LaJunta Tie Study

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1 Introduction

The Rocky Ford area is currently supported by the LaJunta West 115/69kV and the Boone 115/69kV transformers, while the five Rocky Ford diesel generators are run for voltage support under heavy loads. Because of the high operating cost of the Rocky Ford diesel generators, it is desired to use a different method of voltage support for heavy loading. Assuming that the Rocky Ford diesels will not be generating in 2010, the expected summer load values will create overloading on the LaJunta West 115/69kV transformer. In addition to this system intact overloading, Category B outages create overloading on the LaJunta Tri-State 115/69 25MVA transformer as well as the Boone to Boone Tap, LaJunta West to Rocky Ford, and Rocky Ford to S. Fowler Tap 69kV lines, and Category C outages result in violations in the Rocky Ford, LaJunta and Wilow Creek regions. An interconnection between the LaJunta West and LaJunta Tri-State substations has been proposed to solve these problems. This report summarizes the results of the proposed LaJunta tie.

2 Case Setup

2.1 Base Case Updates

The starting case for this study, '10hs2sa1p', was a WECC approved base case with 2010 peak summer loads. Several updates were made to this case to create the benchmark case for this study. These updates can be seen in IDEV format in Appendix A.

2.2 Steady State Analysis Methodology

The proposed project was evaluated by performing steady state voltage and thermal analyses. Category B and C outages were simulated for this study.

2.2.1 Voltage Limits

The voltage criteria used in this study contained a pre-contingent voltage range of 0.95 – 1.05 p.u. and a post contingent voltage range of 0.90 – 1.10 p.u, for all voltage classes of 69kV and above.

2.2.2 Thermal Limits

WECC member utilities follow a planning philosophy whereby normal thermal ratings shall not be violated under system intact conditions, and the applicable emergency rating shall not be exceeded under contingency conditions.

2.3 Steady State Monitoring and Outages

All study work was performed using Power Technologies, Inc. PSS/E version 30.3.3. The list of monitored buses and branches used during simulation can be seen in Appendices B and C, respectively. The list of outages can be seen in Appendix D.

3 Category B Simulations

3.1 Case Naming Convention

The following five topologies were studied to reflect proposed system changes.

System Intact

The system intact case is the WECC approved base case with the updates described in section 2.1 and Appendix A.

Add Transformer

A second LaJunta West 115/69kV – 25MVA transformer is added to the system intact case.

Add Transformer and 69kV Tie

A second LaJunta West 115/69kV – 25MVA transformer and a LaJunta West – LaJunta Tri-State 69kV tie line are added to the system intact case.

Add Transformer and 115kV Tie

A second LaJunta West 115/69kV – 25MVA transformer and a LaJunta West – LaJunta Tri-State 115kV tie line are added to the system intact case.

Add Transformer and 69 and 115kV Ties
A second LaJunta West 115/69kV – 25MVA transformer and a LaJunta West – LaJunta Tri-State 69kV and 115kV tie lines are added to the system intact case.

3.2 Category B Results

The steady state analysis for the 2010 heavy summer case revealed overloads on the LaJunta West and LaJunta Tri-State 115/69kV transformers and the Boone to Boone Tap, LaJunta West to Rocky Ford, and Rocky Ford to S. Fowler Tap 69kV lines following Category B outages. The results for the five cases described in section 3.1 following Category B outages can be seen in Table 1.

3.2.1 Boone – Boone Tap 69kV Overload

Overloading occurs on the Boone – Boone Tap 69kV line when the load in the Rocky Ford region is served only through Boone, and not LaJunta. The path from LaJunta to the Rocky Ford region is limited by the Rocky Ford – LaJunta West 69kV line. Losing this line causes the Boone – Boone Tap 69kV line to overload for each of the six cases. These overload conditions can be mitigated by setting the line CTs to a 800:5 tap.

3.2.2 Boone – LaJunta West 115kV Overload

The Boone – LaJunta West 115kV line is overload following the loss of the Boone – LaJunta Tri-State 115kV line if either the LaJunta West – LaJunta Tri-State 69 or 115kV tie lines are in place. With these La Junta tie configurations, the Boone – LaJunta W 115kV line helps to serve the load at LaJunta and La Secpa. These overload conditions can be mitigated by setting the line CTs to a 700:5 tap.

3.2.3 LaJunta Tri-State 115/69kV - 25MVA Overload

The LaJunta Tri-State 115/69kV – 25MVA transformer is overloaded following the loss of the LaJunta Tri-State 115/69kV – 42MVA transformer. This overload can be corrected by connecting the LaJunta West – LaJunta Tri-State 69kV line to help serve the LaJunta and La Secpa load. This overload can also be corrected by serving the La Secpa load through Prowers by disconnecting the LaJunta Tri-State – La Secpa 69kV and connecting the La Secpa – Prowers_TS 69kV line.

3.2.4 LaJunta West – Rocky Ford 69kV Overload

Overloading occurs on the LaJunta West – Rocky Ford 69kV line when the load in the Rocky Ford region is served only through LaJunta, and not Boone. The path from Boone to the Rocky Ford region is limited by the Boone 115/69kV transformer and the Boone – Boone Tap 69kV line. The loss of either the transformer or the line causes the LaJunta West – Rocky Ford 69kV line to overload for all five of the cases. These overload conditions can be mitigated by setting the line CTs to a 400:5 tap.

3.2.5 LaJunta West 115/69kV Overload

For the system intact case, the LaJunta West 115/69kV transformer is overloaded when all, or the majority, of the load in the Rocky Ford region is served through this transformer. Therefore, adding and second 115/69kV transformer at LaJunta West will be required. With the addition of the second transformer, one transformer will overload following the loss of the second transformer if the LaJunta West – LaJunta Tri-State 69kV line is in place. These overloads can be corrected by replacing the existing La Junta West 115/69 kV transformer with two 115/69 kV transformers with a minimum 30 MVA rating. Higher rated transformers are encouraged to accommodate for future load growth.

3.2.6 Rocky Ford – S. Fowler Tap 69 Overload

The Rocky Ford – S. Fowler Tap 69kV line is overloaded following the loss of the LaJunta West 115/69kV transformer or the Boone – LaJunta West 115kV line for the system intact case. This

overloading can be corrected by add any combination of the LaJunta West – LaJunta Tri-State 69 and 115kV tie lines, or by setting the line CTs to a 700:5 tap.

