Preliminary Interconnection Study Report

NW Colorado Additional Generation Impact

Xcel Energy Transmission Planning
January 30, 2004

A. Executive Summary

A Customer has requested that PSCo evaluate the impact on the transmission system in western Colorado of installing a new generating station ranging in size from 50 MW to 250 MW at three possible sites in western Colorado. The sites include the Craig 345 kV bus, a tap on PSCo's Cameo-Parachute 230 kV line and a tap on the Grand Junction-Rifle CU 345 kV line that PSCo jointly owns with Western Area Power Administration (Western) and Tri-State G&T.

The study examined the proposal under two different conditions – a 2007 on-peak summer season scenario with all resources in western Colorado scheduled at maximum levels to fulfill contract obligations and to schedule excess power to the Front Range, and a 2008-2009 on-peak winter season scenario to simulate maximum load conditions in the area. The study of the summer season incorporated existing TOT5 operating practices to mitigate criteria violations that can occur under high transfers west-to-east across TOT5.

The results of the summer scenario, with TOT 5 at 953 MW, indicated that no transmission enhancements would be required to support the various levels of generation at the three alternative sites. However, the results of the heavy winter scenario indicated that the 50 MW to 250 MW of additional generation at the three sites would cause reliability criteria violations. The criteria violations and enhancements are identified in Table No. 2 in Section D.

B. Introduction

On August 28, 2003, a preliminary generation impact study agreement was executed between PSCo and the Customer. The agreement identified the need to determine the impact on the transmission system of the addition of 50 MW to 250 MW new combustion turbine generation in northwestern Colorado to serve all or part of the Customer's loads.

This study examined the impact of adding potential generator injection points on the western Colorado transmission system to serve the Customer's loads. Three locations were considered – the Craig 345 kV bus, a tap on the Cameo-Parachute 230 kV line (owned by PSCo – Line #5509) near DeBeque, Colorado, and a tap on the Rifle CU-Grand Junction 345 kV line also near DeBeque, Colorado. The study assumed the potential resources would be added in the 2007-2008 time frame. The study assumed injection levels of 50 MW, 100 MW, 150 MW, 200 MW, and 250 MW at the three proposed injection sites. The generation injected was scheduled to Denver by reducing Cherokee generation. The purpose of the study was to determine the criteria violations if any are due to these power injections.

The transmission system in western Colorado is defined as the system in western Colorado that is bounded by TOT5 on the west, TOT1A on the northwest, and TOT2A on the southwest. It contains generation resources that serve the loads within the area and outside the area. Power at generation resources in the area is typically scheduled from west-to-east across TOT5 to eastern Colorado, east-to-west across TOT1A to Utah, and north-to-south across TOT2A to New Mexico. TOT5, TOT1A and TOT2A represent power transfer paths that are recognized by the Western Electricity Coordinating Council (WECC). The TOT5 path defines the power transfers from western Colorado to eastern. The path owners include Western, Tri-State G&T, Platte River Power Authority, and Public Service Co. of Colorado. The following list describes the lines that make up the path:

Line/Transformer	Metered End
Hayden-Archer 230 kV	Archer
Craig-Ault 345 kV	Craig
Gore Pass-Blue River 230 kV	Blue River
Hayden-Gore Pass 138 kV	Gore Pass
Gore Pass230/138-kV transformer	Gore Pass 230
Gunnison-Poncha 230 kV	Poncha
Curecanti-Poncha 230 kV	Curecanti
Basalt-Malta 230 kV	Basalt
Basalt-Hopkins 115 kV	Basalt
Rifle-Hopkins 230 kV	Rifle

The TOT5 transfer path has a west-to-east rating of 1680 MW. That level is achieved through the use of operating practices in place in western Colorado. These operating practices were used in the study.

C. System Impact Study Approach

PSCo adheres to the WECC Reliability Criteria for planning studies. During system intact conditions, criteria are to maintain transmission system bus voltages between 0.95 and 1.05 per-unit of system nominal / normal conditions, and steady state power flows within 1.0 per-unit of all elements thermal (continuous current or MVA) ratings. Operationally, PSCo tries to maintain a transmission system voltage profile ranging from 1.03 per-unit at generation buses, to 1.0 per-unit or higher at transmission load buses. Following a single contingency element outage, transmission system steady state bus voltages must remain within 0.90 to 1.10 per-unit, and power flows within 1.0 per-unit of the elements continuous thermal ratings.

