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Cargill Power Markets LLC
Transmission Service Request Study

Project TSR-08-0606

October 21, 2008

Background

Tri-State received a transmission service request and subsequent application for long-term firm transmission service in a letter dated June 6, 2008 (OASIS queue number TSR-08-0606). The Transmission Customer requested 179 MW of Long-Term Firm Point-to-Point Transmission Service over Tri-State's system from the Springer 115kV bus to the Ojo 345kV bus (east to west direction only). This study evaluates the ability of the transmission system to provide the requested Long-Term Firm Point-to-Point Transmission Service taking into consideration Tri-State's native load requirements over the next ten years and the projected operating conditions of the transmission system.

Scope

This study consists of the following:

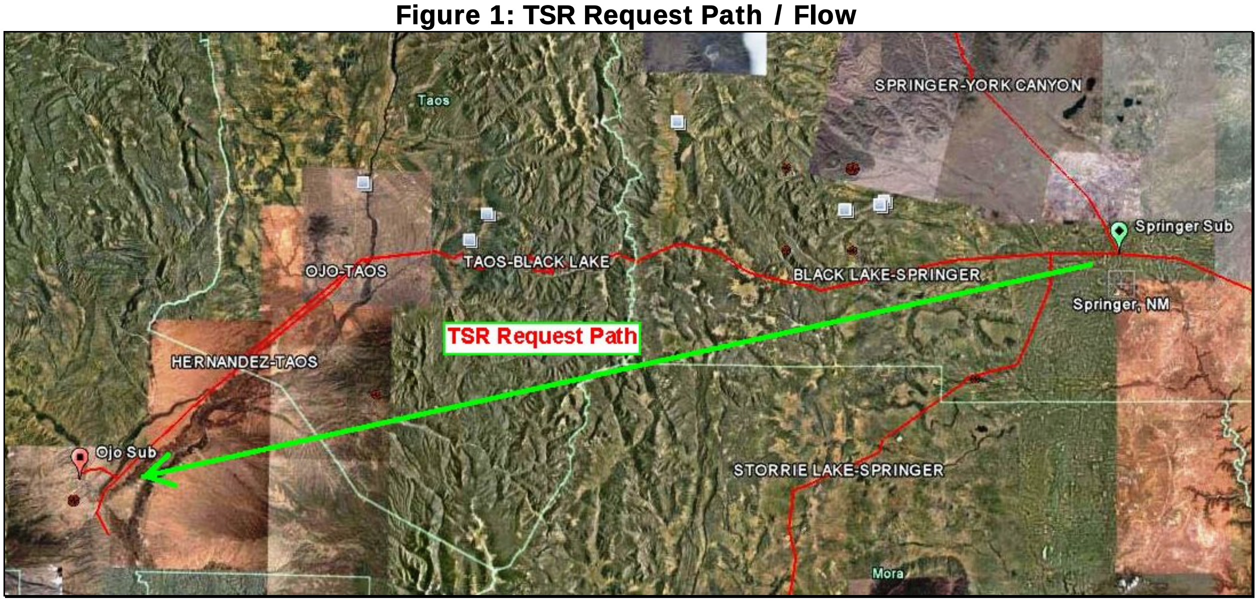
- Evaluation of the Available Transfer Capability (ATC) of the 98.5-mile path which begins at the Springer 115kV bus towards the Black Lake 115kV bus continuing to the Taos 115kV bus through the Taos 345kV/115kV transformer(s) and onto the Ojo 345kV line as shown on the geographical representation in Figure 1.

- Identification of thermal overloads or violations of voltage criteria resulting from providing Transmission Service over the requested path.

- Identification of any voltage instability or inadequately damped response to system disturbances resulting from providing the requested Transmission Service.

- Impacts of Tri-State native load growth through the ten year planning horizon as it will affect the committed uses on the path and the ability of Tri-State to provide the requested Transmission Service.

Figure 1: TSR Request Path / Flow



Study Assumptions

The study was performed utilizing the WECC Approved 2013 Heavy Summer (2013HS) base case with Tri-State's 2010, 2013 and 2018 loads inserted. A light load base case was also considered, however it was determined, as explained in the methodology section of this report, that the highest loading across the requested path depended on native load-serving needs. A light load scenario reduces the native load demand such that it does not result in the maximum flow across the requested path. Therefore, the heavy summer case was utilized to determine the Available Transfer Capability. The following modifications were made to the heavy summer case.

- A 15 MVAr capacitor bank was added at York Canyon
- 10 MW at 0.95 Power Factor of motor load was added at Bravo Dome West
- Approximately 50 MW of motor load at Rosebud
- Springer – Black Lake – Taos 115kV lines were uprated to 230MVA
- The Gladstone to Rosebud 115kV line was uprated to 169 MVA
- The Gladstone to Springer 115kV line was uprated to 159 MVA
- A fictitious 200 MW of generation was modeled at the Gladstone 115kV bus at 1.03 per unit voltage in the N-1 cases
- The Clapham transformer was rated at 42 MVA

The calculated ATC values for each year were determined based on assumed northeast New Mexico load, TOT transfer schedules and resource dispatch assumptions. The following TOT transfer schedules were selected for the power flow cases and were judged to be acceptable for determining ATC values.