Table 1: Category B Steady State Results

Violated Element	Outage Description	Rated MVA	Limit 1	Rating W/out Limit 1	System Intact MVA(%Rating)	Add Xfmr MVA(%Rating)	Add Xfmr and 69kV Tie Line MVA(%Rating)	Add Xfmr and 115kV Tie Line MVA(%Rating)	Add Xfmr, 69 and 115kV Tie Lines MVA(%Rating)
Boone – Boone Tap 69	Boone – LaJunta W 115	24	CT	59	**26.6 (110.8%)**	**26.6 (110.8%)**	-	-	-
Boone – Boone Tap 69	LaJunta W–Rocky Ford 69	24	CT	59	**25.3 (105.4%)**	**25.3 (105.4%)**	**25.3 (105.3%)**	**25.3 (105.4%)**	**25.2 (105.2%)**
Boone – Boone Tap 69	LaJunta W 115-69	24	CT	59	**26.6 (110.8%)**	-	-	-	-
Boone – LaJunta W 115	Boone – LaJunta T 115	40	CT	80	-	-	**43.8 (109.6%)**	**46.5 (116.2%)**	**45.6 (114%)**
LaJunta T 115/69 (25MVA)	LaJunta T 115/69 (42MVA)	25	-	-	**27.1 (108.5%)**	**27.1 (108.5%)**	-	**27.1 (108.3%)**	-
LaJunta W – Rocky Ford 69	Boone – Boone Tap 69	24	CT	32	**24.8 (103.5%)**	**24.8 (103.3%)**	**25.1 (104.6%)**	**24.7 (103.1%)**	**25.1 (104.4%)**
LaJunta W – Rocky Ford 69	Boone 115/69	24	CT	32	**24.9 (103.6%)**	**24.8 (103.4%)**	**25.1 (104.6%)**	**24.7 (103.1%)**	**25.1 (104.4%)**
LaJunta W 115/69	Boone – Boone Tap 69	25	-	-	**34.8 (139.1%)**	-	-	-	-
LaJunta W 115/69	Boone – LaJunta T 115	25	-	-	**29.3 (117.2%)**	-	-	-	-
LaJunta W 115/69	Boone 115/69	25	-	-	**34.8 (139.1%)**	-	-	-	-
LaJunta W 115/69	Boone Tap – S Fwl Tap 69	25	-	-	**32.9 (131.5%)**	-	-	-	-
LaJunta W 115/69	Cty Lam 24/14	25	-	-	**26.6 (106.2%)**	-	-	-	-
LaJunta W 115/69	Cty Lam 69/14	25	-	-	**26.2 (104.7%)**	-	-	-	-
LaJunta W 115/69	LaJunta T – Wilow Ck 115	25	-	-	**25.2 (100.6%)**	-	-	-	-
LaJunta W 115/69 *	LaJunta W 115/69	25	-	-	-	-	**27.7 (110.8%)**	-	**29.6 (118.4%)**
LaJunta W 115/69	Lamar Co – Vilas 115	25	-	-	**26.5 (105.8%)**	-	-	-	-
LaJunta W 115/69	Lamar Co 230/115	25	-	-	**28.7 (114.7%)**	-	-	-	-
LaJunta W 115/69	Rocky Ford – S Fwl Tap 69	25	-	-	**32.9 (131.7%)**	-	-	-	-
LaJunta W 115/69	Vilas 115/69	25	-	-	**26.4 (105.5%)**	-	-	-	-
Rocky Ford – S Fwl Tap 69	Boone – LaJunta W 115	24	CT	58	**24.7 (103.1%)**	**24.7 (103.1%)**	-	-	-
Rocky Ford – S Fwl Tap 69	LaJunta W 115-69	24	CT	58	**24.7 (103.1%)**	-	-	-	-

* These are the same results for each of the two LaJunta West 115/69kV transformers.

3.3 Category B Conclusions

The Category B outage results show that following changes are required:

- Two 115/69kV transformers with a minimum rating of 30 MVA replacing the existing La Junta West 115/69 kV transformer.
- The CTs on the Boone – Boone Tap 69kV line should be tapped to a minimum of 800:5.
- The CTs on the LaJunta West – Rocky Ford 69kV line should be tapped to a minimum of 400:5.
- Add a LaJunta West – LaJunta Tri-State 69kV line.
- One of the following two:
    - The CTs on the Rocky Ford – S. Fowler Tap 69kV line should be tapped to a minimum of 700:5.

    OR
    - The CTs on the Boone – LaJunta West 115kV line should be tapped to a minimum of 700:5.

4 Category C Simulations

4.1 Category C Naming Conventions

To determine the benefits of adding the LaJunta West – LaJunta Tri-State 115kV tie line, the following two topologies were studied for Category C outages. Both of these topologies start with the base case described in Section 2.1 and Appendix A with the addition of the LaJunta West – LaJunta Tri-State 69kV line, a second 115/69kV transfer at LaJunta West and updated CTs on the Boone – Boone Tap and LaJunta West – Rocky Ford 69kV lines.

4.1.1 LaJunta 115kV Tie

In this case, the LaJunta West – LaJunta Tri-State 115kV tie line is added to the case described in 4.1. The 115kV tie line is normally closed and the Boone – LaJunta West 115kV line CTs have been uprated. The addition of the 69kV tie line creates higher overload conditions on the LaJunta West 115/69kV transformer than the eliminated overloading on the LaJunta Tri-State 115/69kV transformer. The overloading on the LaJunta West transformer is also more likely to occur as this violation is caused by loss of either one of the two LaJunta West transformers, where the LaJunta Tri-State overloading is caused by the loss of the LaJunta Tri-State 42MVA transformer. Because of these reasons the 69kV tie line should be left normally open and placed in-service for loss of the LaJunta Tri-State 115/69kV – 42MVA transformer.

4.1.2 No 115kV Tie

In this case, the CTs on the Rocky Ford – S. Fowler Tap 69kV line are updated in the case described in 4.1. Similar to section 4.1.1, the LaJunta West – LaJunta Tri-State 69kV line is normally open. Following the loss of the LaJunta Tri-State 115/69kV 42MVA transformer, the LaJunta West – LaJunta Tri-State 69kV line is closed.

4.2 Category C Prior Outages

The list of prior outages used for Category C testing is the same as the list of outages, which can be seen in Appendix D. Note that for the LaJunta Tri-State 115/69kV 42MVA transformer prior outage, the LaJunta West – LaJunta Tri-State 69kV tie line is closed.

4.3 Category C Results

The steady state analysis for the 2010 heavy summer case revealed multiple category C violations for both the LaJunta 115kV Tie and the No 115kV Tie cases. However, comparing the two cases showed that the 115kV tie line prevents voltage collapse and thermal overloading in the Rocky Ford and Willow Creek areas with a prior outage of the Boone – LaJunta West 115kV, Boone – LaJunta Tri-State 115kV, or Lamar Co – Wilow Ck 115kV lines. The violations of the two cases were compared and the results can be seen in Tables 2 and 3. Table 2 shows violations that exist only when the LaJunta 115kV tie is

out-of-service that do not exist when the LaJunta tie is in-service, while Table 3 shows violations that exist only when the LaJunta 115kV tie is in-service that do not exist when the LaJunta tie is out-of-service. Note that these tables do not show all the Category C violations that exist for the respective cases, only the differences between them.

Table 2 shows that with a prior outage of the Boone – LaJunta West 115kV line, there are multiple contingencies that cause voltage collapse for the Rocky Ford region if the LaJunta 115kV tie is not in place. It should be noted that similar violations exist when the contingencies and prior outages are reversed. For example, with a prior outage of the Boone 115/69kV transformer, the loss of the Boone – LaJunta West 115kV line causes voltage collapse in the Rocky Ford region if the LaJunta 115kV tie is not in place. In addition to voltage collapse, these outages also result in thermal overloading of the Boone 115/69kV transformer and the LaJunta West – Rocky Ford and LaJunta West – Phillips Tap 69kV lines. This table also shows that voltage and thermal overload violations exist with a prior outage of the Lamar Co – Willow Creek 115kV line when the LaJunta 115kV tie is not in place. Note that the violations shown in Table 2 do not exist if the LaJunta 115kV tie is in-service.

Table 3 shows thermal overload violations that exist only when the LaJunta 115kV tie is in-service. Operating procedures will need to be put in place to eliminate the Boone 115/69kV transformer overloading. The overloading on the Rocky Ford – S. Fowler Tap 69kV line can be mitigated by removing the existing CT limitation. Note that these violations do not exist if the LaJunta 115kV tie is out-of-service.

It should be noted that Tables 2 and 3 do not show all Category C violations. These tables show violations that exist with one case and not the other. There are many other Category C violations that should be addressed in further studies. Appendix E shows all the violations for Category C outages for the LaJunta 115kV tie case.