The study area selected is in western Colorado. Figure No. 1 in Appendix A illustrates the western Colorado study area with the locations of proposed injection sites. Figure No. 2 in Appendix A displays the western Colorado system east of Craig/Hayden and Rifle.

In order to determine the impacts of the proposed project, a WECC 2007 heavy summer power flow case (Case: 07hs1ap) and a WECC 2008-2009 heavy winter base case (Case: 0809hw1) were selected. Both cases reflect the expected demand conditions and planned upgrades in the study area. Western Colorado experiences the highest demand during the winter season. Less power is available to transfer west-to-east during this season. Demand in western Colorado is lighter in the summer; therefore, the transfers west-to-east across TOT5 are highest during the summer.

The 2007 heavy summer case was modified to reflect scheduling the available resources in western Colorado (after serving local load) to Denver. The generating units in western Colorado were scheduled at their maximum values and the power was scheduled to Denver. The resulting TOT5 flow was 953 MW. This case was used as the benchmark case. The three injection points were modeled in separate cases (starting with the benchmark case) with generators with capability up to 250 MW. The generation schedules were increased in 50-MW increments starting with 50 MW and ending with 250 MW. The generation at Cherokee was lowered in corresponding amounts. Facility outages were simulated in western Colorado at each generation level and for all three sites. The TOT5 operating practices were used to remove criteria violations. The results are listed in Section D. This scheduling process was also used for the winter season simulations.

D. Transmission Studies for the Three Injection Sites

1. Summer 2007 Study Results

A 2007 heavy summer case was obtained (Case: 07hs1ap). The case displayed the following transfer path flow levels and control area demands :

TOT1A	= 254 MW	PSCo Control Area =	7453 MW
TOT2A'	= 355 MW	WACM Control Area =	4257 MW
TOT2A	= 187 MW	N.Mex Control Area =	3353 MW
TOT3	= 1268 MW	Ariz. Control Area =	16314 MW
TOT5	= 817 MW		

The case was modified by creating a new zone for southeast Colorado loads and scaling loads in the new zone to 238 MW to reflect new load projections. Western's proposed Animas-LaPlata Project was added (20.5 MW at the Durango 115 kV bus). The modified cased was called 07HSA.

The generation at all generating stations in western Colorado was increased up to their maximum levels and scheduled to Cherokee in Denver. This resulted in a TOT5 flow of 953 MW in the summer 2007 time frame (Case: 07HSA-953). The three proposed generating sites were modeled in separate cases (07HSA-953-A1, 07HSA-953-A2, and 07HSA-953-A3). For each of the three scenario cases, generation was added in 50-MW increments up to 250 MW scheduled to Cherokee. TOT5 operating practices were simulated as generation schedules were increased and outages were simulated. Table No. 1 below describes the results of the simulations. At a TOT5 level of 953 MW and existing TOT5 operating practices simulated, no criteria violations were noted at any generation level up to 250 MW for any of the three sites.

Table 1. Summary of Injection Studies
2007 Heavy Summer TOT5 = 953 MW
Injection levels indicate amount scheduled from the injection site to Denver in addition to the amount already scheduled.

	Alternative No. 1 – Craig 345 kV Bus	Alternative No. 2 – Tap on Cameo-Parachute 230 kV line	Alternative No. 3 – Tap on RifleCU-Grand Junction 345 kV line
50 MW	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.
100 MW	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.
150 MW	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.
200 MW	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.
250 MW	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.	No improvements required. Overloads removed by operating practices.

For the three sites at all injection levels, no system enhancements are needed for the 2007 summer season. TOT5 was at 953 MW prior to the addition of the proposed generation and new TOT5 levels were not calculated.

2. Winter 2008-2009 Study Results

A 2008-2009 heavy winter case was obtained (Case: 0809hw1). This case represents the system when the northwest Colorado system load peak for the year. The case displayed transfer path flows and control area demand levels of:

TOT1A	= -53 MW	PSCo Control Area =	5819 MW
TOT2A'	= 645 MW	WACM Control Area =	4091 MW
TOT2A	= 484 MW	N.Mex Control Area =	2875 MW
TOT3	= 986 MW	Ariz. Control Area =	9858 MW
TOT5	= 417 MW		

The case was modified by creating a new zone for southeast Colorado loads. Western's proposed Animas-LaPlata project was

added (20.5 MW at the Durango 115 kV bus). The modified cased was called 0809HW. The case also includes a Tri-State G&T Project planned for this time period that will provide looped transmission service to Tri-State's Garmet Mesa (29.1 MW), North Mesa (5.1 MW), and Hotchkiss (7.3 MW) loads. The project involves tapping Tri-State's Grand Junction-Montrose 115 kV line approximately 23 miles north of Montrose. A 115 kV line will be constructed from the Tap Station (called ROUBD Tap) to Garnet Mesa 115 kV.

