PUC DOCKET NO. 45601

APPLICATION OF LCRA TRANSMISSION SERVICES CORPORATION TO AMEND ITS CERTIFICATE OF CONVENIENCE AND NECESSITY FOR THE PROPOSED ZORN TO MARION 345-KV TRANSMISSION LINE IN GUADALUPE COUNTY, TEXAS BEFORE THE PUBLIC UTILITY COMMISSION OF TEXAS

DIRECT TESTIMONY AND EXHIBITS OF CHARLES M. DEWITT, P.E. 67705

ON BEHALF OF APPLICANT LCRA TRANSMISSION SERVICES CORPORATION

March 1, 2016
PUC DOCKET NO. 45601
DIRECT TESTIMONY AND EXHIBITS OF CHARLES M. DEWITT

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EXHIBITS

Exhibit CMD-1: Excerpt from ERCOT 2013 Regional Transmission Plan

Exhibit CMD-2: Excerpt from ERCOT 2012 Long Term System Assessment report

Exhibit CMD-3: Market Notice W-A102513-02

Exhibit CMD-4: LCRA TSC and CPS Energy Regional Planning Group Project Proposal

Exhibit CMD-5: ERCOT Board of Directors endorsement letter
Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.
A. My name is Charles M. DeWitt. My business address is: Lower Colorado River Authority, 3505 Montopolis Drive, Building D, Austin, Texas 78744.

Q. BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?
A. I am employed by the Lower Colorado River Authority (LCRA) as an Engineering Manager, and am providing testimony in this docket on behalf of LCRA Transmission Services Corporation (LCRA TSC).

Q. PLEASE DESCRIBE YOUR EDUCATIONAL AND PROFESSIONAL QUALIFICATIONS AND BUSINESS EXPERIENCE.
A. I am a licensed Professional Engineer in the State of Texas (license number 67705). I hold a Bachelor of Science degree in Electrical Engineering from Texas A&M University. As an employee of LCRA, I have managed transmission planning activities for LCRA TSC since 2009. In this position, I was responsible for performing annual screening study assessments for LCRA TSC and recommending projects needed to maintain transmission system performance in compliance with the Electric Reliability Council of Texas (ERCOT) Planning Guides and North American Electric Reliability Corporation (NERC) Reliability Standards. In this role, I have performed steady state and dynamics power line simulations in addition to reviewing the work of engineers and associate engineers on my staff. Prior to 2009 and as an employee of LCRA, I supervised a team of transmission line engineers responsible for the design of new and upgraded transmission lines at 69-kilovolt (kV), 138-kV, and 345-kV for seven years. Between 1985 and 2002, I performed studies related to resource planning, transmission planning, advised customers on energy use, and designed transmission lines while employed by Central and South West Corporation (now American Electric Power). Overall, I have 30 years of experience in engineering within the electric utility business.
Q. PLEASE DESCRIBE YOUR CURRENT JOB RESPONSIBILITIES, PARTICULARLY AS THEY APPLY TO THE APPLICATION PENDING IN THIS DOCKET.

A. I manage the transmission system planning group at LCRA. My team performs system assessments to identify areas of the LCRA TSC system that will need improvements in order to meet LCRA TSC’s transmission planning criteria, ERCOT Planning Guides, and NERC Reliability Standards. I am also responsible for representing LCRA TSC at the ERCOT Steady State Working Group (SSWG), the ERCOT Planning Working Group (PLWG), and the ERCOT Regional Planning Group (RPG).

Q. HAVE YOU TESTIFIED PREVIOUSLY BEFORE THE PUBLIC UTILITY COMMISSION OF TEXAS (PUC OR COMMISSION)?

A. Yes, I filed written testimony in the PUC Docket No. 36686 (N. McCamey to Tippet 138-kV transmission line).

II. PURPOSE OF TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY IN THIS DOCKET?

A. The purpose of my testimony is to:

1. Explain the facts supporting the need for the Zorn to Marion 345-kV Transmission Line in Guadalupe County, Texas (the Project).

2. Review transmission planning studies that led to the ERCOT Board of Directors endorsing the Project and designating the Project as critical to reliability.

3. Describe alternatives considered.

4. Explain why the Project is the best option to meet the electric system needs.

5. Describe the benefits to transmission system performance achieved by construction of the Project.

Q. WHAT PORTIONS OF THE APPLICATION IN THIS DOCKET DO YOU SPONSOR?

A. I sponsor the answers to Questions 14, 15, and 16. I co-sponsor the answers to Questions 4 and 11 with Ms. Roxanne Hernandez and Ms. Aimee Pasquarella. I also provided information to POWER Engineers, Inc. (POWER) for Section 1.2 and Section 5.2.3.2 of...
the Environmental Assessment and Alternative Route Analysis for the Proposed Zorn to
Marion 345-kV Transmission Line Project within Guadalupe County, Texas (EA).

Q. WAS YOUR TESTIMONY AND THE INFORMATION YOU HAVE BEEN
IDENTIFIED AS SPONSORING PREPARED BY YOU OR BY
KNOWLEDGEABLE PERSONS UPON WHOSE EXPERTISE, JUDGMENT
AND OPINIONS YOU RELY IN PERFORMING YOUR DUTIES?
A. Yes.

Q. IS THE INFORMATION CONTAINED IN YOUR TESTIMONY AND THE
INFORMATION YOU ARE SPONSORING TRUE AND CORRECT TO THE
BEST OF YOUR KNOWLEDGE AND BELIEF?
A. Yes.

III. PROJECT NEED

Q. PLEASE DESCRIBE THE PROJECT.
A. As provided in LCRA TSC’s application in this docket (the Application), the Project is a
new 345-kV transmission line from the existing LCRA TSC Zorn substation to the
existing LCRA TSC Marion substation. The first circuit to be installed will connect the
Zorn and Marion substations and will use an open position on an existing 345-kV
transmission line between Zorn and the existing LCRA TSC Clear Springs substation.
From the area of the Clear Springs substation, the Project entails construction of new
double-circuit-capable structures, with the installation of the first circuit initially and a
second circuit on the double-circuit capable structures in the future.

Q. WHY IS THE PROJECT NEEDED?
A. The Project is needed to meet the projected demand for electricity in and along the
Interstate 35 (I-35) corridor between San Antonio and Austin and to support north to
south bulk electric system transfers across 138-kV and 345-kV transmission lines within
this corridor. This corridor is composed of Bexar, Comal, Hays, Travis, and Williamson
Counties.
Analysis of the power system using electric demand projects provided in ERCOT SSWG power flow cases showed that multiple 138-kV transmission facilities located in the I-35 corridor will exceed their capacity by 2018. The ERCOT 2013 Regional Transmission Plan (RTP) reported this condition. The relevant excerpt is attached as Exhibit CMD-1. LCRA TSC and CPS Energy confirmed these findings and reported them when they submitted the LCRA TSC and CPS Energy Transmission System Additions project for an ERCOT Independent Assessment in accordance with Section 3 of the ERCOT Nodal Protocols. ERCOT’s Independent Assessment of the Project showed similar results by 2019. I will discuss these studies and their findings later in my testimony.

The ERCOT 2012 Long Term System Assessment (LTSA) report also identified the increased reliance on 138-kV system infrastructure to support bulk power transfers and called for further analysis to verify the cost-effectiveness of upgrades that would be needed. The LTSA goes on to state, “From an economic perspective, the ‘life-lines,’ connecting the EHV SA loop to the 345kV corridor which runs parallel to I-35 (Hutto to Clear Springs) exhibits significant congestion across multiple scenarios.” The relevant excerpt from the 2012 LTSA is attached as CMD-2.

Q. ARE THERE ANY OTHER FACTORS SUPPORTING THE NEED FOR THE PROJECT?

A. Yes, CPS Energy will retire the J.T. Deely generation station in 2019. ERCOT announced CPS Energy’s plan in 2013 with Market Notice W-A102513-02, which I have attached as Exhibit CMD-3. The J.T. Deely generation station currently provides 845 MW to the transmission system during summer peak load conditions according to the power flow cases used to assess the ERCOT transmission system. Retirement of the J.T. Deely generating station increases reliance on the I-35 transmission corridor for power needed to meet demand in the area.
IV. TRANSMISSION PLANNING STUDIES

Q. WHY DOES LCRA TSC UNDERTAKE STUDIES OF THE FUTURE PERFORMANCE OF ITS TRANSMISSION SYSTEM?

A. LCRA TSC is registered as a Transmission Planner with the Texas Reliability Entity, Inc. and is registered as a Transmission Service Provider in ERCOT. In these roles, LCRA TSC is required to perform an assessment of its transmission system to determine if the transmission system meets the performance requirements defined in the ERCOT Planning Guides and in the NERC Transmission Planning (TPL) Reliability Standards. According to PUC Substantive Rule 25.195(b), a Transmission Service Provider (TSP) “shall, consistent with good utility practice, endeavor to construct and place into service sufficient transmission capacity to ensure adequacy and construct, operate, and maintain facilities that are needed to relieve transmission constraints, as recommended by ERCOT….”

Q. WHAT TRANSMISSION STUDIES WERE PERFORMED TO ASSESS THE NEED FOR THE PROJECT?

A. There were two transmission studies that evaluated the need for the Project. The first study was a joint study between CPS Energy and LCRA TSC. This study led to CPS Energy and LCRA TSC submitting the Project for an independent assessment by ERCOT staff in June 2014. The second study was the ERCOT Independent Assessment. This study led to the recommendation of the Project by ERCOT staff and an endorsement and critical designation by the ERCOT Board of Directors in April of 2015.

Q. WHAT WAS THE SCOPE OF THE JOINT STUDY BETWEEN CPS ENERGY AND LCRA TSC?

A. The joint study between LCRA TSC and CPS Energy evaluated the state of the transmission system’s support for loads in northern Bexar, Comal, and Guadalupe counties to determine if the system would meet the performance requirements of the ERCOT Planning Guides and the NERC TPL Reliability Standards. The study evaluated system conditions as anticipated by the SSWG power flow cases and the ERCOT RTP power flow cases. In addition, the study assessed the impact of announced changes to
generation in the area (e.g., the retirement of the J.T. Deely generation station). The study employed steady state contingency analysis using power flow analysis software to determine if the system met performance requirements.

Q. WHAT IS STEADY STATE CONTINGENCY ANALYSIS AND HOW IS IT DETERMINED IF A SYSTEM DOES NOT MEET PERFORMANCE REQUIREMENTS?

A. Steady state contingency analysis is the process of evaluating the performance of the interconnected electric grid under stable (steady state) conditions during a contingency (one or more elements of the system removed) event. The analysis applies a contingency, then reports system performance relative to the allowable limits for each remaining element in the system. The limits used to analyze system performance for the study for the Project were steady state limits. Steady state limits are determined by the current carrying capacity (sometimes referred to as a thermal limit) and the voltage limits (high and low) of each transmission system element. An element is considered overloaded when it will exceed its current carrying capacity (rating or thermal limit) in steady state conditions following a contingency event. Steady state contingency analysis also investigates system adjustments that could be made before, during, or after the contingency in order to avoid exceeding a voltage or thermal limit. The ERCOT Planning Guides and NERC TPL Reliability Standards establish the contingencies, allowable system adjustments, and the performance requirements following contingencies. The system does not meet performance requirements if a steady state contingency analysis identifies that voltage limits are exceeded or elements are overloaded (or nearly overloaded) and no acceptable system adjustment is available to avoid the overload.

Q. WHAT WERE THE FINDINGS OF THE JOINT STUDY?

A. The joint study performed by LCRA TSC and CPS Energy (attached as Exhibit CMD-4) determined that the electric transmission system in northeastern Bexar and Comal counties did not meet the performance requirements contained in the ERCOT Planning Guides and the NERC TPL Reliability Standards. The portion of the system most directly impacted is composed of the 138-kV and 345-kV transmission facilities depicted
in response to Question 16 of LCRA TSC’s Application. The joint study showed that an outage of the double-circuit Marion to Clear Springs to Zorn 345-kV transmission line, particularly when coupled with loss of a generator or an autotransformer in the area, results in overloads on the existing 138-kV system in both the ERCOT RTP cases and the ERCOT SSWG cases. The deficiencies in performance requirements are reported on pages 30-31 of Exhibit CMD-4.

Q. WHAT ACTION DID LCRA TSC AND CPS ENERGY TAKE BASED ON THE RESULTS OF THE JOINT STUDY?
A. LCRA TSC and CPS Energy developed a number of alternatives to address the required system performance, evaluated their effectiveness, and then submitted a recommendation to ERCOT for its independent assessment.