4.4 Category C Overall

Category C outages were run to determine the effect of adding the LaJunta West – LaJunta Tri-State 115kV tie line. Comparing the Category C outages of the two cases showed that adding the LaJunta 115kV tie eliminated many voltage and thermal overloading violations. The study also showed that other violations exist for Category C outages that will need to be addressed in further studies.

Table 2: Category C Violations with the LaJunta 115kV Tie Out-of-Service. Note that this table only shows the violations that exist when the LaJunta 115kV tie is out-of-service that do not exist when the tie is in-service. This table does not show all Category C violations for the No 115 Tie case from Section 4.1.2.

Violation Differences with LaJunta 115kV Tie Out-of-Service													
Violated Element	**Prior Outage**	**Base Voltage (kV)**	**Rating (MVA)**	**Boone 115/69 Transformer**	**Boone - Boone Tap 69**	**Boone Tap - S. Fowler Tap 69**	**Rocky Ford - S. Fowler Tap 69**	**Ft. Lyon - Las Animas 69**	**Ft. Lyon - Ft. Lyon Tap 69**	**Ft. Lyon Tap - City of Lamar 69**	**Boone - LaJunta Tri-State 115**	**Lamar Co 230/115**	**LaJunta T - LaJunta W 115**	**Boone - LaJunta W 115**
Boone	Boone - LaJunta West 115	69	-	0.54	-	-	-	-	-	-	-	-	-	-
Boone Tap	Boone - LaJunta West 115	69	-	0.54	0.539	-	-	-	-	-	-	-	-	-
City LaJunta	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	0.738	-	-	-
City of Lamar	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	0.891	-	-	-
EADS	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	0.884	-	-	-
EADS Tap	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	0.886	-	-	-
Fowler	Boone - LaJunta West 115	69	-	0.499	0.498	0.581	0.571	0.831	0.79	0.765	-	-	-	-
Ft. Lyon	Boone - LaJunta West 115	69	-	0.802	0.801	0.839	0.835	-	0.769	0.736	-	-	-	-
Ft. Lyon	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	0.893	-	-	-
Huerfano	Boone - LaJunta West 115	69	-	0.537	0.536	-	-	-	-	-	-	-	-	-
La Secpa	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	0.709	-	-	-
LaJunta Tri-State 115	Lamar Co - Wilow Ck 115	115	-	-	-	-	-	-	-	-	0.721	-	-	-
LaJunta Tri-State 69	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	0.746	-	-	-
LaJunta W 115	Boone - LaJunta West 115	115	-	0.602	0.601	0.666	0.659	0.801	0.757	0.731	-	-	-	-
LaJunta W 69	Boone - LaJunta West 115	69	-	0.633	0.632	0.701	0.693	0.842	0.797	0.769	-	-	-	-
Las Animas	Boone - LaJunta West 115	69	-	0.759	0.759	0.803	0.798	0.822	0.77	0.738	-	-	-	-
Manzanola	Boone - LaJunta West 115	69	-	0.515	0.514	0.597	0.586	0.842	0.802	0.777	-	-	-	-
Ordway	Boone - LaJunta West 115	69	-	0.498	0.497	0.581	0.571	0.83	0.79	0.764	-	-	-	-
Phillips	Boone - LaJunta West 115	69	-	0.669	0.668	0.73	0.723	0.835	0.787	0.758	-	-	-	-
Phillips Tap	Boone - LaJunta West 115	69	-	0.669	0.669	0.73	0.723	0.836	0.788	0.758	-	-	-	-
Prowers	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	0.734	-	-	-	-
Prowers	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	0.893	-	-	-
Rocky Ford	Boone - LaJunta West 115	69	-	0.55	0.549	0.631	0.621	0.868	0.829	0.805	-	-	-	-
S. Fowler Tap	Boone - LaJunta West 115	69	-	0.545	0.543	0.631	-	-	-	0.896	-	-	-	-
Wilow Ck 115	Lamar Co - Wilow Ck 115	115	-	-	-	-	-	-	-	-	0.803	-	-	-
Wilow Ck 69	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	0.886	-	-	-
Boone - LaJunta W 115	Lamar Co - Wilow Ck 115	-	40	-	-	-	-	-	-	-	43.0 (107.4%) *	-	-	-
Boone 115/69	Boone - LaJunta Tri-State 115	-	33	-	-	-	-	-	-	-	-	-	-	-
Boone 115/69	Boone - LaJunta West 115	-	33	-	-	-	-	40.0 (121.2%)	44.1 (133.7%)	46.7 (141.5%)	-	34.6 (104.8%)	-	-
LaJunta W - Phillips Tap 69	Lamar Co - Wilow Ck 115	-	24	-	-	-	-	-	-	-	33.2 (138.3%) *	-	-	-
LaJunta W - Phillips Tap 69	Boone - LaJunta West 115	-	24	45.4 (181.9%) *	43.7 (182.0%) *	38.2 (159.2%) *	38.7 (161.3%) *	-	-	-	-	-	-	-
LaJunta W - Rocky Ford 69	Boone - LaJunta West 115	-	32	38.8 (121.4%)	38.9 (121.5%)	34.1 (106.5%)	34.5 (107.7%)	-	-	-	-	-	-	-
Rocky Ford - S. Fowler Tap 69	Boone - LaJunta Tri-State 115	-	24	-	-	-	-	-	-	-	-	-	-	-
Rocky Ford - S. Fowler Tap 69	Boone - LaJunta West 115	-	24	-	-	-	-	-	-	-	-	-	-	-

* These overloads can be mitigated by removing the existing CT limitation.

Table 3: Category C Violations with the LaJunta 115kV Tie In-Service. Note that this table only shows the violations that exist when the LaJunta 115kV tie is in-service that do not exist when the tie is out-of-service. This table does not show all Category C violations for the LaJunta 115 Tie case from Section 4.1.1.

Violation Differences with LaJunta 115kV Tie In-Service														
Violated Element	**Prior Outage**	**Base Voltage (kV)**	**Rating (MVA)**	**Boone 115/69 Transformer**	**Boone - Boone Tap 69**	**Boone Tap - S. Fowler Tap 69**	**Rocky Ford - S. Fowler Tap 69**	**Ft. Lyon - Las Animas 69**	**Ft. Lyon - Ft. Lyon Tap 69**	**Ft. Lyon Tap - City of Lamar 69**	**Boone - LaJunta Tri-State 115**	**Lamar Co 230/115**	**LaJunta T - LaJunta W 115**	**Boone - LaJunta W 115**
Boone	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Boone Tap	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
City LaJunta	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	-	-	-	-
City of Lamar	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	-	-	-	-
EADS	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	-	-	-	-
EADS Tap	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Fowler	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Ft. Lyon	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Ft. Lyon	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Huerfano	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
La Secpa	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	-	-	-	-
LaJunta Tri-State 115	Lamar Co - Wilow Ck 115	115	-	-	-	-	-	-	-	-	-	-	-	-
LaJunta Tri-State 69	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	-	-	-	-
LaJunta W 115	Boone - LaJunta West 115	115	-	-	-	-	-	-	-	-	-	-	-	-
LaJunta W 69	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Las Animas	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Manzanola	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Ordway	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Phillips	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Phillips Tap	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Prowers	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Prowers	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Rocky Ford	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
S. Fowler Tap	Boone - LaJunta West 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Wilow Ck 115	Lamar Co - Wilow Ck 115	115	-	-	-	-	-	-	-	-	-	-	-	-
Wilow Ck 69	Lamar Co - Wilow Ck 115	69	-	-	-	-	-	-	-	-	-	-	-	-
Boone - LaJunta W 115	Lamar Co - Wilow Ck 115	-	80 **	-	-	-	-	-	-	-	-	-	-	-
Boone 115/69	Boone - LaJunta Tri-State 115	-	33	-	-	-	-	-	-	-	-	-	-	**35.6 (108%)**
Boone 115/69	Boone - LaJunta West 115	-	33	-	-	-	-	-	-	-	**35.7 (108.1%)**	-	-	-
LaJunta W - Phillips Tap 69	Lamar Co - Wilow Ck 115	-	24	-	-	-	-	-	-	-	-	-	-	-
LaJunta W - Phillips Tap 69	Boone - LaJunta West 115	-	24	-	-	-	-	-	-	-	-	-	-	-
LaJunta W - Rocky Ford 69	Boone - LaJunta West 115	-	32	-	-	-	-	-	-	-	-	-	-	-
Rocky Ford - S. Fowler Tap 69	Boone - LaJunta Tri-State 115	-	24	-	-	-	-	-	-	-	-	-	-	**33.6 (140%) ***
Rocky Ford - S. Fowler Tap 69	Boone - LaJunta West 115	-	24	-	-	-	-	-	-	-	**33.6 (140.2%) ***	-	**24.7 (103.0%) ***	-