- TOT2A ~230MW, Path 48 ~1700MW during System Normal in all 3 cases
- TOT2A ~260MW, Path 48 ~1500MW during N-1 scenarios in all 3 cases

Methodology

The study determined the Available Transfer Capability (ATC) using the following equation:

Equation 1: ATC Equation

ATC = Total Transfer Capability (TTC) – Existing Transmission Commitments (ETC) – Transmission Reliability Margin (TRM)

- TTC was determined in accordance with Tri-State's *Engineering Standards Bulletin – Reliability Criteria for System Planning and Service Standards* which states the maximum loading criteria for transmission lines as a percent of the continuous rating. Based on that criteria, TTC in this study was defined as 100 percent of the thermal rating of the lowest rated line section in the requested path.

- ETC is defined as Tri-State native load-serving needs, current transmission contracts or commitments and higher queued Transmission Service Requests.

- TRM is defined as loop flow across the requested path. WECC operating practice requires transmission providers to accommodate some through-flow which may decrease the available TTC due to this accommodation.

To determine the ATC, the worst local N-1 scenarios were simulated to maximize the flow across the requested path. A fictitious generator was modeled on the Gladstone 115kV bus with the voltage regulated at 1.03 per unit. TOT2A and Path 48 flows were kept at reasonable levels. Phase shifters were not adjusted in any way from the starting WECC base case.

N-1 scenarios simulated:

- Walsenburg-Gladstone 230kV line outage
- Norton – Hernandez 115kV line outage
- San Juan – Ojo 345kV line outage

From the above, it was determined through power flow simulations that the San Juan – Ojo contingency resulted in the maximum flow across the requested path. Therefore, the San Juan – Ojo outage was selected as the N-1 scenario to determine ATC.

ETC for this study was defined as the flow on the Springer to Black Lake 115kV line during an outage of the San Juan – Ojo 345kV line. The flow from Springer to Black Lake defines ETC because the flow reflects the amount of power that is required to serve Tri-State's Taos and Black Lake loads, including losses. Additionally, it should be noted that the flow on the Springer to Black Lake 115kV, during an outage of the San Juan – Ojo 345kV line also includes through-flow to Tri-State's Hernandez load and to the 115kV tie to Norton. Therefore, it was reasoned that the highest Springer to Black Lake 115kV line flow includes through-flow or TRM.

Power flow diagrams were produced and the flow from the Springer 115kV bus to the Black lake 115kV bus was determined to be the ATC for each of the 3 years – 2010, 2013, and 2018.

Results

The normal power flow on the requested path is west to east due to the generation at San Juan and Four Corners and the fact that the Northeast New Mexico system is a substantial sink because of its radial nature and high concentration of motor load. Modeling a fictitious generator at Gladstone demonstrated the expected result of displacing local load and reducing west to east flow on the requested path. Varying the generation at Gladstone had little affect on the maximum flow from Springer to Black Lake during an outage of the San Juan – Ojo 345kV line. The following table summarizes the calculated ATC results.

Table 1: Results of N-1 Power Flow Analysis (MVA)

Year	Contingency	TTC (MVA)	ETC (MVA)	ATC (MVA)
2010	N-1	230.0	76.7	**153.3**
2013	N-1	230.0	76.8	**153.2**
2018	N-1	230.0	77.7	**152.3**

ATC remains relatively constant over a ten year period, even with native load increases. This is due to a larger contribution from the Norton to Hernandez 115kV line, which is supplying an increasing amount of power to the local load-serving needs during an outage of the San Juan – Ojo 345kV line as shown below:

Table 2: MVA Contribution from Norton (PNM) - Hernandez (TSGT) 115kV

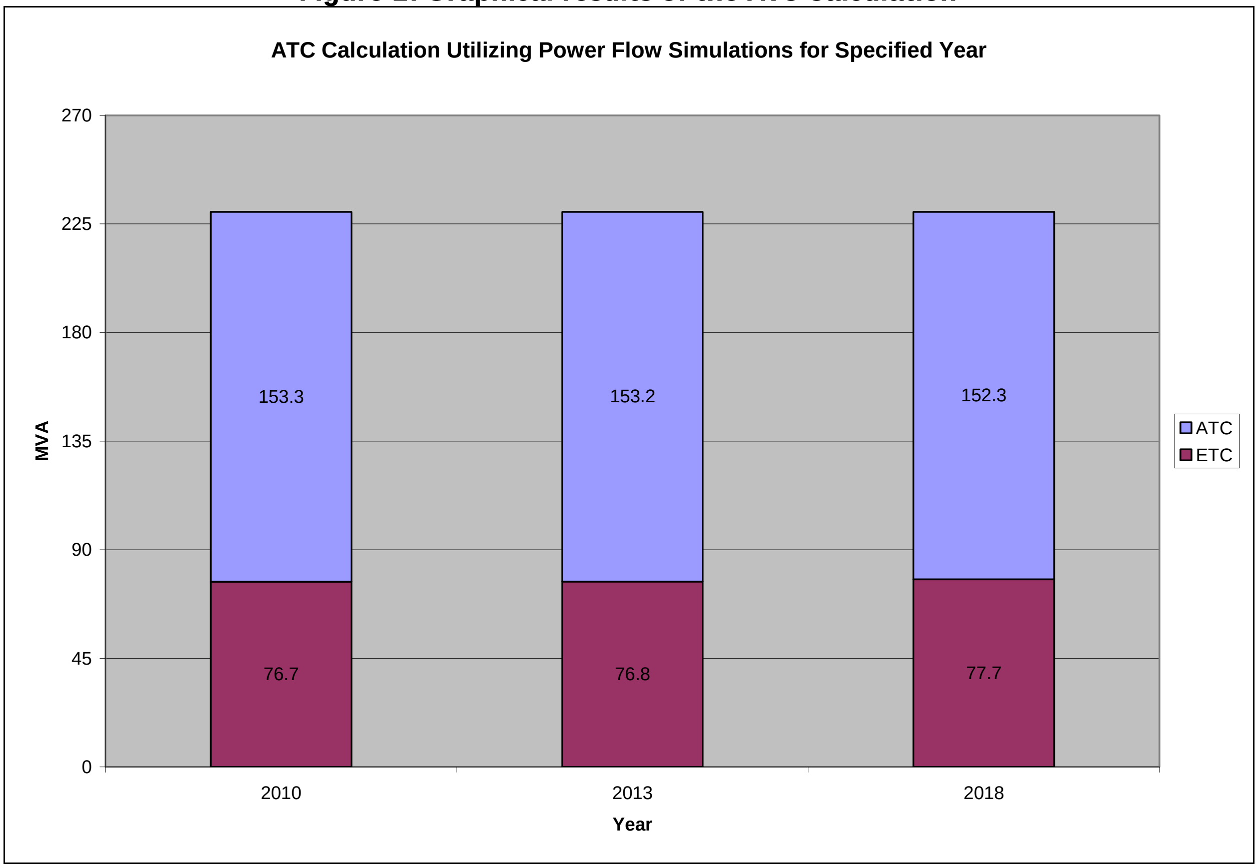
Year	MVA
2010	57.7
2013	63.4
2018	79.2

Table 2 shows that as Tri-State's native load grows, there is a greater MVA contribution south to north from PNM's Norton source. The flow between the Norton and Hernandez 115kV buses is normally north to south, not south to north as in the N-1 contingency case.

There are six power flow diagrams attached to this report. The first set of three power flow diagrams reflect the System Normal cases in order from 2010, 2013 to 2018. The final three sets are the N-1 power flows in the same chronological order.

Reassessment of the path upon termination of the TSR will be necessary as loads and generation levels change.

