By 2018 the 69-kV system serving the Goehmann Lane system is projected to experience violations of system operating limits during contingency conditions due to the load growth in the broader Fredericksburg area. The existing Fredericksburg 138/69-kV autotransformer and the Fredericksburg to Goehmann Lane 69-kV transmission line will overload during the loss of the Gillespie 138/69-kV autotransformer. Similarly, the Gillespie autotransfomer will overload during the loss of the Fredericksburg autotransformer. With the Ferguson Power Plant out-of-service, the Doss and Harper substations will experience voltages below acceptable levels (below 0.92 per unit) during the loss of the Gillespie 138/69-kV autotransformer.

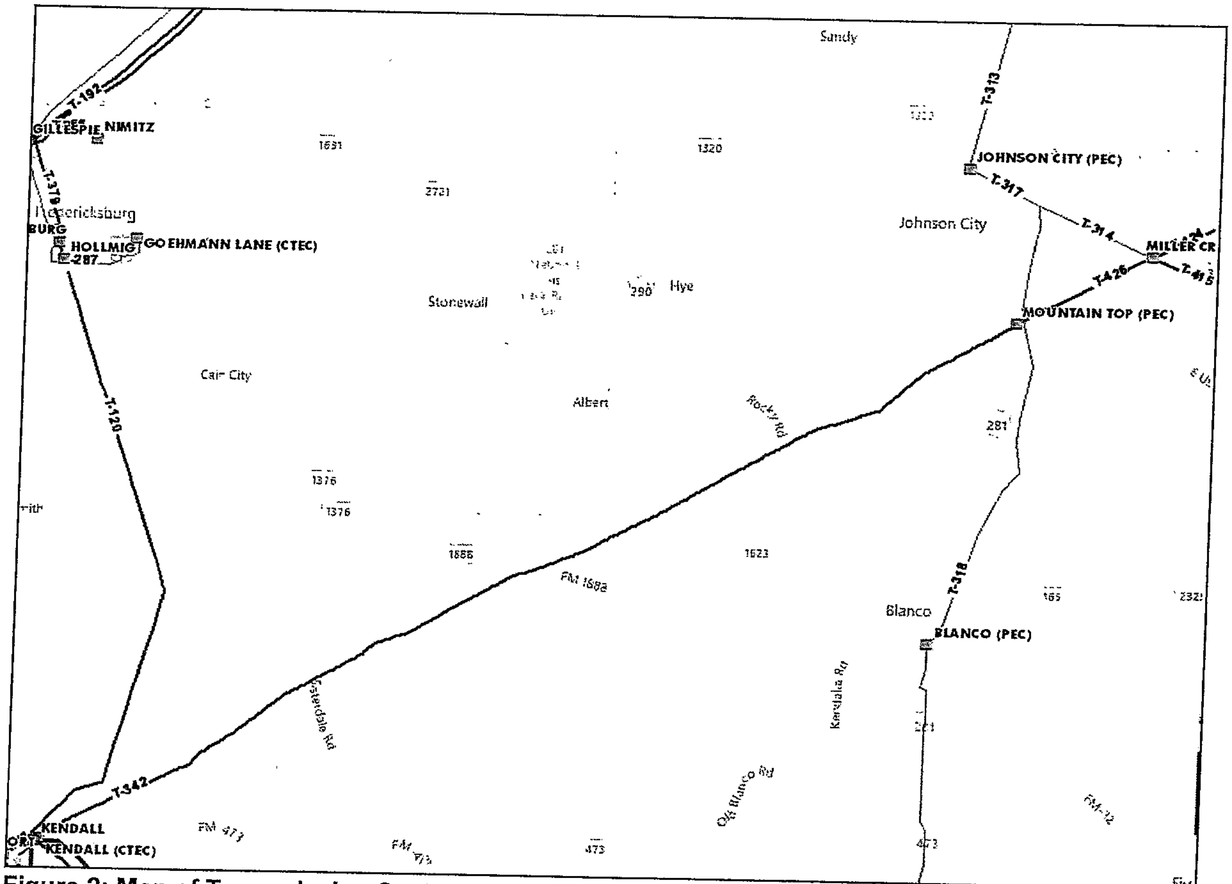


Figure 2: Map of Transmission System

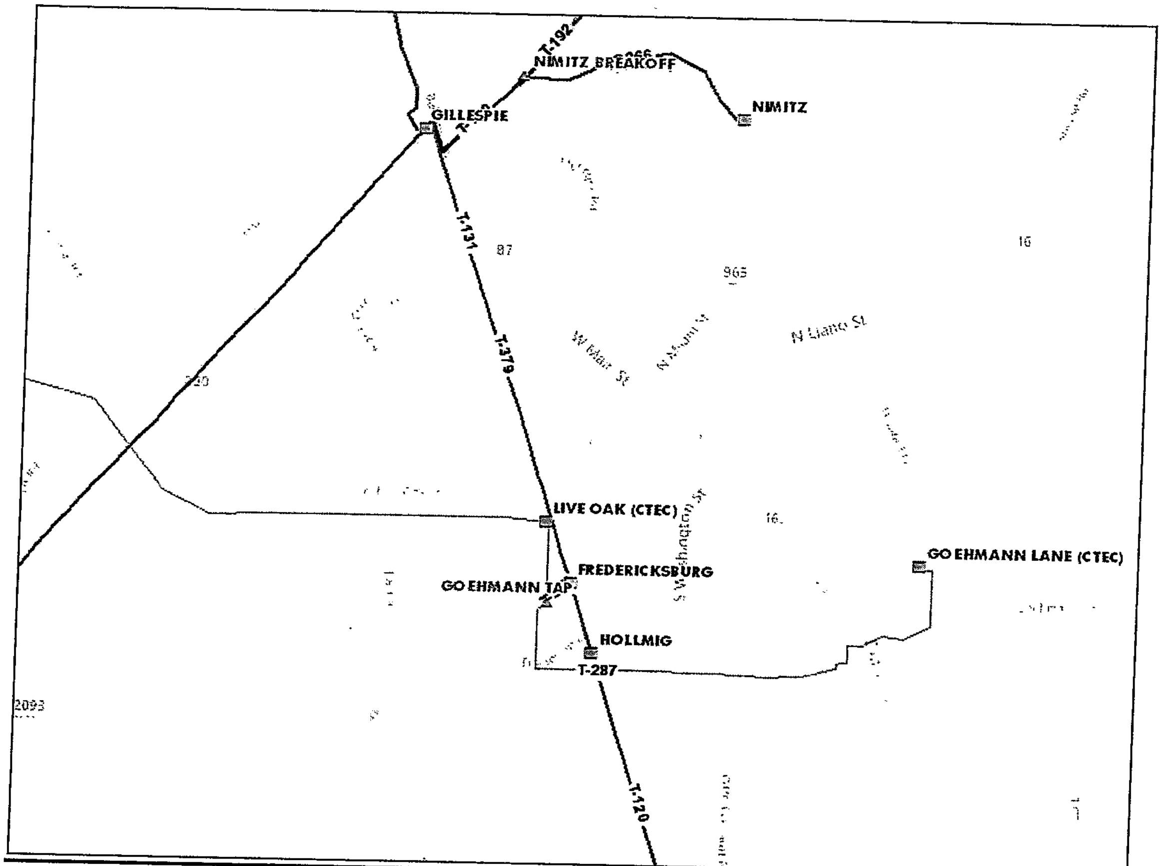


Figure 3: Map of Transmission System

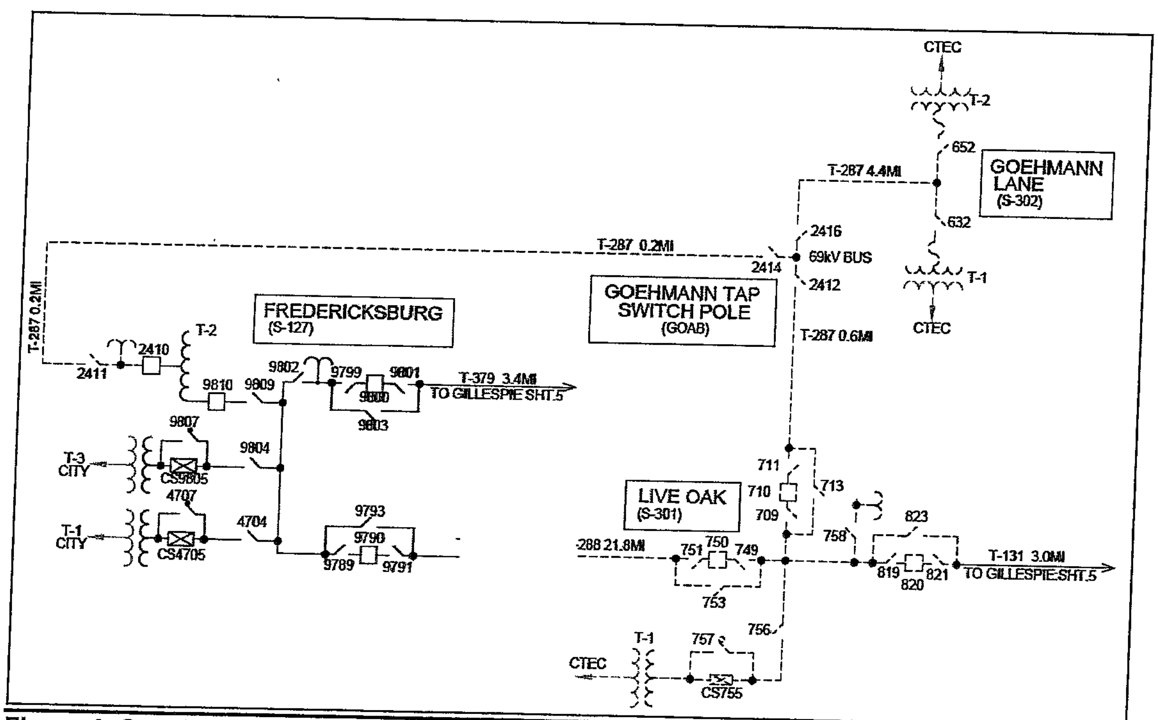


Figure 4: One-line of Transmission System Serving Goehman Lane Substation

AVAILABLE ALTERNATIVES

As stated above, over the last five years, CTEC and LCRA TSC have been working together to defer this type of project by shifting load to area substations. This included the addition of load-serving transformers at the Gillespie, Hollmig and Nebo substations. CTEC has also upgraded the area's distribution facilities to increase the available capacity and to avoid voltage problems until the proposed project is completed. Furthermore, in exploring the expansion of the area's distribution system, CTEC's study concluded that adding load-serving substations adjacent to existing 138-kV transmission lines south and east of the area of concern and the associated distribution lines are not feasible alternatives for further consideration as the area continues to grow.

Looping Goehmann Lane by adding another transmission source to this substation was also considered but was not pursued because this alternative does not address all the distribution system's inability to provide reliable service to the load forecasted to be served by Goehmann Lane as described in the "Need for Project" section above.

Two alternatives for meeting the Blumenthal area load addition are included in this project plan. These alternatives were selected because they provide the transmission infrastructure needed to provide reliable service to the increased area load forecasted for 2018. The following table summarizes the scope and cost for each alternative.

Alternative	Upgrades	Cost ($000,000)
Alternative 1	1) Construct a distribution substation to serve load requirements of the CTEC service territory in the southeastern Gillespie county area. 2) Interconnect the new CTEC load-serving distribution substation by constructing a new 10.5-mile (approximate) 336 ACSR 138-kV transmission line to a tap point on the Kendall – Fredericksburg 138-kV transmission line.	$24.0
Alternative 2	1) Construct a distribution substation to serve load requirements of the CTEC service territory in the southeastern Gillespie county area. 2) Interconnect the new CTEC load-serving distribution substation by constructing a new 11.5-mile (approximate) 336 ACSR 138-kV transmission line to a tap point on the Kendall – Mountain Top 138-kV transmission line.	$24.9

Table 1: Summary of Scope and Cost for Each Alternative

Alternative 1:

Construct a 138-26.18-kV 12/16/20 MVA distribution station to serve load requirements of the CTEC service territory in the southeastern Gillespie county area. Interconnect the new CTEC load-serving distribution substation by constructing a new 10.5-mile (approximate) 336 ACSR 138-kV transmission line (129 MVA) to a tap point on the Kendall – Fredericksburg 138-kV transmission line.

Alternative 1 Results:

There are no thermal or voltage violations on the transmission system during contingency conditions with 2018 area loads and the Alternative 1 upgrades.