Q. WHAT ALTERNATIVES DID THE JOINT STUDY IDENTIFY?
A. The joint study identified two general approaches to address the deficiencies in system performance. One approach is described in Alternative 1 in the report. The other approach, which includes the Project, is contained within Alternatives 2 through 8 in the report. Alternative 1 upgraded the existing transmission line between Marion and Clear Springs, connected the existing Marion to Zorn transmission line at Clear Springs, and required a new transmission line between Clear Springs and a new substation in northeastern Bexar County. Alternatives 2 through 8 added a new 345-kV transmission circuit from Marion to Zorn.

Q. WHAT ALTERNATIVE DID THE JOINT STUDY RECOMMEND?
A. The joint study recommended Alternative 3, which included the construction of a new 345-kV transmission circuit between the Marion and Zorn substations (the Project). LCRA TSC and CPS Energy recommended Alternative 3 because of its lower cost relative to the other options, including Alternative 1, and its effectiveness at reducing the overloads on the existing transmission system.
Q. WHY DID LCRA TSC AND CPS ENERGY SUBMIT THE JOINT STUDY TO ERCOT FOR ITS INDEPENDENT ASSESSMENT?

A. ERCOT Nodal Protocol Section 3.11 Transmission Planning establishes the process for recommending and evaluating projects to be constructed within ERCOT. Project endorsement through the process established in Section 3.11 is intended to “support, to the extent applicable, a finding by the Commission that a project is necessary for the service, accommodation, convenience, or safety of the public within the meaning of [Public Utility Regulatory Act (PURA) § 37.056 and Commission Substantive Rule 25.101].”

The process begins when a TSP submits a proposed project to the RPG for review. The RPG is an ERCOT-led group of ERCOT market participants. TSPs are required to participate in the RPG, but participation is also open to other market participants, consumers, other stakeholders, and PUC Staff.

After receiving a proposed project, ERCOT posts the project for comment by the participants in the RPG. After receiving comments on the proposed project, ERCOT assigns the project a tier designation in accordance with the definitions provided in ERCOT Nodal Protocol Section 3.11.4. A project is assigned Tier 1 when its total estimated capital cost is $50,000,000 or greater. Tier 1 projects require ERCOT to perform an independent assessment of the project and present a report of its assessment to the RPG. Tier 1 projects also require endorsement by the ERCOT Board of Directors.

Q. DID ERCOT COMPLETE THIS REVIEW AND ENDORSEMENT PROCESS FOR THE PROJECT?

A. Yes. The Project, as a component of other transmission system upgrades and improvements, is a Tier 1 project. ERCOT received the proposed project from LCRA TSC and CPS Energy, posted the project for comment on June 27, 2014, received comments from RPG participants, performed an independent assessment, and presented the independent assessment to RPG participants. The ERCOT Board of Directors endorsed the Project as a component of the other upgrades and system improvements at its April 14, 2015 meeting and designated it as critical to reliability. The ERCOT Board of Directors endorsement letter for the Project is attached as Exhibit CMD-5.
Q. WHAT ALTERNATIVES DID ERCOT STUDY TO ADDRESS THE DEFICIENCIES IN SYSTEM PERFORMANCE IDENTIFIED IN ITS INDEPENDENT ASSESSMENT?

A. ERCOT reported results for two alternatives identified as Option A and Option B in its Independent Assessment. Option A includes the Project and was identified in Alternative 3 by LCRA TSC and CPS Energy. Option B focused on upgrades of the existing transmission system and is similar to upgrades identified by LCRA TSC and CPS Energy in Alternative 1. Option A and Option B were described in ERCOT’s Independent Assessment as follows:

**Option A** - Construct a new Zorn to Marion 345-kV line (approximately 21 miles) with an emergency rating of at least 1,959 MVA; Reconfigure the existing Hill Country to Elm Creek/Marion and Skyline to Marion/Elm Creek 345-kV double-circuit lines to form Hill Country to Marion double circuit and Skyline to Elm Creek double circuit. The Elm Creek to Skyline 345-kV double circuit and the Hill Country to Marion 345-kV double circuit are expected to have a minimum emergency rating of 1,077 MVA and 1,104 MVA, respectively; Add a second 345/138-kV transformer at Clear Springs with an emergency rating of at least 525 MVA; Add a second 345/138-kV transformer at Marion with an emergency rating of at least 525 MVA; Upgrade the existing Cibolo to Schertz 138-kV line (approximately 3.6 miles) with an emergency rating of at least 477 MVA.

**Option B** - Reconfigure the existing Hill Country to Elm Creek/Marion and Skyline to Marion/Elm Creek 345-kV double-circuit lines to form Hill Country to Marion double circuit and Skyline to Elm Creek double circuit. The Elm Creek to Skyline 345-kV double circuit and the Hill Country to Marion 345-kV double circuit are expected to have a minimum emergency rating of 1,077 MVA and 1,104 MVA, respectively; Loop the existing Marion to Zorn 345-kV line into Clear Springs and upgrade the Marion to Clear Springs double circuit 345-kV (8.5 miles) with an emergency rating of at least 1,959 MVA; Upgrade several existing 138-kV lines; McCarty Ln to Henne (6.6 miles) with an emergency rating of at least 477 MVA, Henne to Comal double circuit (7.6 miles) with an emergency rating of at least 477 MVA, Comal to Loop337-GPI Switch (5.6 miles) with an emergency rating of at least 789 MVA, GPI Switch to EC...
Mornhinweg to Parkway (10.6 miles) with an emergency rating of at least 435 MVA, and
Henne to Zorn (6.5 miles) with an emergency rating of at least 435 MVA; Add a fourth
345/138-kV transformer at Zorn with an emergency rating of at least 525 MVA; Add a
second 345/138-kV transformer at Clear Springs with an emergency rating of at least 525
MVA.

Q. WHAT CONCLUSION DID ERCOT MAKE IN ITS INDEPENDENT
ASSESSMENT?
A. ERCOT concluded there will be reliability criteria violations in the San Antonio area in
2019, the reliability need is driven primarily by continued load growth in the area and
retirement of the J.T. Deely generating station, and that Option A is the preferred option.
In addition, ERCOT designed the Project, and its completion by the summer of 2019, as
critical to reliability pursuant to PUC Substantive Rule 25.101(b)(3)(D).

Q. WHO DID ERCOT DESIGNATE TO CONSTRUCT THE ELEMENTS OF
OPTION A?
A. ERCOT assigned construction of the Project to LCRA TSC. ERCOT assigned CPS
Energy to construct the reconfiguration of the existing Hill Country to Elm Creek/Marion
and Skyline to Marion/Elm Creek 345-kV double-circuit lines and Guadalupe Valley
Electric Cooperative (GVEC) to construct the upgrade of the existing Cibolo to Schertz
138-kV line.

Q. WHAT WAS ERCOT’S BASIS FOR DESIGNATING THE OWNERSHIP OF
EACH PORTION OF THE PROJECT?
A. ERCOT Nodal Protocols Section 3.11.4.8 states that ERCOT shall designate providers
for the recommended projects and that the default TSP shall be the TSP that owns the end
points of the new projects. ERCOT designated each portion of Option A on this basis.
LCRA TSC owns the end points at the Marion and Zorn substations. CPS Energy owns
the extent of the transmission lines associated with reconfiguring the existing Hill
Country to Elm Creek/Marion and Skyline to Marion/Elm Creek 345-kV double-circuit
lines, and GVEC owns the extent of the existing Cibolo to Schertz 138-kV transmission
line to be upgraded.
Q. WHAT IS YOUR OPINION OF LCRA TSC AND CPS ENERGY’S JOINT REPORT AND THE ERCOT INDEPENDENT ASSESSMENT?

A. LCRA TSC and CPS Energy and ERCOT properly identified overloaded and heavily loaded system elements that require system upgrades. The alternatives considered were reasonable and to varying degrees improve the system to at least the minimum level of performance needed to meet the performance requirements associated with the ERCOT Planning Guides and NERC TPL Reliability Standards.

Q. IS THE PROJECT THE BEST ALTERNATIVE WHEN COMPARED TO OTHER ALTERNATIVES CONSIDERED?

A. Yes, the Project, combined with the other project elements endorsed by ERCOT, is the best project among all of the alternatives considered.

Q. IS THE PROJECT THE BEST ALTERNATIVE TAKING INTO ACCOUNT CONSIDERATIONS OF EFFICIENCY, RELIABILITY, AND COST BENEFITS?

A. Yes. After studying transmission system and the alternatives for meeting the reliability-based performance requirements established by ERCOT and NERC, I conclude that the Project is the best alternative taking into account efficiency, reliability, and cost.

Q. THE PROJECT CALLS FOR A PORTION OF THE TRANSMISSION LINE TO BE CONSTRUCTED ON DOUBLE CIRCUIT CAPABLE STRUCTURES. WHY IS THIS NECESSARY?

A. When constructing new transmission lines, it is prudent to consider the capacity of the new line and evaluate the likelihood that additional capacity will be needed in the future. Therefore, double circuit capable structures are proposed to be constructed from the area around the Clear Springs substation to the Marion substation. It is reasonable to expect that a second circuit will be needed in the foreseeable future as a result of load growth and changing generation patterns.
Q. ARE THERE ANY FACTS ABOUT THE PROJECT THAT ARE IMPORTANT FROM A PLANNING PERSPECTIVE WHEN CONSIDERING ALTERNATIVE ROUTES?
A. Yes. From a planning perspective, the Project serves a function similar to the existing 345-kV transmission lines between the Marion and Clear Springs substations. As a result, the route segments included in the application avoid location within a common corridor to the existing Marion to Clear Springs transmission line.

Q. ARE THE LCRA TSC TRANSMISSION PLANNING CRITERIA GUIDED BY ANY OTHER RELIABILITY CRITERIA?
A. Yes. The NERC TPL Reliability Standards require that transmission planners consider extreme event contingencies and specifically mention consideration of transmission lines located in a common right of way for more than one mile in length. In addition, the ERCOT Planning Guides require analysis of the impact of a common tower outage for circuits that share a common tower for more than 0.5 miles in length.

Q. DO THE ROUTES PRESENTED IN THE APPLICATION IN THIS DOCKET MEET THE PLANNING CRITERIA YOU DESCRIBED?
A. Yes, the routes proposed in the Application and as described in the testimony of Ms. Hernandez avoid placing two 345-kV transmission circuits that provide similar functions in a common corridor.

Q. DID THE CHANGE IN THE STUDY AREA BOUNDARY DESCRIBED IN THE EA AND BY MS. HERNANDEZ CHANGE THE MANNER IN WHICH THE PROJECT MEETS THE NEEDS IDENTIFIED IN ERCOT'S INDEPENDENT ASSESSMENT?
A. No.
V. CONSIDERATION OF PURA AND COMMISSION CRITERIA

Q. IS THE PROJECT NECESSARY FOR THE SERVICE, ACCOMMODATION, OR SAFETY OF THE PUBLIC WITHIN THE MEANING OF PURA § 37.056(a), TAKING INTO ACCOUNT THE FACTORS SET OUT IN PURA § 37.056(c)?

A. Yes. By constructing the Project, LCRA TSC will have met its adequacy and reliability obligation to loads connected to its system and in accordance with the NERC Reliability Standards and ERCOT Planning Guides. In addition, ERCOT deemed the project critical to the reliability of the ERCOT Transmission System.

Q. WILL CONSTRUCTION OF THE PROJECT RESULT IN IMPROVED SERVICE TO THE ELECTRIC SERVICE CUSTOMERS?

A. Yes, construction of the Project will result in improved electric service to end-use consumers in ERCOT because electric system adequacy and reliability will be strengthened as described in Section III above.

Q. WILL THE PROJECT SUPPORT ROBUST WHOLESALE COMPETITION?

A. Yes, the Project supports robust wholesale completion by enhancing the reliability of the bulk electric system connecting generation to load serving entities.

Q. WHAT WILL BE THE EFFECT ON LCRA TSC AND OTHER UTILITIES IN THE AREA IF THE PROJECT IS BUILT?

A. By constructing the Project, the adequacy and reliability of the electric system will be enhanced for the near term and sustained for the long term for electric loads served by CPS Energy, New Braunfels Utilities, GVEC, and the City of San Marcos.

Q. IS THE PROJECT NEEDED TO CONNECT A NEW CUSTOMER?

A. No, the Project is needed in order for the electric transmission system to meet the performance requirements defined by the NERC TPL Reliability Standards and the ERCOT Planning Guides.
Q. **DO THE PROPOSED ROUTING ALTERNATIVES INCLUDED IN THE APPLICATION ADEQUATELY CONSIDER ELECTRICAL EFFICIENCY AND RELIABILITY?**

A. Yes, each of the alternative routes for the Project presented in the Application, as described in the testimony of Ms. Hernandez, adequately provide immediate efficiency and reliability benefits to the electric transmission system as envisioned and supported by stakeholders during the RPG review process, the ERCOT Independent Assessment, and the ERCOT Board of Directors endorsement.

