Transmission System Impact Study Report
REQUEST # T-2005-1

376 MW Transmission Service Request

Public Service Co. of Colorado Transmission Planning - October 2005

I. Executive Summary

This Transmission System Impact Study Report summarizes the analyses performed by the Transmission Planning group of Public Service Company of Colorado to accommodate 376 MW of long-term firm point-to-point transmission service across the TOT1A path beginning January 1, 2011. The analyses were completed in response to a request from a customer dated January 25, 2005. The request identified the stated point of receipt as the Craig substation, and the stated point of delivery as the Vernal substation. Since PSCo Transmission Provider (PSCo T.P.) has no ownership in the TOT1A path, it cannot accommodate the request with existing facilities. A description of the TOT1A path can be found in the Appendix of this report.

The Applicants agreed that two 345 kV alternatives would be evaluated:

1. A new single-circuit Craig – Vernal 345kV transmission line (1242 MVA).
2. A new double-circuit Craig – Vernal 345kV transmission line (2484 MVA).

The study assumed additional 345kV transmission would be required to transfer power from Vernal to loads within Utah, but the configuration of that transmission would be the responsibility of PacifiCorp Transmission Provider (PacifiCorp T.P.) For this study, 345 kV single and double circuit transmission lines between the Vernal Substation and the Terminal Substation in the PacifiCorp T.P. control area were assumed. A simple diagram of the existing transmission system within the study area is shown in Figure 1.

This study determined that either transmission alternative could accommodate the transmission request and concluded the following:

1. A Craig-Vernal 345 kV single-circuit transmission line could accommodate the 376-MW request if the Bonanza/Flaming Gorge remedial action scheme (RAS) is modified to include tripping generation at Bonanza and Flaming Gorge for an outage of the Craig-Vernal 345 kV line or an outage of the Vernal-Terminal 345 kV line. The following was determined:

- The study indicated that the Tot 1A transfer limit could be increased approximately 516 MW[1] from 377 MW to 893 MW. This increase assumes a modified RAS is implemented. The modified RAS consists on tripping the Bonanza generating unit and up to two Flaming Gorge units for loss of either the Craig-Vernal 345 kV line or the Vernal-Terminal 345 kV line.

- The cost for the single-circuit alternative would be approximately $85.2 million[2]. A Craig-Vernal 345 kV single-circuit transmission line could not accommodate the 376-MW request unless the RAS is modified. Studies showed that the increase in the TOT1A transfer limit would be approximately 138 MW if the RAS were not modified. This would not be sufficient to accommodate the request.

2. A Craig-Vernal 345 kV double-circuit transmission line could accommodate the 376-MW request. The following was determined:

   - The study indicated that the TOT1A transfer limit could increase approximately 529 MW from 377 MW to 906 MW without using the Bonanza/Flaming Gorge RAS
   - If the Bonanza/Flaming Gorge RAS is used, the TOT1A transfer limit could increase approximately 1160 MW from 377 MW to 1537 MW.
   - The approximate cost for a Craig-Vernal 345 kV double-circuit transmission line would be approximately $105.7 million[3].

3. The approximate time required for siting, land rights, land acquisition, substation and transmission engineering, equipment procurement, and transmission and substation construction is estimated to be between 54 and 60 months for either alternative from the time an authorization to proceed has been received. The schedule does not include time to obtain CPCN approval from the State of Colorado or the equivalent approval from the State of Utah. If these are required, additional time may be necessary. The details for the cost assumptions can be found in Section V.

4. Short-circuit and transient stability studies were not conducted for this system impact study per the agreed study scope. PSCo T.P. recommends that these studies be conducted as part of a Facilities Study.

A summary of the study results can be found in Table No. 1 below.

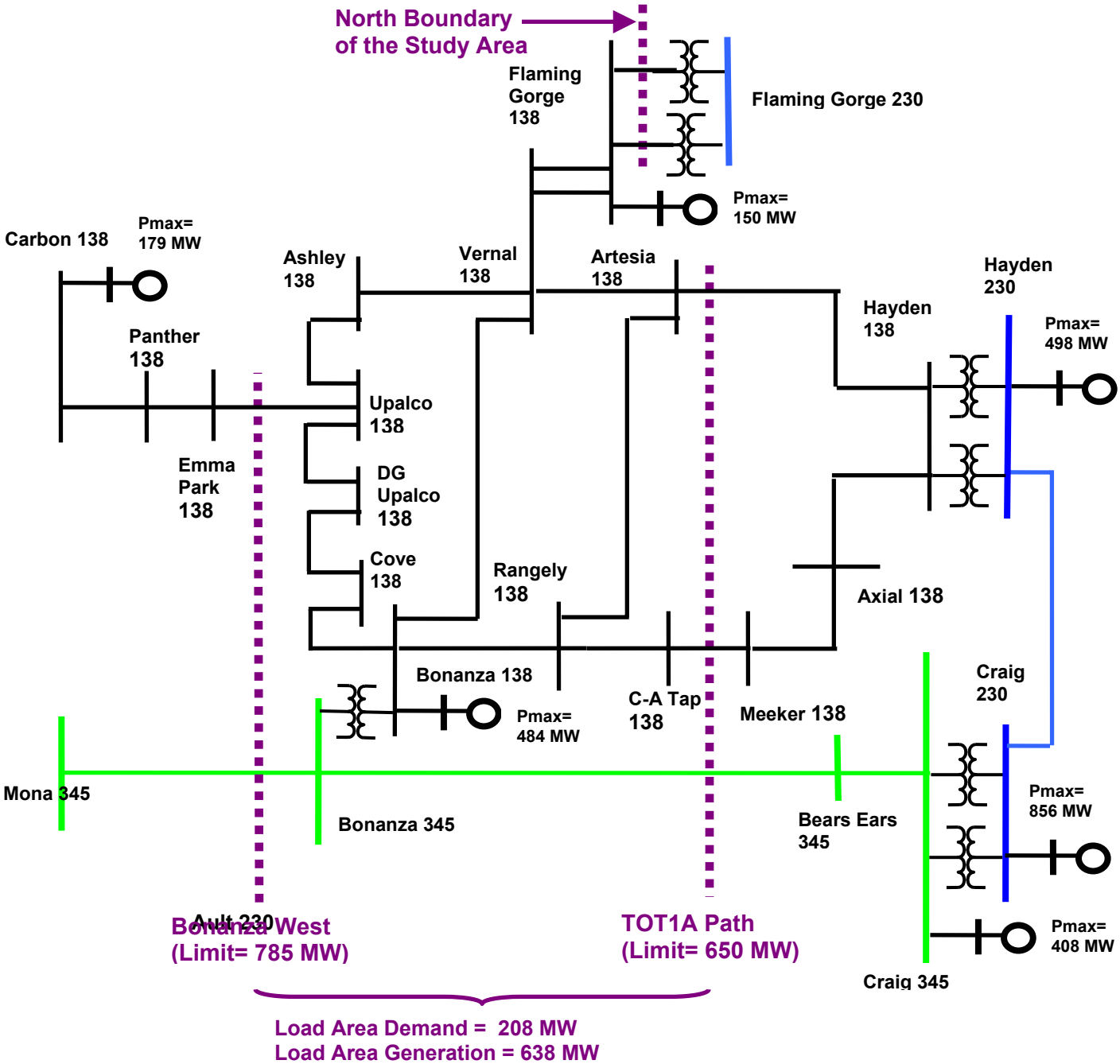
[1] The transfer limits indicated in this report are indicative and not meant to imply an official TTC limit. Additional joint studies would have to be conducted to refine the actual limits.
[2] This cost represents a +/- 30% scoping estimate in 2005-year dollars.
[3] The cost represents a +/- 30% scoping estimate in 2005-year dollars.