Table 2 indicates the maximum load that can be served by the tap point in 2018 with Alternative 1 upgrades without causing thermal violations on the transmission system.

Maximum Load	MW
Blumenthal	80

Table 2: Alternative 1 Maximum Load

Cost of Alternative 1: $24.0 Million

Alternative 2 (Proposed project):
Construct a 138-26.18-kV 12/16/20 MVA distribution station to serve load requirements of the CTEC service territory in the southeastern Gillespie county area. Interconnect the new CTEC load-serving distribution substation by constructing a new 11.5-mile (approximate) 336 ACSR 138-kV transmission line (129 MVA) to a tap point on the Kendall – Mountain Top 138-kV transmission line.

Alternative 2 Results:
There are no thermal or voltage violations on the transmission system during contingency conditions with 2018 area loads and the Alternative 2 upgrades. Table 3 indicates the maximum load that can be served by the tap point in 2018 with Alternative 2 upgrades without causing thermal violations on the transmission system.

Maximum Load	MW
Blumenthal	306

Table 3: Alternative 2 Maximum Load

Cost of Alternative 2: $24.9 Million

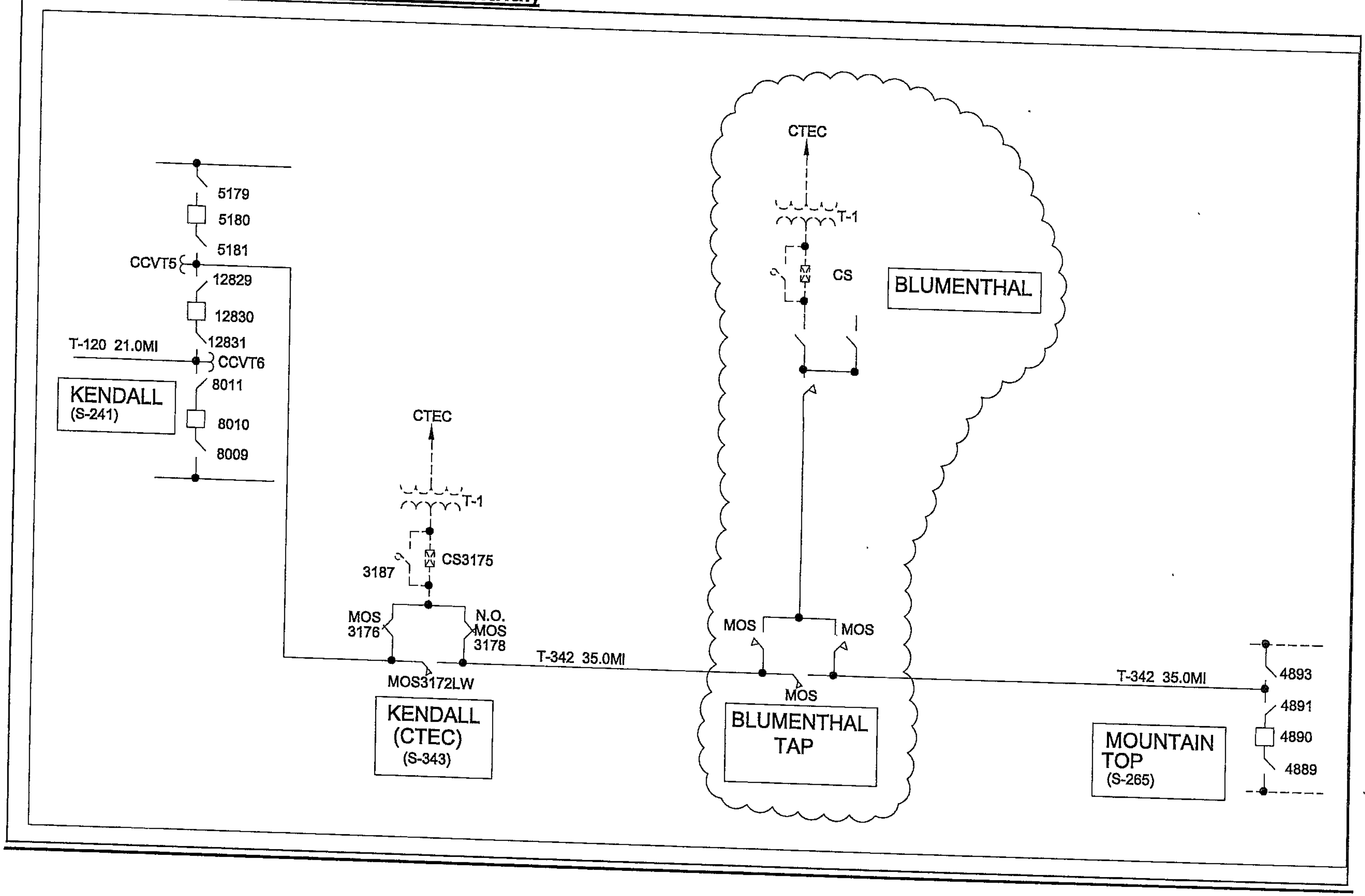
BENEFITS OF THE PROPOSED PROJECT (Alternative 2)

1. Increases the service reliability for the loads in Fredericksburg area by serving the new Blumenthal Substation from a 138-kV source that is different from the 138-kV sources that currently serve all the substations in this area;
2. Provides more than three times the capacity to serve load than Alternative 1;
3. Ability to serve the load needs of CTEC's service territory;
4. Provides a new substation (Blumenthal) appropriately located within an area experiencing high load growth;
5. Reduces the loading on the heavily loaded 69-kV transmission system in the Fredericksburg area;
6. Removes thermal overloads on the transmission system in the Fredericksburg area during contingency conditions; and,
7. Removes voltage violations on the transmission system in the Fredericksburg area during contingency conditions.

SUPPORTING INFORMATION
Steady state case file and idevs supporting this study are listed below.

Case: 13DSB_2018SUM1_Blumenthal_02182013_V32.raw
Alternative 1 idev: Blumenthal Alternative 1.idv
Alternative 2 idev: Blumenthal Alternative 2.idv

STATION ONE-LINE DIAGRAM (Blumenthal)



April 29, 2013

Mr. Stuart Nelson
Executive Manager, Transmission Services
Lower Colorado River Authority
P.O. Box 220
Austin, TX 78767-0220

RE: Blumenthal Substation and Transmission Line Addition Project

Dear Mr. Nelson:

On April 19, 2013 I received an email from Brad Woods on behalf of the LCRA Transmission Services Corporation with a submission for a project for Regional Planning Group (RPG) review. The project was the Blumenthal Substation and Transmission Line Addition Project.

I have reviewed the proposed project scope which entails constructing a new radial 138 kV transmission line from a new load-serving substation (Blumenthal Substation) to a tap point on the existing Kendall to Mountain Top 138 kV transmission line. The submitted report states that the primary purpose of the project is to serve new and growing load in the area. Based on ERCOT Protocol Section 3.11.4.4, ERCOT concludes that this project is classified as a "Neutral" project since the scope of the project is to build a radial transmission line to meet local load serving needs. Because of this, the project will be categorized as a Tier 4 project and will not undergo RPG review.

Should you have any questions please contact me at any time.

Sincerely,

Jeff Billo
Manager, Transmission Planning
Electric Reliability Council of Texas

cc: Warren Lasher, ERCOT

SCHNEIDER ENGINEERING

CENTRAL TEXAS ELECTRIC COOPERATIVE, INC. | GOEHMANN LANE DISTRIBUTION ALTERNATIVE STUDY

SEPTEMBER 25, 2012

STATE OF TEXAS
LANCE T. PETTIGREW
84775
LICENSED
PROFESSIONAL ENGINEER

9-25-12

EXECUTIVE SUMMARY

The purpose of this study was to evaluate viability of system improvement alternatives to meet growing electrical demands on the eastern portion of the Central Texas Electric Cooperative (CTEC) distribution system in the Fredericksburg area in the vicinity of the existing Goehmann Lane substation. The increasing demand on the electric system, and distribution system topology challenges with regard to the existing Goehmann Lane substation and its feeders present limited alternatives for distribution service plan options to meet reliability criteria requirements. The Blumenthal substation alternative is the only alternative evaluated that provides a complete solution to the increasing demand and exposure. It should be strategically located to intercept Goehmann Lane Feeders #3 and #4 on the eastern side of the study area.

The study reviews options to satisfy two existing system reliability planning criteria which are presently not being met:

1. No more than 20 MW of peak load shall be interrupted for a single anticipated event. (LCRA TSC Planning Criteria – Appendix A)

2. To maintain adequate consumer reliability which meets or exceeds present levels, individual feeder loadings will be limited to 6,000 kW. (CTEC Planning Criteria – Appendix B)

System alternatives considered need to provide long term resolution to both of the above two criteria violations in order to be viable alternatives.

Two new substation delivery points have been approved as part of the CTEC 2008-12 Construction Work Plan, and are in stages of implementation as of this study as a part of the solution to the resolving the load problem on Goehmann Lane. The Hollmig Substation will be commissioned in July 2012, and the Nebo substation will be commissioned in January 2013, and the two new substations will facilitate a reduction in overall loading on Goehmann Lane to less than 20 MW until 2015, thereby temporarily deferring other transmission improvements; however, the geographic location of Hollmig and Nebo substations, and their associated distribution projects will not accomplish a reduction of load on Goehmann Lane Feeders #3 and #4 which still serve in excess of 6 MW load due to geographic location of the feeders. Even with these two new substations, a distribution only solution did not provide long or short term relief to the loading problem along the eastern portion of the system. In fact, with Nebo and Hollmig in service, the load at Goehmann Lane is projected to exceed 20 MW again in 2015.

The study evaluated additional substation delivery points under existing transmission lines to the south of Fredericksburg near Grapetown and Sisterdale. In each case, extensive distribution tie lines would be required, and in both cases the improvements were geographically unable to resolve the load growth on the feeders east of Fredericksburg. The Grapetown and Sisterdale substation alternatives were not considered further at this time.

INTRODUCTION

Goehmann Lane Study Area

The Central Texas Electric Cooperative ("CTEC" or the "Cooperative") system study area under evaluation designated as the Goehmann Lane area is located to the east of Fredericksburg, Texas between the City of Fredericksburg to the West, and the Gillespie/Blanco County Line to the east. It is represented in 'Exhibit 1 – Goehmann Lane Existing System' as the area shaded in blue on the eastern part of the system. The existing Goehmann Lane Substation serves the entire blue shaded area, which includes the following general boundary: north to the Gillespie and Llano county line; east to the Gillespie and Blanco County Line; south across the Gillespie and Kendall County lines, and west to the vicinity of Grapetown.

Growth in Gillespie County in and around the City of Fredericksburg and to the east of Fredericksburg along the Highway 290 corridor toward Stonewall has increased the electrical demand on the Goehmann Lane substation, concentrated significant load on one distribution substation, and thus provides exposure to a significant number of CTEC members to a single contingency transmission outage. The growing load center is east of Fredericksburg n the area along the Highway 290 corridor from Blumenthal to Stonewall, and is a significant distance away from the Goehmann Lane substation, and has no available source for backup in the event of a power outage.

For a single contingency outage at Goehmann Lane, local critical assets such as the Stonewall Water Supply and Water Treatment Plant, and the Stonewall VFD, would be subject to extended power outages. Prolonged electrical outages would also potentially have an impact on communication tower infrastructure, and economic impacts on local economy functions such as the LBJ Park and Ranch, and the growing number of local area small businesses servicing the hill county.

System Planning - Background

As a participant in the Rural Development Utilities Program Department of the U.S. Department of Agriculture (formally known as Rural Utility Services, and hereafter referred to as RUS in the report), CTEC engages in regular system planning studies in accordance with the RUS Guidelines. The Cooperative commits to two planning processes, as required by RUS to determine the most economical means of providing reliable electric service to its Members: (1) Construction Work Plans (Presently in the last year of the 2009-2012 Construction Work Plan), (2) System Long Range Plan (Presently operating under the 2008 – 2027 System Long Range Plan.) The Construction Work Plans are prepared every 4-5 years and detail specific system improvements required to accomplish the Cooperative's reliability goals. The System Long Range Plan is a strategic document that covers a 20 year strategic system outlook and is a guide in making practical reliability and system development decisions in the interim periods based on load levels.