Q. **IS THE PROJECT THE BETTER OPTION TO MEET THE NEED WHEN COMPARED TO EMPLOYING DISTRIBUTION FACILITIES?**

A. Yes. Distribution alternatives are inadequate to resolve the need to improve transmission system reliability identified in LCRA TSC’s analysis and the ERCOT Independent Assessment.

**VI. SUMMARY AND CONCLUSION**

Q. **PLEASE SUMMARIZE YOUR CONCLUSIONS REGARDING THE PROJECT.**

A. The Project is needed in order for the transmission system to meet the reliability performance requirements established by the LCRA TSC transmission planning criteria, ERCOT Planning Guides, and NERC TPL Reliability Standards. LCRA TSC appropriately followed the process for submitting a project for review by ERCOT in accordance with the ERCOT Nodal Protocols. ERCOT appropriately followed the requirements in the ERCOT Nodal Protocols and ERCOT Planning Guides for obtaining stakeholder input, reviewing the Project, evaluating alternatives, designating TSPs, and ultimately endorsing the Project as critical to reliability.

Q. **DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?**

A. Yes.
ERCOT System Planning:
2013 Regional Transmission Plan Report
82. CPS Northeast Switchyard

The 345-kV double circuit contingencies between Zorn and Marion transfer power flow onto and overload several segments of the underlying 138-kV system just northeast of San Antonio. Adding an alternative path with a new substation to tie the 345-kV system with the 138-kV lines in the area helps resolve this issue. This project includes tapping the 345-kV line between Kendall and Hays Energy at Highway 46 and adding a 345/138-kV transformer at the existing substation. The new Northeast Switchyard substation has been tested with 345-kV connections to Clear Springs and Highway 46, and 138-kV connections to Tri County, Skyline, Stonegate, Green Mountain, and Bulverde. This project is needed by 2018 to resolve N-1 issues, with portions of it necessary by 2016 to resolve both N-1 and G-1 + N-1 overloads with the loss of generation at Calaveras unit 2. LCRA and CPS are testing project alternatives to determine which 345-kV connections best address long term needs of the system and will be submitting a proposal to the RPG.
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<td>Zorn – Marion &amp; Zorn – Clear Springs 345-kV line</td>
<td>-</td>
<td>109.54</td>
</tr>
</tbody>
</table>
The Zorn – York Creek – Seguin 138-kV line exceeds its emergency rating under two G-1 + N-1 conditions. With the prior outage of generation at Calaveras unit 2 and the contingency loss of the double circuit 345-kV lines from Zorn to Clear Springs causes the line to overload in 2016. Additionally, the prior outage of Coleto unit 1 and the contingency loss of the Geronimo – Clear Springs 138-kV line cause the line to overload in 2018. The Zorn – York Creek – Seguin 138-kV line needs to be upgraded to an emergency rating of at least 326-MVA. This upgrade is needed by 2016.

<table>
<thead>
<tr>
<th>Overloaded Element</th>
<th>Contingency</th>
<th>Percent Overload</th>
</tr>
</thead>
<tbody>
<tr>
<td>York Creek – Seguin 138-kV line</td>
<td>Geronimo – Clear Springs 138-kV line &amp; Calaveras generation</td>
<td>- 102.55 -</td>
</tr>
<tr>
<td></td>
<td>Geronimo – Clear Springs 138-kV line &amp; Coleto generation</td>
<td>- - 105.12 -</td>
</tr>
<tr>
<td></td>
<td>Zorn – Clear Springs CKT 1 &amp; Zorn – Clear Springs CKT 2 345-kV lines &amp;</td>
<td>- 107.07 -</td>
</tr>
<tr>
<td></td>
<td>Calaveras generation</td>
<td></td>
</tr>
<tr>
<td>Zorn – York Creek 138-kV line</td>
<td>Geronimo – Clear Springs 138-kV line &amp; Calaveras generation</td>
<td>- 104.23 -</td>
</tr>
<tr>
<td></td>
<td>Geronimo – Clear Springs 138-kV line &amp; Coleto generation</td>
<td>- - 106.88 -</td>
</tr>
</tbody>
</table>
Long-Term System Assessment
for the ERCOT Region
December 2012
thermal generation was added in these areas. Full build-out of the Competitive Renewable Energy Zones (CREZ) created a strong generation source west of DFW and resulted in an efficient delivery of power through CREZ connections to DFW load. Scenarios without a strong western generation source required reliability upgrades to existing south and east import paths to accommodate forecasted load growth in the DFW region.

From a stability perspective, most scenarios demonstrated that incremental import paths into Dallas would be required outside of the 10-year study horizon. In several scenarios, moderate additions of static or dynamic reactive resources improved stability margins in a cost-effective manner. The most severe need for expanded imports into Dallas was observed in the Retirements Scenario, though it occurred after 2022. Multiple import paths were needed in Dallas before 2032 to support voltage stability.

From an economic perspective, congestion into Dallas was primarily located south and southeast of Dallas. This congestion was generally attributable to hypothetical generation expansion sites south and southeast of Dallas and the limited existing infrastructure to deliver the new, low cost resources to DFW load. No upgrades associated with this congestion were uniformly recognized across scenarios or consistently met ERCOT's economic criteria. Thus, it is expected that new import paths into the DFW area will be identified in a shorter-term planning horizon when generation siting location assumptions are better known.

### 4.2.3 Austin/San Antonio Region

The Austin Metropolitan region, as modeled, shows increasing dependence upon 138kV infrastructure connecting to the 345kV system east of the load pocket to serve growing loads to the extreme west of the load pocket. Disproportionate load growth in counties west of Austin led to an investigation of opportunities to introduce a western 345kV source to support future needs.

From a reliability and voltage stability perspective, the existing infrastructure with incremental upgrades to existing 138kV circuits was capable of supporting projected loads through the ten-year study horizon. Over the 20-year course of this study, several 138kV circuits became overloaded and required upgrades to create a reliable case. In light of these overloaded circuits, ERCOT investigated several options to bring new 345kV sources into the Austin Area. In this analysis these alternatives were not cost-competitive with upgrading existing 138kV infrastructure. However, the feasibility of the upgrades shown to be needed is not known at this time. Further analysis is required to verify the cost-effectiveness of these upgrades.
San Antonio (SA) is notably different from other load pockets within ERCOT, possessing a well-defined extra high voltage (EHV) loop around the metropolitan area. This loop is generally adequate to serve load growth in the region within the 10-year study horizon. From an economic perspective, the “life-lines,” (Hill Country – Marion, Skyline – Marion) connecting the EHV SA loop to the 345kV corridor which runs parallel to I-35 (Hutto to Clear Springs) exhibits significant congestion across multiple scenarios. Limited options to redispach resources internal to the loop to offset post-contingent overloads for the loss of either of these two circuits resulted in significant congestion. This was most evident in the retirement scenario, where fewer thermal resources are available to alleviate congestion. Conversely, in wind-heavy scenarios, the CREZ connection west of San Antonio (at Kendall) delayed import needs to at least 2032. ERCOT assessed multiple options to add additional connectivity to the 345kV ring and mitigate the individual impact of a contingency to any 345kV circuit connection to the ring. System upgrades on all sides of the 345kV ring were evaluated. While all of the new connections to the 345kV ring evaluated did not provide sufficient economic savings to be considered economic, study results indicate that upgrading either of the existing 345kV connections would meet ERCOT’s current economic criteria. At this time it is not known if upgrading these circuits is possible given the likely duration and outage requirements of such a project.

4.2.4 Lower Rio Grande Valley

The Lower Rio Grande Valley (LRGV) area is located at the southernmost portion of the ERCOT region along the international border with Mexico. It includes the cities of Edinburg, McAllen, Harlingen, and Brownsville. The LRGV area is experiencing high rates of population and economic growth and consequently a high rate of electric load growth. Currently, the load is primarily served by local natural gas generation and power imports from the rest of the ERCOT system. The two existing major 345kV import paths are the Ajo - Rio Hondo and the Lon Hill - North Edinburg 345kV lines.

The recent ERCOT independent review of the LRGV area indicated the need for a new 345kV line from Lobo to North Edinburg to improve the power transfer capability to the LGRV and to increase the maintenance window for the two existing 345kV circuits. The new circuit is scheduled to be in-service by 2016.

While the new connection from Lobo to North Edinburg will be constructed as a single-circuit, it will be placed on double-circuit capable towers. As the addition of a second circuit then becomes the most cost-effective option to increase import (and export) capability from the
NOTICE DATE: November 13, 2013

NOTICE TYPE: W-A102513-02 Operations

SHORT DESCRIPTION: Initial and Final determination of RMR status for CPS Energy (RE), CALAVERS_JTD1 and CALAVERS_JTD2

INTENDED AUDIENCE: ERCOT Market Participants

DAY AFFECTED: December 31, 2018

LONG DESCRIPTION: On October 25, 2013, ERCOT received a Notification of Suspension of Operations (NSO) for the following Generation Resources with a proposed effective date of December 31, 2018:

- CPS Energy (RE) – CALAVERS_JTD1
- CPS Energy (RE) – CALAVERS_JTD2

ERCOT did not conduct a Reliability Must Run (RMR) analysis because it has confirmed with the affected Transmission Service Provider (TSP) that any reliability concerns can be addressed through the transmission planning process. ERCOT has therefore determined that CALAVERS_JTD1 and CALAVERS_JTD2 are not needed to support ERCOT transmission system reliability and may be mothballed according to the schedule in the NSO. This determination should be regarded as the initial and final determination for purposes of Protocols Section 3.14.1.2, ERCOT Evaluation.

ACTION REQUIRED: The NSO is posted under the Notice of Suspension of Operations portlet on the Grid/Generation page of the ERCOT Market Information System (MIS) Secure Area. An ERCOT Digital Certificate is required to access the MIS.

CONTACT: If you have any questions, please contact your ERCOT Account Manager. You may also call the general ERCOT Client Services phone number at (512) 248-3900 or contact ERCOT Client Services via email at ClientServices@ercot.com.

If you are receiving email from an ERCOT distribution list that you no longer wish to receive, please follow this link in order to unsubscribe from this list: http://lists.ercot.com.
LCRA TSC and CPS Energy
Transmission System Additions

June 20, 2014

Prepared by:
LCRA TSC
CPS Energy
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1. Executive Summary

This report presents the results of power flow analysis of the CPS Energy and LCRA Transmission Services Corporation (LCRA TSC) electric transmission systems (area shown in Figure 1.1 below) during anticipated load and generation conditions, including generation retirements in the CPS Energy area. The report recommends system improvements to correct contingency-driven deficiencies. Transmission system improvements are needed to maintain the reliability of CPS Energy and LCRA TSC’s transmission service in the northeast San Antonio area. Several contingency events cause transmission element overloads in the area beginning in 2018 under the anticipated operating conditions. The overloads include Skyline and Hill Country 345/138 kV autotransformers, the Skyline to Marion, Hill Country to Marion, and the Zorn to Marion 345 kV circuits and six 138 kV transmission circuits. CPS Energy and LCRA TSC studied eight alternatives for resolving the system deficiencies identified in the report and recommends the following set of projects (shown as Alternative 3 in the report):

- Extend the LCRA TSC Kendall to Hays Energy 345 kV line on separate double-circuit capable structures in order to loop into the proposed CPS Energy Bracken switching station
- Construct a new 345 kV circuit between LCRA TSC’s Zorn and Marion switching stations by using an open position on an existing transmission line between Zorn and Clear Springs and constructing a new 345 kV transmission line from Clear Springs to Marion using double-circuit capable structures
- Reconfigure the Skyline double-circuit to Marion and Elm Creek and the Hill Country double-circuit to Marion and Elm Creek to become a double-circuit from Hill Country to Marion and a double-circuit from Skyline to Elm Creek
- Construct a new CPS Energy switching station at Bracken with two 345/138 kV autotransformers
- Convert the existing CPS Energy Howard Road 138 kV switching station to a 345/138 kV switching station with two autotransformers
- Add a second 345/138 kV autotransformer with a minimum rating of 478 MVA at LCRA TSC Marion switching station
- Construct a new 138 kV double-circuit transmission line to loop the proposed CPS Energy Bracken switching station into the Bulverde to Green Mountain 138 kV circuit
- Construct a new 138 kV double-circuit transmission line to loop the proposed CPS Energy Bracken switching station into the Skyline to Tri-County 138 kV circuit
- Upgrade the LCRA TSC Kerrville Stadium to Kendall 138 kV circuit to a minimum rating of 446 MVA
- Upgrade the LCRA TSC Kendall to Comfort 138 kV circuit to a minimum rating of 382 MVA
- Rebuild the CPS Energy Randolph to Weiderstein 138 kV circuit to a minimum rating of 478 MVA
- Upgrade the CPS Energy Hamilton Wolfe to Medical Center 138 kV circuit to a minimum rating of 570 MVA

This set of projects will provide relief to the CPS Energy autotransformers at Cagnon, Skyline and Hill country, as well as, to the North to South transfer through the LCRA TSC system, and provide a necessary 345 kV import path to northern Bexar County. Alternative 3 is recommended for construction with a completion date of June 2019. The total cost is estimated at $237,317,000. The LCRA TSC portion of the Kendall to Hays Energy 345 kV extension to Bracken and the new LCRA TSC 345 kV line from Zorn to Marion will require a CCN.

