Xcel Energy
Transmission Capital 5-Year Budget Submittal
2011-2015

Revision #: **Date Submitted:**	2/18/2009	**Total Project Cost:** $6,963,000
Project Title:	Hopkins 230-115kV Transformer #2	
Project Manager:	Robb Nielsen	
Planner:	W. Anderson	
In Service Date:	June 1, 2012	
Area of Work (NSP, NSPW, PSCo, CHY, SPS)	PSCo	
State Work Being Completed:	Colorado	
Project Category:	PL	
Project Priority	High	
Request Type (New, Carryover, Reimbursable)	New	
Project Start Date:	Engineering 18 months prior to ISD	
Date Submitted:	January 18, 2010	
Discretionary / Non Discretionary	Discretionary	
Distribution Associated Projects N/A		**Distribution Funded Yes / No:** No
O&M Dollars Needed N/A		

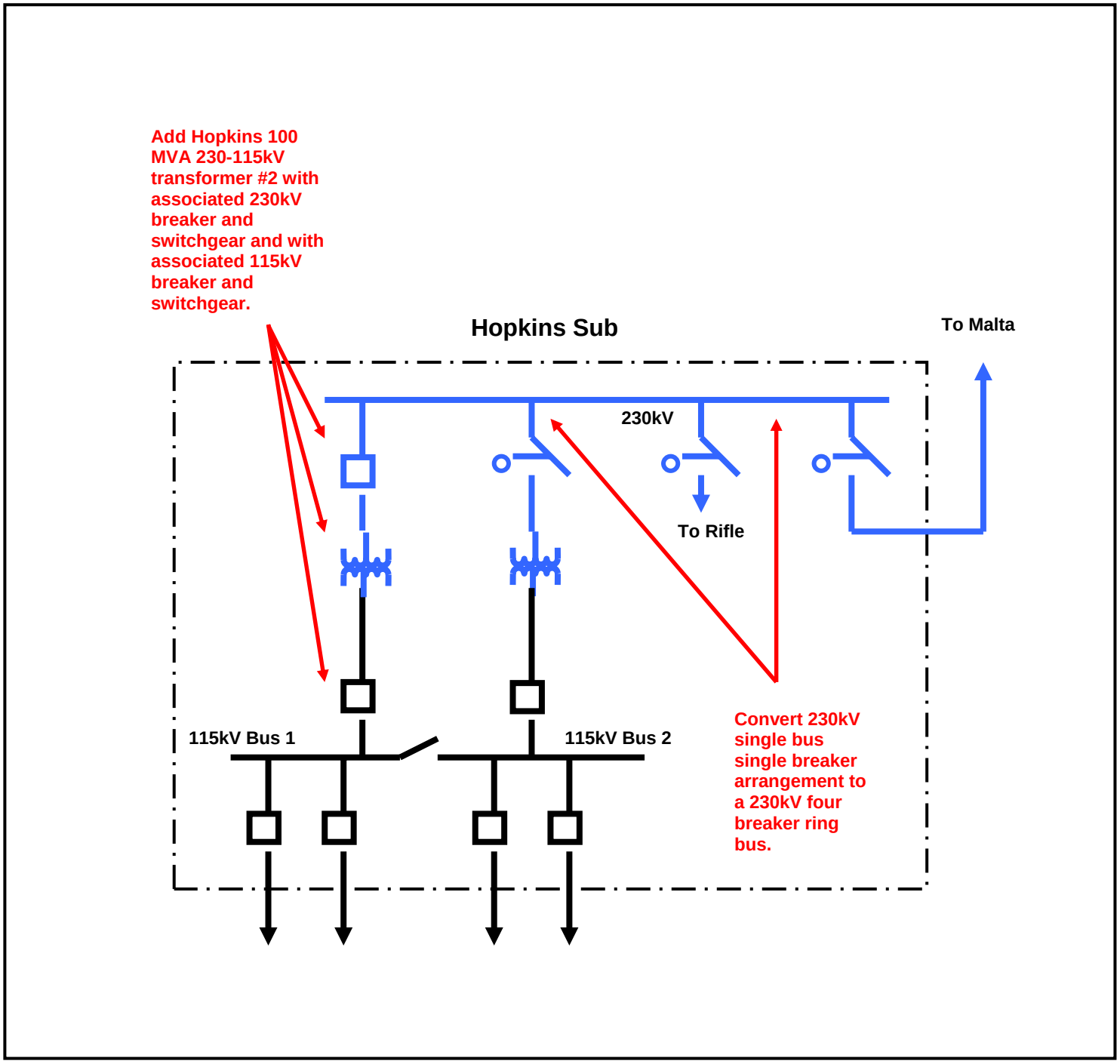
Project Description (Board Level)

The project consists of adding a second Hopkins 100 MVA 230-115kV transformer. The 230kV single bus single breaker arrangement will be converted to a 230kV four breaker ring bus.