* These overloads can be mitigated by removing the existing CT limitation.
** The addition of the LaJunta W - LaJunta T 115kV tie line required that the CTs on the Boone - LaJunta W 115kV line be uprated/retapped.

5 Conclusions

This report describes the power flow studies performed to determine the impacts of the proposed LaJunta Tie project. The study work performed evaluated Category B and Category C outages. From the Category B Outage results, it was shown that the existing La Junta West 115/69kV transformer should be replace with two 115/69 kV transformers with a minimum rating of 30 MVA, the LaJunta West – LaJunta Tri-State 69kV line should be added, and the CT taps should be changed on the Boone – Boone Tap and LaJunta West – Rocky Ford 69kV lines.

The LaJunta West – LaJunta Tri-State 69kV line eliminates the thermal overloading on the LaJunta Tri-State 25MVA 115/69 transformer following the loss of the LaJunta Tri-State 42MVA 115/69 transformer; however, this line also creates overloading on one of the LaJunta West 115/69 transformers following the loss of the other. For this reason, the LaJunta West – LaJunta Tri-State 69kV line should be operated normally open.

The Category C outage results determined that the LaJunta West – LaJunta Tri-State 115kV line would mitigate many post-contingent voltage violations and thermal overloads in both the Rocky Ford and Willow Creek regions. However, the addition of the line also created overloading on the Boone 115/69kV transformer and the Rocky Ford – S. Fowler Tap 69kV line. The Rocky Ford – S. Fowler Tap 69kV line thermal overloads could be mitigated by changing the CT taps. Category B outage simulations showed that the addition of the LaJunta West – LaJunta Tri-State 115kV line created overloading on the Boone – LaJunta West 115kV line, which could be mitigated by changing the existing CT taps.

Overall, this study recommends that the following additions be made:

- Two 115/69kV transformers with a minimum rating of 30 MVA replacing the existing La Junta West 115/69 kV transformer.
- The CT taps on the following lines should be changed:
    - Boone – Boone Tap 69kV line to a minimum of 800:5
    - LaJunta West – Rocky Ford 69kV line to a minimum of 400:5
    - Boone – LaJunta West 115kV line to a minimum of 700:5
    - Rocky Ford – S. Fowler Tap 69kV line to a minimum of 700:5
- The LaJunta West – LaJunta Tri-State 69kV line should be added and operated normally open.
- The LaJunta West – LaJunta Tri-State 115kV line should be added and operated normally closed.

Further analysis will be required to fully identify the impacts and prevention of Category C outages. It may be necessary to create an operating procedure to avoid thermal overload and voltage violations in the interim period before the specified transmission upgrades are complete. Additional analysis will also be required to develop operating procedures which will dictate under what situations and operating conditions the La Junta 69 kV tie should be closed.