The time necessary to implement any of the eight alternatives considered in this assessment will be substantial. Given the requirements and processes that must be followed, it will be challenging and potentially costly to complete a significant new 345 kV transmission project to address the stated need by 2019. Additionally, should the growth in the area increase at a faster pace than projected in this study, the required in-service date for this project would need to be earlier than 2019. Accordingly, to better meet the area needs, CPS Energy and LCRA TSC believe that the alternative selected by ERCOT’s independent analysis should be designated as “critical to reliability” for the ERCOT Region.
Figure 1.1: Transmission System in Bexar, Comal and Guadalupe Counties
2. Background

CPS Energy is the nation’s largest municipally-owned energy utility providing both natural gas and electric service. Presently, CPS Energy serves over 741,000 electric customers in and around the seventh largest city in the nation within a 1,514 square mile service area (Figure 2.1) that includes Bexar County and portions of Atascosa, Bandera, Comal, Guadalupe, Kendall, Medina, and Wilson counties.

LCRA Transmission Services Corporation (LCRA TSC) is a non-profit corporation providing regulated transmission, transformation, and metering services throughout the Electric Reliability Council of Texas (ERCOT) region. In the Central Texas area, LCRA TSC facilities help support the electric service needs of more than 40 transmission customers. These transmission customers include municipalities, electric cooperatives, other transmission providers and generators.

LCRA TSC 345 kV transmission facilities that are located between San Antonio and Austin serve as a key transmission source into the CPS Energy transmission network from the North. The 2012 ERCOT Long-Term System Assessment (LTSA) describes portions of this path as the “life-lines” to the CPS Energy system. The ERCOT LTSA also noted the high loading of this transmission path under several scenarios, especially when coupled with a generation retirement scenario. The 2013 ERCOT Regional Transmission Plan (RTP), released December 2013, identified the overload of several 345 kV and 138 kV transmission lines that support North to South transfers between LCRA TSC and CPS Energy. The report evaluated the addition of new transmission lines from LCRA TSC’s Highway 46 substation to the CPS Energy Northeast switching station\(^1\) and from LCRA TSC’s Clear Springs switching station to the CPS Energy Northeast switching station concluding that the project was “needed by 2018 to resolve N-1 issues, with portions of it necessary by 2016 to resolve both N-1 and G-1 overloads with the loss of generation at Calaveras unit 2.” As indicated by the 2013 ERCOT RTP report, the area around northeast Bexar County, which includes CPS Energy and LCRA TSC (Figure 1.1), will experience increased loading of the existing 345/138 kV autotransformers and 138 kV transmission lines in the next five years, which will lead to violations of NERC Reliability Standards, ERCOT, LCRA TSC and CPS Energy Transmission Planning Criteria unless upgrades to the transmission system are implemented.

ERCOT received a Notification of Suspension of Operations (NSO) for the CPS Energy J.T. Deely power plant (Calaveras units 1 and 2) on October 25, 2013, with a proposed effective date of December 31, 2018. The announcement was not incorporated into ERCOT staff’s analysis during development of the 2013 ERCOT RTP.

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\(^1\) The CPS Energy Northeast switching station is referred to as the Bracken switching station in other sections of this report.
Figure 2.1: CPS Energy Service Territory
3. Project Need

The factors creating the need for this project include load growth, North to South bulk power transfers through the LCRA TSC 345 kV system and planned generation retirements in the CPS Energy area. These factors result in single contingency overload condition of various elements of the existing Bulk Electric System (as indicated in the 2013 ERCOT RTP report). In addition, no existing CPS Energy 345/138 kV switching stations have adequate space for the addition of new autotransformers. This creates the need for a new 345/138 kV switching station in the CPS Energy system.

3.1 Load Growth

Non-coincident load in the Austin to San Antonio corridor is forecasted to grow to 12,426 MW by 2019\(^2\), representing an average annual growth rate of 2.81% for the area.

<table>
<thead>
<tr>
<th>County</th>
<th>2015 (kW)</th>
<th>2016 (kW)</th>
<th>2017 (kW)</th>
<th>2018 (kW)</th>
<th>2019 (kW)</th>
<th>Average Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>BEXAR</td>
<td>5,359,274</td>
<td>5,528,334</td>
<td>5,705,638</td>
<td>5,882,332</td>
<td>6,063,036</td>
<td>3.13%</td>
</tr>
<tr>
<td>COMAL</td>
<td>527,932</td>
<td>544,198</td>
<td>561,124</td>
<td>578,528</td>
<td>594,758</td>
<td>3.02%</td>
</tr>
<tr>
<td>HAYS</td>
<td>609,899</td>
<td>635,490</td>
<td>658,884</td>
<td>685,373</td>
<td>712,356</td>
<td>3.96%</td>
</tr>
<tr>
<td>TRAVIS</td>
<td>3,172,218</td>
<td>3,217,087</td>
<td>3,267,208</td>
<td>3,313,389</td>
<td>3,393,202</td>
<td>1.70%</td>
</tr>
<tr>
<td>WILLIAMSON</td>
<td>1,454,541</td>
<td>1,514,423</td>
<td>1,570,584</td>
<td>1,630,275</td>
<td>1,663,566</td>
<td>3.42%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>11,123,864</td>
<td>11,439,532</td>
<td>11,763,438</td>
<td>12,089,897</td>
<td>12,426,918</td>
<td>2.81%</td>
</tr>
</tbody>
</table>

*Table 3.1.1: Summer Peak Load in Austin to San Antonio Corridor*

3.2 Power Transfer

Table 3.2.1 indicates North to South bulk power transfers through the LCRA TSC 345 kV system under contingency, according to the 2013 ERCOT RTP 2018 base case. The table indicates power flow across the Zorn to Marion and Clear Springs to Marion 345 kV lines, representing the bulk power transfer from the North to the South. As indicated, there is little to no available capacity under contingency conditions in 2018.

<table>
<thead>
<tr>
<th>North to South Transfer</th>
<th>Contingency</th>
<th>Thermal Limit (MW)</th>
<th>2018 RTP Loading (MW)</th>
<th>Available Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZORN(7042)-MARION(7044)-1</td>
<td>MARION(7044)-CLEARSPRINGS(7050)-1</td>
<td>1103</td>
<td>1044</td>
<td>59</td>
</tr>
<tr>
<td>MARION(7044)-CLEARSPRINGS(7050)-1</td>
<td>ZORN(7042)-MARION(7044)-1</td>
<td>1103</td>
<td>1179</td>
<td>-76</td>
</tr>
</tbody>
</table>

*Table 3.2.1: North to South Transfer*

\(^2\) According to the ERCOT 2013 Annual Load Data Request
3.3 Generation Retirements

Another factor creating the need for this project is the recent announcement of plans to retire the J.T. Deely power plant by 2018. The J.T. Deely power plant consists of two units (Calaveras units 1 and 2) with a total power output of 850 MW. Figure 3.3.1 indicates forecasted generation capacity in the CPS Energy area for the next ten years.

![Generating Capacity Diagram](image)

**Figure 3.3.1:** Generating Capacity
### 3.4 2013 ERCOT RTP Facility Loading

The following study results were taken from the 2013 ERCOT RTP report. These results indicate overloaded facilities in the CPS Energy and LCRA TSC systems.

<table>
<thead>
<tr>
<th>Monitored Facility</th>
<th>Contingency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Springs - Marion 345 kV</td>
<td>Zorn - Marion 345 kV</td>
</tr>
<tr>
<td>Clear Springs 345/138 kV autotransformer</td>
<td>Zorn - Marion 345 kV, Marion - Clear Springs 345 kV</td>
</tr>
<tr>
<td>Comal - Loop 337 138 kV</td>
<td>Zorn - Marion 345 kV, Marion - Clear Springs 345 kV, Calaveras generation</td>
</tr>
<tr>
<td>Henne - Comal 138 kV</td>
<td>Zorn - Marion 345 kV, Marion - Clear Springs 345 kV</td>
</tr>
<tr>
<td>Loop 337 - GPI Switch 138 kV</td>
<td>Zorn - Marion 345 kV, Marion - Clear Springs 345 kV, Calaveras generation</td>
</tr>
<tr>
<td>Marion - Skyline 345 kV</td>
<td>Elm Creek - Hill Country 345 kV, Hill Country - Marion 345 kV, Calaveras generation</td>
</tr>
<tr>
<td>Marion 345/138 kV autotransformer</td>
<td>Alamo Tap - Alamo Cement 138 kV, Skyline - Tri County 138 kV, Alamo Tap - Green Mountain 138 kV, Alamo Tap - Skyline 138 kV</td>
</tr>
<tr>
<td></td>
<td>Clear Springs 345/138 kV autotransformer</td>
</tr>
<tr>
<td></td>
<td>Fratt - Kirby 138 kV, Randolph - WB Tuttle 138 kV</td>
</tr>
<tr>
<td></td>
<td>Green Mountain - Tri County 138 kV, Skyline - Tri County 138 kV</td>
</tr>
<tr>
<td>McCarty Lane - Henne 138 kV</td>
<td>Zorn - Marion 345 kV, Marion - Clear Springs 345 kV</td>
</tr>
<tr>
<td></td>
<td>Zorn - Marion 345 kV, Zorn - Clear Springs 345 kV</td>
</tr>
<tr>
<td>York Creek - Seguin 138 kV</td>
<td>Geronimo - Clear Springs 138 kV</td>
</tr>
<tr>
<td></td>
<td>Zorn - Marion 345 kV, Marion - Clear Springs 345 kV</td>
</tr>
<tr>
<td></td>
<td>Zorn - Marion 345 kV, Zorn - Clear Springs 345 kV</td>
</tr>
<tr>
<td>Zorn - York Creek 138 kV</td>
<td>Geronimo - Clear Springs 138 kV</td>
</tr>
<tr>
<td></td>
<td>Zorn - Marion 345 kV, Marion - Clear Springs 345 kV</td>
</tr>
<tr>
<td></td>
<td>Zorn - Marion 345 kV, Zorn - Clear Springs 345 kV</td>
</tr>
</tbody>
</table>

#### Table 3.4.1: 2013 ERCOT RTP Study Results
Due to load growth and generation retirement, additional autotransformers are needed in the San Antonio area. CPS Energy currently has three 345/138 kV switching stations with four autotransformers planned for each within the next three years. Additional autotransformers cannot be added to these three existing sites due to space limitations. The existing 345 kV lines that import power from the northeast to the CPS Energy system are reaching their capacity during contingency events and there is a need for an additional import path into the system. Again, due to space limitations, additional circuits cannot be terminated at the three existing switching station sites. Therefore, two new switching stations will need to be located and constructed within the CPS Energy service territory to accommodate the expected autotransformer loading, load growth, generation retirements and import constraints. The new switching stations should be located such that they are beneficial for both CPS Energy and LCRA TSC needs.
4. Alternative Development

Eight alternatives have been identified in order to resolve the issues identified in Section 3 [Project Need]. A detailed description of each alternative is given in Section 4.2, with modifications common to all alternatives given in Section 4.1. Note that site control has not been attained for any proposed transmission facilities, and therefore, the maps in this document are not meant to indicate an actual geographic location for these proposed facilities and are only intended to indicate electrical connections.

4.1 Modifications Common to All Alternatives

4.1.1 CPS Energy 345 kV Reconfiguration

All of the alternatives include a reconfiguration of the Skyline to Marion, Skyline to Elm Creek, Hill Country to Marion, and Hill Country to Elm Creek double-circuit lines (Figure 4.1.1.1). These circuits will be reconfigured such that there will be a double-circuit from Hill Country to Marion and a double-circuit from Skyline to Elm Creek (Figure 4.1.1.2). The purpose of this reconfiguration is to eliminate overloading of the Skyline to Marion 345 kV circuit.
4.1.2 **CPS Energy Switching Station**

As identified in Section 3.5, there is a need to site two new 345/138 kV switching stations within the CPS Energy service territory between the CPS Energy and LCRA TSC areas. The first 345/138 kV switching station should be located in order to provide a new import path between CPS Energy and LCRA TSC. The second 345/138 kV switching station is to serve the needs of the CPS Energy system. Two sites were considered for the first switching station, one site (Bracken) is located in the northeast portion of Bexar County (Figure 4.1.2.1) and the other (Martinez) is located in the eastern portion (Figure 4.1.2.2). The site chosen for the second 345/138 kV switching station is at the existing Howard Road 138 kV switching station (Figure 4.1.2.3).