Detailed Project Description

Add a second Hopkins 100 MVA 230-115kV transformer along with the associated 115kV circuit breaker and facilities. Convert the existing 230-kV single bus single breaker bus configuration to a 230kV four breaker ring bus.

Figure 1 Hopkins Substation Conceptual One-Line



Project Necessity

The flow across the Hopkins 230-115kV transformer is impacted by:

- Local Area Loads (Mountain Area)
- Shoshone Hydro Generation
- TOT5 Transfer Path Flows

A. Load Effect on the Hopkins 230-115kV Transformer Contingency Flow

The Hopkins 230-115kV transformer delivers bulk power from the 230kV transmission system to the 115kV load-serving system. The 115kV load-serving system includes the Carbondale 115kV load, the Basalt 115kV loads (Basalt, Aspen, Snowmass, Crystal) that connect to the Hopkins 115kV bus through the Hopkins-Basalt 115kV line, and the Hopkins 69kV loads (Roaring Fork, Glenwood Springs, Mitchell Creek and New Castle 69kV loads) that connect to the Hopkins 115kV bus through the Hopkins 115-69kV transformer . The Basalt 115kV loads have a connection to the 230kV bulk transmission system through the Basalt 230-115kV transformer. Because the loads in the Mountain Area of Colorado experience higher demands in the winter than the summer, higher contingency flows across the Hopkins 230-115kV transformer are observed in the winter than the summer.

Table 1 represents the Hopkins 230-115kV contingency flows for the 2012 Summer Season. The Shoshone Hydro generation is at 15 MW and the TOT5 transfer flows is at 1362 MW (west-to-east). Table 2 represents the Hopkins 230-115kV contingency flows for the 2014 Winter Season. The Shoshone Hydro generation is at 15 MW and the TOT5 transfer flows is at 1336 MW (west-to-east). With the Shoshone generation level at 15 MW for both seasons and the TOT5 flow at approximately the same transfer level, it can be seen that the Hopkins 230-115kV transformer experiences significantly higher contingency flows during the winter season than the summer season due to the higher winter demand in the Mountain Area of Colorado.

Table 1 Hopkins 230-115kV Transformer Contingency Flow – SUMMER SEASON IN 2012
TOT5 = 1362 MW (West-to-East), Shoshone Hydro = 15 MW

Case: 2012HS_BCSUY_T5_1362_PS_S.sav					
Monitored Element	Ckt	Limiting Contingency	Rating	LnFlow	%O/L
HOPKINS 115.00-HOPKINS 230.00	**T1**	HOPKINS 230.0-MALTA 230.0-1	100.0	131.0	**131.0**
HOPKINS 115.00-HOPKINS 230.00	**T1**	HAYDEN 230.0-FOIDELCK 230.0-1	100.0	124.6	**124.6**
HOPKINS 115.00-HOPKINS 230.00	T1	WOLCOTT 230.0-FOIDELCK 230.0-1	100.0	114.7	114.7
HOPKINS 115.00-HOPKINS 230.00	T1	COOLEYMA 230.0-WOLCOTT 230.0-1	100.0	101.2	101.2

Table 2 Hopkins 230-115kV Transformer Contingency Flow – WINTER SEASON IN 2014
TOT5 = 1336 MW (West-to-East), Shoshone Hydro = 15 MW