Table No. 1 Study Summary Table

Alternative	TOT1A Transfer Limit (MW)	Increase in TOT1 from Benchmark with RAS (MW)	RAS	Cost
Benchmark	301	-76	No	
Benchmark	377	0	Yes	
Craig-Vernal 345 kV S.C.	515	138	No	$ 85.2 million
Craig-Vernal 345 kV S.C.	893	516	Yes	
Craig-Vernal 345 kV D.C.	906	529	No	$ 105.7 million
Craig-Vernal 345 kV D.C.	1537	1160	Yes	

Note: An allocation study of the potential TOT1A transfer limit increase was not performed as part of this study.

Figure 1 - Regional Transmission Network – Study Area



II. Background

On January 25, 2005, the customer submitted an application for transmission service to the PSCo Transmission Provider (PSCo T.P.). The request was for 376 MW of long-term firm east-to-west transmission service across the TOT 1A path. The stated point of receipt was the Craig substation, and the stated point of delivery was the Vernal substation.

On February 10, 2005, the customer, PacifiCorp Transmission Provider (PacifiCorp T.P.), PSCo Transmission Provider (PSCo T.P.), and the TOT1A owners met to discuss the transmission service request. The meeting participants agreed that there is little available transfer capability on TOT1A. A description of the TOT1A path that lists the path ownership can be found in the Appendix of this report. PSCo T.P. has no ownership in TOT1A; therefore, it is unable to accommodate the request with existing generation. For this reason, a system impact study was initiated to identify system upgrades to allow the power to be transferred across TOT1A from the Craig Substation to the Vernal Substation. The Vernal Substation is between the TOT1A path and the Bonanza-West Path and is a boundary point on the PacifiCorp T.P. network bubble. The power received by PacifiCorp T.P. at Vernal will be evaluated as a separate network service request on the PacifiCorp-Utah (Wasatch Front) system. The PacifiCorp T.P. Group will identify enhancements needed for this request.

On June 30, 2005, the customer and PSCo T.P. signed a Transmission System Impact Study Agreement. The purpose of the agreement was to conduct a study to determine the adequacy of PSCo T.P.'s transmission system to accommodate a request for new point-to-point transmission service and/or any required network upgrades from the Craig Substation in Colorado to the Vernal Substation in Utah. The request was for a total of 376 MW over a 22-year period starting January 1, 2011 through December 31, 2032.

III. Study Methodology

A. Base Case

Powerflow studies represent a 2011 peak summer condition. The study case was created from a Western Electricity Coordinating Council (WECC) 2009 Heavy Summer (09HS1) base case. The case reflects heavy Northwest to California schedules resulting in higher east-to-west flows across TOT1A. The TOT1A owners and PacifiCorp T.P. reviewed the 2009 heavy summer base case and recommended minor configuration and demand changes so that the case would reflect 2011 heavy summer conditions. These are listed in the Appendix. PSCo T.P. made the recommended changes to the base case to create the 2011 heavy summer study case.

B. Study Scope and Assumptions

- This study consisted of powerflow analysis only. Angle or voltage stability studies and short circuit studies were not performed for this study.
- The studies assumed a single-circuit Vernal-Terminal 345kV line for the Craig-Vernal 345 kV single-circuit alternative and a double-circuit Vernal-Terminal 345 kV line for the Craig-Vernal 345 kV double-circuit studies.
- System criteria violations outside of the study area were monitored; however, system upgrades outside the study area were not developed to mitigate these issues.
- Power transfers across TOT1A from east-to-west were modeled by modifying interchange schedules between Western and PSCo T.P. on the east and PacifCorp T.P. on the west. Local generation was used to accomplish the interchange changes.
- Contingencies included only single facility outages. No double-contingency outages were simulated.
- The TOT1A transfer path depends on a remedial action scheme (RAS) that requires tripping of the Bonanza and Flaming Gorge units in response to an outage of the Bonanza-Mona 345 kV line. This RAS was used in the study to determine approximate TOT1A transfer limit increases.
- The TOT1A transfer path depends on emergency ratings for critical transmission lines in the study area. These emergency ratings were used to determine approximate TOT1A transfer limit increases.
- The transmission study assumed a second Bonanza 345-138 kV transformer in “hot-standby” mode.
- This study did not determine how any increase in TOT1A transfer capability would be allocated among the TOT1A path owners and the parties requesting additional transmission service.
- Simultaneous impacts on other paths were not studied. For example, the TOT2A path is south of the study area. Flows on this transfer path were allowed to increase as the TOT1A transfers were increased; however, the study did not consider the impact of high TOT2A flows on the TOT1A path.