**Bracken Switching Station**

Seven of the alternatives (Alternative 1 through 7) have the new switching station (Bracken) located in the northeastern portion of Bexar County. This new switching station is proposed to be located in an area with a high forecasted load growth. The 138 kV portion for these seven alternatives are common, as shown in Figure 4.1.2.1. This includes the addition of new double-circuit 138 kV transmission lines to loop Bracken into the future Bulverde to Green Mountain circuit and the Skyline to Tri-County circuit (as shown by the dashed blue lines in Figure 4.1.2.1).
Martinez Switching Station

One of the alternatives (Alternative 8) has the new switching station (Martinez) located in the eastern portion of Bexar County. This new switching station is proposed to be located in an area within the CPS Energy system where there is existing 138 kV and 345 kV infrastructure. The 138 kV portion for this alternative, is shown in Figure 4.1.2.2. This switching station will intercept all of the 138 kV circuits in the right-of-way, which include J.T. Deely to Converse, J.T. Deely to Walzem, O.W. Sommers to Kirby and Beck Rd to Kirby. Martinez is also planned to intercept both of the J.K. Spruce to Skyline 345 kV circuits, as shown in Figure 4.1.2.2.

Figure 4.1.2.2: 138 kV systems for Alternative 8
Howard Road Switching Station

All of the alternatives have the 138 kV Howard Road switching station converted to a 345/138 kV switching station. The 345 kV and 138 kV portion for this alternative are shown in Figure 4.1.2.3. Howard Road is planned to intercept both the Cagnon to J.K. Spruce and Cagnon to A.V Rosenburg 345 kV circuits, as shown in Figure 4.1.2.3.

Figure 4.1.2.3: Howard Road 138 kV switching station
### 4.2 Alternative Descriptions

Table 4.2.1 provides a summary of each alternative.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Upgrades</th>
</tr>
</thead>
</table>
| 1 | 1) Construct a new 345 kV double-circuit transmission line from Bracken to Clear Springs  
2) Loop the Zorn to Marion 345 kV line to Clear Springs  
3) Rebuild Marion to Clear Spring 345 kV lines  
4) CPS Energy 345 kV reconfiguration  
5) Add three (3) 345/138 kV Autotransformers at Bracken  
6) Add two (2) 345/138 kV Autotransformers at Howard Road  
7) Add second Marion Autotransformer  
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit  
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit  
10) Rebuild Randolph to Weiderstein 138 kV line  
11) Rebuild Kerrville St to Kendall 138 kV line  
12) Upgrade Kendall to Comfort 138 kV line |
| 2 | 1) Loop Kendall to Hays Energy 345 kV line into Bracken  
2) Construct a new 345 kV circuit from Zorn to Marion  
3) CPS Energy 345 kV reconfiguration  
4) Add three (3) 345/138 kV Autotransformers at Bracken  
5) Add two (2) 345/138 kV Autotransformers at Howard Road  
6) Add second Marion Autotransformer  
7) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit  
8) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit  
9) Rebuild Hamilton Wolfe to Medical Center 138 kV line  
10) Rebuild Randolph to Weiderstein 138 kV line  
11) Rebuild Kerrville St to Kendall 138 kV line  
12) Upgrade Kendall to Comfort 138 kV line |
| 3 | 1) Loop Kendall to Hays Energy 345 kV line into Bracken  
2) Construct a new 345 kV circuit from Zorn to Marion  
3) CPS Energy 345 kV reconfiguration  
4) Add two (2) 345/138 kV Autotransformers at Bracken  
5) Add two (2) 345/138 kV Autotransformers at Howard Road  
6) Add second Marion Autotransformer  
7) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit  
8) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit  
9) Rebuild Hamilton Wolfe to Medical Center 138 kV line  
10) Rebuild Randolph to Weiderstein 138 kV line  
11) Rebuild Kerrville St to Kendall 138 kV line  
12) Upgrade Kendall to Comfort 138 kV line |
| 4 | 1) Construct a new 345 kV double-circuit transmission line from Bracken to Clear Springs  
2) Construct a new 345 kV circuit from Highway 46 to Bracken on double-circuit capable structures  
3) Construct a new 345 kV circuit from Zorn to Marion  
4) CPS Energy 345 kV reconfiguration  
5) Add three (3) 345/138 kV Autotransformers at Bracken  
6) Add two (2) 345/138 kV Autotransformers at Howard Road  
7) Add second Marion Autotransformer  
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit  
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit  
10) Rebuild Randolph to Weiderstein 138 kV line  
11) Rebuild Kerrville St to Kendall 138 kV line  
12) Upgrade Kendall to Comfort 138 kV line |
<table>
<thead>
<tr>
<th>Alternative</th>
<th>Upgrades</th>
</tr>
</thead>
</table>
| 5           | 1) Construct a new 345 kV double-circuit transmission line from Bracken to Marion  
2) Construct a new 345 kV circuit from Highway 46 to Bracken on double-circuit capable structures  
3) Construct a new 345 kV circuit from Zorn to Marion  
4) CPS Energy 345 kV reconfiguration  
5) Add three (3) 345/138 kV Autotransformers at Bracken  
6) Add two (2) 345/138 kV Autotransformers at Howard Road  
7) Add second Marion Autotransformer  
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit  
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit  
10) Rebuild Randolph to Weiderstein 138 kV line  
11) Rebuild Kerrville St to Kendall 138 kV line  
12) Upgrade Kendall to Comfort 138 kV line |
| 6           | 1) Construct a new 345 kV double-circuit transmission line from Bracken to Clear Springs  
2) Construct a new 345 kV circuit from Bergheim to Bracken on double-circuit capable structures  
3) Construct a new 345 kV circuit from Zorn to Marion  
4) CPS Energy 345 kV reconfiguration  
5) Add three (3) 345/138 kV Autotransformers at Bracken  
6) Add two (2) 345/138 kV Autotransformers at Howard Road  
7) Add second Marion Autotransformer  
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit  
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit  
10) Rebuild Randolph to Weiderstein 138 kV line  
11) Rebuild Kerrville St to Kendall 138 kV line  
12) Upgrade Kendall to Comfort 138 kV line |
| 7           | 1) Construct a new 345 kV double-circuit transmission line from Bracken to Marion  
2) Construct a new 345 kV circuit from Bergheim to Bracken on double-circuit capable structures  
3) Construct a new 345 kV circuit from Zorn to Marion  
4) CPS Energy 345 kV reconfiguration  
5) Add three (3) 345/138 kV Autotransformers at Bracken  
6) Add two (2) 345/138 kV Autotransformers at Howard Road  
7) Add second Marion Autotransformer  
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit  
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit  
10) Rebuild Randolph to Weiderstein 138 kV line  
11) Rebuild Kerrville St to Kendall 138 kV line  
12) Upgrade Kendall to Comfort 138 kV line |
| 8           | 1) Construct new 345 kV circuit from Elm Creek to Martinez  
2) Construct new 345 kV circuit from Rio Nogales to Elm Creek  
3) Construct a new 345 kV circuit from Zorn to Marion  
4) Loop J.K. Spruce to Skyline 345 kV line into Martinez  
5) CPS Energy 345 kV reconfiguration  
6) Add three (3) 345/138 kV Autotransformers at Martinez  
7) Add two (2) 345/138 kV Autotransformers at Howard Road  
8) Add second Marion Autotransformer  
9) Loop 138 kV circuits into Martinez from J.T. Deely to Converse, J.T. Deely to Walzem, O.W. Sommers to Kirby and Beck Rd to Kirby  
10) Rebuild Kerrville St to Kendall 138 kV line  
11) Upgrade Kendall to Comfort 138 kV line |

**Table 4.2.1: Scope Summary for Each Alternative**
Alternative 1

1) Construct a new 345 kV double-circuit transmission line from Bracken to Clear Springs
2) Construct a new 345 kV circuit from Highway 46 to Bracken on double-circuit capable structures
3) Loop the Zorn to Marion 345 kV line into Clear Springs
4) Rebuild Marion to Clear Spring 345 kV lines
5) CPS Energy 345 kV reconfiguration
6) Add three (3) 345/138 kV Autotransformers at Bracken
7) Add two (2) 345/138 kV Autotransformers at Howard Road
8) Add second Marion Autotransformer
9) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit
10) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit
11) Rebuild Randolph to Weiderstein 138 kV line
12) Rebuild Kerrville St to Kendall 138 kV line
13) Upgrade Kendall to Comfort 138 kV line

Figure 3.2.1: Alternative 1
Alternative 2

1) Construct a new 345 kV double-circuit transmission line from Bracken to Clear Springs
2) Loop Kendall to Hays Energy 345 kV line into Bracken
3) Construct a new 345 kV circuit from Zorn to Marion
4) CPS Energy 345 kV reconfiguration
5) Add three (3) 345/138 kV Autotransformers at Bracken
6) Add two (2) 345/138 kV Autotransformers at Howard Road
7) Add second Marion Autotransformer
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit
10) Rebuild Hamilton Wolfe to Medical Center 138 kV line
11) Rebuild Randolph to Weiderstein 138 kV line
12) Rebuild Kerrville St to Kendall 138 kV line
13) Upgrade Kendall to Comfort 138 kV line

Figure 3.2.2: Alternative 2
**Alternative 3**

1) Loop Kendall to Hays Energy 345 kV line into Bracken
2) Construct a new 345 kV circuit from Zorn to Marion
3) CPS Energy 345 kV reconfiguration
4) Add two (2) 345/138 kV Autotransformers at Bracken
5) Add two (2) 345/138 kV Autotransformers at Howard Road
6) Add second Marion Autotransformer
7) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit
8) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit
9) Rebuild Hamilton Wolfe to Medical Center 138 kV line
10) Rebuild Randolph to Weiderstein 138 kV line
11) Rebuild Kerrville St to Kendall 138 kV line
12) Upgrade Kendall to Comfort 138 kV line

![Map](image)

**Figure 3.2.3: Alternative 3**
**Alternative 4**

1) Construct a new 345 kV double-circuit transmission line from Bracken to Clear Springs
2) Construct a new 345 kV circuit from Highway 46 to Bracken on double-circuit capable structures
3) Construct a new 345 kV circuit from Zorn to Marion
4) CPS Energy 345 kV reconfiguration
5) Add three (3) 345/138 kV Autotransformers at Bracken
6) Add two (2) 345/138 kV Autotransformers at Howard Road
7) Add second Marion Autotransformer
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit
10) Rebuild Randolph to Weiderstein 138 kV line
11) Rebuild Kerrville St to Kendall 138 kV line
12) Upgrade Kendall to Comfort 138 kV line

---

![Figure 3.2.4: Alternative 4](image-url)
Alternative 5

1) Construct a new 345 kV double-circuit transmission line from Bracken to Marion
2) Construct a new 345 kV circuit from Highway 46 to Bracken on double-circuit capable structures
3) Construct a new 345 kV circuit from Zorn to Marion
4) CPS Energy 345 kV reconfiguration
5) Add three (3) 345/138 kV Autotransformers at Bracken
6) Add two (2) 345/138 kV Autotransformers at Howard Road
7) Add second Marion Autotransformer
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit
10) Rebuild Randolph to Weiderstein 138 kV line
11) Rebuild Kerrville St to Kendall 138 kV line
12) Upgrade Kendall to Comfort 138 kV line

Figure 3.2.5: Alternative 5
Alternative 6

1) Construct a new 345 kV double-circuit transmission line from Bracken to Clear Springs
2) Construct a new 345 kV circuit from Bergheim to Bracken on double-circuit capable structures
3) Construct a new 345 kV circuit from Zorn to Marion
4) CPS Energy 345 kV reconfiguration
5) Add three (3) 345/138 kV Autotransformers at Bracken
6) Add two (2) 345/138 kV Autotransformers at Howard Road
7) Add second Marion Autotransformer
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit
10) Rebuild Randolph to Weiderstein 138 kV line
11) Rebuild Kerrville St to Kendall 138 kV line
12) Upgrade Kendall to Comfort 138 kV line
Alternative 7

1) Construct a new 345 kV double-circuit transmission line from Bracken to Marion
2) Construct a new 345 kV circuit from Bergheim to Bracken on double-circuit capable structures
3) Construct a new 345 kV circuit from Zorn to Marion
4) CPS Energy 345 kV reconfiguration
5) Add three (3) 345/138 kV Autotransformers at Bracken
6) Add two (2) 345/138 kV Autotransformers at Howard Road
7) Add second Marion Autotransformer
8) Construct a new double-circuit transmission line to loop Bracken into the Bulverde to Green Mountain 138 kV circuit
9) Construct a new double-circuit transmission line to loop Bracken into the Skyline to Tri-County 138 kV circuit
10) Rebuild Randolph to Weiderstein 138 kV line
11) Rebuild Kerrville St to Kendall 138 kV line
12) Upgrade Kendall to Comfort 138 kV line

Figure 3.2.7: Alternative 7
**Alternative 8**

1) Construct new 345 kV circuit from Elm Creek to Martinez
2) Construct new 345 kV circuit from Rio Nogales to Elm Creek
3) Construct a new 345 kV circuit from Zorn to Marion
4) Loop J.K. Spruce to Skyline 345 kV line into Martinez
5) CPS Energy 345 kV reconfiguration
6) Add three (3) 345/138 kV Autotransformers at Martinez
7) Add two (2) 345/138 kV Autotransformers at Howard Road
8) Add second Marion Autotransformer
9) Loop 138 kV circuits into Martinez from J.T. Deely to Converse, J.T. Deely to Walzem, O.W. Sommers to Kirby and Beck Rd to Kirby
10) Rebuild Kerrville St to Kendall 138 kV line
11) Upgrade Kendall to Comfort 138 kV line

*Figure 3.2.8: Alternative 8*
5. Steady-State Study

5.1 Study Assumptions

The following ERCOT Steady-State Working Group (SSWG) base cases and the 2013 ERCOT RTP 2018 base case were used to perform the studies:

1) 2018 ERCOT SSWG Summer Peak (14DSB_2018_SUM1_Final_10152013.raw)
2) 2013 ERCOT RTP 2018 Base Case (2018SUM_ReliabilityCase_SE_08192013.raw)
3) 2020 ERCOT SSWG Summer Peak (14DSB_2020_SUM1_Final_10152013.raw)

These base cases include all CPS Energy and LCRA TSC facilities of 60 kV and higher voltage, as well as all individual generators with their step-up transformers as they are expected to operate in 2018 and 2020. The base cases were modified such that the swing bus was moved from the Centerpoint area to the ONCOR area. Specifically, it was moved from the W. A. Parish bus (110015) to the Monticello bus (120033), which is sufficiently far enough from the study area not to affect the study results.