Case: 2014HW_BCSUY_T5_1336_PS2_E.sav					
Monitored Element	Ckt	Limiting Contingency	Rating	LnFlow	%O/L
HOPKINS 115.00-HOPKINS 230.00	**T1**	HAYDEN 230.0-FOIDELCK 230.0-1	100.0	170.8	**170.8**
HOPKINS 115.00-HOPKINS 230.00	**T1**	HOPKINS 230.0-MALTA 230.0-1	100.0	152.8	**152.8**
HOPKINS 115.00-HOPKINS 230.00	**T1**	WOLCOTT 230.0-FOIDELCK 230.0-1	100.0	152.3	**152.3**
HOPKINS 115.00-HOPKINS 230.00	**T1**	COOLEYMA 230.0-WOLCOTT 230.0-1	100.0	121.6	**121.6**
HOPKINS 115.00-HOPKINS 230.00	T1	COOLEYMA 230.0-BASALT 230.0-1	100.0	116.0	116.0
HOPKINS 115.00-HOPKINS 230.00	T1	BASALT 115.0-BASALT 230.0-T2	100.0	110.0	110.0
HOPKINS 115.00-HOPKINS 230.00	T1	NEWCASTL 69.00-SILTUSBR 69.00-1	100.0	105.3	105.3
HOPKINS 115.00-HOPKINS 230.00	T1	RIFLE_CU 69.00-SILTUSBR 69.00-1	100.0	105.3	105.3
HOPKINS 115.00-HOPKINS 230.00	T1	MITCHLCR 69.00-NEWCASTL 69.00-1	100.0	102.8	102.8
HOPKINS 115.00-HOPKINS 230.00	T1	AULT 345.0-CRAIG 345.0-1	100.0	102.0	102.0

HOPKINS 115.00-HOPKINS 230.00	T1	RIFLE_CU 69.00-RIFLE_CU 138.0-T2	100.0	101.2	101.2

B. Shoshone Generation Level Effect on the Hopkins 230-115kV Transformer Contingency Flow

Under 2010HW conditions with TOT2A at 110 MW, TOT5 at 380 MW and Shoshone Hydro off-line, an outage of the Basalt 230-115kV transformer results in a flow on the Hopkins 230-115kV transformer of 130.7% of its 100 MVA rating (See Table 3).

Table 3 Hopkins 230-115kV Transformer Contingency Flow – 2010HW – Shoshone Gen=0 MW

10hw2ap.sav					
Monitored Element	Ckt	Limiting Contingency	Rating	LnFlow	%O/L
HOPKINS 115.00-HOPKINS 230.00	**T1**	BASALT 115.0-BASALT 230.0-T2	100.0	130.7	**130.7**
HOPKINS 115.00-HOPKINS 230.00	**T1**	HAYDEN 230.0-FOIDELCK 230.0-1	100.0	122.1	**122.1**
HOPKINS 115.00-HOPKINS 230.00	T1	WOLCOTT 230.0-FOIDELCK 230.0-1	100.0	103.2	103.2

Placing the Shoshone Hydro on-line at 15 MW reduces the contingency flow across the Hopkins 230-115kV transformer to 120.6% of its 100 MVA rating for an outage of the Basalt 230-115kV transformer (See Table 4). This compares closely with the 2014HW case. A similar effect is noted for other contingencies.

Table 4 Hopkins 230-115kV Transformer Contingency Flow – 2010HW – Shoshone Gen=15 MW

Case: 10hw2ap_S.sav					
Monitored Element	Ckt	Limiting Contingency	Rating	LnFlow	%O/L
HOPKINS 115.00-HOPKINS 230.00	**T1**	BASALT 115.0-BASALT 230.0-T2	100.0	117.6	**117.6**
HOPKINS 115.00-HOPKINS 230.00	**T1**	HAYDEN 230.0-FOIDELCK 230.0-1	100.0	116.9	**116.9**

C. TOT5 (West-to-East) Transfer Level Effect on the Hopkins 230-115kV Transformer Contingency

The 2014HW case was used. The case had the Shoshone Generation at 15 MW. The TOT5 west-to-east flows were increased to demonstrate the effect of increasing TOT5 west-to-east transfers on the Hopkins 230-115kV contingency flow. Tables 5 through 8 demonstrate that as the TOT5 west-to-east transfers increase, more branch outages result in criteria violations on the Hopkins 230-115kV transformer with the overload level increasing as the TOT5 transfers increase. Table 5 and Table 6 represent a low TOT5 transfer level, Table 7 represents a moderate TOT5 transfer level, and Table 8 represents a high TOT5 transfer level.

Table 5 Hopkins 230-115kV Transformer Contingency Flow – TOT5 = 290 MW (West-to-East)

Case: 2014HW_BCSUY_E.sav					
Monitored Element	Ckt	Limiting Contingency	Rating	LnFlow	%O/L
HOPKINS 115.00-HOPKINS 230.00	**T1**	BASALT 115.0-BASALT 230.0-T2	100.0	120.3	**120.3**
HOPKINS 115.00-HOPKINS 230.00	**T1**	HAYDEN 230.0-FOIDELCK 230.0-1	100.0	110.8	**110.8**

Table 6 Hopkins 230-115kV Transformer Contingency Flow – TOT5 = 644 MW (West-to-East)