C. Alternatives

The following transmission alternatives were evaluated:

- Benchmark Analysis – No alternative
- Single-circuit Craig-Vernal 345kV transmission line
- Double-circuit Craig-Vernal 345kV transmission line

Figure No. 2 below illustrates the Craig-Vernal 345 kV single-circuit alternative and Figure No. 3 illustrates the Craig-Vernal 345 kV double-circuit alternative. Figure No. 4 and Figure No. 5 are one-line drawings of the alternatives.

Figure 2 - Regional Transmission Network with Alternative No. 1

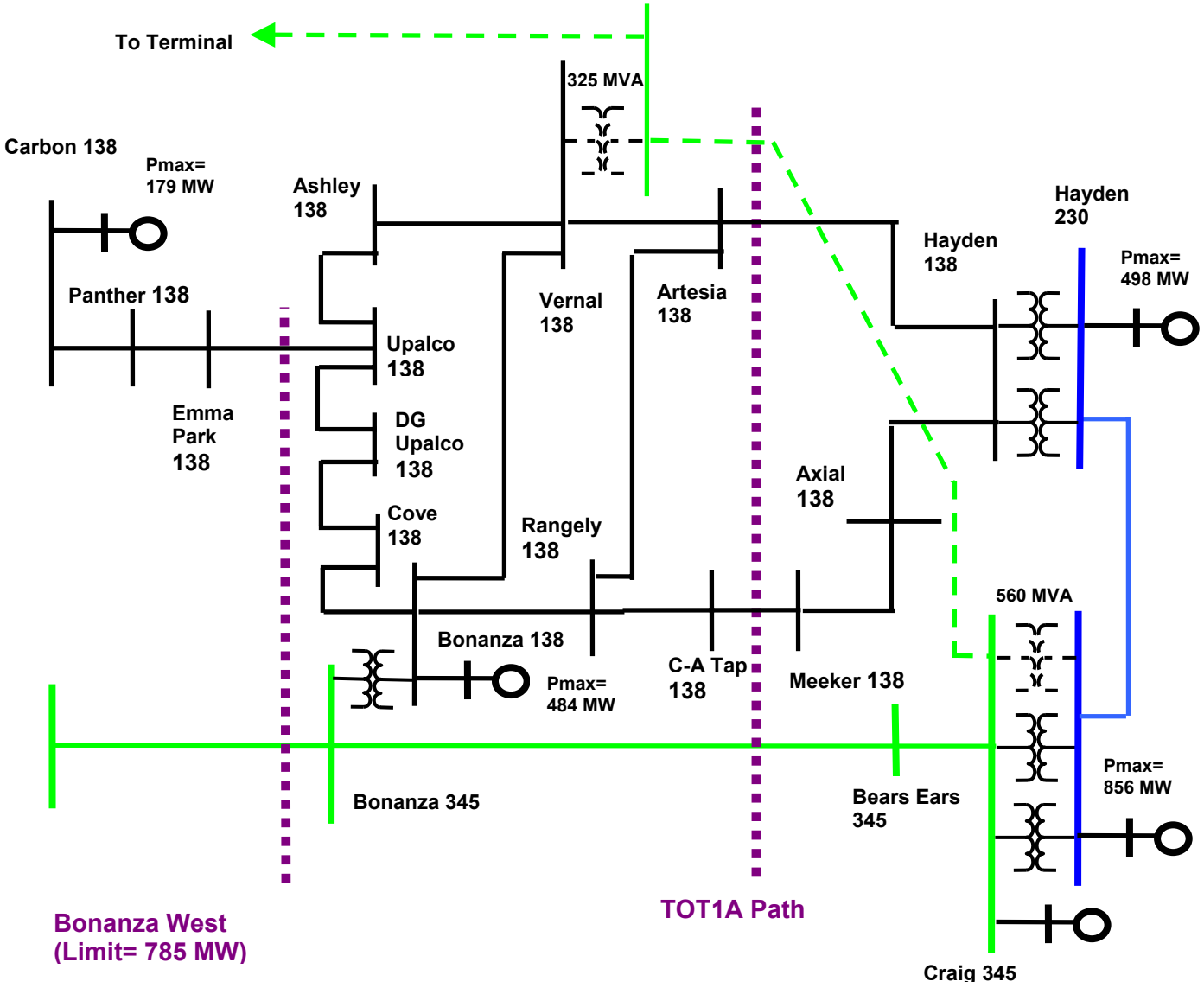


Figure 3 - Regional Transmission Network with Alternative No. 2

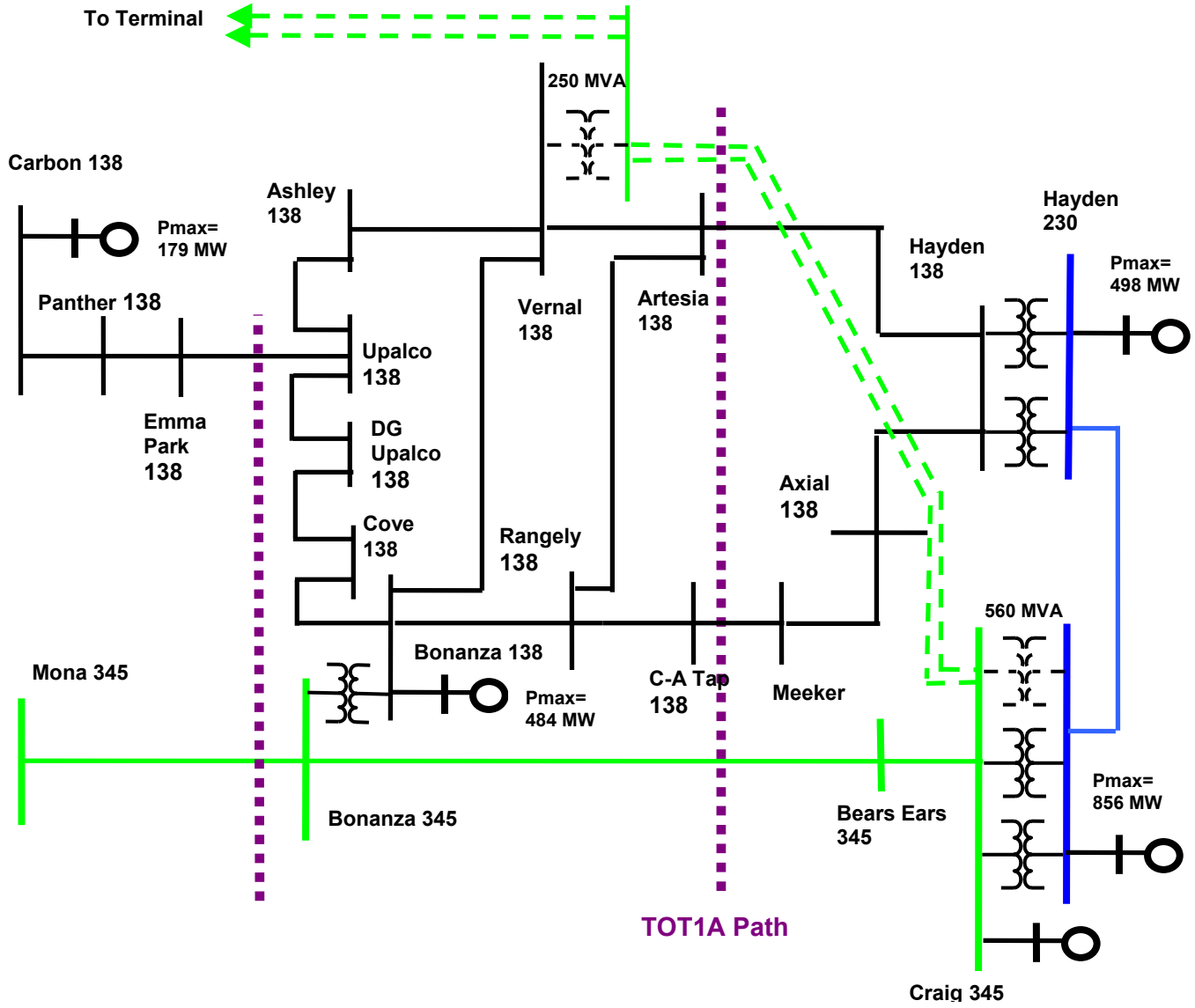


Figure 4 – Proposed One-Line for Alternative No. 1

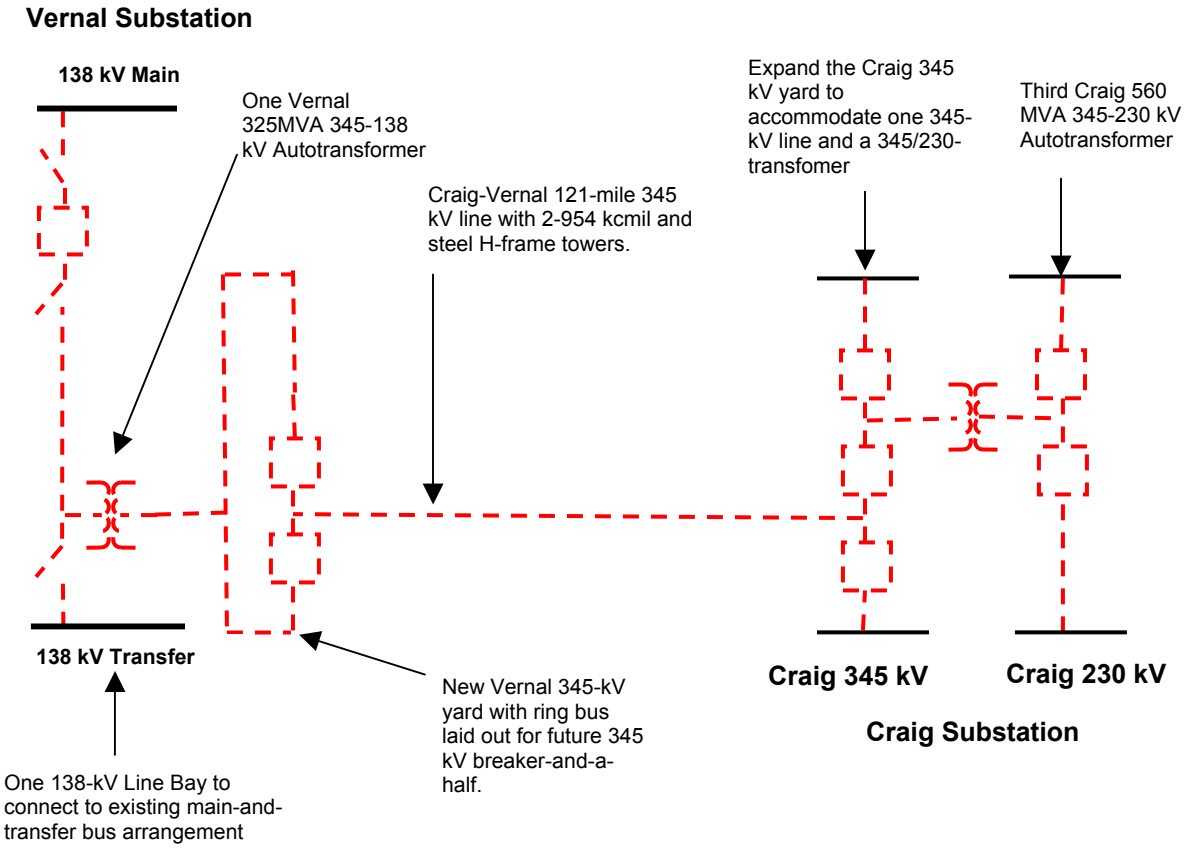
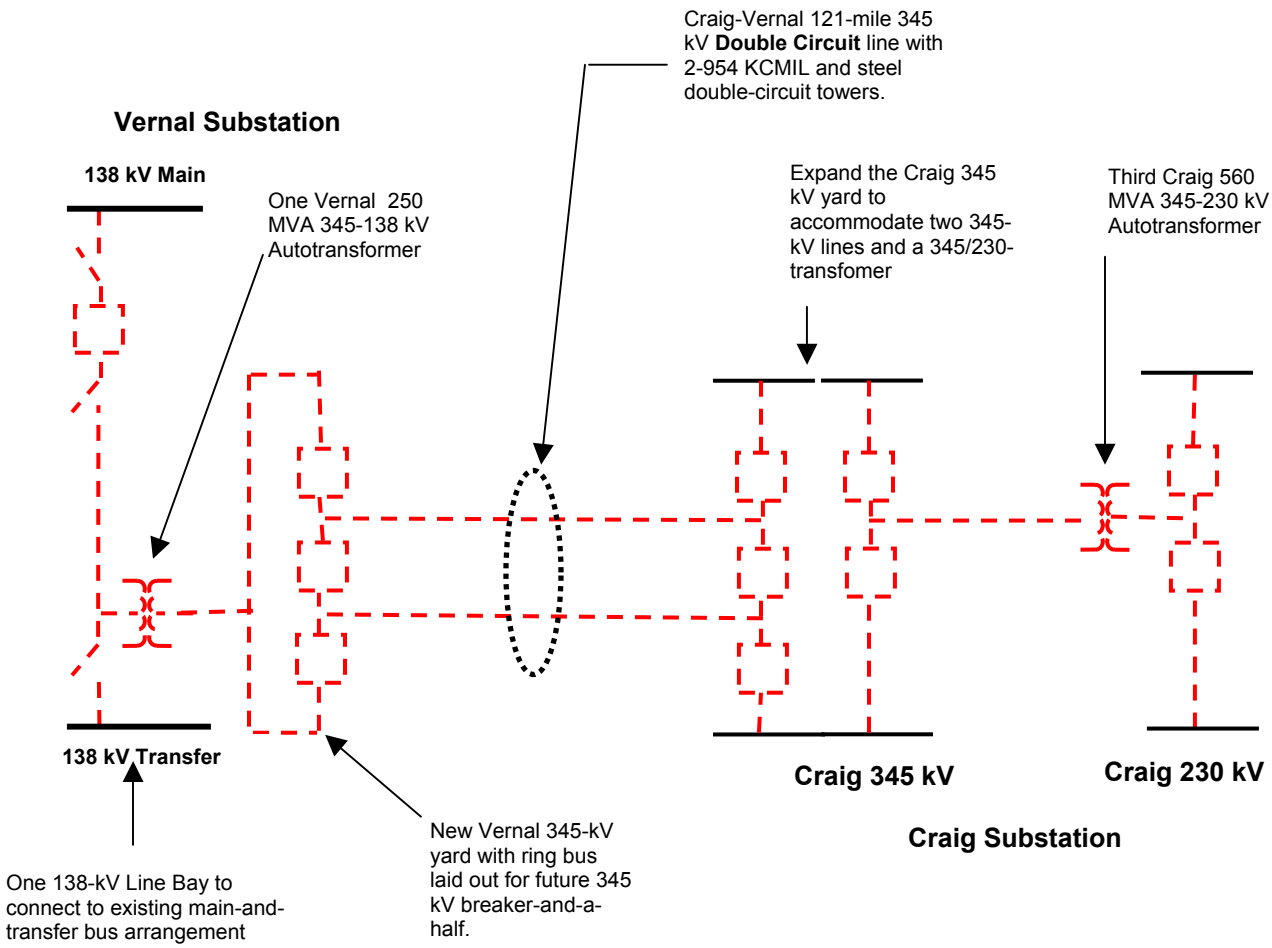


Figure 5 – Proposed One-Line for Alternative No. 2



D. Criteria

1. System Intact

Bus voltages in the study are to be maintained between 0.95 and 1.05 p.u. (95% and 105% of the nominal voltage rating of the line at a bus). The flow on a transmission branch is not to exceed 