5.1.1 Generation Assumptions

Effective February 1, 2013, ERCOT Planning Guide Section 6.9 was revised to clarify that a Signed Generation Interconnection Agreement (SGIA), notice to proceed, and any necessary security are required to include a prospective generator in planning models built by the SSWG. Table 5.1.1.1 lists prospective generator projects located in the broader central Texas area that meet this new criterion. The base cases used in this analysis already include these new generators.

<table>
<thead>
<tr>
<th>TDSP</th>
<th>Project Name</th>
<th>County</th>
<th>Fuel</th>
<th>Total Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPS Energy</td>
<td>OCI Alamo 1</td>
<td>Bexar</td>
<td>Solar</td>
<td>50</td>
</tr>
<tr>
<td>LCRA TSC</td>
<td>Goldthwaite Wind Energy</td>
<td>Mills</td>
<td>Wind</td>
<td>150</td>
</tr>
<tr>
<td>LCRA TSC</td>
<td>Ferguson Replacement Project</td>
<td>Llano</td>
<td>Gas</td>
<td>570</td>
</tr>
</tbody>
</table>

Table 5.1.1.1: New Generation Included in Base Cases

The base cases were modified to account for the retirement of the J.T. Deely power plant in 2018. The retired 850 MW of generation was accounted for in the cases by increasing generation in the ONCOR area. Generation in ONCOR was increased at random and not according to any dispatch methodology. The specific generators that were increased are listed in Table 5.1.1.2.

<table>
<thead>
<tr>
<th>Generator</th>
<th>Unit #</th>
<th>SSWG 2018 Base Case/Modified Dispatch (MW)</th>
<th>RTP 2018 Base Case/Modified Dispatch (MW)</th>
<th>SSWG 2020 Base Case/Modified Dispatch (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SANDOW (170091)</td>
<td>SDSES_UNIT4</td>
<td>No Change</td>
<td>330/400</td>
<td>No Change</td>
</tr>
<tr>
<td>SANDOW (170092)</td>
<td>SD5SES_UNIT5</td>
<td>No Change</td>
<td>500/565</td>
<td>No Change</td>
</tr>
<tr>
<td>OAK GROVE (120131)</td>
<td>OGSES_UNIT1A</td>
<td>No Change</td>
<td>381/835</td>
<td>No Change</td>
</tr>
<tr>
<td>OAK GROVE (120132)</td>
<td>OGSES_UNIT2</td>
<td>No Change</td>
<td>510/825</td>
<td>No Change</td>
</tr>
<tr>
<td>VALLEY SES (140022)</td>
<td>VLSES_UNIT2</td>
<td>0/495</td>
<td>No Change</td>
<td>0/500</td>
</tr>
<tr>
<td>VALLEY SES (140023)</td>
<td>VLSES_UNIT3</td>
<td>0/355</td>
<td>No Change</td>
<td>0/360</td>
</tr>
</tbody>
</table>

Table 5.1.1.2: ONCOR Generation Adjusted
5.1.2 Transmission Network Assumptions

Table 5.1.2.1 indicates transmission system additions in the CPS Energy and LCRA TSC areas assumed to be completed before or within the 2018 to 2020 timeframe. In this table, an “X” indicates that the transmission system addition is either not applicable or is already included in the base case, and a “√” indicates that the transmission system addition was added to the base case.

<table>
<thead>
<tr>
<th>Transmission System Addition</th>
<th>SSWG 2018</th>
<th>RTP 2018</th>
<th>SSWG 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition of Fourth Skyline Autotransformer</td>
<td>X</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>Addition of a Bergheim Capacitor Bank</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Rebuild of the Merida to Westside 138 kV circuit</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Upgrade of the Zorn to York Creek to Seguin 138 kV circuits ²</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Upgrade of the Lockhart to Lulling City 138 kV circuit</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Rebuild of the Howard Road to Somerset 138 kV circuit</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Upgrade of the Howard Road to Leon Creek 138 kV circuit</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Addition of the Marion to Cibolo 138 kV circuit</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Addition of CPS Energy Comal 138 kV Substation</td>
<td>X</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>Addition of CPS Energy Pontranco 138 kV Substation</td>
<td>X</td>
<td>√</td>
<td>X</td>
</tr>
<tr>
<td>Addition of CPS Energy Southton 138 kV Substation</td>
<td>X</td>
<td>√</td>
<td>X</td>
</tr>
</tbody>
</table>

Table 5.1.2.1: Load in the CPS Energy and LCRA TSC areas

5.1.3 Load Assumptions

The load for the CPS Energy and LCRA TSC areas are shown in Table 5.1.3.1. The load power factor is not uniform across the CPS Energy and LCRA TSC systems. The load power factor at each individual substation in the base cases is based on data from the 2013 Annual Load Data Request (ALDR).

<table>
<thead>
<tr>
<th>Case</th>
<th>CPS Energy Load (MW)</th>
<th>LCRA TSC Load (MW)</th>
<th>Total Load (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSWG 2018 SUM</td>
<td>5,949</td>
<td>5,121</td>
<td>11,070</td>
</tr>
<tr>
<td>RTP 2018 SUM</td>
<td>6,206</td>
<td>4,990</td>
<td>11,196</td>
</tr>
<tr>
<td>SSWG 2020 SUM</td>
<td>6,272</td>
<td>5,410</td>
<td>11,682</td>
</tr>
</tbody>
</table>

Table 5.1.3.1: Load in the CPS Energy and LCRA TSC areas

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² 2013 ERCOT RTP overload resolved with an upgrade of the line ratings to 478 MVA
5.2 Steady-State Contingency Analysis Results

A comparison of the contingency analysis between the original posted base cases and those with the J. T. Deely retirement is described in section 5.2.1. Contingency analysis for each of the alternatives is described in Section 5.2.2. For all of the results presented, only the contingency that causes the highest facility loading are provided. Table 5.2.1 defines the labels found under the ‘CONT TYPE’ column in Tables 5.2.1.1, 5.2.2.1, 5.2.2.2 and 5.2.2.3. The NERC Type designation of A, B, C and D corresponds to the labeling found in NERC TPL standards TPL-001, TPL-002, TPL-003 and TPL-004. The ERCOT Type designation of 1, 2 and 3 corresponds to the contingency numbers found in Table 1 of the ERCOT Planning Guide Section 4.1.1.2.

<table>
<thead>
<tr>
<th>CONT TYPE</th>
<th>NERC TYPE</th>
<th>ERCOT TYPE</th>
<th>CONTINGENCY DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>N/A</td>
<td>No Contingency</td>
</tr>
<tr>
<td>B_E1</td>
<td>B</td>
<td>N/A</td>
<td>N-1 (loss of a single generator, transformer or transmission line)</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>1</td>
<td>Common Tower Outage (loss of a double-circuit tower)</td>
</tr>
<tr>
<td>B_E2</td>
<td>C</td>
<td>2</td>
<td>Generator Unavailable in Combination with loss of a transformer or transmission line</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>2</td>
<td>Generator Unavailable in Combination with a Common Tower Outage</td>
</tr>
<tr>
<td>B_E3</td>
<td>C</td>
<td>3</td>
<td>Autotransformer Unavailable in Combination with N-1</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>3</td>
<td>Autotransformer Unavailable in Combination with a Common Tower Outage</td>
</tr>
</tbody>
</table>

Table 5.2.1: Contingency Type Description
5.2.1  **Base Case and Generation Retirement Case Results Comparison**

In order to understand the effects of the retirement of the J. T. Deely power plant, a comparison was made between the posted base cases and these same cases modified with the generation retirement. Facility loading was monitored under contingency conditions. The results of this contingency analysis are shown in Table 5.2.1.1. For the results in this table, the original posted SSWG base cases and RTP case are labeled with “Base” and the cases modified to reflect the J. T. Deely retirements are labeled with “Mod”.

<table>
<thead>
<tr>
<th>CONT TYPE</th>
<th>MONITORED FACILITY</th>
<th>RATING (MVA)</th>
<th>AUTOTRANSFORMER OR GENERATOR UNAVAILABLE</th>
<th>CONTINGENCY</th>
<th>SSWG 2018 Base (%)</th>
<th>SSWG 2018 Mod (%)</th>
<th>RTP 2018 Base (%)</th>
<th>RTP 2018 Mod (%)</th>
<th>SSWG 2020 Base (%)</th>
<th>SSWG 2020 Mod (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>NO OVERLOADS</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>B_E1</td>
<td>HILL COUNTRY AUTO #2</td>
<td>600</td>
<td>N/A</td>
<td>HILL COUNTRY AUTO #1</td>
<td>83</td>
<td>94</td>
<td>87</td>
<td>98</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>SKYLINE(5371)-MARION(7044)-1</td>
<td>1104</td>
<td>N/A</td>
<td>ELMCREEK(5133)-HILLCOUNTRY(5211)-1 HILLCOUNTRY(5211)-MARION(7044)-1</td>
<td>72</td>
<td>96</td>
<td>95</td>
<td>119</td>
<td>78</td>
<td>102</td>
</tr>
<tr>
<td></td>
<td>ZORN(7042)-MARION(7044)-1</td>
<td>1103</td>
<td>N/A</td>
<td>MARION(7044)-CLEARSPRINGS(7050)-1</td>
<td>40</td>
<td>65</td>
<td>95</td>
<td>121</td>
<td>50</td>
<td>76</td>
</tr>
<tr>
<td></td>
<td>MARION(7044)-CLEARSPRINGS(7050)-1</td>
<td>1103</td>
<td>N/A</td>
<td>MARION(7044)-ZORN(7042)-1</td>
<td>47</td>
<td>74</td>
<td>107</td>
<td>136</td>
<td>58</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>KERRVILLE ST(7138)-KENDALL(7150)-1</td>
<td>221</td>
<td>N/A</td>
<td>KENDALL AUTO #1</td>
<td>87</td>
<td>93</td>
<td>30</td>
<td>102</td>
<td>108</td>
<td></td>
</tr>
<tr>
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5.2.2   Alternative Results Comparison

The contingency analysis results are presented in the following tables for each alternative. The results are presented for each base case separately. All base cases and alternatives were modeled to reflect the J. T. Deely retirements. Table 5.2.2.1 provides results for the SSWG 2018 DSB modified base case (labeled “SSWG 2018 Mod”) and associated alternatives. Table 5.2.2.2 provides results for the 2013 ERCOT RTP 2018 modified case (labeled “RTP 2018 Mod”) and associated alternatives. Table 5.2.2.3 provides results for the SSWG 2020 DSB modified base case (labeled “SSWG 2020 Mod”) and associated alternatives.

SSWG 2018 DSB

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### Table 5.2.2.3: SSWG 2020 DSB Contingency Analysis Results by Alternative

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### 5.3 Transmission System Losses

The transmission system losses are presented for each base case separately. Table 5.3.1 provides losses for the SSWG 2018 DSB base case, Table 5.3.2 provides losses for the ERCOT RTP 2018 case and Table 5.3.3 provides losses for the SSWG 2020 DSB base case. For the losses in these tables, the original posted SSWG base cases and RTP case modified to reflect the J. T. Deely retirements are labeled with “Mod”. Each table has the losses shown by voltage and by area for both CPS Energy and LCRA TSC. The total losses are the combination of the CPS Energy and LCRA TSC losses.