Both Cooperative system planning processes are prepared utilizing two sets of complementary planning criteria as the basis for engineering the system. First, the document in Appendix B – CTEC Distribution Planning Criteria represents the set of reliability guidelines that have been adopted by the Cooperative for use in making reliable distribution planning engineering decisions. Additionally, the Cooperative participates in a joint transmission planning process with its Transmission Operator – the Lower Colorado River Authority (the Lower Colorado River Authority Transmission Services Corporation "LCRA TSC") for planning necessary transmission and substation improvements as a result of the load growth and distribution planning needs of the Cooperative. Through a contractual agreement with the LCRA TSC (the "Lease"), the collaborative process, which includes LCRA TSC and other distribution utilities participating in the Lease, seeks to develop system transmission and substation projects for the Central Texas Area to maintain acceptable levels of reliability, meet the growing needs of the system, and optimize engineering and operations expenses. The LCRA TSC Planning Criteria is included in Appendix A.

Planning Criteria Violations

The study discussion below and alternative development that follows is the result of two separate planning criteria violations that are the result continued load growth in the area:

From the CTEC Distribution Planning Criteria:

> Section III, Paragraph C. To maintain adequate consumer reliability which meets or exceeds present levels, individual feeder loadings will be limited as follows: 6,000 kW for Transition I, 6,000 kW for Transition II and 7,000 for Transition III.

From the LCRA TSC Transmission System Planning Criteria:

> Section III, Paragraph B ("20 MW Rule"):
>
> No more than 20 megawatts (MW) of peak load shall be interrupted for a single contingency event, except when the single anticipated event is failure of a single power transformer with a peak load greater than 20 MW.
>
> *(Complete 20 MW rule reliability criteria is available in Appendix A)*

The application of both of these criteria to the electric system around the Goehmann Lane area has precipitated the need for this alternatives study and will be the subject planning criteria of the remaining discussion of the report.

Goehmann Lane Area Existing Electric System Discussion

In 2011, the Goehmann Lane substation experienced a winter peak of 31.4 MW as shown below in Table 1. This demand level clearly violates the 20 MW rule criteria for exposure at a substation for a single contingency transmission event. The table also shows that without any consideration of improvements, in 2016, the substation loading will approach 39 MW. Additionally, feeders 1, 4, and 5 have current loadings, and load forecast projects that exceed the Cooperative's reliability planning criteria load limit of 6 MW. The CTEC distribution system peaks during the winter loading based on a predominance of electric heating throughout the system.

The Cooperative, over the last 5 years has diligently pursued substation and distribution system improvements to facilitate the transfer of excessive load on Goehmann Lane Substation to other adjacent substations, and to reduce the feeder loading levels and to acceptable levels.

Substation	Feeder	2011 Peak (kW)	2016 Forecast (kW)
Goehmann Lane	1	7,621	11,915
Goehmann Lane	2	3,486	3,609
Goehmann Lane	3	5,202	8,133
Goehmann Lane	4	8,035	8,318
Goehmann Lane	5	7,131	7,383
		31,475	39,358

Table 1: Goehmann Lane Loads – Unimproved (Based on 2011)

In the 2008-2012 Construction Work Plan, the Cooperative identified two new substation delivery points to assist in transferring load off of Goehmann Lane: (1) Hollmig Substation (expected completion date of July 2012), and (2) Nebo (anticipated January 2013). Both new substations are shown in attached 'Exhibit 2: Distribution Only Option.' The Hollmig Substation has been constructed on the south side of the City of Fredericksburg, and the Nebo substation will be constructed to the northeast of Fredericksburg along State Highway 16 under an existing transmission line.

The Nebo substation is able to provide significant load relief to Goehmann Lane Feeder #5, but limited relief to the other Goehmann Lane feeders based on its geographic location to the northeast and distance to the load center. The Hollmig substation will provide relief to Goehmann Lane Feeder #1 as well as distribution switching options to the existing CTEC Live Oak Substation.

The alternatives developed for consideration in this study assumes that the Nebo and Hollmig Substations have been constructed and commissioned into service, and contemplate the use of these stations with each alternative, including the distribution only alternative.

ALTERNATIVE ANALYSIS AND DISCUSSION

Alternative 1 - Distribution Only

Objective:

Evaluate a distribution only solution that would keep each feeder loading below the 6MW limit and Goehmann Lane Substation below the 20MW limit. A distribution only solution must involve use of new and existing tie lines to existing substations in order to reduce the Goehmann Lane load to below 20 MW, and achieve a feeder loading of less than 6 MW.

Alternative Description

The distribution solution involves switching the existing Goehmann Lane load to surrounding substation feeders at the Hollmig, Nebo, and Live Oak substations, and balancing the remaining feeder loading feeder loading on the existing feeders. Extensive use of existing and new required tie lines to the Hollmig, Nebo and Live Oak substations are required. The Distribution Only Alternative is depicted in Exhibit 2.

The 'Distribution Only' solution considered the use of double circuit lines to reduce the load on each distribution feeder. The double circuit considerations used the same routes and same poles for the circuits to achieve the reduction in loading, and did not improve reliability by failing to eliminate single points of failure.

This alternative consists of the following:

- Construct a tie line from Goehmann Lane Feeder 3 to Hollmig Substation.
- Construct a tie line from the Hollmig East Feeder to Live Oak Substation
- Balance load from Goehmann Feeder 4 to Goehmann Feeder 3, and Goehmann Feeder 3 to Feeder 1.

The final feeder loading results following the distribution construction, load switching, and load balancing is shown below:

Substation	Feeder	2011 kW Demand
Goehmann Lane	1	3,499
Goehmann Lane	2	3,262
Goehmann Lane	3	6,044
Goehmann Lane	4	6,067
Goehmann Lane	5	118
		18,990

Substation	Feeder	2011 kW Demand
Hollmig	East	5,864
Nebo	1	5,601
Nebo	2	1,265
Live Oak	2	4,748
		17,478

Table 2: Load Switching Results – Distribution Only (Based on 2011)

Findings:

The proposed load switching will reduce the total load on the Goehmann Lane substation (18,990 kW) below the 20 MW limit; however, the demand on Goehmann Lane feeders 3 and 4 still exceeds the 6 MW limit using the 2011 kW demand. The resolution to the 20 MW rule by the load reduction is also only a temporary deferment of additional expensive transmission improvements due to continued load growth.

No additional viable distribution construction options are available for reducing load on Goehmann Feeder #3. In addition, both Goehmann Lane Feeder #3 and #4 extend 23 miles toward the eastern end of the CTEC certificated area. Based on the geographical location of the load on Goehmann Feeder #4, there are no additional existing substations or distribution feeders available to switch load, and achieve the planning criteria load levels of less than 6 MW.

The distribution only alternative temporarily resolves the 20 MW planning criteria, but does not resolve the distribution feeder loading criteria for Goehmann Lane Feeder #3 and #4 as evidenced above.

Because these distribution projects are an integral part of resolving the load levels at Goehmann Lane substation, and are a part of the commitment to build Nebo and Hollmig as a means of also diversifying the exposure by the territory served by Goehmann Lane, the Cooperative will be constructing this alternative as a part of the overall system strategy.

Alternative 2 - Grapetown Substation

Objective:

Evaluate a solution to the planning criteria violations that includes the construction of a new substation delivery point underneath an existing transmission line near Grapetown to keep each feeder loading below the 6MW limit and Goehmann Lane Substation below the 20MW limit.

Alternative Description:

The Grapetown Substation Alternative involved constructing a new 24.9 kV substation to the southeast of Fredericksburg under the existing Fredericksburg – Kendall 138 kV transmission line along Doebbler Road and is depicted in Exhibit 3. In addition to constructing the substation, the following improvements are required:

- Construct the distribution improvements contemplated in Alternative 1 in the Distribution Only Alternative solution
- Construct two Grapetown feeders built east along Doebbler Road facilitates switching load from Goehmann Lane feeder 3 to the Grapetown substation.
- Additional system improvements including voltage conversion, rebuilding existing single and three phase lines, and building new three phase tie lines are required to switch load to the Grapetown substation.

Findings:

Construction of the of the new Grapetown substation and subsequent tie lines facilitated the shifting of approximately 3 MW of load from Goehmann Lane Feeder 3. Following other load balancing to adjacent existing substations, the results of the load switching are shown in the following table:

Substation	Feeder	2014 kW Load	2015 kW Load
Goehmann Lane	1	4,241	4,683
Goehmann Lane	2	3,885	4,118
Goehmann Lane	3	5,654	5,853
Goehmann Lane	4	5,719	6,107
Goehmann Lane	5	127	130
		19,626	20,891

Substation	Feeder	2014 kW Load	2015 kW Load
Hollmig	East	5,638	6,107
Nebo	1	6,421	6,808
Nebo	2	1,700	1,780
Grapetown	1	2,491	2,769
Grapetown	2	1,769	1,777

Table 3: Load Switching Results: Grapetown Alternative (2014-15)

As shown above, this solution to the Goehmann Lane loading problem would expire between the 2014-2015 winter peak seasons. Following the distribution improvements, including load switching to new substations, the total radial load on Goehmann Lane is 19,626 kW in 2014; however, the load transfers contemplated in Table 3 above, in the case of Nebo Feeder 1, introduce new feeders now loaded to greater than 6 MW that were not present before.

The load transfer from Goehmann Lane Feeder 3 temporarily reduces loading to less than 6 MW, but Feeder 4 is still greater than 6 MW. Since Feeders 3 and 4 follow the same general circuit path, there are limitations to load transfers between the two feeders that provide any benefit.

This option does not provide comprehensive resolution to both of the planning criteria violations with regard to substation and distribution feeder loading and therefore is not a viable alternative that is considered further.

Alternative 3 - Sisterdale Substation

Objective:

Evaluate a solution to the planning criteria violations that includes the construction of a new substation delivery point underneath an existing transmission line near Sisterdale to keep each feeder loading below the 6MW limit and Goehmann Lane Substation below the 20MW limit.

Alternative Description

The Sisterdale Substation Alternative involves constructing a new 24.9 kV substation to the southeast of Fredericksburg under the existing Kendall – Mountaintop 138 kV transmission at Sisterdale Road as depicted in Exhibit 4. In addition to constructing the substation, the following improvements are required:

- Construct the distribution improvements contemplated in Alternative 1 in the distribution only solution to switch load from Goehmann Lane to Nebo, Hollmig, and Live Oak substations
- Construct one feeder built northwest along Sisterdale Road facilitates switching load from Goehmann Lane feeder three to the Sisterdale substation.
- Additional system improvements including voltage conversion, rebuilding existing single and three phase lines, and building new three phase tie lines are required to switch load to the Sisterdale substation.

The portion of load described in Alternative 2 - Grapetown substation is the same portion of Goehmann Lane load switched to the Sisterdale substation. Consequently, they both fail to solve the problem in the same manner. The results of the load switching are shown in the following table:

Substation	Feeder	2014 kW Load	2015 kW Load
Goehmann Lane	1	4,241	4,683
Goehmann Lane	2	3,885	4,118
Goehmann Lane	3	5,654	5,853
Goehmann Lane	4	5,719	6,107
Goehmann Lane	5	127	130
		19,626	20,891

Substation	Feeder	2014 kW Load	2015 kW Load
Hollmig	East	5,638	6,107
Nebo	1	6,421	6,808
Nebo	2	1,700	1,780
Sisterdale	1	4,595	4,906

Table 4: Load Switching Results – Sisterdale Substation Alternative

As with the Grapetown Alternative, this solution would expire at the forecasted 2014 winter peak for feeder loading and substation loading exceeding 20 MW. Switching options to transfer load to the surrounding stations have likewise not provided solutions to the feeder loading problem, and have introduced new loading issues at Nebo in the same fashion.

This option does not provide comprehensive resolution to both of the planning criteria violations with regard to substation and distribution feeder loading and therefore is not a viable alternative that is considered further.

Alternative 4 - Blumenthal Substation

Objective:

Evaluate a solution to the Goehmann Lane 20 MW planning criteria violation, and the 6 MW CTEC feeder loading limit criteria by constructing a new substation delivery point in the Blumenthal area.

Alternative Description

The Blumenthal Substation alternative involves constructing a new substation east of the Fredericksburg area north of State Highway 290 in the vicinity of Jones Lane. In Exhibit #5, the Blumenthal Substation is shown constructed to intercept Goehmann Feeders #3 and #4 that extend east of the area toward the Gillespie and Blanco county lines. The substation would provide a means of reducing the line length exposure of the feeders, and thereby reducing the feeder loading along the corridor. In addition, it provides a solution to the 20 MW loading criteria at Goehmann Lane.