100% percent of the continuous rating of the branch. For the purposes of this study, busses and branches in the study area for system intact conditions were monitored with busses flagged for voltages outside the 0.95 p.u. and 1.05 p.u. range.

Manual or automatic system adjustments such as shunt capacitor or reactor switching, generator scheduling, or LTC tap adjustment are allowed. Area interchanges and phase shifter adjustments are allowed.

2. Single Contingency

Bus voltages in the study are to be maintained between 0.90 and 1.10 p.u. (90% and 110% of the nominal voltage rating of the line at a bus) during contingencies. The flow on a transmission branch is not to exceed 100% of the continuous rating of the branch. For the purposes of this study, busses and branches in the study area were monitored with busses flagged for voltages outside the 0.90 p.u. and 1.10 p.u. range and branch flows flagged that are above 100% of the nominal rating of the branch.

Devices that can automatically adjust in response to contingency events are allowed to adjust during outage simulations. These included automatic shunt capacitors or reactors, phase shifting transformers and load tap changing (LTC) transformers. Manual system adjustments such as generation dispatch are not allowed. Area interchange adjustments are not allowed.

3. Emergency Ratings

Emergency ratings were used to benchmark the TOT1A path. The emergency and normal ratings are listed in the Appendix.

IV. Study Results Summary

A. Benchmark Study Summary

1. Benchmark Without Bonanza/Flaming Gorge RAS

Schedules in the study case were modified until a TOT1A transfer limit of 301 MW east-to-west was achieved without using the Bonanza/Flaming Gorge RAS. The limiting condition is an overload of the Upalco-Emma Park 138 kV line for an outage of Bonanza-Mona 345 kV line.

2. Benchmark With Bonanza/Flaming Gorge RAS

Schedules in the study case were modified until a TOT1A transfer limit of 377 MW east-to-west was achieved using the Bonanza/Flaming Gorge RAS. The limiting condition is an overload of the Bonanza-Mona 345 kV line for an outage of the Flaming Gorge-Little Mtn 230 kV line.