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<td></td>
<td></td>
<td>215</td>
<td>204</td>
<td>204</td>
<td>206</td>
<td>206</td>
<td>208</td>
<td>205</td>
<td>208</td>
<td>203</td>
</tr>
</tbody>
</table>
PV Analysis was performed for eight of the Alternatives (1, 2, 3, 4, 5, 6, 7 and 8) to determine voltage stability when transferring power into the CPS Energy system. By studying these select Alternatives, we were able to understand the transfer effect between the two main switching station locations, as well as, major changes in import line connections. The analysis was performed by increasing load in the San Antonio area and decreasing load in the neighboring TSPs’ systems. The curves (provided in Appendix A) plot the incremental power transfer versus the bus voltage (p.u.) at the Cagnon Rd 345 kV switching station. Cagnon Rd bus was chosen because it is the furthest in the CPS Energy system from a strong import source. Table 5.4.1 indicates the maximum incremental transfer limit until voltage collapse (thermal limits were ignored) for the worst-case contingency.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>SSWG 2018 (MW)</th>
<th>RTP 2018 (MW)</th>
<th>SSWG 2020 (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified Base Case</td>
<td>1963</td>
<td>1375</td>
<td>1800</td>
</tr>
<tr>
<td>Alternative 1</td>
<td>2500</td>
<td>1762</td>
<td>2194</td>
</tr>
<tr>
<td>Alternative 2</td>
<td>2506</td>
<td>1800</td>
<td>2200</td>
</tr>
<tr>
<td>Alternative 3</td>
<td>2531</td>
<td>1700</td>
<td>2343</td>
</tr>
<tr>
<td>Alternative 4</td>
<td>2656</td>
<td>1806</td>
<td>2387</td>
</tr>
<tr>
<td>Alternative 5</td>
<td>2618</td>
<td>1768</td>
<td>2418</td>
</tr>
<tr>
<td>Alternative 6</td>
<td>2531</td>
<td>1793</td>
<td>2450</td>
</tr>
<tr>
<td>Alternative 7</td>
<td>2481</td>
<td>1925</td>
<td>2400</td>
</tr>
<tr>
<td>Alternative 8</td>
<td>2394</td>
<td>1781</td>
<td>2381</td>
</tr>
</tbody>
</table>

Table 5.4.1: Maximum Incremental Power Transfer
5.5 **Summary of Steady State Study**

All alternatives alleviate the 2018 overloads identified in the ERCOT 2013 Regional Transmission Plan. All alternative solutions resolve the contingency overloads that occur in the modified base cases, except for overloads caused by the outage of the Clear Springs autotransformer followed by the outage of an additional transmission element (Tables 5.2.2.2 and 5.2.2.3). This contingency condition results in the overload of the Marion autotransformers (#1 and #2), the Marion to Clear Springs 345 kV line, the Henne to Comal 138 kV line, the Henne to McCarty Lane 138 kV line and the Henne to Zorn 138 kV line. The overloads caused by these contingencies are resolved by energizing a standby autotransformer at Clear Springs (installed in 2014).

The transmission system losses are similar across all alternatives; however, Alternative 2 and Alternative 8 are among the lowest (Tables 5.3.1, 5.3.2 and 5.3.3).

As indicated in Table 5.4.1 and PV plots shown in Appendix A, alternatives with Bracken (Alternatives 1 through 7) generally have higher import capacity than the alternative with Martinez (Alternative 8). Also, Alternatives with a second 345 kV circuit from Zorn to Marion (Alternatives 2 through 7) generally have a higher import capacity than the alternative where Clear Springs is cut into the existing Zorn to Marion 345 kV line (Alternative 1).
6. Cost Estimates

A summary of the cost for each alternative is provided in Table 5.2.1. The ‘Total Miles’ column is a total of the estimated mileage for new right-of-way required for new circuits identified in each alternative, in addition to the total mileage of lines to be upgraded.

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Total Miles</th>
<th>Substation ($M)</th>
<th>Transmission ($M)</th>
<th>Total Cost ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>92</td>
<td>$104.4</td>
<td>$238.3</td>
<td>$342.7</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
<td>$90.9</td>
<td>$250.7</td>
<td>$341.7</td>
</tr>
<tr>
<td>3</td>
<td>77</td>
<td>$76.0</td>
<td>$161.3</td>
<td>$237.3</td>
</tr>
<tr>
<td>4</td>
<td>104</td>
<td>$89.6</td>
<td>$264.6</td>
<td>$354.2</td>
</tr>
<tr>
<td>5</td>
<td>94</td>
<td>$102.3</td>
<td>$226.4</td>
<td>$328.7</td>
</tr>
<tr>
<td>6</td>
<td>110</td>
<td>$99.1</td>
<td>$286.0</td>
<td>$385.1</td>
</tr>
<tr>
<td>7</td>
<td>100</td>
<td>$102.5</td>
<td>$247.8</td>
<td>$350.3</td>
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<tr>
<td>8</td>
<td>75</td>
<td>$92.8</td>
<td>$183.5</td>
<td>$276.3</td>
</tr>
</tbody>
</table>

Table 6.1: Cost Estimates

7. Recommendation

CPS Energy and LCRA TSC recommend construction of Alternative 3 with a project completion date of June 2019. The total project cost is estimated at $237.3 M. The LCRA TSC portion of the Kendall to Hays Energy 345 kV extension to Bracken and the new LCRA TSC 345 kV line from Zorn to Marion will require a CCN.

As indicated in Section 3.5, the new switching station should be located such that it is beneficial to both CPS Energy and LCRA TSC in the long-term. In order for this to occur, it should be located in an area with a high forecasted load growth. Forecasted load growth for the eastern and northeastern portion of the CPS Energy service territory for the next five years is shown in Table 7.1. The table indicates that load is forecasted to grow at a higher rate in the northeast area of San Antonio, which is the area that Bracken will serve (Alternatives 1 through 7) as compared with the load growth in the east, which will be served by Martinez (Alternative 8). PV analysis in Section 5.4 indicates that the Bracken location has higher import capability and better voltage support in 2018 than the Martinez location. For these reasons, Bracken is the preferred location to site the new switching station. Table 6.1 indicates that Alternative 3 is the lowest cost alternative.

Lastly, the extension of the Kendall to Hays Energy 345 kV transmission line into the Bracken switching station effectively reduces the risk for area generation to become unstable under sub-synchronous resonance conditions during certain multi-line contingencies, which was studied under a separate confidential study. Therefore, based upon the results presented in Section 5.2, cost estimates found in Table 6.1 and the reasons listed above, Alternative 3 is recommended as the best alternative to alleviate the identified overloads and provide for the long term electric system needs for the area.

<table>
<thead>
<tr>
<th>San Antonio Area</th>
<th>2015 (MW)</th>
<th>2016 (MW)</th>
<th>2017 (MW)</th>
<th>2018 (MW)</th>
<th>2019 (MW)</th>
<th>2020 (MW)</th>
<th>Average Growth Rate (%)</th>
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<tr>
<td>NORTHEAST</td>
<td>466.2</td>
<td>489.2</td>
<td>513.4</td>
<td>539.4</td>
<td>557.1</td>
<td>572.6</td>
<td>4.20%</td>
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<tr>
<td>EAST</td>
<td>495.7</td>
<td>510.4</td>
<td>525.4</td>
<td>539.8</td>
<td>552.9</td>
<td>566.3</td>
<td>2.70%</td>
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Table 7.1: Load in the CPS Energy and LCRA TSC areas

---

5 Buses included in load forecast for the Northeast area include Bulverde, Cibolo Creek, Encino Park, Green Mountain, Panther Springs, Stonegate and Tri-County. Buses included in load forecast for the eastern area include Beck Road, Converse, Fratt, Kirby, Martinez, Sulpher Springs, St. Hedwig and Walzem.
7.1 **Project Scope**

- Extend the LCRA TSC Kendall to Hays Energy 345 kV line on separate double-circuit capable structures in order to loop into the proposed CPS Energy Bracken switching station. (The extension of this line to Bracken will be on separate structures and on independent right-of-way in order to avoid creating a common-tower outage.)
- Construct a new 345 kV circuit between LCRA TSC’s Zorn and Marion switching stations by using an open position on an existing transmission line between Zorn and Clear Springs and constructing a new 345 kV transmission line from Clear Springs to Marion using double-circuit capable structures
- Reconfigure the Skyline double-circuit to Marion and Elm Creek and the Hill Country double-circuit to Marion and Elm Creek to become a double-circuit from Hill Country to Marion and a double-circuit from Skyline to Elm Creek
- Construct a new CPS Energy switching station at Bracken with two 345/138 kV autotransformers
- Convert the existing CPS Energy Howard Road 138 kV switching station to a 345/138 kV switching station with two autotransformers
- Add a second 345/138 kV autotransformer with a minimum rating of 478 MVA at LCRA TSC Marion switching station
- Construct a new 138 kV double-circuit transmission line to loop the proposed CPS Energy Bracken switching station into the Bulverde to Green Mountain 138 kV circuit
- Construct a new 138 kV double-circuit transmission line to loop the proposed CPS Energy Bracken switching station into the Skyline to Tri-County 138 kV circuit
- Upgrade the LCRA TSC Kerrville Stadium to Kendall 138 kV circuit to a minimum rating of 446 MVA
- Upgrade the LCRA TSC Kendall to Comfort 138 kV circuit to a minimum rating of 382 MVA
- Rebuild the CPS Energy Randolph to Weiderstein 138 kV circuit to a minimum rating of 478 MVA
- Upgrade the CPS Energy Hamilton Wolfe to Medical Center 138 kV circuit to a minimum rating of 570 MVA

**Critical to Reliability Status**

The time necessary to implement any of the eight alternatives considered in this assessment will be substantial. Given the requirements and processes that must be followed, it will be challenging and potentially costly to complete a significant new 345 kV transmission project to address the stated need by 2019. Additionally, should the growth in the area increase at a faster pace than projected in this study, the required in-service date for this project would need to be earlier than 2019. Accordingly, to better meet the area needs, CPS Energy and LCRA TSC believe that the alternative selected by ERCOT’s independent analysis should be designated as “**critical to reliability**” for the ERCOT Region.
Table A.1.1: Modified Base Case
Table A.1.2: Alternative 1
Table A.1.3: Alternative 2
Table A.1.4: Alternative 3
Table A.1.5: Alternative 4
Table A.1.6: Alternative 5
Table A.1.7: Alternative 6
Table A.1.8: Alternative 7
A.2: ERCOT 2018 RTP MOD

Table A.2.1: Modified Base Case
Table A.2.2: Alternative 1
Table A.2.3: Alternative 2
Table A.2.4: Alternative 3
Table A.2.5: Alternative 4
Table A.2.6: Alternative 5
Table A.2.7: Alternative 6
Table A.2.8: Alternative 7
Table A.2.9: Alternative 8
A.3: SSWG 2020 DSB MOD

Table A.3.1: Modified Base Case
Table A.3.3: Alternative 2
Table A.3.4: Alternative 3
Table A.3.5: Alternative 4
Table A.3.6: Alternative 5
Table A.3.7: Alternative 6
Table A.3.8: Alternative 7
Table A.3.9: Alternative 8
Appendix B: Supporting Information

Steady State case files and idevs supporting this study listed below.