Findings

Construction of the Blumenthal Substation provides the following feeder load results:

Substation	Feeder	2014 kW Load	2015 kW Load
Goehmann Lane	1	4,241	4,683
Goehmann Lane	2	3,885	4,118
Goehmann Lane	3	2,060	2,212
Goehmann Lane	4	0	0
Goehmann Lane	5	2,042	2,105
		12,228	13,118

Substation	Feeder	2014 kW Load	2015 kW Load
Blumenthal	1	2,336	2,444
Blumenthal	2	5,508	5,800
Blumenthal	3	3,908	4,140
Blumenthal	4	1,806	1,920
		13,558	14,304

Substation	Feeder	2014 kW Load	2015 kW Load
Hollmig	East	5,637	5,766
Nebo	1	4,506	4,833
Nebo	2	1,700	1,780
Live Oak (from F3)		965	1,056

Table 5: Load Switching Results – Blumenthal Alternative

As demonstrated in the above loading tables, construction of the Blumenthal solution resolves the feeder loading reliability issue on Feeder #3 and #4 and additionally reduces the load on the Goehmann Lane substation to significantly less than 20 MW.

While the 2014 and 2015 loads on the new Blumenthal Feeder #2 will approach 6 MW prior to 2016, there are sufficient distribution improvements that can be made with this new delivery point that will assist in assuring compliance with our planning criteria.

The Blumenthal Substation alternative will require a new radial 138 kV transmission line to be constructed to provide service to the new substation. While this substation will be a radial transmission station, and not looped, similarly to Goehmann Lane, it will provide distribution backup to some of the feeders from Goehmann Lane feeders as described above that is not available presently from other sources. The distribution backup ability provided by the new Blumenthal substation, in addition to reducing the overall loading of the distribution feeders provides sufficient additional benefit to justify constructing the project as a new radial substation.

CONCLUSION

This study evaluated four alternatives to address system load growth east of the Fredericksburg area. The magnitude of the load growth and the location of the developing load has exceeded the ability of the existing system to maintain system loading at acceptable reliable levels according to two specific reliability planning criteria related to system loading: (1) no more than 20 MW of load interrupted for a single contingency transmission event, and (2) limit feeder loading to less than 6,000 KW.

Utilizing existing system substations and distribution feeders failed to provide resolution to both system loading issues primarily due to location of the growing load center in the Blumenthal and Stonewall areas around State Highway 290 to the east of Goehmann Lane, and limitations in available circuit capacity and topology from adjacent substations.

Of the three new substation delivery options considered, only the Blumenthal alternative provides a long term solution to the system growth and reliability needs of CTEC. The Grapetown and Sisterdale substation options take advantage of constructing substations under existing transmission lines, but their respective proximity to the load center east of Fredericksburg does not provide an adequate reliable alternative to satisfy both the 20 MW rule at Goehmann Lane and the growing reliability loading issue on Goehmann Feeder #3 and #4. The Blumenthal alternative is the only solution that accomplishes both for system reliability and growth.

The Blumenthal substation alternative provides the feeder loading solutions that meet the CTEC reliability planning criteria and also is a part of the long term solution to keeping the Goehmann Lane composite substation loading below the target 20 MW level.

Based on the study results, the Blumenthal alternative is recommended.

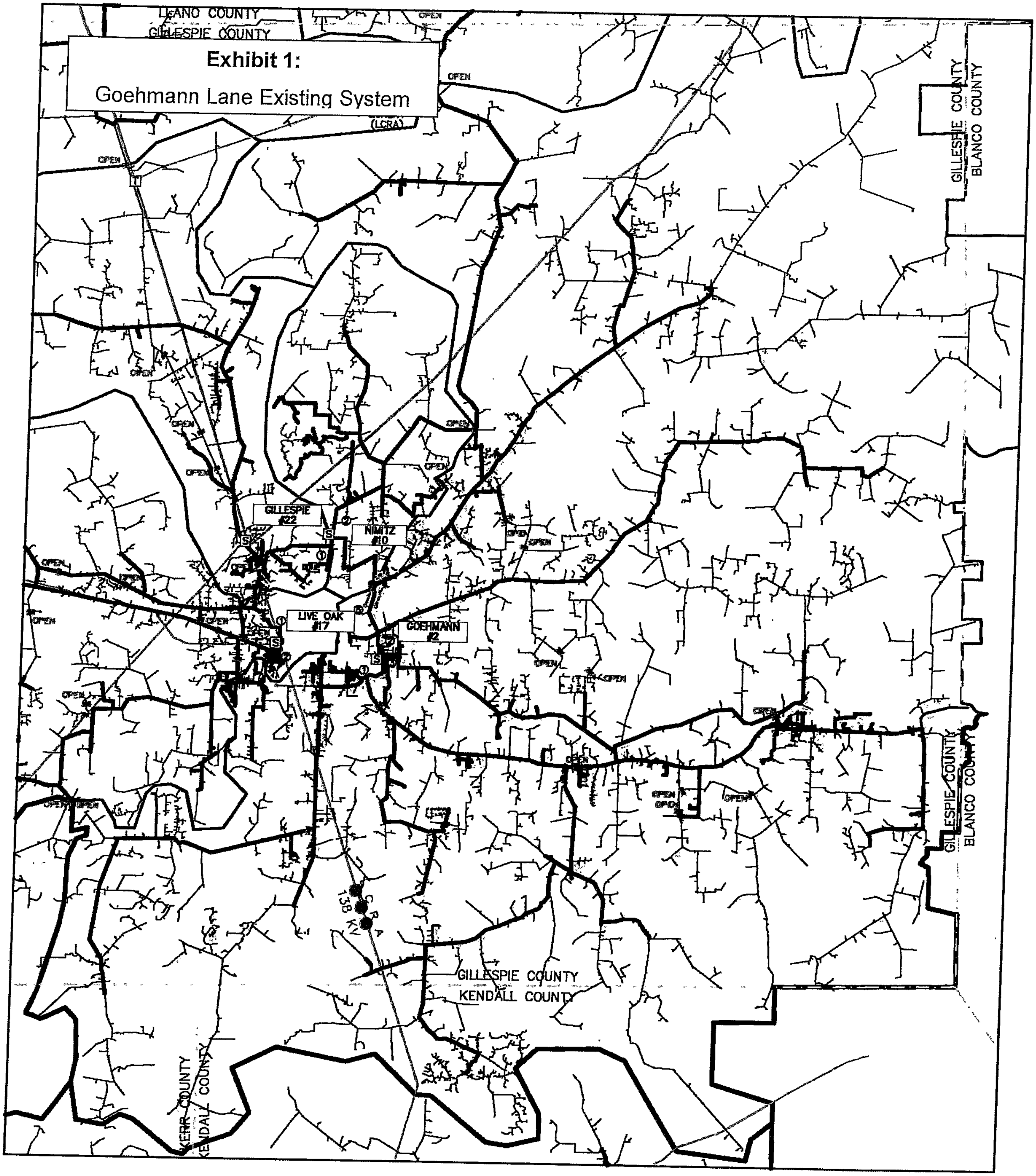
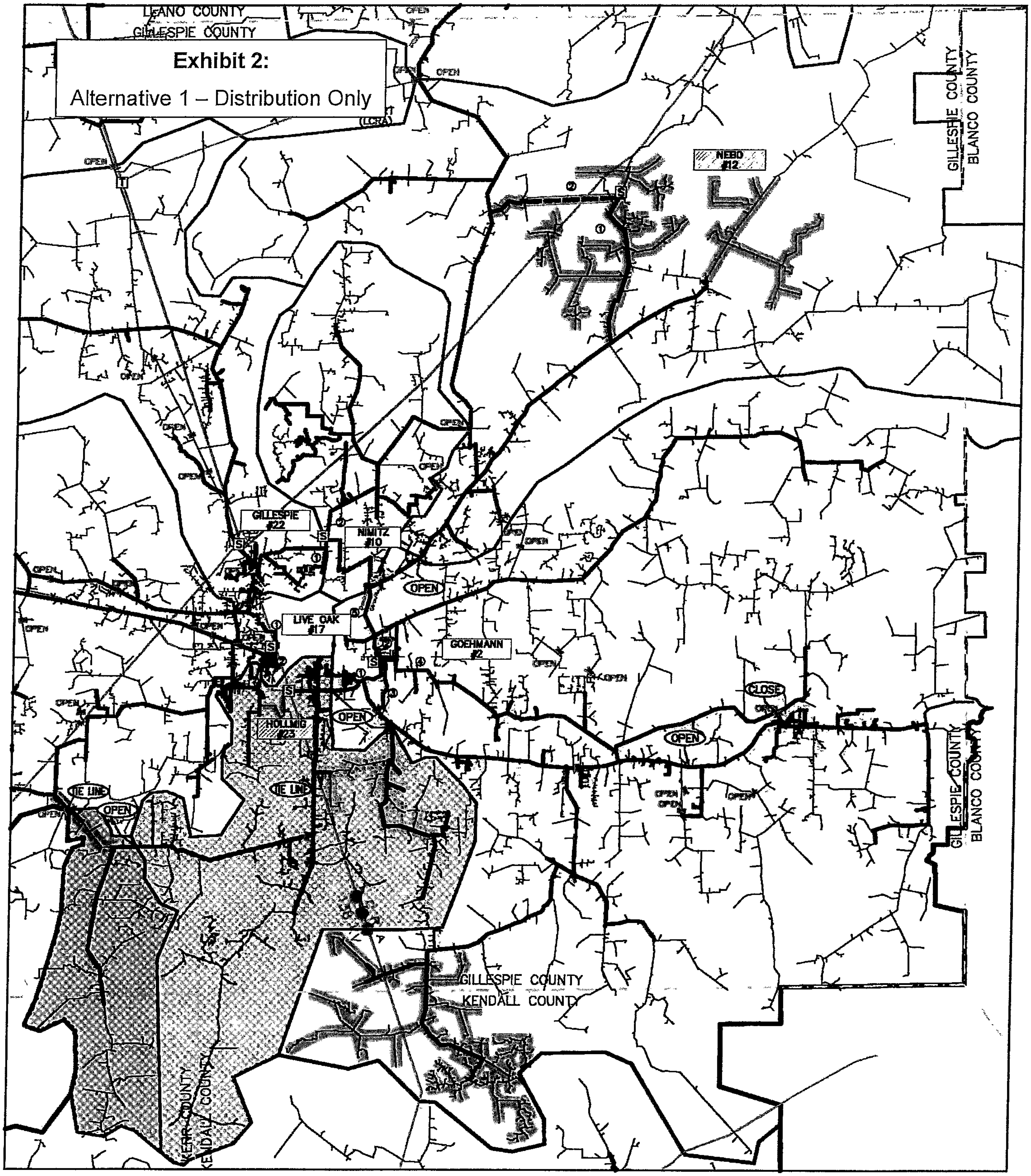


Exhibit 1:
Goehmann Lane Existing System
LLANO COUNTY
GILLESPIE COUNTY
GILLESPIE COUNTY
BLANCO COUNTY
GILLESPIE #22
NIMITZ #10
LIVE OAK #17
GOEHMANN #2
LCRA 138 KV
GILLESPIE COUNTY
KENDALL COUNTY
KERR COUNTY
KENDALL COUNTY


LLANO COUNTY
GILLESPIE COUNTY
Exhibit 2:
Alternative 1 – Distribution Only
GILLESPIE COUNTY
BLANCO COUNTY
NEBO #12
GILLESPIE #22
NIMITZ #10
LIVE OAK #17
GOEHMANN #2
HOLLMIG #23
OPEN
CLOSE
GILLESPIE COUNTY
KENDALL COUNTY
KERR COUNTY
KENDALL COUNTY