Figure 2: Graphical results of the ATC Calculation

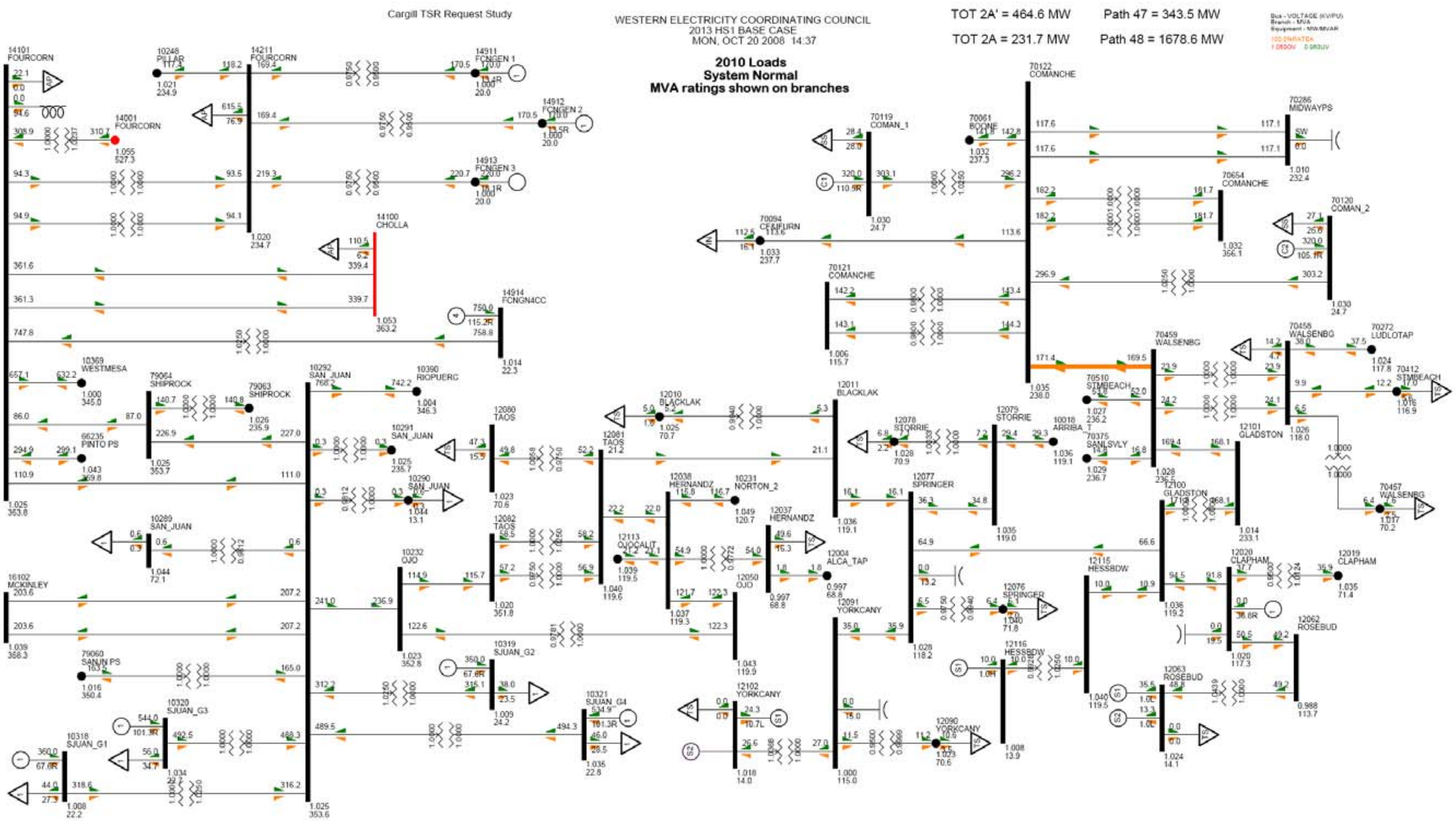


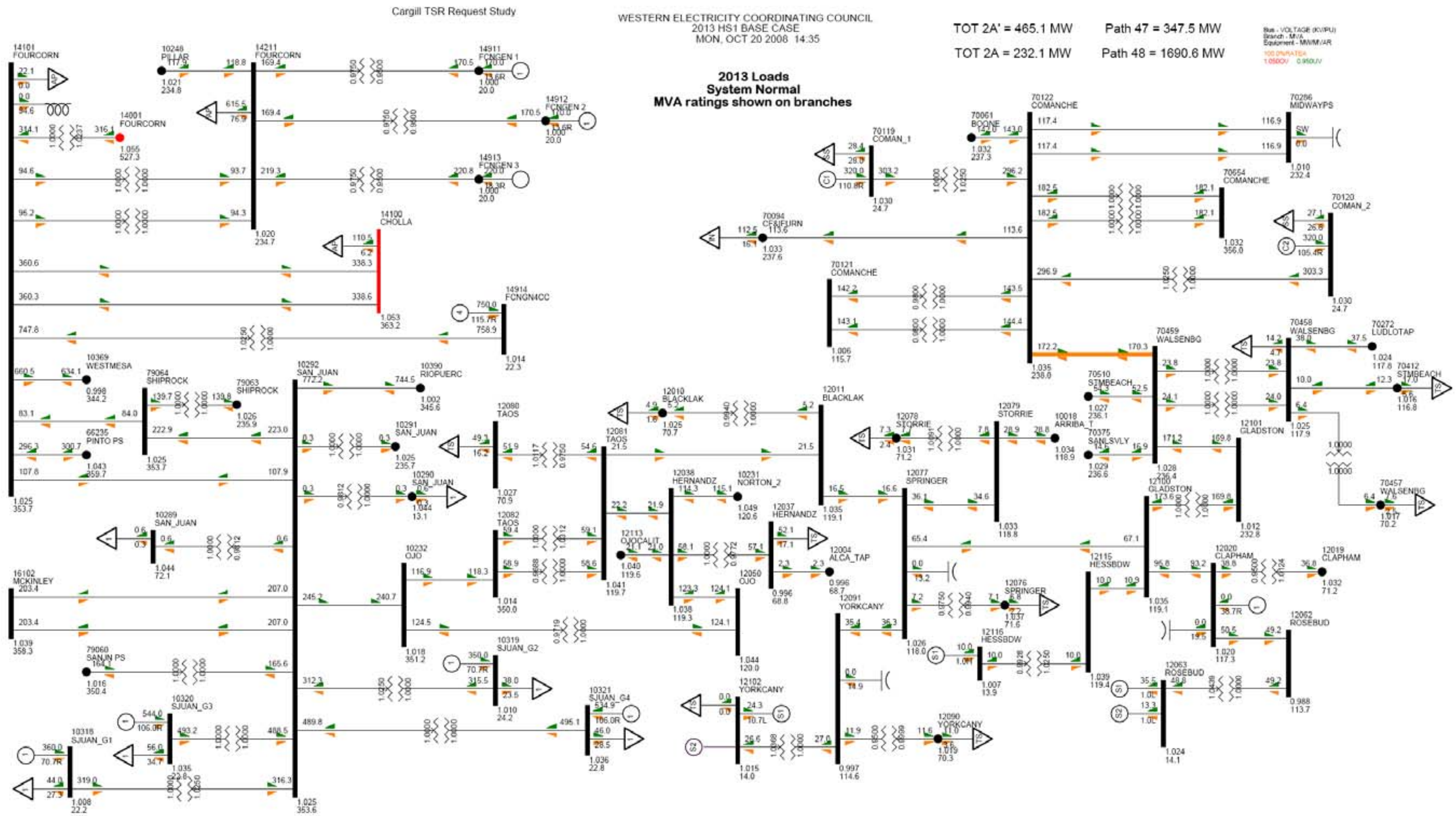
Conclusion

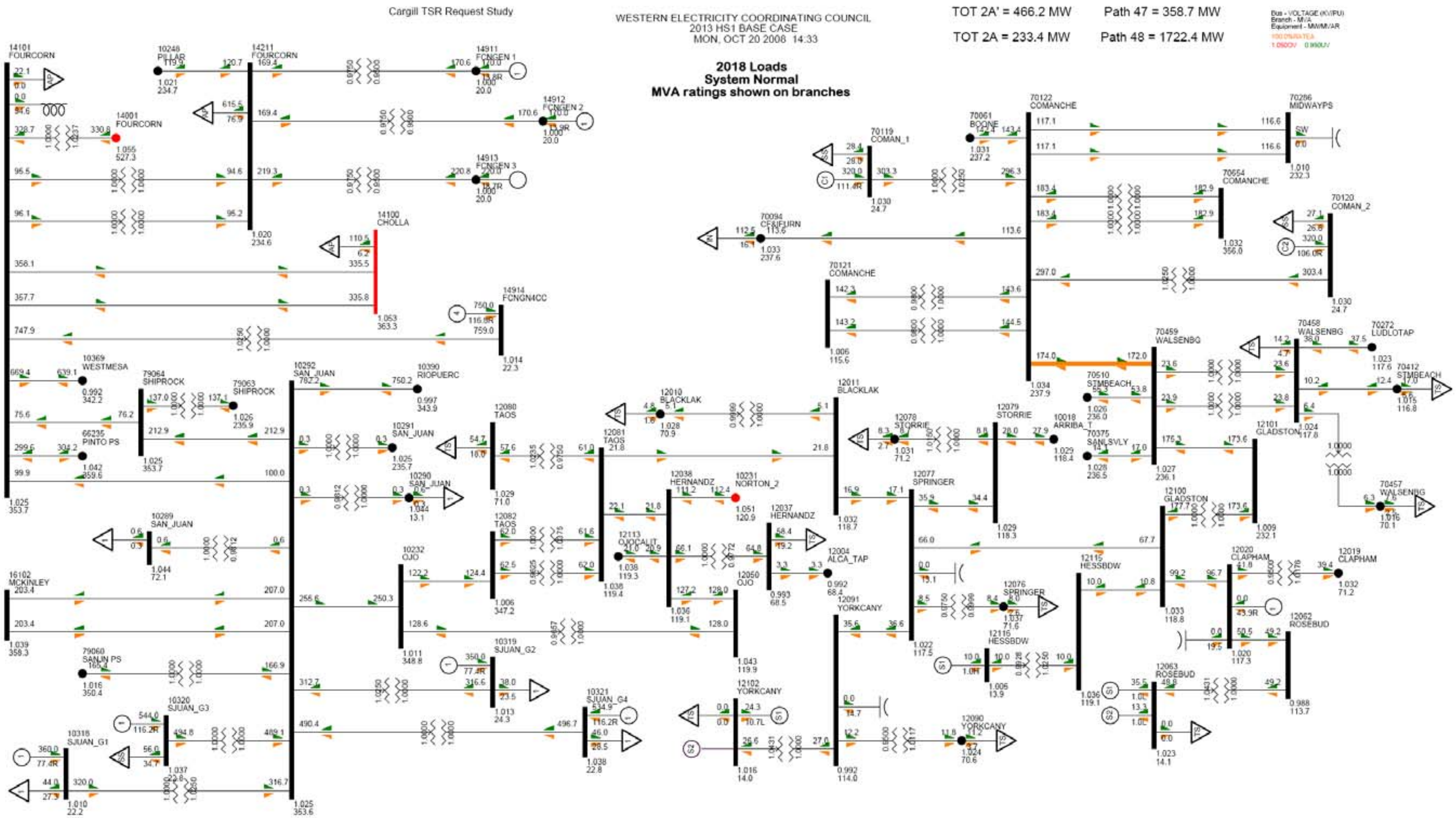
The transmission service customer requested 179MW of Long-Term Firm Point-to-Point Transmission Service over Tri-State's system from the Springer 115kV bus to the Ojo 345kV bus (east to west direction only). However, based on the results of this study, 153 MVA is available for the customer.