Appendix A – IDEV Case Update Files

```
/* Delete old transformer
BAT_PURGBRN,70134,70135,'1'
/* Define new 70135 voltage
BAT_BUS_DATA,70135,2,,,,,, 13.8,, 36.14,'CTY LAM'
BAT_PLANT_DATA,70135,,,,;
/* New transformer 13.8/69 kV
BAT_TWO_WINDING_DATA,70136,70135,'1',,70135,733,,,,999,,,,0,0,2,2,, 0.0057, 0.057,, 69.0, 69.0,, 13.8, 13.8, 22.4, 22.4, 22.4,,,,,,,0.0,0.0,0.0,0.0,,,'CTY LAM'
/* New generation on 70135MW bus
BAT_MACHINE_DATA,70135,'1',,,,,, 18.0,, 8.7,-5.9, 20.36, 10.0, 20.3,, 0.2,,,,,,,,;
/*Delete not existing transformers and buses
BAT_PURGBRN,70226,70227,'1'
BAT_BSYSO,2,70227
BAT_EXTR,2,0,0,0
BAT_PURGBRN,70134,70226,'1'
BAT_BSYSO,2,70226
BAT_EXTR,2,0,0,0
/* Add new 0.575kV bus and transformer
BAT_BUS_DATA,70128,2,70,712,65,,, 0.575, 1.0281, 40.56,'CTY LAM 2'
BAT_TWO_WINDING_DATA,70128,70134,'1',,,733,,,,999,,70128,,-1,0,2,2,, 0.00577, 0.0577,, 0.575, 0.575,, 24.0, 24.0, 10.5, 10.5, 10.5,,,,,,,,,,,,'LAMAR 2'
/*Model new generator. 4 - 1.5 MW GE Units
BAT_PLANT_DATA,70128,,,,;
BAT_MACHINE_DATA,70128,'1',,,,,, 6.0,, 1.97,-2.9, 6.0,0.0, 6.68,, 0.14,,,,,,,,;
/*Revise the 25MVA Transformer (backup) data and add the existing 42 MVA transformer at LaJunta Tri-State bus.
BAT_TWO_WINDING_DATA,70247,70248,'1',,,,,,,,,,0,1,,,, 0.01965, 0.26059,,,,,,, 42.0, 42.0, 42.0,,,,,, 0.00037,,,,,,,'LAJUNTAT'
BAT_FDNS,0,0,0,0,1,1,0,99,0
/* 69kV system for Lamar area
BAT_BRANCH_DATA,70243,70248,'1',,,,,,, 0.38372, 0.47211, 0.0068683, 29.0, 29.0, 29.0,,,,,,,,,;
BAT_BUS_DATA,70800,,70,712,66,,, 69.0, 1.0035, 42.16,'EADS_TAP'
BAT_BUS_DATA,70801,,70,712,65,,, 69.0, 1.0017, 42.58,'PROWERS_TS'
BAT_BUS_DATA,70802,,70,712,66,,, 69.0, 1.0017, 44.63,'FT. LYON_TP'
BAT_BRANCH_DATA,70161,70473,'1',0,,,,,, 0.2854,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,70136,70333,'1',0,,,,,,,,,,,,,,,,,,,,,;
BAT_BRANCH_DATA,70800,70473,'1',,70473,,,,, 0.015858, 0.031271, 0.0005419, 40.0, 40.0, 40.0,,,,,,,,,;
BAT_BRANCH_DATA,70161,70800,'1',,,,,,, 0.26562, 0.52378, 0.0090776, 40.0, 40.0, 40.0,,,,,,,,,;
BAT_BRANCH_DATA,70801,70800,'1',0,,66,,,, 0.050746, 0.10007, 0.0017342, 40.0, 40.0, 40.0,,,,,,,,,;
BAT_BRANCH_DATA,70333,70801,'1',,70801,66,,,, 0.069767, 0.085837, 0.0012488, 29.0, 29.0, 29.0,,,,,,,,,;
BAT_BRANCH_DATA,70243,70801,'1',0,70801,66,,,, 0.46511, 0.57225, 0.0083252, 29.0, 29.0, 29.0,,,,,,,,,;
BAT_BRANCH_DATA,70802,70333,'1',,70333,66,,,, 0.038386, 0.097887, 0.001609, 66.7, 66.7, 66.7,,,,,,,,,;
BAT_BRANCH_DATA,70136,70802,'1',,,66,,,, 0.012586, 0.030683, 0.0005526, 66.7, 66.7, 66.7,,,,,,,,,;
BAT_BRANCH_DATA,70185,70802,'1',,,66,,,, 0.125856, 0.313884, 0.00054, 66.7, 66.7, 66.7,,,,,,,,,;


/* ----------------------------------------Update Line Ratings to 2010 values----------------------------------
BAT_BRANCH_DATA 70271,70320,1,,,,,,,,,63,63,63,,,,,,,,;          // From LS ANMAS    69.000 to PHLPS TP    69.000
BAT_BRANCH_DATA 70185,70271,1,,,,,,,,,63,63,63,,,,,,,,;          // From FT. LYON    69.000 to LS ANMAS    69.000
BAT_BRANCH_DATA 70178,70275,1,,,,,,,,,32,32,32,,,,,,,,;          // From FOWLER      69.000 to MANZANOL    69.000
BAT_BRANCH_DATA 70178,70372,1,,,,,,,,,32,32,32,,,,,,,,;          // From FOWLER      69.000 to S FWL TP    69.000
BAT_BRANCH_DATA 70063,70372,1,,,,,,,,,62,62,62,,,,,,,,;          // From BOONE TP    69.000 to S FWL TP    69.000
BAT_BRANCH_DATA 70319,70320,1,,,,,,,,,32,32,32,,,,,,,,;          // From PHILLIPS    69.000 to PHLPS TP    69.000
```

```
BAT_BRANCH_DATA 70060,70159,1,,,,,,,,,100,100,100,,,,,,,,;        // From BOONE       115.00 to DOT TAP     115.00
BAT_BRANCH_DATA 70062,70063,1,,,,,,,,,24,24,24,,,,,,,,;           // From BOONE       69.000 to BOONE TP    69.000
BAT_BRANCH_DATA 70235,70317,1,,,,,,,,,62,62,62,,,,,,,,;           // From HUERFANO    69.000 to PDA TAP     69.000
BAT_BRANCH_DATA 70317,70405,1,,,,,,,,,32,32,32,,,,,,,,;           // From PDA TAP     69.000 to ST.CHAS.    69.000
BAT_BRANCH_DATA 70049,70051,1,,,,,,,,,32,32,32,,,,,,,,;           // From BELMONT     69.000 to BLENDE      69.000
BAT_BRANCH_DATA 70054,70455,1,,,,,,,,,48,48,48,,,,,,,,;           // From BMONT TP    69.000 to W.STATON    69.000
BAT_BRANCH_DATA 70338,70455,1,,,,,,,,,63,63,63,,,,,,,,;           // From PUEBPLNT    69.000 to W.STATON    69.000
BAT_BRANCH_DATA 70415,70455,1,,,,,,,,,29,29,29,,,,,,,,;           // From STONMOOR    69.000 to W.STATON    69.000
BAT_BRANCH_DATA 70415,70422,1,,,,,,,,,62,62,62,,,,,,,,;           // From STONMOOR    69.000 to SUNSETPK    69.000
BAT_BRANCH_DATA 70332,70422,1,,,,,,,,,62,62,62,,,,,,,,;           // From PRAIRIE     69.000 to SUNSETPK    69.000
BAT_BRANCH_DATA 70181,70332,1,,,,,,,,,62,62,62,,,,,,,,;           // From FREEMARY    69.000 to PRAIRIE     69.000
BAT_BRANCH_DATA 70022,70159,1,,,,,,,,,105,105,105,,,,,,,,;        // From APT TAP2    115.00 to DOT TAP     115.00
BAT_BRANCH_DATA 70019,70159,1,,,,,,,,,105,105,105,,,,,,,,;        // From PDA 5       115.00 to DOT TAP     115.00
BAT_BRANCH_DATA 70019,70158,1,,,,,,,,,105,105,105,,,,,,,,;        // From PDA 5       115.00 to DOT         115.00
BAT_BRANCH_DATA 70022,70549,1,,,,,,,,,105,105,105,,,,,,,,;        // From APT TAP2    115.00 to APT MEM     115.00
BAT_BRANCH_DATA 70022,70031,1,,,,,,,,,105,105,105,,,,,,,,;        // From APT TAP2    115.00 to APT TAP     115.00
BAT_BRANCH_DATA 70030,70549,1,,,,,,,,,105,105,105,,,,,,,,;        // From APT PARK    115.00 to APT MEM     115.00
BAT_BRANCH_DATA 70352,70549,1,,,,,,,,,175,175,175,,,,,,,,;        // From READER      115.00 to APT MEM     115.00
BAT_BRANCH_DATA 70285,70301,1,,,,,,,,,100,100,100,,,,,,,,;        // From MIDWAYPS    115.00 to NTHRIDGE    115.00
BAT_BRANCH_DATA 70193,73412,1,,,,,,,,,105,105,105,,,,,,,,;        // From FTN VALL    115.00 to MIDWAYBR    115.00
BAT_BRANCH_DATA 70193,70449,1,,,,,,,,,105,105,105,,,,,,,,;        // From FTN VALL    115.00 to DESRTCOV    115.00
BAT_BRANCH_DATA 70449,70456,1,,,,,,,,,105,105,105,,,,,,,,;        // From DESRTCOV    115.00 to W.STATON    115.00
BAT_BRANCH_DATA 70236,70456,1,,,,,,,,,105,105,105,,,,,,,,;        // From HYDEPARK    115.00 to W.STATON    115.00
BAT_BRANCH_DATA 70236,70339,1,,,,,,,,,105,105,105,,,,,,,,;        // From HYDEPARK    115.00 to PUEBPLNT    115.00
BAT_BRANCH_DATA 70352,70549,1,,,,,,,,,175,175,175,,,,,,,,;        // From READER      115.00 to APT MEM     115.00
BAT_BRANCH_DATA 70004,70352,1,,,,,,,,,100,100,100,,,,,,,,;        // From FREEMARY    115.00 to READER      115.00
BAT_BRANCH_DATA 70002,70004,1,,,,,,,,,105,105,105,,,,,,,,;        // From BURNT MI    115.00 to FREEMARY    115.00
BAT_BRANCH_DATA 70002,70456,1,,,,,,,,,100,100,100,,,,,,,,;        // From BURNT MI    115.00 to W.STATON    115.00
BAT_BRANCH_DATA 70330,70390,1,,,,,,,,,105,105,105,,,,,,,,;        // From PORTLAND    115.00 to SKALA       115.00
BAT_BRANCH_DATA 70086,70390,1,,,,,,,,,105,105,105,,,,,,,,;        // From CANONCTY    115.00 to SKALA       115.00
BAT_BRANCH_DATA 70394,70550,1,,,,,,,,,133,133,133,,,,,,,,;        // From SMELTER     115.00 to W CANON     115.00
BAT_BRANCH_DATA 70378,70550,1,,,,,,,,,87,87,87,,,,,,,,;           // From AREQUGCH    115.00 to W CANON     115.00
BAT_BRANCH_DATA 70130,70306,1,,,,,,,,,32,32,32,,,,,,,,;           // From CRPLE CK    69.000 to P P MINE    69.000
BAT_BRANCH_DATA 70306,70451,1,,,,,,,,,32,32,32,,,,,,,,;           // From P P MINE    69.000 to VICTOR      69.000
BAT_BRANCH_DATA 70160,70293,1,,,,,,,,,32,32,32,,,,,,,,;           // From E CANON     69.000 to NCANON      69.000
BAT_BRANCH_DATA 70160,70176,1,,,,,,,,,32,32,32,,,,,,,,;           // From E CANON     69.000 to FLORENCE    69.000
BAT_BRANCH_DATA 70176,70220,1,,,,,,,,,35,35,35,,,,,,,,;           // From FLORENCE    69.000 to HIGHLND     69.000
BAT_BRANCH_DATA 70220,70370,1,,,,,,,,,63,63,63,,,,,,,,;           // From HIGHLND     69.000 to S CANON     69.000
BAT_BRANCH_DATA 70318,70329,1,,,,,,,,,32,32,32,,,,,,,,;           // From PENROSE     69.000 to PORTLAND    69.000
BAT_BRANCH_DATA 70371,70391,1,,,,,,,,,32,32,32,,,,,,,,;           // From S CANONW    69.000 to SKINNER     69.000
BAT_BRANCH_DATA 70085,70294,1,,,,,,,,,32,32,32,,,,,,,,;           // From CANONCTY    69.000 to NCANON W    69.000

/* ----------------------------Update Loads to 2010 values----------------------------------------------
BAT_LOAD_DATA, 70130, 'WP',,,,, 006.47280, -000.30609,,,,,;        // CRIPPLE CREEK
BAT_LOAD_DATA, 70306, 'WP',,,,, 007.81260, 001.68595,,,,,;         // ANGLOGOLD
BAT_LOAD_DATA, 70451, 'WP',,,,, 000.91590, 001.25837,,,,,;         // VICTOR
BAT_LOAD_DATA, 70293, 'WP',,,,, 008.46153, 001.87529,,,,,;         // NORTH CANON XFMR
BAT_LOAD_DATA, 70086, 'WP',,,,, 016.77271, 003.98836,,,,,;         // CANON PLANT UNIT SUB
BAT_LOAD_DATA, 70330, 'WP',,,,, 035.00000, 008.80000,,,,,;         // PORTLAND - HOLCIM 115kV
BAT_LOAD_DATA, 70390, 'WP',,,,, 007.74633, 003.86173,,,,,;         // SKALA
BAT_LOAD_DATA, 70370, 'WP',,,,, 007.02300, 002.47113,,,,,;         // SOUTH CANON
BAT_LOAD_DATA, 70391, 'WP',,,,, 005.45720, 001.79369,,,,,;         // SKINNER
BAT_LOAD_DATA, 70329, 'WP',,,,, 000.00000, 000.00000,,,,,;         // PORTLAND - HOLCIM 69kV
```