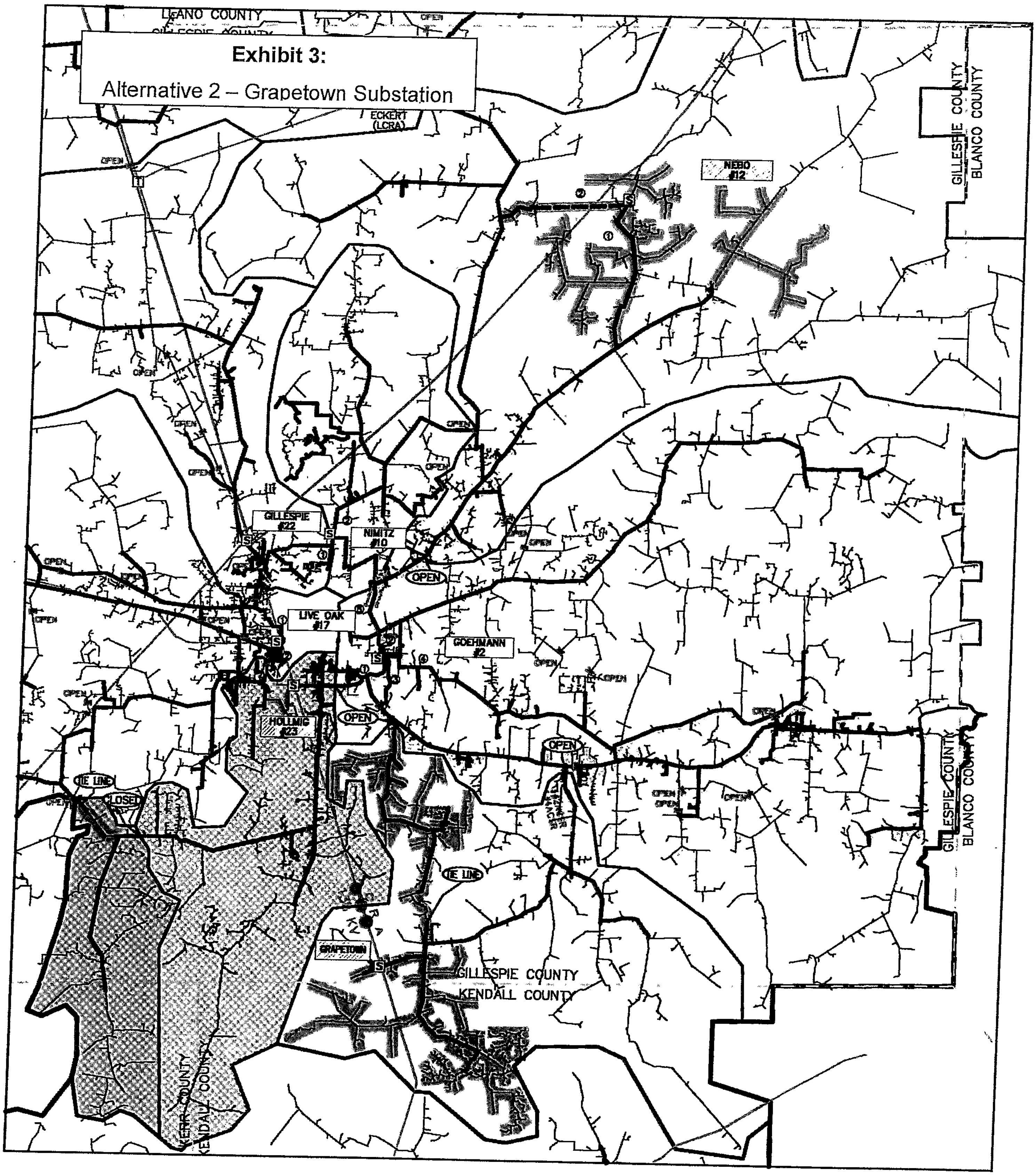


Exhibit 3:
Alternative 2 – Grapetown Substation
LLANO COUNTY
GILLESPIE COUNTY
ECKERT (LCRA)
NEBO #12
GILLESPIE COUNTY
BLANCO COUNTY
GILLESPIE #22
NIMITZ #10
OPEN
LIVE OAK #17
GOEHMANN #2
HOLLMIG #23
TIE LINE
CLOSED
GRAPETOWN
GILLESPIE COUNTY
KENDALL COUNTY
KERR COUNTY
KENDALL COUNTY

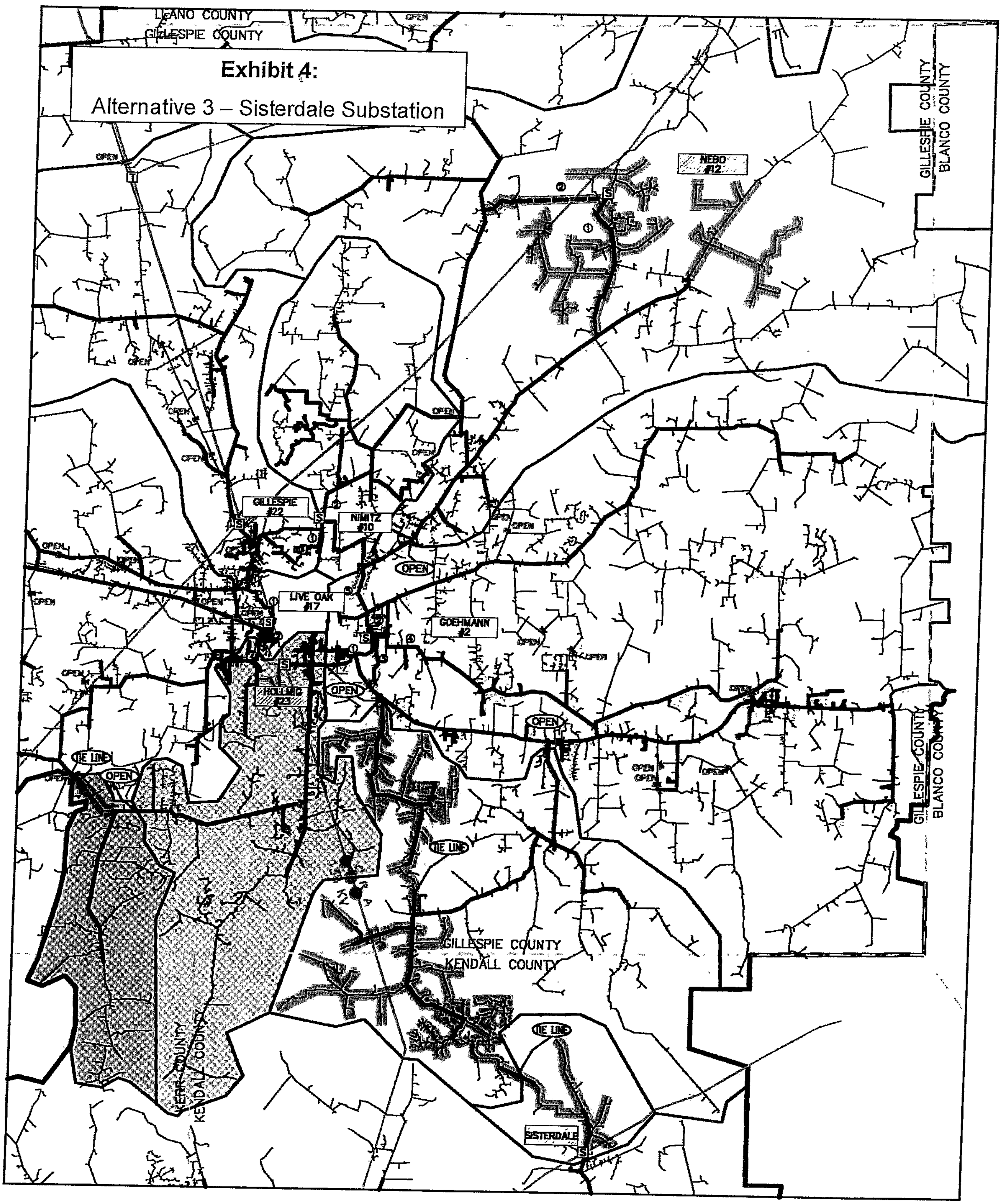


Exhibit 4:
Alternative 3 – Sisterdale Substation
LLANO COUNTY
GILLESPIE COUNTY
GILLESPIE COUNTY
BLANCO COUNTY
NEBO #12
GILLESPIE #22
NIMITZ #10
LIVE OAK #17
GOEHMANN #2
HOLLMIG #23
OPEN
TIE LINE
GILLESPIE COUNTY
KENDALL COUNTY
KERR COUNTY
KENDALL COUNTY
SISTERDALE

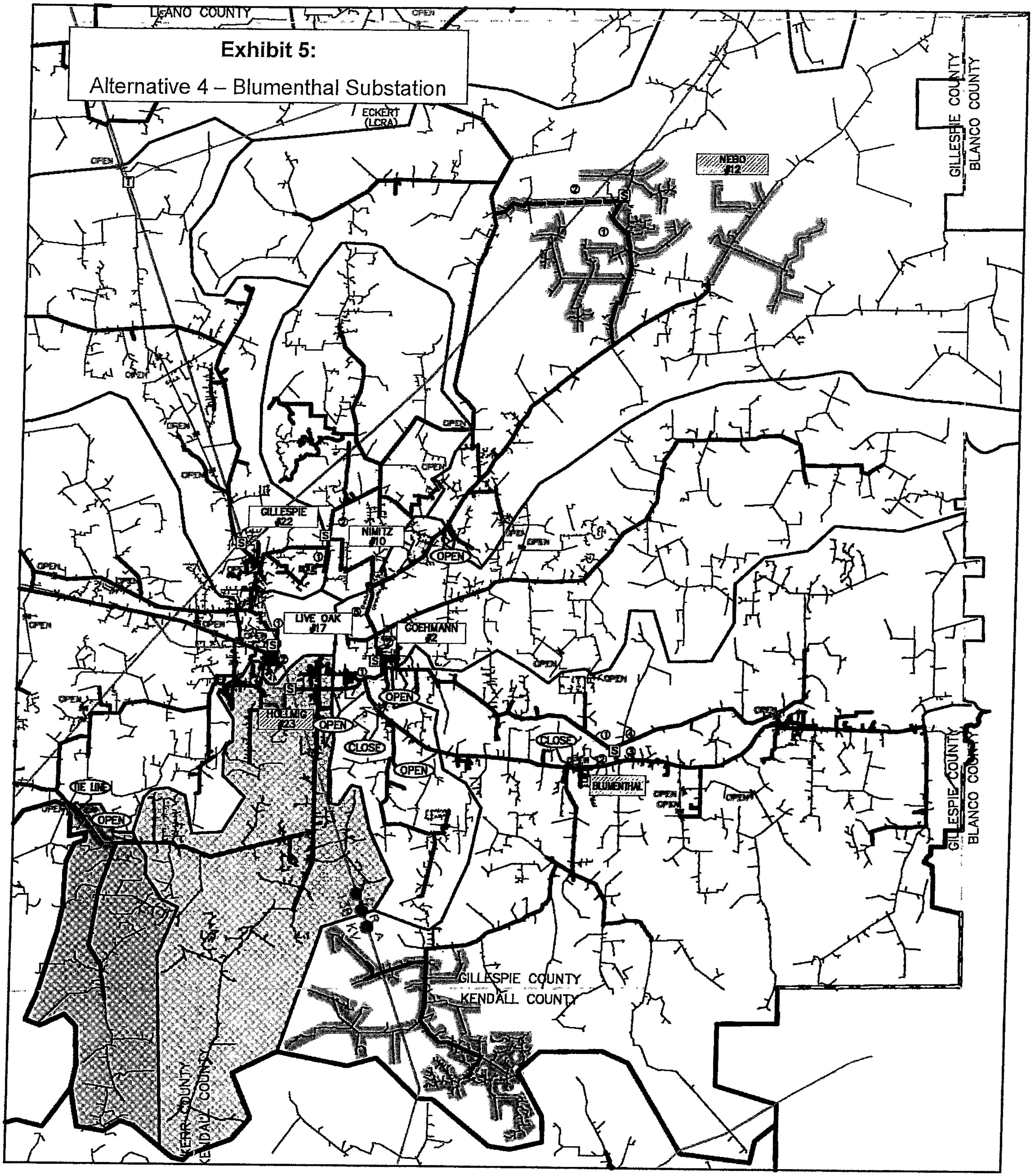


Exhibit 5:

Alternative 4 – Blumenthal Substation

Appendix A
LCRA Planning Criteria

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

Original Publication Approved on 01/27/1998
Revision A Approved on 08/24/1999 – Revised Section III.B. System Reliability
Revision B Approved on 10/26/1999 – Revised Section II. Add Table 1
Revision C Approved on 08/27/2002 – Revised Section I –Substation Bus Design Criteria
Revision D Approved 10/17/2005 – Revised Sections E and F

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

I. INTRODUCTION

The Lower Colorado River Authority (LCRA) and the Association of Wholesale Customers (AWC) have adopted this document as the criteria used to maintain an acceptable level of transmission reliability during normal or contingency conditions. The planning criteria are in compliance with Electric Reliability Council of Texas (ERCOT) and North American Electric Reliability Council (NERC) recommended transmission system planning guidelines.

II. STANDARDS

A. Normal Condition

Normal conditions are defined as the state of the power system before any planned or unplanned outage. There are no contingencies assumed for normal conditions. Normal system conditions shall not include the generating capacity of any hydro units within the LCRA control area. During normal conditions, all system equipment limits or impacts shall be within the applicable ratings as defined in Section III of this document.