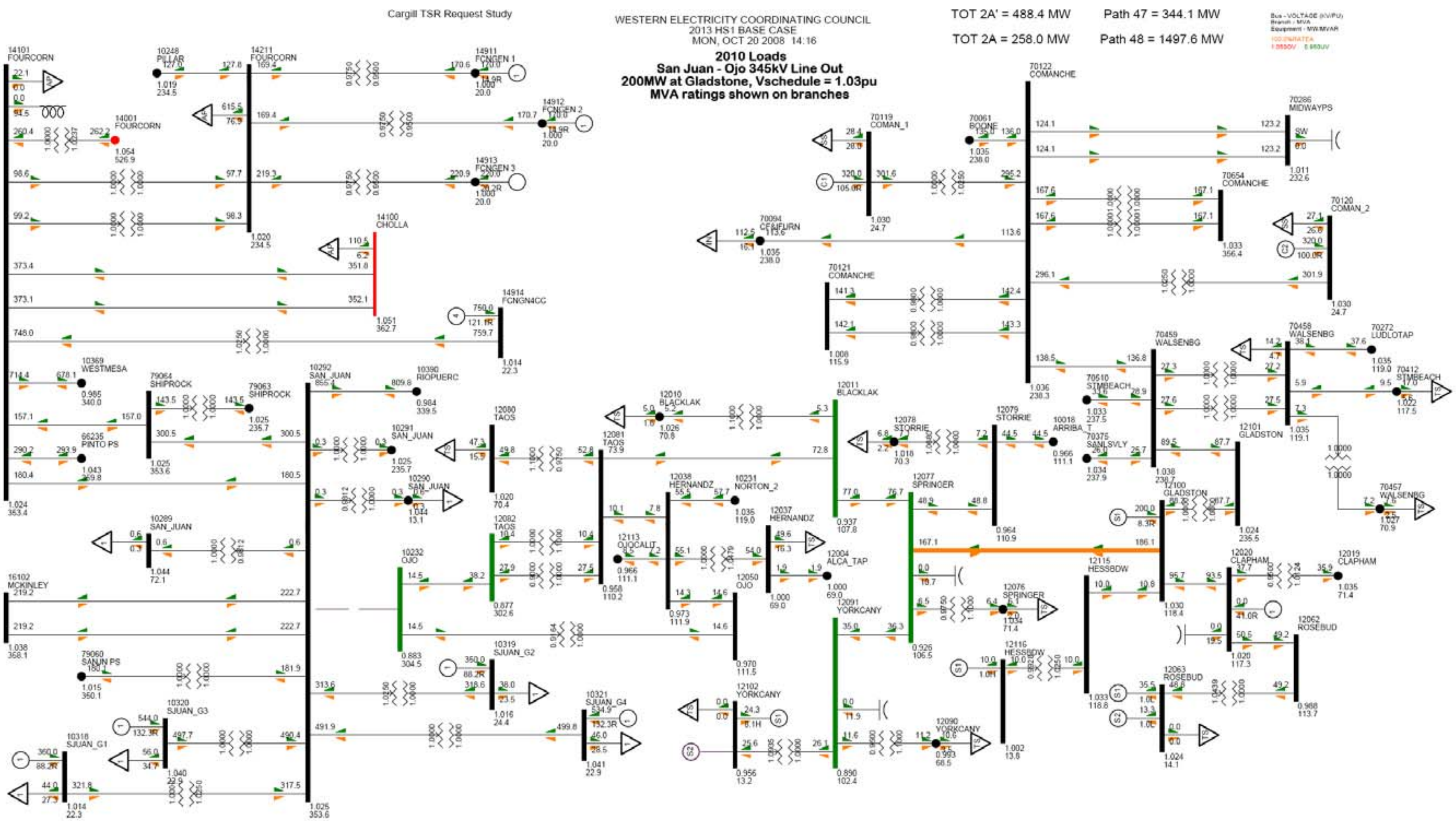
Appendix 1

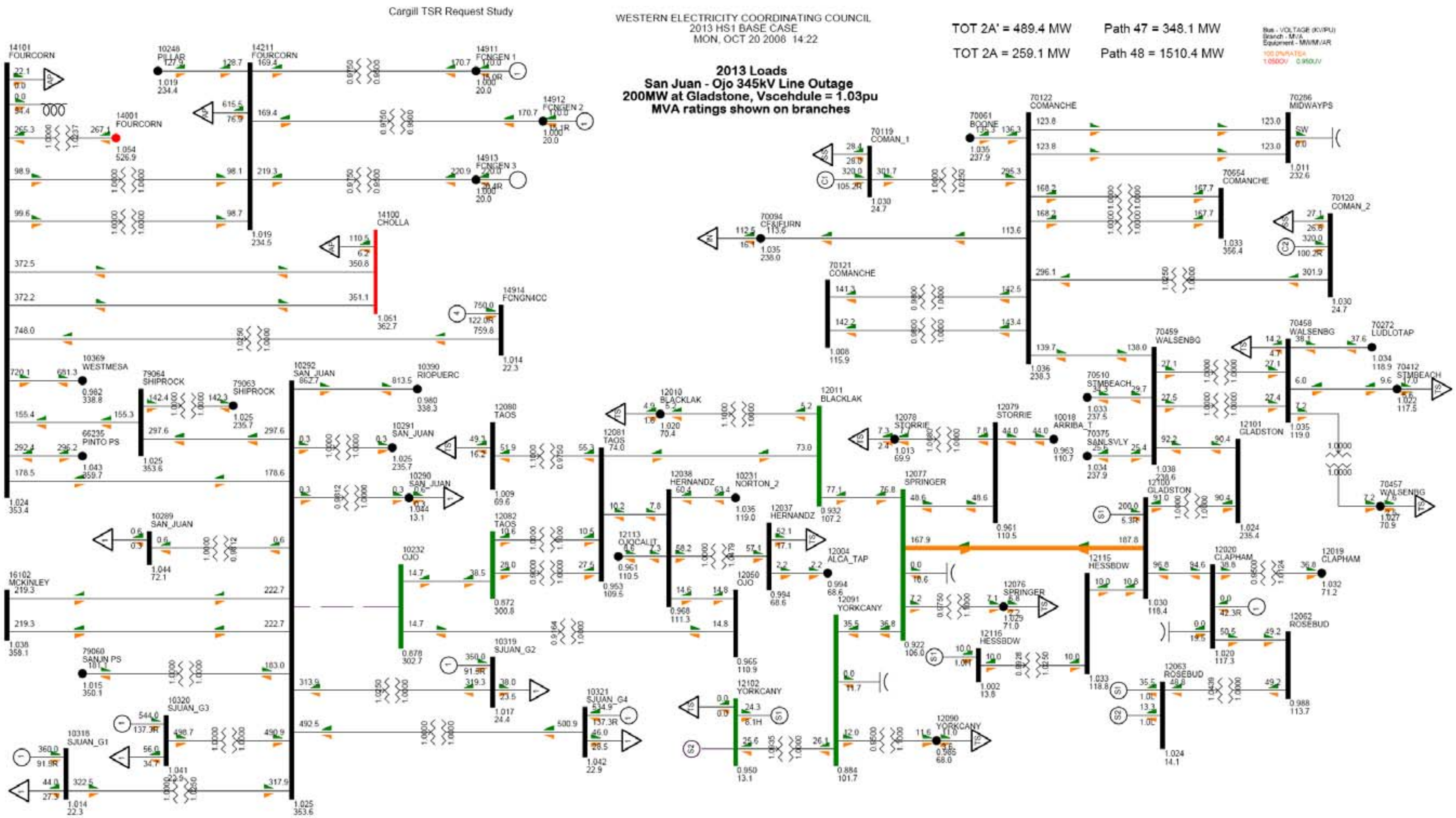
Steady State Power Flow Diagrams in MVA

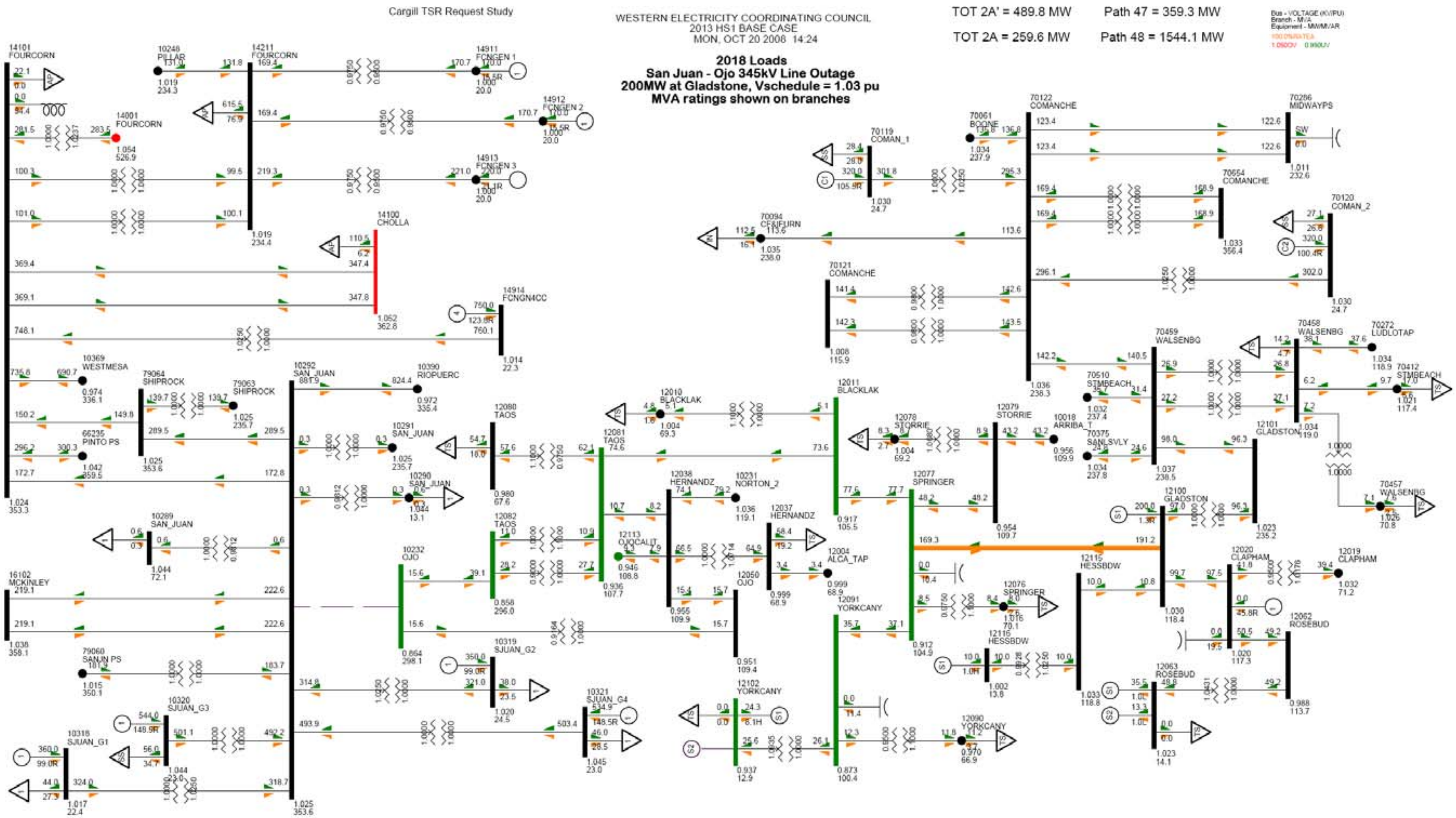

Cargill TSR Request Study
WESTERN ELECTRICITY COORDINATING COUNCIL
2013 HS1 BASE CASE
MON, OCT 20 2008 14:37
2010 Loads
System Normal
MVA ratings shown on branches
TOT 2A' = 464.6 MW
Path 47 = 343.5 MW
TOT 2A = 231.7 MW
Path 48 = 1678.6 MW


Cargill TSR Request Study
WESTERN ELECTRICITY COORDINATING COUNCIL
2013 HS1 BASE CASE
MON, OCT 20 2008 14:35
TOT 2A' = 465.1 MW
Path 47 = 347.5 MW
TOT 2A = 232.1 MW
Path 48 = 1690.6 MW