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BAT_LOAD_DATA, 70318, 'WP',,,,, 006.44453, 001.27196,,,,,;        // PENROSE
BAT_LOAD_DATA, 70220, 'WP',,,,, 001.14870, 000.37756,,,,,;        // HIGHLAND TAP
BAT_LOAD_DATA, 70176, 'WP',,,,, 005.72938, 002.67641,,,,,;        // FLORENCE
BAT_LOAD_DATA, 70160, 'WP',,,,, 008.40852, 004.26806,,,,,;        // EAST CANON
BAT_LOAD_DATA, 70019, 'WP',,,,, 004.00000, 002.00000,,,,,;        // PDA 115kV
BAT_LOAD_DATA, 70030, 'WP',,,,, 023.40883, 006.96012,,,,,;        // AIRPORT INDUSTRIAL
BAT_LOAD_DATA, 70049, 'WP',,,,, 015.74962, 000.79296,,,,,;        // BELMONT
BAT_LOAD_DATA, 70051, 'WP',,,,, 014.13790, 002.18953,,,,,;        // BLENDE
BAT_LOAD_DATA, 70158, 'WP',,,,, 002.29741, 000.75512,,,,,;        // DOT
BAT_LOAD_DATA, 70181, 'WP',,,,, 011.22549, 001.54107,,,,,;        // FREEMARY 69
BAT_LOAD_DATA, 70193, 'WP',,,,, 000.88463, 000.38635,,,,,;        // FOUNTAIN VALLEY
BAT_LOAD_DATA, 70235, 'WP',,,,, 001.87239, 000.51575,,,,,;        // HUERFANO
BAT_LOAD_DATA, 70236, 'WP',,,,, 015.33255, 003.11741,,,,,;        // HYDEPARK
BAT_LOAD_DATA, 70301, 'WP',,,,, 033.98398, 003.28098,,,,,;        // NORTH RIDGE #1&2
BAT_LOAD_DATA, 70305, 'WP',,,,, 008.88214, 003.58906,,,,,;        // OVERTON 69
BAT_LOAD_DATA, 70316, 'WP',,,,, 001.72306, 000.56634,,,,,;        // PDA 69kV
BAT_LOAD_DATA, 70332, 'WP',,,,, 017.29772, 003.04535,,,,,;        // PRAIRIE AVE.
BAT_LOAD_DATA, 70338, 'WP',,,,, 007.91251, 000.95666,,,,,;        // PUEBLO KD circuit
BAT_LOAD_DATA, 70339, 'WP',,,,, 015.62047, -001.08528,,,,,;       // PUEBLO NP,SP,CP circuits
BAT_LOAD_DATA, 70405, 'WP',,,,, 009.12130, 004.66114,,,,,;        // ST. CHARLES
BAT_LOAD_DATA, 70415, 'WP',,,,, 015.19824, 003.31389,,,,,;        // STONEMOOR
BAT_LOAD_DATA, 70422, 'WP',,,,, 005.19214, 001.40461,,,,,;        // SUNSET
BAT_LOAD_DATA, 70549, 'WP',,,,, 015.94048, 006.36352,,,,,;        // AIRPORT MEMORIAL
BAT_LOAD_DATA, 70449, 'WP',,,,, 019.71530, 007.45209,,,,,;        // DESERT COVE
BAT_LOAD_DATA, 70004, 'WP',,,,, 000.00000, 000.00000,,,,,;        // FREEMARY 115   (2012)
BAT_LOAD_DATA, 70002, 'WP',,,,, 014.93316, 006.12690,,,,,;        // BURNT MILL 115
BAT_LOAD_DATA, 70366, 'WP',,,,, 009.01889, 004.00841,,,,,;        // ROCKY FORD
BAT_LOAD_DATA, 70178, 'WP',,,,, 004.67329, 001.53611,,,,,;        // FOWLER XFMR
BAT_LOAD_DATA, 70250, 'WP',,,,, 003.09856, 000.44212,,,,,;        // LA JUNTA 69Kv
BAT_LOAD_DATA, 70275, 'WP',,,,, 000.47489, 000.76410,,,,,;        // MANZANOLA
BAT_LOAD_DATA, 70303, 'WP',,,,, 004.71499, 001.06028,,,,,;        // ORDWAY
BAT_LOAD_DATA, 70319, 'WP',,,,, 000.79240, 000.38711,,,,,;        // PHILLIPS
BAT_LOAD_DATA, 70270, 'WP',,,,, 000.00000, 000.00000,,,,,;        // Las ANIMAS
BAT_LOAD_DATA, 70185, 'WP',,,,, 000.00000, 000.00000,,,,,;        // FT. LYON