B. Single Contingency Condition

Single contingency conditions shall include the planned or unplanned outage of one transmission element or generation unit. During single contingency conditions, all system equipment limits or impacts shall be within the applicable ratings as defined in Section III of this document. Single contingency (category B) conditions are summarized in Table 1.

C. Multiple Contingency Condition

Multiple contingency conditions shall include the planned or unplanned outage of multiple transmission elements or generation units. During multiple contingency conditions, all system equipment limits or impacts shall be within the applicable ratings as defined in Section III of this document. The multiple contingency (category C) conditions are summarized in Table 1.

D. Extreme Contingency Conditions

In addition to the normal, single, and multiple contingency condition tests described above and detailed in Table 1, extreme (category D) conditions will also be conducted to ensure that the planned system conforms to the following additional requirements:

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

1. The contingency loss of a multiple circuit transmission line that is equal to or greater than 0.5 miles in length (either without a fault or subsequent to a normally-cleared non-three-phase fault) with all other facilities normal should not cause a) cascading or uncontrolled outages, b) instability of generating units at multiple plant locations, or c) interruption of service to firm demand or generation other than that isolated by the double-circuit loss, following the execution of all automatic operating actions such as relaying and special protection systems. Furthermore, the loss should result in no damage to or failure of equipment and, following the execution of specific non-automatic predefined operator-directed actions such as re-dispatch, curtailment of interruptible load, or curtailment of unplanned transfers, should not result in applicable voltage or thermal ratings being exceeded.

2. The contingency loss of multiple transmission lines within a common corridor that is equal to or greater than 0.5 miles in length (either without a fault or subsequent to a normally-cleared non-three-phase fault) with all other facilities normal should not cause a) cascading or uncontrolled outages, b) instability of generating units at multiple plant locations, or c) interruption of service to firm demand or generation other than that isolated by the loss of the common corridor, following the execution of all automatic operating actions such as relaying and special protection systems. Furthermore, the loss should result in no damage to or failure of equipment and, following the execution of specific non-automatic predefined operator-directed actions such as re-dispatch, curtailment of interruptible load, or curtailment of unplanned transfers, should not result in applicable voltage or thermal ratings being exceeded. Transmission lines are defined to be within a common corridor if said lines are located in close proximity to each other such that catastrophic failure of one line could cause an outage or failure of another.

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

Table I. Transmission Systems Standards — Normal and Contingency Conditions

Category	Contingencies		System Limits or Impacts				
	Initiating Event(s) and Contingency Component(s)	Components Out of Service	Thermal Limits	Voltage Limits	System Stable	Loss of Demand or Curtailed Firm Transfers	Cascading [c] Outages
A - No Contingencies	All Facilities in Service	None	Normal	Normal	Yes	No	No
B Event resulting in the loss of a single component	Single Line Ground (SLG) or 3-Phase (3Ø) Fault, with Normal Clearing: 1. Generator 2. Transmission Circuit 3. Transformer Loss of a Component without a Fault.	Single Single Single Single	Applicable Rating [a] (A/R) A/R A/R A/R	Applicable Rating [a] (A/R) A/R A/R A/R	Yes Yes Yes Yes	No [b] No [b] No [b] No [b]	No No No No
C Event(s) resulting in the loss of two or more (multiple) components.	SLG Fault, with Normal Clearing: 1. Bus Section 2. Breaker (failure or internal fault)	Multiple Multiple	A/R A/R	A/R A/R	Yes Yes	Planned [d] Planned [d]	No No
	SLG or 3Ø Fault, with Normal Clearing, Manual System Adjustments, followed by another SLG or 3Ø Fault, with Normal Clearing: 3. Category B (B1, B2, B3, or B4) contingency, manual system adjustments, followed by another Category B (B1, B2, B3, or B4) contingency	Multiple	A/R	A/R	Yes	Planned [d]	No
	Fault (non 3Ø), with Normal Clearing: 4. Double Circuit Towerline	Multiple	A/R	A/R	Yes	Planned [d]	No
	SLG Fault, with Delayed Clearing: 5. Generator 7. Transformer 6. Transmission Circuit 8. Bus Section	Multiple Multiple	A/R A/R	A/R A/R	Yes Yes	Planned [d] Planned [d]	No No

Original Approved 1-27-1998
Revised 10-17-2005

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

D [e] – Extreme event resulting in two or more (multiple) components removed or cascading out of service	3Ø Fault, with Delayed Clearing (stuck breaker or protection system failure): 1 Generator 3 Transformer 2 Transmission Circuit 4 Bus Section 3Ø Fault, with Normal Clearing: 5. Breaker (failure or internal fault) Other 6 Loss of tower line with three or more circuits 7 All transmission lines on a common right-of way 8. Loss of a substation (one voltage level plus transformers) 9 Loss of a switching station (one voltage level plus transformers) 10 Loss of all generating units at a station 11 Loss of a large load or major load center 12 Failure of a fully redundant special protection system (or remedial action scheme) to operate when required 13 Operation, partial operation, or misoperation of a fully redundant special protection system (or remedial action scheme) for an event or condition for which it was not intended to operate 14 Impact of severe power swings or oscillations from disturbances in another Regional Council	Evaluate for risks and consequences. • May involve substantial loss of customer demand and generation in a widespread area or areas. • Portions or all of the interconnected systems may or may not achieve a new, stable operating point. • Evaluation of these events may require joint studies with neighboring systems. • Document measures or procedures to mitigate the extent and effects of such events. • Mitigation or elimination of the risks and consequences of these events shall be at the discretion of the entities responsible for the reliability of the interconnected transmission systems.

Footnotes to Table I.

a) Applicable rating (A/R) refers to the applicable normal and emergency facility thermal rating or system voltage limit as determined and consistently applied by the system or facility owner.

b) Planned or controlled interruption of generators or electric supply to radial customers or some local network customers, connected to or supplied by the faulted component or by the affected area, may occur in certain areas without impacting the overall security of the interconnected transmission systems. To prepare for the next contingency, system adjustments are permitted, including curtailments of contracted firm (non-recallable reserved) electric power transfers.

c) Cascading is the uncontrolled successive loss of system elements triggered by an incident at any location. Cascading results in widespread service interruption which cannot be restrained from sequentially spreading beyond an area predetermined by appropriate studies.

d) Depending on system design and expected system impacts, the controlled interruption of electric supply to customers (load shedding), the planned removal from service of certain generators, or the curtailment of contracted firm (non-recallable reserved) electric power transfers may be necessary to maintain the overall security of the interconnected transmission systems.

e) A number of extreme contingencies that are listed under Category D and judged to be critical by the transmission planning entity(ies) will be selected for evaluation. It is not expected that all possible facility outages under each listed contingency of Category D will be evaluated.

Original Approved 1-27-1998
Revised 10-17-2005

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

III. APPLICABLE RATINGS

A. SYSTEM BUS VOLTAGE

The LCRA and AWC transmission system is operated at nominal voltage levels of 345 kilovolts (kV), 138 kV, and 69 kV. The transmission system voltages shall not exceed 105 percent nor fall below 95 percent of nominal voltage during normal conditions (category A). The transmission system voltages shall not exceed 105 percent nor fall below 92 percent of nominal voltage during single, multiple, or extreme contingency conditions (category B, C and D). No single anticipated event shall result in more than a 7 percent voltage swing for three or more substations.

B. SYSTEM RELIABILITY

No more than twenty (20) megawatts (MW) of peak load shall be interrupted for a single anticipated event, except when the single anticipated event is the failure of a single power transformer with a peak load of greater than 20 MW.

1. Reliability to radially supplied station(s), exceeding 20 MW of peak load, shall be addressed by the most technically and economically feasible of the alternatives described below.

   a. Looped transmission service to the radial station may be provided by a separate transmission circuit configuration (separate transmission towers).

   b. Looped transmission service to the radial station may be provided by a double circuit transmission configuration (same transmission towers) from the same source or from multiple sources. If the looped transmission service is from the same source, the transmission source bus must be of a multiple bus construction, and the double circuit to the radial station is terminated on separate buses. Additionally, distribution back-up to support the double circuit supplied station load requirements must be provided. The source(s) of distribution back-up must have the available capacity to support the entire station load without violating emergency loading and voltage levels of the Distribution Planning Criteria. This alternative must include the cost required to limit emergency loading and voltage conditions to within 8 hours.

   c. Limit a radial station load to 20 MW and provide the added capacity requirements from available area stations.

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

2. Station(s) with looped transmission service, whose peak load exceeds 20 MW, shall be identified as requiring circuit breakers such that the single total interrupted load is 20 MW or less.

3. Any distribution voltage bus that experiences six outages per year or multiple outages totaling more than five hours per year due to failures on the transmission system shall be deemed to have inadequate reliability.

C. CONDUCTOR RATINGS

Planned transmission line loading will be such that National Electrical Safety Code line-to-ground clearances will be maintained for all anticipated normal and contingency conditions (category A, B, C and D). Transmission system power flow shall not exceed 100 percent of the conductor thermal rating.

Conductor thermal ratings are assigned for commonly used transmission conductors as shown in Table 2 below. These conductor ratings are based upon a 93.33° C (200° F) average conductor temperature using coefficients of emissivity and absorptivity of 0.5, a 40.55° C (105° F) ambient temperature, an elevation of 600 feet above sea level, north-south line orientation, 30 degree latitude, 2:00 PM solar conditions, clear atmosphere, and a wind velocity of 2 feet per second normal to the conductor.

TABLE 2 – TYPICAL CONDUCTOR THERMAL RATINGS

Conductor Size	Conductor Ampacity	MVA Rating (69 kV)	MVA Rating (138 kV)	MVA Rating (345 kV)
1/O ACSR	256	31	not used	not used
4/O ACSR	396	47	95	not used
336 ACSR	534	64	128	not used
336x2 ACSR	1068	128	255	not used
477 ACSR	666	81	159	not used
795 ACSR	920	110	220	not used
795x2 ACSR	1840	220	440	1099

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

1192.5 ACSR	1168	140	279	not used

D. AUTOTRANSFORMER RATINGS

Planned loading on autotransformers, during normal, single, or multiple contingency conditions (category A, B, C, or D) shall be limited to 100 percent of the auto-transformer's maximum megavoltampere (MVA) rating as specified by the manufacturer.

E. STATION EQUIPMENT RATINGS

The criteria for determining the required performance related to station equipment is provided below. At ERCOT's direction and driven by potential congestion, station equipment upgrades may be necessary for performance above and beyond what is required in this criteria.

1. During any new transmission line project, all station equipment related to that line will be designed such that the continuous rating of all station equipment is greater than or equal to the continuous rating of the new line. During any transmission line upgrade project, station equipment related to that line will be upgraded as necessary such that the continuous rating of all station equipment allows for operating conditions described in 2 and 3 below.

2. Station equipment (circuit breakers, circuit switches, wave traps, jumpers, connectors, current transformers, relays, relay settings, etc.) connected in series with the conductor shall be upgraded (independent of a conductor upgrade) if either of the following two conditions are met:

   a. The continuous rating of the station equipment is less than or equal to 50 percent of the continuous rating of the conductor; or

   b. The loading through the station equipment during either Category A or Category B conditions is greater than or equal to 80 percent of the continuous rating of the station equipment.

3. Interrupting duty of station equipment switching devices (circuit breakers and circuit switchers) shall be planned as follows:

   a. The interrupting rating of circuit breakers shall be at least 120 percent of the maximum available close-in fault at the point of application.

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

b. The interrupting rating of circuit switchers shall be at least 110 percent of the maximum available close-in fault at the point of application.

F. SUBSTATION BUS DESIGN CRITERIA

New Substation Consideration

The ultimate layout for all new 345-kV stations shall be of the ring type, breaker-and-a-half type, or double bus-double breaker type ("improved bus arrangement").

The ultimate layout for all new 138-kV and 69-kV switching stations (i.e. stations with more than two circuits) should allow for an improved bus arrangement where possible.

The type of improved bus arrangement shall be consistent with ultimate plans or potential growth of the substation. The table below lists the accepted improved bus arrangements based on the number of transmission elements connected to the substation. The most cost-effective improved bus arrangement shall be selected.

Transmission Elements*	Accepted Improved Bus Arrangements
Up to Five	1) Ring Bus, 2) Double Bus Double Breaker, or 3) Breaker-and-a-Half
Six-Nine	1) Double Bus Double Breaker, or 2) Breaker-and-a-Half
Ten and Larger	1) Breaker-and-a-Half

*Transmission elements include capacitor banks, generators, lines, and autotransformers.