The three proposed generating sites were modeled in separate cases (08HW-A1, 08HW-A2, and 08HW-A3). For each of the three scenario cases, generation was added in 50-MW increments up to 250 MW scheduled to Cherokee. No operating practices in western Colorado were simulated. Table No. 2 below describes the results of the simulations. The criteria violations listed occur as a result of the proposed generation. There were pre-existing criteria violations in the 2008-2009 heavy winter case that are not noted in the table below. Capacitor additions are required without the additional generation; however, the amount needed increase under various proposed generation scenarios to support high power transfers. This study did not specifically identify those levels of reactive support.

Table 2. Summary of Injection Studies 2008-2009 Heavy Winter
Injection levels indicate amount scheduled from the injection site to Denver.

	Alternative No. 1 – Craig 345 kV bus	**Alternative No. 2 – Tap on Cameo-Parachute 230kV line**	**Alternative No. 3 – Tap on RifleCU-Grand Junction 345 kV line**
50 MW	No improvements required other than capacitive reactors to support the power transfers.	No improvements required other than capacitive reactors to support the power transfers.	No improvements required other than capacitive reactors to support the power transfers.
100 MW	No improvements required other than capacitive reactors to support the power transfers.	Cameo-Vineland 69 kV o/l (102.5%) for an outage of GrandJct-Montrose 345 kV line.	No improvements required other than capacitive reactors to support the power transfers.
150 MW	Hopkins 230-115 kV transformer o/l (101.3%) for outage of Hayden-Foidel Creek 230 kV line.	Cameo-Vineland 69 kV o/l (106.6%) for an outage of GrandJct-Montrose 345 kV line. Vineland-GrandJct 69 kV o/l (101.0%) for an outage of GrandJct-Montrose 345 kV line.	Hopkins 230-115 kV transformer o/l (100.8%) for outage of Hayden-Foidel Creek 230 kV line.

200 MW	Hopkins 230-115 kV transformer o/l (101.9%) for outage of Hayden-Foidel Creek 230 kV line. Craig-Rifle CU 230 kV o/l (100.7%) for outage of Craig-RifleCU 345KV line.	Cameo-Vineland 69 kV o/l (111.1%) for an outage of GrandJct-Montrose 345 kV line. Vineland-GrandJct 69 kV o/l (105.4%) for an outage of GrandJct-Montrose 345 kV line.	Hopkins 230-115 kV transformer o/l (102.1%) for outage of Hayden-Foidel Creek 230 kV line.
250 MW	Hopkins 230-115 kV transformer o/l (102.8%) for outage of Hayden-Foidel Creek 230 kV line. Craig-RifleCU 230 kV o/l (102.3%) for outage of Craig-RifleCU 345 KV line.	Cameo-Vineland 69 kV o/l (115.3%) for an outage of GrandJct-Montrose 345kV line. Vineland-GrandJct 69 kV o/l (109.7%) for an outage of GrandJct-Montrose 345 kV line. Hopkins 230-115 kV transformer o/l (105.4%) for outage of Hayden-Foidel Creek 230 kV line.	Hopkins 230-115 kV transformer o/l (103.5%) for outage of Hayden-Foidel Creek 230 kV line. Cameo-Vineland 69 kV o/l (101.6%) for an outage of GrandJct-Montrose 345 kV line.

The results listed in Table 2 demonstrate that transmission system improvements would be required for all three generating scenarios at levels varying from 100 MW to 250 MW.

The following are some possible transmission enhancements to mitigate the criteria violations identified in Table No. 2.

1. Increase the rating of PSCo's Cameo-Vineland 69 kV line (Line # 6671) from 65 MVA to 82 MVA by re-conductoring the 336 MCM conductor with 477 MCM conductor.

2. Increase the rating of PSCo's Vineland-Grand Junction 69 kV line (Line # 6671) from 65 MVA to 82 MVA by re-conductoring the 336 MCM conductor with 477 MCM conductor.