/*-------------------Add La Junta W to La Junta T 115 kV line-----------------------
BAT_BRANCH_DATA,70247,70249,'1',0,70249,65,66,0,0,0.002469,0.009671,0.0011,140,140,140,,,,,0.5,0.5,0.5,0,0

/*-----------------Add La Junta W to La Junta T 69kV line as normally open----------
BAT_BRANCH_DATA,70248,70250,'1',0,70250,65,66,0,0,0.00285,0.00741,0.00014,63,63,63,,,,,0.5,0.5,0.5,0,0

/*-------------------Add La Junta W 115/69kV Transformer as switched off-------------
BAT_TWO_WINDING_DATA,70249,70250,'2',0,70250,66,0,0,0,25,,70250,70250,-1,0,2,1,1,0,0.116,100,72.588,69,0,115,115,25,25,25,1,1,1,1,,,1.105,0.9538,1.03,1.0067,,,'LAJUNTAW'

/*--------------------------Remove Rocky Ford Diesels-------------------------------
BAT_DSCN,70344

/*---------------Add 24MVAR cap (4 banks of 6MVAR) at Rocky Ford--------------------
BAT_SWITCHED_SHUNT_DATA,70366,4,0,0,0,0,0,0,0,0,0,6,0,0,0,0,0,0,0,1.0124,0.9724,12,100,""
```

Appendix B – Monitored Buses

Bus Number	Bus Name	Voltage
70019	PDA 5	115
70022	APT TAP2	115
70060	BOONE	115
70061	BOONE	230
70062	BOONE	69
70063	BOONE TP	69
70132	CTY LAJ	69
70136	CTY LAM	69
70158	DOT	115
70159	DOT TAP	115
70161	EADS	69
70178	FOWLER	69
70185	FT. LYON	69
70235	HUERFANO	69
70243	LA SECPA	69
70247	LAJUNTAT	115
70248	LAJUNTAT	69
70249	LAJUNTAW	115
70250	LAJUNTAW	69
70253	LAMAR CO	115
70254	LAMAR CO	230
70271	LS ANMAS	69
70275	MANZANOL	69
70303	ORDWAY	69
70316	PDA	69
70317	PDA TAP	69
70319	PHILLIPS	69
70320	PHLPS TP	69
70333	PROWERS	69
70366	ROCKYFRD	69
70372	S FWL TP	69
70472	WILOW CK	115
70473	WILOW CK	69
70801	PROWERS_TS	69
70800	EADS_TAP	69
70802	FT. LYON_TP	69

Appendix C – Monitored Branches

From Bus	From Bus	To Bus	To Bus	ID
70060	BOONE 115.00	70061	BOONE 230.00	1
70060	BOONE 115.00	70062	BOONE 69.000	1
70133	CTY LAM 14.400	70134	CTY LAM 24.000	1
70134	CTY LAM 24.000	70135	CTY LAM 4.2000	1
70134	CTY LAM 24.000	70136	CTY LAM 69.000	1
70134	CTY LAM 24.000	70136	CTY LAM 69.000	2
70134	CTY LAM 24.000	70226	HOLLY 25.000	1
70226	HOLLY 25.000	70227	HOLLY 4.0000	1
70247	LAJUNTAT 115.00	70248	LAJUNTAT 69.000	1
70247	LAJUNTAT 115.00	70248	LAJUNTAT 69.000	2
70249	LAJUNTAW 115.00	70250	LAJUNTAW 69.000	1
70249	LAJUNTAW 115.00	70250	LAJUNTAW 69.000	2
70249	LAJUNTAW 115.00	70247	LAJUNTAT 115.00	1
70250	LAJUNTAW 69.000	70248	LAJUNTAT 69.000	1
70253	LAMAR CO 115.00	70254	LAMAR CO 230.00	1
70270	LS ANMAS 13.800	70271	LS ANMAS 69.000	1
70452	VILAS 115.00	70453	VILAS 69.000	1
70472	WILOW CK 115.00	70473	WILOW CK 69.000	1
70472	WILOW CK 115.00	70473	WILOW CK 69.000	2
70019	PDA 5 115.00	70158	DOT 115.00	1
70019	PDA 5 115.00	70159	DOT TAP 115.00	1
70022	APT TAP2 115.00	70159	DOT TAP 115.00	1
70022	APT TAP2 115.00	70549	APT MEM 115.00	1
70060	BOONE 115.00	70159	DOT TAP 115.00	1
70060	BOONE 115.00	70247	LAJUNTAT 115.00	1
70060	BOONE 115.00	70249	LAJUNTAW 115.00	1
70061	BOONE 230.00	70122	COMANCHE 230.00	1
70061	BOONE 230.00	70254	LAMAR CO 230.00	1
70061	BOONE 230.00	70286	MIDWAYPS 230.00	1
70062	BOONE 69.000	70063	BOONE TP 69.000	1
70063	BOONE TP 69.000	70235	HUERFANO 69.000	1
70063	BOONE TP 69.000	70372	S FWL TP 69.000	1
70132	CTY LAJ 69.000	70248	LAJUNTAT 69.000	1
70136	CTY LAM 69.000	70333	PROWERS 69.000	1
70136	CTY LAM 69.000	70473	WILOW CK 69.000	1
70136	CTY LAM 69.000	70473	WILOW CK 69.000	2
70161	EADS 69.000	70473	WILOW CK 69.000	1
70178	FOWLER 69.000	70275	MANZANOL 69.000	1
70185	FT. LYON 69.000	70271	LS ANMAS 69.000	1
70243	LA SECPA 69.000	70248	LAJUNTAT 69.000	1
70247	LAJUNTAT 115.00	70472	WILOW CK 115.00	1
70250	LAJUNTAW 69.000	70320	PHLPS TP 69.000	1
70250	LAJUNTAW 69.000	70366	ROCKYFRD 69.000	1
70253	LAMAR CO 115.00	70452	VILAS 115.00	1
70253	LAMAR CO 115.00	70472	WILOW CK 115.00	1
70254	LAMAR CO 230.00	70560	LAMAR DC 230.00	1

70254	LAMAR CO 230.00	70700	COLO GRN 230.00	1
70271	LS ANMAS 69.000	70320	PHLPS TP 69.000	1
70275	MANZANOL 69.000	70303	ORDWAY 69.000	1
70275	MANZANOL 69.000	70366	ROCKYFRD 69.000	1
70319	PHILLIPS 69.000	70320	PHLPS TP 69.000	1
70366	ROCKYFRD 69.000	70372	S FWL TP 69.000	1
70243	LA SECPA 69.000	70801	PROWERS _TS 69.000	1
70801	PROWERS _TS 69.000	70800	EADS_TAP 69.000	1
70801	PROWERS _TS 69.000	70333	PROWERS 69.000	1
70800	EADS_TAP 69.000	70161	EADS 69.000	1
70800	EADS_TAP 69.000	70473	WILOW CK 69.000	1
70802	FT. LYON_TP 69.000	70333	PROWERS 69.000	1
70802	FT. LYON_TP 69.000	70136	CTY LAM 69.000	1
70802	FT. LYON_TP 69.000	70185	FT. LYON 69.000	1

Appendix D – Facility Outages Studied

Outage #	From Bus	To Bus	ID	From Bus	To Bus
1	70060	70061	1	BOONE 115.00	BOONE 230.00
2	70060	70062	1	BOONE 115.00	BOONE 69.000
3	70247	70248	1	LAJUNTAT 115.00	LAJUNTAT 69.000
4	70247	70248	2	LAJUNTAT 115.00	LAJUNTAT 69.000
5	70247	70248	2	LAJUNTAT 115.00	LAJUNTAT 69.000
6	70249	70250	1	LAJUNTAW 115.00	LAJUNTAW 69.000
7	70249	70250	2	LAJUNTAW 115.00	LAJUNTAW 69.000