Improved bus arrangements are required for 138-kV and 69-kV substations meeting the following considerations:

a. Transmission System Considerations

1) The substation includes known plans or has a potential for more than two transmission elements to originate at the substation bus.

2) The substation is located in high load growth or alternative generation corridor.

Lower Colorado River Authority & Association of Wholesale Customers
TRANSMISSION SYSTEM PLANNING CRITERIA

3) The loss of the entire substation bus causes other elements in the system to reach loading levels above 90 percent of their maximum thermal capacity.

4) The loss of the entire substation bus causes system voltage to fall below acceptable defined limits.

b. Load Considerations

1) Substation includes multiple power transformers totaling more than 60 MW of capacity and without adequate transformer back-up.

2) The loss of the entire substation bus causes outages at multiple substations (substation bus is the only source to radial supplied substation serving more than 10 MW).

Existing Substation Consideration

This design guideline, incorporated into this planning criteria on August 2002, addresses all new projects. For systems existing or under development prior to this date, substation bus requirements shall be reviewed on a case by case basis to establish the need for a more reliable bus arrangement.

As major projects are identified through the annual planning process, consideration to items b) 1 and b) 2 above will dictate the need for retrofitting an existing substation to an improved bus arrangement (e.g. when items a) 1-4 above do not by themselves demonstrate the need). However, feasibility and cost to implement solutions that include improved bus designs shall be a factor in making this determination.

If substation property constraints and associated costs prohibit the expansion of an existing substation to one of an improved bus arrangement, a single bus-single breaker design may be acceptable. However, relocation to another substation site should be considered.

Appendix B
CTEC Planning Criteria

SYSTEM PLANNING CRITERIA

The system planning criteria used in the preparation of the Long Range Plan is based upon CTEC, RUS and ERCOT system planning guidelines. A great deal of emphasis is placed on obtaining an accurate existing system data base on which to base the engineering analysis and system improvement recommendations. Once an accurate system data base has been obtained, a detailed engineering analysis is made of the existing system to determine the system improvements needed to maintain reliable and economic service during the Long Range Plan period. The system improvements recommended are based on the existing system needs with a view towards long range system objectives. Following is a description of the planning criteria used in the preparation of this system planning document.

I. Transmission Planning Criteria

A. Transmission voltages shall be maintained between 105% and 95% of nominal operating voltages for normal operating conditions and at 92% or above during contingency situations involving loss of a transmission facility.

B. Transmission facility loadings will be limited to 85% of the facility MVA ratings for normal operating conditions and 90% for contingency situations. The 15% and 10% margins are used to compensate for weather extremes and lead times associated with transmission system facility upgrades.

C. Fault currents do not exceed 85% of transmission system protective device interrupting ratings.

D. Transmission system power factors maintained between 1.05 and .95 during peak load conditions.

E. No more than 20 MW of peak load shall be interrupted for a single anticipated or unanticipated event to include loss of transmission line, circuit breaker, station bus, etc. Radial stations with more than 20 MW of peak load shall be identified as requiring looped transmission service.

When these transmission planning criteria are not met, an analysis is made to determine the need for transmission system facility upgrades to include:

1. Conversion of existing transmission lines to higher operating voltages and/or larger conductors.
2. Upgrade equipment ratings.
3. Construct new transmission facilities.

II. Substation Planning Criteria

A. Power transformers will be loaded to 85% of their Summer and Winter Normal MVA Ratings for normal operating conditions. See the Power Transformer Loading Levels table included as page 5-2-5 of this section. An 85% loading criteria is used to compensate for extreme weather conditions and lead times associated with procuring new power transformers.

B. Substations will be expanded to an ultimate 20 MVA power transformer capacity during the planning period. The following substations will be limited to an ultimate of one 20 MVA power transformer during the planning period:

- Ingram (4)
- Rim Rock (11)
- Fredonia (13)
- Streeter (15)

C. Voltage regulators will be loaded to 85% of their MVA rating. The 15% margin is used to compensate for weather extremes and phase unbalance.

D. Hydraulic oil filled reclosers will be loaded to 70% of their continuous current ratings. Electronic reclosers will be loaded to 70% of their continuous current rating.

E. Fault currents do not exceed 85% of interrupting rating of substation protective devices.

When these substation planning criteria are not met, an analysis is made to determine the need for substation system facility upgrades to include:

1. Switching load to adjacent substation areas to relieve facility loading problems.
2. Upgrade equipment ratings.
3. Construct new substation.

III. Distribution System Planning Criteria

A. Single phase distribution voltages on a 120 volt base will be maintained between 126 volts and 118 volts. Three phase main line voltages on a 120 volt base will be maintained between 126 volts and 120 volts.

B. A conductor loading level of 60% of Maximum Ratings will be used as general guideline for optimum conductor loading. See the Conductor Loading Ampacity Levels table included as page 5-2-6 of this section.

C. To maintain adequate consumer reliability which meets or exceeds present levels, individual feeder loadings will be limited as follows: 6,000 kW for Transition I, 6,000 kW for Transition II and 7,000 for Transition III.

D. To allow for proper sectionalizing and phase balance, single phase distribution lines will, in general, be limited to 35 amps.

E. Substations will be expanded to a with additional distribution feeders as needed, with the following feeder quantity limits:

- Ingram (2 feeder max)
- Pitsburg (5 feeder max)
- Rim Rock (2 feeder max)

F. New three-phase lines or three-phase rebuilds will use only 1/0 ACSR or 336.4 MCM ACSR conductors (see Economic Conductor Loading, Exploratory Plan section).

G. New single phase lines or single phase rebuilds will use only #4 ACSR or 1/0 ACSR conductors (see Economic Conductor Loading, Exploratory Plan section),

H. Line equipment loadings, including voltage regulators and step down transformers, will be limited to 85% of their thermal load ratings.

I. Cascaded distribution line voltage regulators will be used in the first and second transition only. Transition three will not have any cascaded distribution line voltage regulators on the distribution system.

J. System power factors will be fixed at 0.98 during peak load conditions.

K. Physical condition of distribution line conductors, poles, etc. is adequate to provide reliable service during the Long Range Plan period. New and replaced poles will use 40 foot Class 5.

L. New three phase and single phase line will be located along improved roads when possible.

When these system planning criteria are not met, the following system improvements are considered:

1. Transfer load to adjacent feeders with surplus capacity when available.
2. Install voltage regulators
3. Increasing line conductor size.
4. Increase equipment ratings.
5. Convert 1Ø lines to 3Ø.
6. Convert 7.2/12.5 kV lines to operation at 14.4/24.9 kV.
7. Construct tie lines to allow switching load to stronger source.
8. Construct new substation.

Power Transformer Ratings
All Ratings are shown in MVA
ANSI/IEEE C57.92-1981

Transformer Cooling Type	Transformer Rating @ 55 °C	Transformer Rating @ 65 °C	Summer Rating			Winter Rating		
			Normal	Maximum	Emergency	Normal	Maximum	Emergency
OA	1		0.9	1	1.4	1.4	1.5	1.8
OA	1.5		1.4	1.5	2.0	2.1	2.3	2.7
OA	2.5		2.3	2.5	3.4	3.4	3.8	4.6
OA	3		2.7	3	4.1	4.1	4.6	5.5
OA	3.75		3.4	3.75	5.1	5.1	5.7	6.9
OA	3.75	4.2	3.8	4.2	5.3	5.4	6.0	7.2
OA	4.5		4.1	4.5	6.1	6.2	6.8	8.2
OA	5		4.5	5	6.8	6.8	7.6	9.2
OA	5	5.6	5.0	5.6	7.1	7.2	8.0	9.6
OA	5	5.75	5.2	5.75	7.3	7.4	8.2	9.8
OA	7.5		6.8	7.5	10.2	10.3	11.4	13.7
OA	7.5	8.4	7.6	8.4	10.7	10.8	12.0	14.4
OA	10		9.0	10	13.6	13.7	15.2	18.3
OA	12.5	14	12.6	14	17.8	18.0	20.0	23.9
OA / FA	2.2 / 2.8		2.5	2.8	3.8	3.6	3.9	4.7
OA / FA	2.5 / 3.125		2.8	3.125	4.2	4.0	4.4	5.3
OA / FA	2.5 / 3.125	2.8 / 3.5	3.2	3.5	4.4	4.3	4.7	5.5
OA / FA	3.75 / 4.687		4.2	4.687	6.3	5.9	6.6	7.9
OA / FA	3.75 / 4.687	4.2 / 5.25	4.7	5.25	6.6	6.4	7.1	8.3
OA / FA	4 / 5		4.5	5	6.8	6.3	7.1	8.4
OA / FA	4.6 / 5.75		5.2	5.75	7.8	7.3	8.1	9.7
OA / FA	5 / 6.25		5.6	6.25	8.4	7.9	8.8	10.5
OA / FA	5 / 6.25	5.6 / 7	6.3	7	8.8	8.5	9.5	11.1
OA / FA	5.6 / 7		6.3	7	9.5	8.9	9.9	11.8
OA / FA	7.5 / 9.375		8.4	9.375	12.7	11.9	13.2	15.8
OA / FA	7.5 / 9.375	8.4 / 10.5	9.5	10.5	13.2	12.8	14.2	16.6
OA / FA		10 / 12.5	11.3	12.5	15.8	15.2	16.9	19.8
OA / FA	10 / 12.5		11.3	12.5	16.9	15.9	17.6	21.0
OA / FA	10 / 12.5	11.2 / 14	12.6	14	17.6	17.0	18.9	22.1
OA / FA	15 / 20	16.8 / 22.4	20.2	22.4	28.2	27.2	30.2	35.4
OA / FA / FA	3.75/4.687/6	4.2 /5.25/6.75	6.1	6.75	8.6	8.0	8.9	10.4
OA / FA / FA	7.5/9.375/12	8.4/10.5/13.5	12.2	13.5	17.3	16.0	17.8	20.8
OA / FA / FA	12/16/20		18.0	20	26.4	24.8	27.6	32.4
OA / FA / FA	12/16/20	13.4/17.9/22.4	20.2	22.4	28.7	26.6	29.6	34.5
OA / FA / FA	13.1/17.5/21.9	14.7/19.6/24.5	22.1	24.5	31.4	29.1	32.3	37.7
OA / FA / FA	15 / 20 / 25	16.8/22.4/28	25.2	28	35.8	33.3	37.0	43.1
OA / FA / FA		20/26.7/33.3	30.0	33.3	42.6	39.6	44.0	51.3
OA / FA / FA	18 / 24 / 30	20.2/26.9/33.6	30.2	33.6	43.0	39.9	44.4	51.7
OA / FA / FA	24 / 32 / 40	26.9/35.8/44.8	40.3	44.8	57.3	53.2	59.1	69.0

All ratings are based upon 70 percent preloading, 8 hour peak loading, and maximum allowable average winding temperature rise except the Summer Maximum Rating, which is limited to the unit's maximum rating as specified by the manufacturer.
All ratings for normal loading are based upon 90 percent of maximum loading.
All ratings for maximum loading are based upon no power transformer loss of life.
All ratings for emergency loading are based upon a one percent power transformer loss of life.
All ratings for summer loading are based upon 40 °C ambient air temperature.
All ratings for winter loading are based upon 0 °C ambient air temperature.
Cooling Types: OA = Self Cooled OA / FA = Forced Air Cooled (one stage of fans) OA / FA / FA = Forced Air Cooled (two stages of fans)
All MVA values are based upon power transformer ratings rather than substation ratings. Substation equipment such as regulators, buses, or fuses may reduce actual ratings.

Conductor Ratings
All Ratings are shown in Amps
IEEE Std. 738-1993

Conductor		Summer Rating		Winter Rating	
Type	Strands	Normal	Emergency	Normal	Emergency
795 ACSR	26 / 7	730	920	1130	1240
477 ACSR	26 / 7	530	670	820	900
336 ACSR	26 / 7	430	530	650	720
4/0 ACSR	6 / 1	320	390	490	530
2/0 ACSR	6 / 1	240	290	360	390
1/0 ACSR	6 / 1	210	250	310	340
2 ACSR	6 / 1	140	170	220	230
4 ACSR	6 / 1	110	130	170	180
795 AAC	37	700	890	1090	1200
477 AAC	19	520	650	800	870
336 AAC	19	410	520	640	690
4/0 AAC	19	310	380	470	520
2/0 AAC	19	230	290	350	380
1/0 AAC	19	200	250	310	330
4/0 CU	19	390	490	600	660
2/0 CU	7	300	360	450	490
1/0 CU	7	260	310	390	420
2 CU	7	190	230	290	310
4 CU	3	150	180	220	240
6 CU	3	110	130	170	180
8 CU	1	80	90	120	120

All ratings are based upon the following constants:

Wind velocity = 2 feet/second
Elevation = 600 feet
Emissivity = 0.5
Solar Absorptivity = 0.5
Line Orientation = North-South
Latitude = 30°
Atmosphere = Clear
Time of Day = 2:00 PM

All ratings for normal loading are based upon a maximum conductor temperature of 75 °C.