B. Alternative No. 1 (Craig-Vernal-Terminal 345 Single-Circuit Line)

1. Alternative No. 1 Without Bonanza/Flaming Gorge RAS

Alternative No. 1 was added to the study case. Alternative No. 1 includes a Craig-Vernal 345 kV line with bundled 954 kcmil conductor on single-circuit towers along with a 325 MVA Vernal 345-138 kV transformer. A Vernal-Terminal 345 kV line to allow transfers from Vernal to the Wasatch Front area in Utah was added. Schedules east-to-west across TOT1A were increased until a TOT1A transfer limit of 515 MW was achieved without using the Bonanza/Flaming Gorge RAS. The limiting condition (at a TOT1A east-to-west transfer limit of 515 MW) is an overload of the Bonanza-Vernal 138 kV line for an outage of the Bonanza-Mona 345 kV line. The increase in TOT1A transfer capability from 377 MW to 515 MW is 138 MW. This is not sufficient to accommodate the 376 MW request. Therefore, a modified TOT1A RAS would be needed

2. Alternative No. 1 With Modified Bonanza/Flaming Gorge RAS

Alternative No. 1 was added to the case along with a modified TOT1A RAS that includes tripping the Bonanza generator and up to two Flaming Gorge generators for loss of either the Craig-Vernal 345 kV line or the Vernal-Terminal 345 kV line. Schedules across TOT1A were increased until a new transfer limit was reached at 893 MW east-to-west. The limiting condition for a TOT1A east-to-west transfer limit of 893 MW is an overload of the Bonanza-Mona 345 kV line (100.3% of its 650 MVA rating) for an outage of the Vernal-Terminal 345 kV line (with a modified TOT1A RAS utilized). This represents a 516 MW increase in the TOT1A transfer limit and this increase would allow the 376 MW transmission service request to be accommodated. A third 560 MVA Craig 345-230 kV transformer would be required at this high TOT1A east-to-west transfer level.

C. Alternative No. 2 (Craig-Vernal-Terminal 345 Double Circuit Line)

1. Alternative No. 2 Without Bonanza/Flaming Gorge RAS

Alternative No. 2 was added to the study case. Alternative No. 2 includes a Craig-Vernal double-circuit 345 kV line with bundled 954 KCMIL conductor on double-circuit towers along with a 250 MVA Vernal 345-138 kV transformer. A Vernal-Terminal 345 kV double-circuit line was also modeled in the study case to allow power transfers from Vernal to the Wasatch Front area. The TOT1A RAS that trips the Bonanza generation and Flaming Gorge generation was not implemented. East-to-west schedules across TOT1A were increased until the TOT1A transfer limit of 906 MW was reached. The limiting condition for east-to-west TOT1A transfers is an overload of the Bonanza-Vernal 138 kV line for an outage of the Bonanza-Mona 345 kV line. The increase in the TOT1A transfer limit from 377 MVA to 906 MVA represents an increase of 529 MW. This is sufficient to accommodate the entire 376 MW transmission service request. A third 560 MVA Craig 345-230 kV transformer would be required at this high TOT1A east-to-west transfer level

2. Alternative No. 2 With Modified Bonanza/Flaming Gorge RAS

Alternative No 2 Alternative No. 1 was added to the case along with a modified TOT1A RAS that includes tripping the Bonanza generator and up to two Flaming Gorge generators for loss of either the Craig-Vernal 345 kV line or the Vernal-Terminal 345 kV line.. Schedules across TOT1A were increased until a new transfer limit was reached at 1537 MW east-to-west. The limiting condition for a TOT1A east-to-west transfer limit of 1537 MW is an overload of the Bonanza-Mona 345 kV line (100.3% of its 650 MVA rating) for an outage of the Carbon-Spanish Fork 138 kV #2 line or an overload of the Bonanza-Mona 345 kV line (100.0% of its 650 MVA rating) for an outage of the Bonanza-Vernal 138 kV line. . This represents an 1160 MW increase in the TOT1A transfer limit and this increase would allow the 376 MW transmission service request to be accommodated.

Table No. 2 below provides a summary of the study results.

Table No. 2 – Study Summary – Benchmark, Alternative No. 1 and Alternative No. 2

Case Name	Description	TOT1A east-to-west	BonWest east-to-west[2]	TOT2A north-to-south	TOT5 east-to-west	FlamGorg230 to 138 flow	RAS
11HS_T1_02	Benchmark w/o RAS Upalco-Emma Park contingency overload of 100.2% for a Bonanza-Mona 345 kV outage.	301	595	124	687	-148	None
11HS_T1_1	Benchmark with RAS From 11HS_T1 with RAS. Bonanza-Mona contingency overload of 100.3% for a FlamGorg-Littlemt 230 kV outage.	377	664	165	570	-153	Boz/FG
11HS_T1_A1_0_S1	Alternative No. 1 w/o RAS Add a Craig-Vernal-	515	420	41	565	-87	None

1 The «BonWest east-to-west» flow does not include line flows on the Vernal-Terminal 345 kV single-circuit or double-circuit lines

	Terminal 345 kV single circuit line and a 325 MVA Vernal 345-138 kV transformer. Bonanza-Vernal 138 kV o/l of 100.0% of its 192 MVA rating for an outage of the Bonanza-Mona 345 kV line.						
11HS_T1_A1_6_S1	Alternative No. 1 with modified RAS. The Bonanza-Mona 345 kV line o/l at 100.3% of 650 MVA rating for an outage of the Vernal-Terminal 345 kV line (with modified RAS).	893	623	181	55	-99	Boz/FG
11HS_T1_A2_2	Alternative No. 2 w/o RAS.. Add a Craig-Vernal-Terminal 345 kV double circuit line and a 250 MVA Vernal 345-138 kV transformer. Bonanza-Vernal 138 kV contingency o/l of 100.0% for an outage of Bonanza-Mona 345 kV. Note: The Craig 345-230 kV contingency o/'l of 108.5% (< 110% emergency level).	906	438	66	160	-72	None
11HS_T1_A2_15	Alternative No. 2 with modified RAS. The Bonanza-Mona 345 kV line o/l at 100.3% of its 650 MVA rating for an outage of the Carbon-SpanFrk 138#2 and Bonanza-Mona 345 kV line o/l at 100.0% of its 650 MVA rating for an outage of the Bonanza-Vernal 138 kV line.	1537	691	255	-625	-88	Boz/FG

V. Cost Estimates and Construction Schedule

The approximate costs to conduct siting, land rights, surveying, engineering, equipment specification, bid and award evaluation, land purchase, equipment procurement, construction were evaluated. A construction scheduled was also developed. The results are listed in tables that follow.