8	70250	70248	1	LAJUNTAW 69.000	LAJUNTAT 69.000
9	70253	70254	1	LAMAR CO 115.00	LAMAR CO 230.00
10	70452	70453	1	VILAS 115.00	VILAS 69.000
11	70472	70473	1	WILOW CK 115.00	WILOW CK 69.000
12	70472	70473	2	WILOW CK 115.00	WILOW CK 69.000
13	70019	70158	1	PDA 5 115.00	DOT 115.00
14	70019	70159	1	PDA 5 115.00	DOT TAP 115.00
15	70022	70159	1	APT TAP2 115.00	DOT TAP 115.00
16	70022	70549	1	APT TAP2 115.00	APT MEM 115.00
17	70030	70549	1	APT PARK 115.00	APT MEM 115.00
18	70060	70159	1	BOONE 115.00	DOT TAP 115.00
19	70060	70247	1	BOONE 115.00	LAJUNTAT 115.00
20	70060	70249	1	BOONE 115.00	LAJUNTAW 115.00
21	70247	70249	1	LAJUNTAT 115.00	LAJUNTAW 115.00
22	70061	70122	1	BOONE 230.00	COMANCHE 230.00
23	70061	70286	1	BOONE 230.00	MIDWAYPS 230.00
24	70062	70063	1	BOONE 69.000	BOONE TP 69.000
25	70063	70235	1	BOONE TP 69.000	HUERFANO 69.000
26	70063	70372	1	BOONE TP 69.000	S FWL TP 69.000
27	70121	70352	1	COMANCHE 115.00	READER 115.00
28	70121	70352	2	COMANCHE 115.00	READER 115.00
29	70132	70248	1	CTY LAJ 69.000	LAJUNTAT 69.000
30	70136	70333	1	CTY LAM 69.000	PROWERS 69.000
31	70136	70473	1	CTY LAM 69.000	WILOW CK 69.000
32	70136	70473	2	CTY LAM 69.000	WILOW CK 69.000
33	70178	70275	1	FOWLER 69.000	MANZANOL 69.000
34	70185	70271	1	FT. LYON 69.000	LS ANMAS 69.000
35	70185	70136	1	FT. LYON 69.000	CTY LAM 69.000
36	70243	70248	1	LA SECPA 69.000	LAJUNTAT 69.000
37	70247	70472	1	LAJUNTAT 115.00	WILOW CK 115.00
38	70250	70320	1	LAJUNTAW 69.000	PHLPS TP 69.000
39	70250	70366	1	LAJUNTAW 69.000	ROCKYFRD 69.000
40	70253	70452	1	LAMAR CO 115.00	VILAS 115.00
41	70253	70472	1	LAMAR CO 115.00	WILOW CK 115.00
42	70254	70560	1	LAMAR CO 230.00	LAMAR DC 230.00
43	70254	70700	1	LAMAR CO 230.00	COLO GRN 230.00
44	70271	70320	1	LS ANMAS 69.000	PHLPS TP 69.000
45	70275	70303	1	MANZANOL 69.000	ORDWAY 69.000
46	70275	70366	1	MANZANOL 69.000	ROCKYFRD 69.000

47	70319	70320	1	PHILLIPS 69.000	PHLPS TP 69.000
48	70352	70549	1	READER 115.00	APT MEM 115.00
49	70366	70372	1	ROCKYFRD 69.000	S FWL TP 69.000
50	70243	70801	1	LA SECPA 69.000	PROWERS _TS 69.000
51	70801	70800	1	PROWERS _TS 69.000	EADS_TAP 69.000
52	70801	70333	1	PROWERS _TS 69.000	PROWERS 69.000
53	70800	70161	1	EADS_TAP 69.000	EADS 69.000
54	70800	70473	1	EADS_TAP 69.000	WILOW CK 69.000
55	70333	70136	1	PROWERS 69.000	CTY LAM 69.000
56	70333	70802	1	PROWERS 69.000	FT. LYON_TP 69.000
57	70802	70136	1	FT. LYON_TP 69.000	CTY LAM 69.000
58	70802	70185	1	FT. LYON_TP 69.000	FT. LYON 69.000
59	70136	70135	1	CTY LAM 69.000	CTY LAM 13.800
60	70136	70134	1	CTY LAM 69.000	CTY LAM 24.000
61	70136	70134	2	CTY LAM 69.000	CTY LAM 24.000
62	70134	70128	1	CTY LAM 24.000	CTY LAM 2 0.600
63	70134	70133	1	CTY LAM 24.000	CTY LAM 14.400

Appendix E – Violations for Category C Outages with the LaJunta 115kV Tie In-Service

Prior Outage	Post Outage Contingency																								
	Boone 230/115	Boone 115/69	LaJunta T 115/69	LaJunta W 115/69	LaJunta W - LaJunta T 69	Lamar Co 230/115	Vilas 115/69	Boone - DOT Tap 115	Boone - LaJunta T 115	Boone - LaJunta W 115	LaJunta T - LaJunta W 115	Boone - Comanche 230	Boone - Midway PS 230	Boone - Boone Tap 69	Boone Tap - S. Fowler Tap 69	Comanche - Reader 115	LaJunta T - Wilow Ck 115	Lamar Co - Vilas 115	Lamar Co - Wilow Ck 115	Lamar Co - Lamar DC 230	Rocky Ford - S. Fowler Tap 69	City Lamar 69/24 - 25MVA	City Lamar 69/24 - 11MVA	City Lamar 24kV - City Lamar 2	City Lamar 24/14
Boone 230/115						*		*																	
Boone 115/69			*	*																					
LaJunta T 115/69 (42MVA)		*		*	*									*	*						*				
LaJunta W 115/69		*	*											*	*		*				*				
Lamar Co 230/115	*						*										*	*	*						
Vilas 115/69						*													*						
APT Tap2 - Dot TP 115	*																								
APT Tap2 - APT Mem 115	*																								
Boone - DOT TP 115	*																								
Boone – LaJunta T 115										*															
Boone – LaJunta W 115									*		*														
LaJunta T – LaJunta W 115										*															
Boone - Comanche 230													*												
Boone – Midway PS 230												*													
Boone - Boone TP 69			*	*																					
Boone TP - S Fowler Tap 69				*																					
Comanche - Reader 115																*									
LaJunta T - Wilow Ck 115				*		*																			
LaJunta W - Rocky Ford 69	*																								
Lamar Co - Vilas 115						*													*						
Lamar Co - Wilow Ck 115						*	*											*							
Lamar Co - Lamar DC 230																						*			
Reader - Apt Mem 115	*																								
Rocky Ford-S Fowler Tp 69				*																					
City Lamar 69/24 (25MVA)																				*				*	*
City Lamar 69/24 (11MVA)																									*
City Lamar 24/0.575																						*			
City Lamar 24/14						*																*	*		

* Designates that violations occur for the specified Category C outage.