All ratings for emergency loading are based upon a maximum conductor temperature of 93.3 °C.

All ratings for summer loading are based upon 40 °C ambient air temperature.

All ratings for winter loading are based upon 0 °C ambient air temperature.

SCHNEIDER ENGINEERING

CENTRAL TEXAS ELECTRIC COOPERATIVE, INC. | GOEHMANN LANE DISTRIBUTION ALTERNATIVE STUDY

SUPPLEMENTAL REPORT

JUNE 10, 2013

STATE OF TEXAS
LANCE T. PETTIGREW
84775
LICENSED
PROFESSIONAL ENGINEER

6-10-13

EXECUTIVE SUMMARY

This supplement to the July 2012 Goehmann Lane Distribution Alternatives Study is submitted based on revisions to the load forecast projections for load growth in the area. The load forecast has been revised based on actual winter 2012 peak load data, which reflects a mild 2012 winter season.

This supplement applied the new load forecast data to the alternatives discussed in the original report, and assessed the impact of the alternatives studied in the original report. . While the new lower peak load projections in the updated load forecast actually deferred some of the problem areas a couple of years, the end result of the supplemental analysis validated the Blumenthal Alternative as the best long term strategic solution.

The enclosed report includes revised load forecast projections for each alternative, and briefly discusses the results of modified load projections as they relate to the following four alternatives:

1. Alternative 1: Distribution Only
2. Alternative 2: Grapetown Substation
3. Alternative 3: Sisterdale Substation
4. Alternative 4: Blumenthal Substation

INTRODUCTION

Goehmann Lane Area Existing Electric System Discussion

Table 1 from the original report has been revised as shown below to include both 2011 and 2012 actual peak loading for Goehmann Lane. The lower 2012 actual peaks were significantly lower than the 2011 peaks based on a 2012 mild winter season. The table also reflects load switching from Goehmann Lane to Hollmig prior to the 2012 peak.

The revised load forecast and the load switch to Hollmig substations still result in a 20 MW rule violation, and presents feeder loading issues in 2013. The red text in the table represents load levels in years that they present planning criteria violations. (This will be typical throughout the report.)

The forecast load on Goehmann for 2016 has been revised down from the original load forecast level of 39.4 MW to 28.8 MW.

Substation	Fdr	2011 Actual Peak kW	2012 Actual Peak kW	2013 Forecast (kW)	2014 Forecast (kW)	2015 Forecast (kW)	2016 Forecast (kW)	2017 Forecast (kW)	2018 Forecast (kW'
Goehmann Lane	1	9,150	4,424	544	1,001	1,458	1,915	2,198	2,485
Goehmann Lane	2	3,359	2,292	2,140	2,124	2,115	2,106	2,101	2,300
Goehmann Lane	3	4,306	4,528	6,021	6,171	6,321	6,471	6,795	7,115
Goehmann Lane	4	7,889	5,380	6,063	6,305	6,547	6,789	7,031	7,080
Goehmann Lane	5	6,893	4,258	5,842	6,000	6,161	6,322	6,488	6,658
Total		**31,597**	**20,882**	**20,610**	**21,601**	**22,602**	**23,603**	**24,613**	**25,638**
		Peak kW	**Peak kW**	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**
Hollmig (1)		-	3,700	4,427	4,690	4,953	5,216	5,479	5,742
Hollmig (2)		-	-	3,309	3,505	3,701	3,897	4,093	4,289

Table 1: Goehmann Lane Loads – Unimproved (Updated to 2012 Peak)

Notes
(1) Load switched from Goehmann Lane.
(2) Load switched from Live Oak.

The July 2012 study also commented on two substations previously approved as a part of the 2008-2012 Construction Work Plan: (1) Hollmig substation has been completed as previously mentioned, and (2) Nebo is presently under construction with a July 2013 anticipated completion date. The July 2012 report had assumed those two stations completed in the analysis that followed, and that assumption is still valid.

ALTERNATIVE ANALYSIS AND DISCUSSION

Alternative 1 - Distribution Only

Table 2 from the original report has been expanded and updated with the new load forecast numbers. The final feeder loading results following the distribution construction, load switching, and load balancing discussed in the original report is shown below:

Substation	Feeder	2013 Forecast (kW)	2014 Forecast (kW)	2015 Forecast (kW)	2016 Forecast (kW)	2017 Forecast (kW)	2018 Forecast (kW)	2019 Forecast (kW)
Goehmann Lane	1	544	1,001	1,458	1,915	2,198	2,485	2,835
Goehmann Lane	2	2,140	2,124	2,115	2,106	2,101	2,300	2,482
Goehmann Lane	3	6,021	6,171	6,321	6,471	6,795	7,115	7,304
Goehmann Lane	4	6,063	6,305	6,547	6,789	7,031	7,080	7,269
Goehmann Lane	5	270	275	280	285	290	295	300
Total		15,038	15,876	16,721	17,566	18,415	19,275	20,190
		(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
Hollmig (1)		4,427	4,690	4,953	5,216	5,479	5,742	6,017
Hollmig (2)		3,309	3,505	3,701	3,897	4,093	4,289	4,495
Nebo (3)		5,572	5,725	5,881	6,037	6,198	6,363	6,532

Table 2: Load Switching Results – Distribution Only

Notes
(1) Load switched from Goehmann Lane.
(2) Load switched from Live Oak.
(3) Load Switched from Goehmann Lane feeder 5.

The proposed load switching will reduce the total load on the Goehmann Lane substation below the 20 MW limit until 2019; however, the demand on Goehmann Lane feeders 3 and 4 still exceeds the 6 MW limit using the projected 2013 peak demand data.

Alternative 2 - Grapetown Substation

Updated forecast numbers associated with this supplement project the total radial load on Goehmann Lane to be 16,538 kW in 2019. The Grapetown alternative solves the 20 MW criteria violation until approximately 2021. The load transfer for feeder load balance only provides relief for Goehmann Lane Feeder 3 until 2019

Substation	Feeder	2013 Forecast (kW)	2014 Forecast (kW)	2015 Forecast (kW)	2016 Forecast (kW)	2017 Forecast (kW)	2018 Forecast (kW)	2019 Forecast (kW)
Goehmann Lane	1	1,168	1,650	2,131	2,613	2,931	3,253	3,631
Goehmann Lane	2	2,140	2,124	2,115	2,106	2,101	2,300	2,482
Goehmann Lane	3	5,054	5,210	5,368	5,524	5,758	5,904	6,054
Goehmann Lane	4	3,395	3,531	3,666	3,802	3,937	3,965	4,071
Goehmann Lane	5	270	275	280	285	290	295	300
Total		12,027	12,790	13,560	14,330	15,017	15,717	16,538
	Feeder	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
Hollmig	2	4,427	4,690	4,953	5,216	5,479	5,742	6,017
Hollmig	1	3,309	3,505	3,701	3,897	4,093	4,289	4,495
Total		7,736	8,195	8,654	9,113	9,572	10,031	10,512
	Feeder	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
Nebo	1	4,068	4,179	4,293	4,407	4,525	4,645	4,768
Nebo	2	1,504	1,546	1,588	1,630	1,673	1,718	1,764
Total		5,572	5,725	5,881	6,037	6,198	6,363	6,532
	Feeder	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
Grapetown	1	1,758	1,802	1,846	1,890	1,984	2,078	2,133
Grapetown	2	1,253	1,284	1,315	1,346	1,414	1,480	1,519
Total		3,011	3,086	3,161	3,236	3,398	3,558	3,652

Table 3: Load Switching Results: Grapetown Alternative (2013-2019)

Providing long term relief to the growing load is still not attainable with this alternative due to the geographic location of the Goehmann Lane circuits relative to the approximate location of the Grapetown substation alternative

The revised load forecast provided some additional benefit to the Grapetown Alternative, but still failed to provide a comprehensive solution to the growing reliability problems west of Goehmann Lane. The updated results provided no change in the original conclusion with regard to the Grapetown Alternative which was to explore other alternatives that may provide a comprehensive longer term strategic benefit.

Alternative 3 - Sisterdale Substation

With the updated load forecast projections, the Sisterdale Alternative solution deferred the 6 MW feeder planning criteria violation to 2019, and deferred the Goehmann Lane radial 20 MW criteria violation until approximately 2021.

Because the Sisterdale substation only provides a short term deferment of planning violations until 2019, it is still not was not considered as a viable strategic alternative.

Table 3 below shows the revised expanded forecast

Substation	Feeder	2013 Forecast (kW)	2014 Forecast (kW)	2015 Forecast (kW)	2016 Forecast (kW)	2017 Forecast (kW)	2018 Forecast (kW)	2019 Forecast (kW)
Goehmann Lane	1	1,168	1,650	2,131	2,613	2,931	3,253	3,631
Goehmann Lane	2	2,140	2,124	2,115	2,106	2,101	2,300	2,482
Goehmann Lane	3	5,054	5,210	5,368	5,524	5,758	5,904	6,054
Goehmann Lane	4	3,395	3,531	3,666	3,802	3,937	3,965	4,071
Goehmann Lane	5	270	275	280	285	290	295	300
Total		12,027	12,790	13,560	14,330	15,017	15,717	16,538
	Feeder	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**
Hollmig	2	4,427	4,690	4,953	5,216	5,479	5,742	6,017
Hollmig	1	3,309	3,505	3,701	3,897	4,093	4,289	4,495
Total		7,736	8,195	8,654	9,113	9,572	10,031	10,512
	Feeder	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**
Nebo	1	4,068	4,179	4,293	4,407	4,525	4,645	4,768
Nebo	2	1,504	1,546	1,588	1,630	1,673	1,718	1,764
Total		5,572	5,725	5,881	6,037	6,198	6,363	6,532
	Feeder	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**	**(kW)**
Sisterdale	1	3,011	3,086	3,161	3,236	3,398	3,558	3,652

Table 4: Load Switching Results – Sisterdale Substation Alternative

Alternative 4 - Blumenthal Substation

Table 5 represents the updated load forecast with consideration of the Blumenthal Substation alternative. The updated load forecast results still support Blumenthal as the best long term alternative to resolve the Goehmann Lane 20 MW radial loading issue, and long term feeder loading issues.

Substation	Feeder	2013 Forecast (kW)	2014 Forecast (kW)	2015 Forecast (kW)	2016 Forecast (kW)	2017 Forecast (kW)	2018 Forecast (kW)	2019 Forecast (kW)
Goehmann Lane	1	544	1,001	1,458	1,915	2,198	2,485	2,835
Goehmann Lane	2	2,140	2,124	2,115	2,106	2,101	2,300	2,482
Goehmann Lane	3	6,021	6,171	6,321	1,359	1,427	1,494	1,534
Goehmann Lane	4	6,063	6,305	6,547	1,193	1,406	1,416	1,454
Goehmann Lane	5	270	275	280	285	290	295	300
Total		15,038	15,876	16,721	6,858	7,422	7,990	8,605
	Feeder	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
Hollmig	2	4,427	4,690	4,953	5,216	5,479	5,742	6,017
Hollmig	1	3,309	3,505	3,701	3,897	4,093	4,289	4,495
Total		7,736	8,195	8,654	9,113	9,572	10,031	10,512
	Feeder	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
Nebo	1	4,068	4,179	4,293	4,407	4,525	4,645	4,768
Nebo	2	1,504	1,546	1,588	1,630	1,673	1,718	1,764
Total		5,572	5,725	5,881	6,037	6,198	6,363	6,532
	Feeder	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)
Blumenthal	1				1,623	1,631	1,643	1,686
Blumenthal	2				5,112	5,368	5,621	5,770
Blumenthal	3				2,742	2,756	2,775	2,849
Blumenthal	4				1,231	1,238	1,246	1,280
Total					10,708	10,993	11,285	11,258

Table 5: Load Switching Results – Blumenthal Alternative

CONCLUSION

The information provided in this supplement is a result of revised load forecast data that was developed based on actual winter 2012 system peak demands. Each of the original alternatives was evaluated with the new load projections to assess any potential difference in outcome from the original report conclusions.

The updated analysis demonstrated that the Blumenthal Substation Alternative still provides the only comprehensive long term solution to the growing load needs of the study area, and is still the recommended solution.