Case: 2014HW_BCSUY_T5_644_PS_E.sav					
Monitored Element	Ckt	Limiting Contingency	Rating	LnFlow	%O/L
HOPKINS 115.00-HOPKINS 230.00	**T1**	HAYDEN 230.0-FOIDELCK 230.0-1	100.0	128.8	**128.8**
HOPKINS 115.00-HOPKINS 230.00	**T1**	BASALT 115.0-BASALT 230.0-T2	100.0	117.3	**117.3**
HOPKINS 115.00-HOPKINS 230.00	T1	WOLCOTT 230.0-FOIDELCK 230.0-1	100.0	108.7	108.7

Table 7 Hopkins 230-115kV Transformer Contingency Flow – TOT5 = 934 MW (West-to-East)

Case: 2014HW_BCSUY_T5_934_PS2_E.sav					
Monitored Element	Ckt	Limiting Contingency	Rating	LnFlow	%O/L
HOPKINS 115.00-HOPKINS 230.00	**T1**	HAYDEN 230.0-FOIDELCK 230.0-1	100.0	151.1	**151.1**
HOPKINS 115.00-HOPKINS 230.00	**T1**	WOLCOTT 230.0-FOIDELCK 230.0-1	100.0	131.3	**131.3**
HOPKINS 115.00-HOPKINS 230.00	**T1**	HOPKINS 230.0-MALTA 230.0-1	100.0	120.0	**120.0**
HOPKINS 115.00-HOPKINS 230.00	T1	BASALT 115.0-BASALT 230.0-T2	100.0	113.2	113.2
HOPKINS 115.00-HOPKINS 230.00	T1	COOLEYMA 230.0-WOLCOTT 230.0-1	100.0	100.0	100.0

Table 8 Hopkins 230-115kV Transformer Contingency Flow – TOT5 = 1336 MW (West-to-East)

Case: 2014HW_BCSUY_T5_1336_PS2_E.sav					
Monitored Element	Ckt	Limiting Contingency	Rating	LnFlow	%O/L
HOPKINS 115.00-HOPKINS 230.00	**T1**	HAYDEN 230.0-FOIDELCK 230.0-1	100.0	170.8	**170.8**
HOPKINS 115.00-HOPKINS 230.00	**T1**	HOPKINS 230.0-MALTA 230.0-1	100.0	152.8	**152.8**
HOPKINS 115.00-HOPKINS 230.00	**T1**	WOLCOTT 230.0-FOIDELCK 230.0-1	100.0	152.3	**152.3**
HOPKINS 115.00-HOPKINS 230.00	**T1**	COOLEYMA 230.0-WOLCOTT 230.0-1	100.0	121.6	**121.6**
HOPKINS 115.00-HOPKINS 230.00	T1	COOLEYMA 230.0-BASALT 230.0-1	100.0	116.0	116.0
HOPKINS 115.00-HOPKINS 230.00	T1	BASALT 115.0-BASALT 230.0-T2	100.0	110.0	110.0
HOPKINS 115.00-HOPKINS 230.00	T1	NEWCASTL 69.00-SILTUSBR 69.00-1	100.0	105.3	105.3
HOPKINS 115.00-HOPKINS 230.00	T1	RIFLE_CU 69.00-SILTUSBR 69.00-1	100.0	105.3	105.3
HOPKINS 115.00-HOPKINS 230.00	T1	MITCHLCR 69.00-NEWCASTL 69.00-1	100.0	102.8	102.8
HOPKINS 115.00-HOPKINS 230.00	T1	AULT 345.0-CRAIG 345.0-1	100.0	102.0	102.0
HOPKINS 115.00-HOPKINS 230.00	T1	RIFLE_CU 69.00-RIFLE_CU 138.0-T2	100.0	101.2	101.2

Based on the results of the power flow studies, it is recommended that a second Hopkins 230-115kV 100 MVA 230-115kV transformer be constructed.

Consequences of Not Doing Project

A second Hopkins 100 MVA 230-115kV transformer is needed for reliability. If the project is not constructed, unloading the transformer would require load-shedding and/or reductions in the TOT5 transfer level.

Operating Procedures

Not Applicable

Capital Financing: (AFUDC Excluded)
(Whole Dollar Value)

Years	Trans Line	Trans / Dist Sub	ROW	Land	Total
(2010)					
2011	$111,000	$1,559,000			
2012	$567,000	$4,726,000			
2013					
2014					
2015					
Total	$678,000	$6,285,000			$6,963,000