3. Western's Craig-Rifle 230 kV line is constructed with bundled 1272 MCM conductor and spaced for 345-kV operation. The line rating is relay-limited and CT-limited to 478 MVA. By making minor modifications, the rating of the line can be increased to its thermal limit of 956 MVA at 230-kV.

4. PSCo's Hopkins 230-115 kV transformer overload for an outage of Hayden-Foidel Creek 230 kV may fall within the multi-cycle loading criteria for the transformer and would require further study.

APPENDIX A

SYSTEM DRAWINGS

Figure No. 1 – Western Colorado Area – Generation Injection Locations

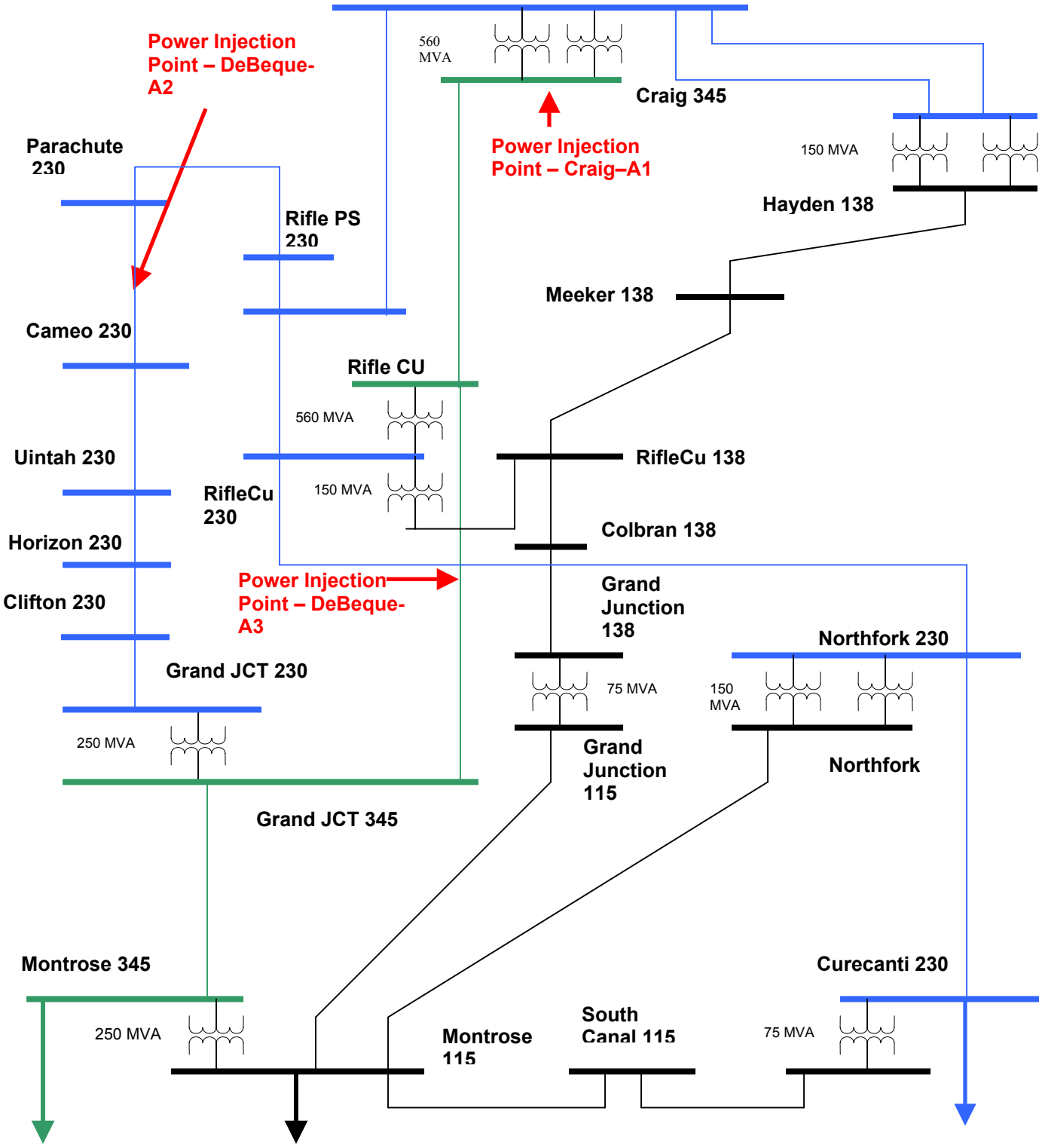

Figure No. 2 – Western Colorado Area