A. Alternative No. 1 – Craig-Vernal 345 kV single-circuit 345 kV line

Table No. 3 lists the cost estimates to construct a Craig-Vernal single-circuit 345 kV line.

Table 3 Cost Estimates – Alternative No. 1

	Description	Cost
Craig Substation	New 345kV line termination for new transmission line to the Vernal Substation. The following major equipment will be required: • One 345kV breaker-and-a-half addition in the existing breaker-and-a-half bay • One 230kV, two-breaker addition in an existing breaker-and-a-half bay • A third Craig 560 MVA 345-230 kV transformer • One 50 MVAR line reactor	**$9,700k**

	Description	Cost
Vernal Substation	New 345kV line termination for new trans line from the Craig Substation. The following equipment will be required: • One 138-kV main-and-transfer bay • One 325 MVA 345-138 kV transformer • New 345-kV yard at Vernal that includes a 345 kV ring bus laid out for future breaker-and-a-half to terminate one 345-kV line and one transformer. • One 50 MVAR line reactor	**$11,600k**
New Trans Line from Craig Substation to Vernal Substation	New single circuit 345 kV transmission line from the Craig Substation to the Vernal Substation (approx. 121 miles). Bundled 954 kcmil conductor with OPGW on tubular steel poles with foundations.	**$60,500k**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, easement acquisition & permitting.	**$3,400k**
	TOTAL COST OF PROJECT	**$85,200k**

B. Alternative No. 2 – Craig-Vernal 345 kV double-circuit 345 kV line

Table No. 4 lists the cost estimates to construct a Craig-Vernal double-circuit 345 kV line.

Table 4 Cost Estimates – Alternative No. 2

	Description	Cost
Craig Substation	New 345kV line termination for new transmission line to the Vernal Substation. The following equipment will be required: • One 345kV breaker-and-a-half addition in the existing breaker-and-a-half bay and another two-breaker bay addition • One 230kV, two-breaker addition in an existing breaker-and-a-half bay • A third Craig 560 MVA 345-230 kV transformer • Two 50 MVAR line reactors	**$12,600k**

	Description	Cost
Vernal Substation	New 345kV line termination for new trans line from the Craig Substation. The following equipment will be required: • One 138-kV main-and-transfer bays • One 250 MVA 345-138 kV transformer • New 345-kV yard at Vernal that includes a 345 kV ring bus laid out for future breaker-and-a-half to terminate two 345-kV lines and one transformer • Two 50 MVAR line reactors	**$13,400k**
New Trans Line from the Craig Substation to the Vernal Substation	New double circuit 345 kV transmission line from the Craig Substation to the Vernal Substation (approx. 121 miles). Bundled 954 kcmil conductor with OPGW on tubular steel poles with foundations.	**$76,300k**
Siting, Permitting and Acquisition	Siting and Land Rights activities including siting study, easement acquisition & permitting.	**$3,400k**
	TOTAL COST OF PROJECT	**$105,700k**

C. Cost Estimate Assumptions

The following assumptions apply to the cost estimates. No field trips were taken to inspect the substation sites or possible line routes. The transmission line costs were based on a "cost-per-mile" guide. Design work was not conducted, as a scope of work has not been defined in sufficient detail. A Certificate of Public Convenience and Necessity (CPCN) was not assumed for the cost estimates.

- It is assumed that the estimated costs provided are "scoping estimates" with an accuracy of ± 30%. No detailed engineering was performed. The actual metering method will be determined. None is included with the estimates.
- It is assumed that estimates are based on 2005-year dollars.
- It is assumed that there is adequate space available (five acres) at the Craig Substation for the 345kV yard expansion and for the new 345kV line termination.
- It is assumed that there is adequate space available (five acres) at the Vernal Substation for the new 345kV yard and 138kV expansion.
- It is assumed that the transmission line route would be relatively similar to the existing transmission lines in the vicinity. The length of 121 miles was estimated based on a system map.

- It is assumed that the transmission line tower structural style would be steel H-frames for the 345kV single circuit alternative.
- It is assumed that the transmission line tower structural style would be steel pole double circuit structures for the 345kV double circuit alternative.
- It is assumed that the conductor would be bundled 954 MCM for both transmission alternatives.
- It is assumed that siting, permitting and easement acquisition would be based on a 121-mile long 150-foot wide 345 kV transmission line right-of-way from Craig to Vernal. The cost estimation is assumed to be valid for both the single circuit alternative and the double circuit alternative.
- It is assumed that the transmission line would cross through Moffat County, Uintah County and BLM lands. The right-of-way acquisition costs are assumed at $500/acre.
- It is assumed that NEPA and EIS will probably be required including substantial public involvement.
- It is assumed that S&LR construction support will be provided.

D. Construction Schedule

The estimated time for siting, permitting, acquisition, design and construction for the facilities required is between 54 months and 60 months after authorization to proceed has been granted. This schedule is based upon identified assumptions for Siting and Land Rights, Substation Engineering and Transmission Engineering. A Certificate of Public Convenience and Necessity (CPCN) was not assumed for the construction schedule. The following schedule estimates were used to create a construction schedule.

- It is estimated that it will take approximately 18 months for equipment specifications, bid evaluations, award, engineering and construction for substations estimates.
- It is estimated that it will take approximately 24 months for equipment specifications, bid evaluations, award, engineering and construction for transmission line estimates.
- It is estimated that it will take approximately 36 months to site, permit, and acquire land rights for either alternative.

