	260
Cedar Creek Wind	300	63	63	63
Missile Site wind	200	42	42	42
Peetz Logan wind	575	121	121	121
RidgeCrest windfarm	30	6.3	6.3	6.3
Spring Canyon Wind	60	12.6	12.6	12.6
Fort Sain Vrain	969	680	680	680
TOT3		1070	1051	1044

Table-2 TOT3 flow in MW during the system peak for the past 4 years

<b>Year</b>	<b>TOT3 Flow in MW during peak</b>
2007	1025
2008	956
2009	1096
2010	950

Looking at the historical flow data on TOT3 from Table -2, the values are not consistent but fall in the range of 950MW-1100MW, so a TOT3 flow of 1040-1100 MW is selected for the studies.

The worst overload under N-1 contingency is due to the outage of either Smoky Hill – Spruce 230 kV line or Smoky Hill – Powhatan – Spruce 230 kV line. The worst overload under N-2 contingency is due to the outage of both the Smoky Hill

– Spruce 230 KV line and Smoky Hill – Powahnton – Spruce 230 KV line. Under N-2 conditions, depending on the generation in the North east, the overloads can vary from 135% - 145% of the rated value (280 MVA).

Table-3 gives the loading on the Chambers auto in the 2012HS case under System intact, N-1 contingency and N-2 contingency conditions for all the three scenarios

Table-3: System Intact, N-1 contingency and N-2 Contingency loading on the Chambers #1 transformer in the 2012HS case

<b>2012HS Case</b>	<b>System Intact</b>	<b>N-1 Contingency</b>	<b>N-2 Contingency</b>
Scenario-1	70%	81%	136%
Scenario-2	72%	83%	139%
Scenario-3	72%	84%	143%

Scenario-1 already represents an economic dispatch. Given the 1165MW wind generation and the intermittent nature of wind, and all the coal and gas fired generation in the North east, redispatch options may not provide operational flexibility. Table -4 and 5 give the possible redispatch options studied using the 2012HS scenario-1 case and the % loading on the transformer. The only possible units for redispatching generation are Fort Saint Vrain, Fountain Valley and Fort Lupton. Given the heavy summer condition, all the other generation is on. PSCo's contracts with Fountain Valley generation expire in 2013, which makes Table-4 the only possible redispatch scenario. Even after curtailing approximately 400MW of generation, the transformer is overloaded by 18%. So PSCo proposes to add a second transformer at the Chambers Substation.

PSCo uses the standard capacity of 100MVA/150 MVA/280 MVA/560 MVA for a 230/115 kV transformer. Since the existing transformer is 280 MVA, a second transformer of similar capacity is being proposed.

The actual need for the transformer exists as of date. Considering the lead time required to order a new transformer, a 2013 summer in service data has been proposed for the second transformer.

Table-4: Loading of the Chambers #1 auto under N-2 condition when generation in the North east is decreased. The redispatch is performed on the 2012HS Scenario-1 case

<b>Generation decreased</b>	<b>Loading of Chambers 230/115 kV, 280 MVA #1</b>	<b>TOT3 flow</b>	<b>Generation Increased</b>
Spruce 130 MW	126%	1058 MW	Fort Sain Vrain 130 MW
Spruce 260 MW	118%	1055 MW	Fort Sain Vrain 260 MW
Spruce 260 MW , Brush4 119 MW	118%	1060 MW	Fort Lupton 100 MW, Fort Saint Vrain 280 MW

Table-5: Loading of the Chambers #1 auto under N-2 condition when generation in the North east is decreased. The redispatch is performed on the 2012HS Scenario-1 case

<b>Generation decreased</b>	<b>Loading of Chambers 230/115 kV, 280 MVA #1</b>	<b>TOT3 flow</b>	<b>Generation Increased</b>
Spruce 130 MW	122%	1058 MW	Fountain Valley 120 MW
Spruce 260 MW	109%	1074.8 MW	Fountain Valley 240 MW
Spruce 260 MW , Brush4 119 MW	109%	1091.4 MW	Fountain Valley 240 MW and Fort Lupton 100 MW