2013 Loads
System Normal
MVA ratings shown on branches


Cargill TSR Request Study
WESTERN ELECTRICITY COORDINATING COUNCIL
2013 HS1 BASE CASE
MON, OCT 20 2008 14:33
2018 Loads
System Normal
MVA ratings shown on branches
TOT 2A' = 466.2 MW
Path 47 = 358.7 MW
TOT 2A = 233.4 MW
Path 48 = 1722.4 MW


Cargill TSR Request Study
WESTERN ELECTRICITY COORDINATING COUNCIL
2013 HS1 BASE CASE
MON, OCT 20 2008 14:16
2010 Loads
San Juan - Ojo 345kV Line Out
200MW at Gladstone, Vschedule = 1.03pu
MVA ratings shown on branches
TOT 2A' = 488.4 MW
Path 47 = 344.1 MW
TOT 2A = 258.0 MW
Path 48 = 1497.6 MW


Cargill TSR Request Study
WESTERN ELECTRICITY COORDINATING COUNCIL
2013 HS1 BASE CASE
MON, OCT 20 2008 14:22
2013 Loads
San Juan - Ojo 345kV Line Outage
200MW at Gladstone, Vscehdule = 1.03pu
MVA ratings shown on branches
TOT 2A' = 489.4 MW
Path 47 = 348.1 MW
TOT 2A = 259.1 MW
Path 48 = 1510.4 MW


Cargill TSR Request Study
WESTERN ELECTRICITY COORDINATING COUNCIL
2013 HS1 BASE CASE
MON, OCT 20 2008 14:24
2018 Loads
San Juan - Ojo 345kV Line Outage
200MW at Gladstone, Vschedule = 1.03 pu
MVA ratings shown on branches
TOT 2A' = 489.8 MW
Path 47 = 359.3 MW
TOT 2A = 259.6 MW
Path 48 = 1544.1 MW