VI. Appendix

A. Base Case Changes

The TOT1A owners and PacifiCorp T.P. reviewed the case and found it to be configured correctly with one small modification. A new bus called "Ca Tap 138kV" was added approximately 60% of the distance from Meeker to SW Rangely. Eight MW's of load was shifted to the new bus from Rangely for the

Deserado Coal Mine and a new 13 MW load was placed at the “Ca Tap 138 kV” bus for a total of 21 MW. The Meeker 138 kV load was represented at 6.4 MW @ 0.95 pf and the Axial 138 kV load was represented at 12.4 MW @ 0.95 pf. Table No 5 lists the loads in the study area.

Table No. 5 Loads in the Study Area

NAME	KV	ID	MW	MVAR
ASHLEY	69	1	29.0	9.7
BONANZA	24	1	24.0	18.0
BONANZA	138	1	6.3	2.1
CA TAP	138	1	8.0	2.6
CA TAP	138	TS	13.0	4.3
COVE TP	138	1	18.3	6.0
DG UPLCO	138	1	37.3	12.3
FLAMGORG	69	DG	22.0	7.2
RANGELY	138	1	46.2	15.2
VERNAL	138	DG	4.0	1.3
TOTAL			208.1	78.7

The study area has a load demand of 208 MW and generation of 638 MW. The generating plants include Bonanza (one unit at Pgen=484 MW), Flaming Gorge (three units at Pgen=48 MW) and Fontenelle (Pgen=10 MW).

DG&T is in the process of adding a second Bonanza 345-138 kV transformer by the end of 2006 that will be used as a “hot stand-by” transformer. For an outage or overload of the Bonanza 345-138 kV transformer, the second transformer can be switched in. DG&T does not anticipate operating both transformers simultaneously under system normal conditions. Because of the information supplied by DG&T, the second Bonanza 345-138 kV transformer was not modeled in the study case. Overloads of the Bonanza 345-138 kV transformer or outages of facilities due to an outage of the Bonanza 345-138 kV transformer were monitored but not used to determine the TOT1A transfer path limit.

The Flaming Gorge 138-230 kV transformers have a nominal rating of 100 MVA each. Western conducts seasonal TOT1A operating studies and uses an emergency rating of 150 MVA each for the Flaming Gorge 138-230 kV transformers. These emergency ratings were used for this study.

B. Study Area

The study area was defined as the transmission system west of the TOT1A path, east of the Bonanza West path, and south of the north boundary that is defined by Western as the Vernal-Flaming Gorge 138-kV lines. For this study, the north boundary was changed to the Flaming Gorge 138-230 kV transformers in order to include the DGT load at the Flaming Gorge 69 kV bus and the Fontenelle Power Plant that is connected to the study area by the Flaming Gorge-LymanSW-Fontenelle 69 kV radial line.

C. Emergency Ratings

Emergency ratings were used to benchmark the TOT1A path transfer limit. The emergency and normal ratings are listed in Table No. 6. For this study, whenever the emergency rating listed in the case (Rate B in MVA) differed from the emergency rating listed in the WECC 2005 Path Rating Catalog, the "WECC 2005 Path Catalog" rating was used. The Flaming Gorge 138-230 kV transformers have a nominal rating of 100 MVA each. Western conducts seasonal TOT1A operating studies and uses an emergency rating of 150 MVA each for the Flaming Gorge 138-230 kV transformers. These emergency ratings were used for this study.

Table No. 6 Emergency Ratings

Bus Name	Bus Name	Ckt ID	Emergency Rating (PRC[3])	Emergency Rating (Rate B in Case)	Normal Rating (Case)
Hayden 138	Artesia 138	1	140	0	146[4]
Ashley 138	Upalco 138	1	None listed	163	136
Bonanza 138	Rangely 138	1	None listed	160	115
Rangely 138	Artesia 138	1	None listed	160	115
Meeker 138	CA Tap 138	1	160	160	115
CA Tap 138	Rangely 138	1	160	160	115
Upalco 138	Emma Park 138	1	145	163	136
Emma Park 138	Panther 138	1	145	163	136
Panther 138	Carbon 138	1	145	163	136
Flaming Gorge 230	Flaming Gorge 138	1 or 2	125	0	100

D. TOT1A Transfer Path Definition

"TOT1A" is a Western Electricity Coordinating Council (WECC) defined power transfer path located in the vicinity of the study area. TOT1A is

[3] "PRC" stands for the WECC 2005 Path Rating Catalog (See Item 1-84).
[4] The Hayden-Artesia 138 kV normal rating is 146 MVA in the base case and the emergency rating is 0 MVA in the case. The PRC lists the emergency rating as 140 MVA, less than the normal rating in the case.

comprised of transmission lines that operate in conjunction to allow power to be transferred between northwest Colorado and northeast Utah. The path is shown in Figure No. 1 listed above. The path has a maximum east-to-west rating of 650 MW;however, the path rating is highly dependant on the level of load the on-line generation in the area including Bonanza and Flaming Gorge. The facilities that comprise TOT1A are as follows:

Transmission Line	Metered End
Bears Ears – Bonanza 345 kV	Bears Ears
Hayden – Artesia 138 kV	Hayden
Meeker – Rangely 138 kV	Rangely

These transmission lines connect the Craig / Hayden area of Northwest Colorado to the Bonanza / Vernal area of Northeast Utah. The prevailing flow is east-to-west; however, when the path is lightly loaded, the Meeker – Southwest Rangely line may have a west-to-east flow. Western Area Power Administration's Rocky Mountain Region (Western) is the path operator. The path owners are:

- Western Area Power Administration,
- Tri-State Generation and Transmission Association (TSGT)
- Platte River Power Authority (PRPA)
- Utah Associated Municipal Power System (UAMPS).

The WECC Reliability Criteria Agreement recognizes a remedial action scheme that affects the TOT1A (Path 30) that involves tripping the Bonanza and Flaming Gorge generation for loss of the Bonanza-Mona 345 kV line to achieve the maximum rating on TOT1A. Depending on the generation level at Flaming Gorge, arming of the Flaming Gorge units may take place. At no time are all three units armed at the same time because Western needs to maintain a minimum flow on the Green River per mandate from the U.S. Fish and Wildlife Service for the protection of the endangered species. For this study, two units at Flaming Gorge were tripped with one unit left on-line.