Case Files (raw)
SSWG 2018 Case: 14DSB_2018_SUM1_Final_10152013.raw
RTP 2018 Case: 2018SUM_ReliabilityCase_08192013_SE.raw
SSWG 2020 Case: 14DSB_2020_SUM1_Final_10152013.raw

Change Files (idv)
Alternative 1: ALT_1.idv
Alternative 2: ALT_2.idv
Alternative 3: ALT_3.idv
Alternative 4: ALT_4.idv
Alternative 5: ALT_5.idv
Alternative 6: ALT_6.idv
Alternative 7: ALT_7.idv
Alternative 8: ALT_8.idv

Additional Change Files (idv)
- CPS_Rebuild Howard_Somerset.idv
- CPS_Rebuild Merida_Westside.idv
- CPS_Skyline_4xfmr.idv
- LCRATSC_Bergheim_Cap_Bank.idv
- LCRATSC_Lockhart_Luling-TL_Upgrade_2017.idv
- LCRATSC_Marion_Cibolo_2nd_TL.idv
- LCRATSC_Zorn_York_Seguin_Merrimack.idv
Appendix C: One-line of Recommended Project

Figure C.1: Selected Project one-line diagram
May 4, 2015

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Mr. Richard Medina
Sr. Director System Planning & Technical Services
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System Engineer,
Guadalupe Valley Electric Cooperative, Inc.
6400 West IH-10
Seguin, TX 78155

RE: LCRA TSC and CPS Energy Transmission System Addition project

On April 14, 2015 the Electric Reliability Council of Texas (ERCOT) Board of Directors endorsed the following Tier 1 transmission project as needed to support the reliability of the ERCOT Regional transmission system:

LCRA TSC and CPS Energy Transmission System Addition project:

- Reconfigure the existing Hill Country-Elm Creek/Marion and Skyline- Marion/Elm Creek 345 kV double-circuit lines to form Hill Country-Marion double circuit and Skyline-Elm Creek double circuit. The Elm Creek-Skyline 345 kV double circuit and the Hill Country-Marion 345 kV double circuit are expected to have a minimum emergency rating of 1077 MVA and 1104 MVA, respectively
- Construct a new Zorn-Marion 345 kV line\(^1\) (approximately 21 miles) with an emergency rating of at least 1959 MVA; Add a second 345/138 kV transformer at Clear Springs with an emergency rating of at least 525 MVA
- Add a second 345/138 kV transformer at Marion with an emergency rating of at least 525 MVA
- Upgrade the existing Cibolo-Schertz 138 kV line (approximately 3.6 miles) with an emergency rating of at least 477 MVA

\(^1\) Portion of the new line between Zorn and Clear Springs will utilize the open position on the existing double circuit capable Gillesland Creek-Clear Springs transmission line, and the remaining portion of the new line will be built on the new double circuit capable structure.
Further, the Board deemed the new Zorn-Marion 345 kV line critical to the reliability of the ERCOT System. Additional details on this project are included in the Attachment A to this letter.

This project was supported throughout the ERCOT planning process, which included participation of all market segments through the ERCOT RPG. ERCOT’s recommendation to the Board was reviewed by the ERCOT Regional Planning Group and the ERCOT Technical Advisory Committee (TAC). ERCOT staff looks forward to the successful completion of the work and is ready to assist you with any planning and operations related activities.

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

Sincerely,

Brad Jones
Sr. Vice President and Chief Operating Officer
Electric Reliability Council of Texas

cc:
Shawnee Claiborn-Pinto, PUCT
Trip Doggett, ERCOT
Warren Lasher, ERCOT
Jeff Billo, ERCOT
Prabhu Gnanam, ERCOT
ERCOT Independent Review of the LCRA TSC and CPS Energy Transmission System Addition Project

March 2015
## Document Revisions

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<th>Version</th>
<th>Description</th>
<th>Author(s)</th>
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<td>03/19/2015</td>
<td>1.0</td>
<td>Final</td>
<td>Sun Wook Kang, Ying Li</td>
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<td></td>
<td></td>
<td>Review ed by</td>
<td>Prabhu Gnanam, Jeff Billo</td>
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<tr>
<td>03/19/2015</td>
<td>2.0</td>
<td><strong>Correction in Section 8:</strong> The designated provider for the new proposed 345/138 kV transformers at Clear Springs and Marion has been changed to LCRA TSC instead of GVEC, since LCRA TSC owns the Clear Springs and Marion substations.</td>
<td>Sun Wook Kang / Prabhu Gnanam</td>
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</tbody>
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1. Executive Summary

The San Antonio area is one of the major load centers of the ERCOT system, located in the South Central weather zone. The load in the area is served by the generation inside the area and a 345 kV transmission loop connected to a 138 kV network. The system is connected to the rest of the ERCOT system mainly through the major 345 kV lines in the region including the key paths running between San Antonio and Austin. The power import into the region is expected to increase as the existing J.T. Deely Plant (850 MW) is scheduled to retire by December 2018, and the load in the area continues to grow.

Identifying the reliability need to improve the transmission capability in the San Antonio area, CPS Energy and LCRA TSC submitted a Regional Planning Group (RPG) project proposal in June 2014. ERCOT conducted an independent review for the proposed project and determined that several 345 kV and 138 kV lines supporting the San Antonio system and the existing 345/138 kV transformers serving the area load are vulnerable to thermal overloads under various contingency conditions by 2019.

Based on the independent review, ERCOT concludes that new transmission reinforcement is needed to meet the reliability criteria in 2019. ERCOT evaluated project alternatives to address the reliability problems and concluded that the transmission project defined as Option A is the best solution to address the reliability need in the area by 2019. The detailed description of Option A is as follows.

- Reconfigure the existing Hill Country-Elm Creek/Marion and Skyline-Marion/Elm Creek 345 kV double-circuit lines to form Hill Country-Marion double circuit and Skyline-Elm Creek double circuit. The Elm Creek-Skyline 345 kV circuits and the Hill Country-Marion 345 kV circuits are expected to have a minimum emergency rating of 1077 MVA and 1104 MVA, respectively.
- Construct a new Zorn-Marion 345 kV line (approximately 21 miles) with an emergency rating of at least 1959 MVA.
- Add a second 345/138 kV transformer at Clear Springs with an emergency rating of at least 525 MVA.
- Add a second 345/138 kV transformer at Marion with an emergency rating of at least 525 MVA.
- Upgrade the existing Cibolo-Schertz 138 kV line (approximately 3.6 miles) with an emergency rating of at least 477 MVA.

The project will address the reliability need and improve the transmission system supporting San Antonio. The estimated cost of the preferred project is approximately $86 million in 2019 dollars. The estimate may vary as the designated providers of the new transmission reinforcement (CPS Energy, Guadalupe Valley Electric Cooperative (GVEC), and LCRA TSC) perform more detailed cost analysis.

---

1 Portion of the new line between Zorn and Clear Springs will utilize the open position on the existing double circuit capable Gillesland Creek-Clear Springs transmission line.
2. Introduction

The load in the San Antonio area is served by the generation inside the area and a 345 kV transmission loop connected to a 138 kV network. The system is connected to the rest of the ERCOT system mainly through the major 345 kV lines in the region including the key paths running between San Antonio and Austin. The power import into the region is expected to increase as the existing J.T. Deely Plant (850 MW) is scheduled to retire by December 2018, and the load in the area continues to grow.

Recently, CPS Energy and LCRA TSC jointly submitted an RPG project proposal for new transmission reinforcement by 2019 to address identified reliability needs. ERCOT conducted an independent review to evaluate the RPG project jointly submitted by CPS Energy and LCRA TSC. As described in this report, ERCOT performed various studies, determined the reliability need, and identified the best solution that addresses the reliability need. Figure 2.1 shows the system map of the study area.

![Figure 2.1: Transmission System map of study area with key substations](image-url)
3. Criteria, Study Assumption, and Methodology

ERCOT studied various system conditions to determine the reliability need and to find a robust and cost-effective solution from both near-term and long-term transmission planning perspectives. The study criteria, assumption, and methodology for the ERCOT independent review are described in this section and are consistent with the NERC reliability standards, ERCOT Protocols, and the ERCOT Planning Guide.

3.1 Study Criteria and Monitored Area

The criteria applied for the AC power flow analyses are consistent with ERCOT Planning Guide 4.1.1.2 and the 2014 Regional Transmission Plan (RTP). For the reliability analysis, the following thermal and voltage limits were enforced:

- Rate A under pre-contingency conditions for 60 kV and above transmission lines and transformers with a low side voltage of 60 kV and above
- Rate B under post-contingency conditions for 60 kV and above transmission lines and transformers with a low side voltage of 60 kV and above
- 0.95 pu voltage under pre-contingency conditions for 100 kV and above transmission lines and transformers with a low side voltage of 100 kV and above
- 0.90 pu voltage under post-contingency conditions for 100 kV and above transmission lines and transformers with a low side voltage of 100 kV and above

The monitored area in the study is the South Central weather zone, particularly the transmission system in the Bexar, Comal, and Guadalupe Counties.

3.2 Study Assumption and Methodology

3.2.1 Study Base Case

The base case selected for this independent review is the 2019 South/South Central (SSC) summer peak case built for the 2014 RTP. The base case was built for the 2014 RTP for the year 2019 based on the 2014 Dataset B developed by the Steady-State Working Group (SSWG).

During the course of the independent review, CPS Energy notified ERCOT that it would be revising the load forecast for the CPS Energy area in the upcoming Annual Load Data Request (ALDR) filing (March-2015). Based on the new information, ERCOT adjusted the total load of CPS Energy in the RTP base case to 5,406 MW to create the RPG study base case. The adjustment resulted in a total load of 13,825 MW for the South Central weather zone. The reliability analysis was conducted based on this adjusted load forecast.

The RTP base case contained various transmission upgrades and projects to address the N-1 reliability issues identified during the 2014 RTP. The upgrades include a placeholder project related to this RPG proposal. ERCOT removed the placeholder project from the RTP base case to create the RPG study base case. The RTP base case also had other transmission projects modeled in and around the region as listed below. ERCOT concluded that these upgrades would
not provide significant impact on the independent review of this RPG project. These projects were kept in the RPG study base case and are listed below:

- Marion-Cibolo second circuit addition (2017 In-service year, Tier 4 Project ID 2792);
- Zorn-York-Seguin 138 kV line upgrade (2016 In-service year, Tier 4 Project ID 3966);
- Tapping the Shiner-Moulton 138 kV line and adding a 69/138kV transformer at the GVEC Moulton substation (2019 In-service year); and
- Lockhart auto and Lockhart-Seawillow-Luling 138kV line upgrade (2017 In-service year, Tier 4 Project ID 3963).

In the RTP base case, all three units at Frontera, in the Lower Rio Grande Valley area, were modeled online. Based on the Notice of System Planning Data Request for Switchable Resources dated July 25, 2014 (as updated on September 25, 2014), ERCOT modeled the Frontera units offline in the RPG study base case to reflect the status of the units in the year 2019. To accommodate the change in the Frontera generation and to balance supply and demand, ERCOT reduced a total of 555 MW load in the North, North Central, West, Far West, East and Coast weather zones.

In the RPG study base case, J.T. Deely units 1 and 2 were not modeled based on the notification of Suspension of Operations of a Generator Resources submitted by CPS Energy on October 25, 2013.

In the RPG study base case, the DC ties (flows) are modeled consistent with the 2014 RTP scope assumption.

### 3.2.2 Study Methodology

To evaluate the reliability need, ERCOT studied the 2019 RPG study base case by applying the planning criteria in Section 3.1. Then, ERCOT studied two options to address the reliability issues identified in the 2019 RPG study base case. The two options were created based on analyzing the identified reliability issues and reviewing the RPG project submittal which was conducted using a higher load initially forecasted for the study area compared to the most recent load forecast used in this analysis. More details of the two options can be found in Section 5.

For need analysis and project option evaluation, ERCOT performed N-1, G-1+N-1 (generator outage), and X-1+N-1 (transformer outage) contingency analyses. ERCOT also tested severe events (i.e., NERC Category C and D conditions) with and without each project option to check the robustness of each transmission option.

In addition to comparing the system performance of each option, ERCOT also compared the cost estimates of the two options.

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3.2.3 Tools

ERCOT utilized PowerWorld version 18 with SCOPF for AC power flow analysis as the software tool for the independent review of the CPS Energy/LCRA TSC Transmission Addition project.

3.2.4 Contingencies

All ERCOT Category B contingencies were evaluated for the AC power flow analyses. For G-1+N-1 analysis, the following generator outages were considered as the worst G-1 condition for the study area:

- JK Spruce 2 (JKS2, 775 MW)
- OW Sommers 1 (OWS1, 420 MW)
- VH Braunig 3 (VHB3, 412 MW)

For the X-1+N-1 analysis, ERCOT considered the following 345/138 kV transformers (as the prior outage condition) in the study area:

- Hill Country 345/138 kV transformer #1 or #3
- Cagnon 345/138 kV transformer #1 or #3
- Skyline 345/138 kV transformer #3
- Marion 345/138 kV transformer #1
- Zorn 345/138 kV transformer #2
- Clear Springs 345/138 kV transformer #1

In addition, ERCOT also tested approximately 193 multi-element contingencies representing the NERC C and D events, based on the knowledge of the system in the study area and the combinations of the major transmission lines in the area of interest.

4. Project Need

Driven by the continued load growth in the area and the announced generation retirement in San Antonio, several reliability issues (thermal post-contingency overloads) were identified on the 345 and 138 kV transmission facilities coming from the north/east into San Antonio area by 2019.

ERCOT conducted an AC power flow analysis using the RPG study base case. The study result indicated overloads of approximately 16 miles of 345 kV line and 14 miles of 138 kV lines in the area under N-1 contingency conditions. The N-1 issues were aggravated further under the G-1+N-1 contingency conditions resulting in overloads of approximately 69 miles of 345 kV lines, 26 miles of 138 kV lines, and one 345/138 kV transformer in the area. The result of the G-1+N-1 analysis indicated that the outage of JK Spruce 2 would cause the most severe impact on the 345 kV facilities in the area compared to other G-1 conditions (OW Sommers 2 or VH Braunig 3). The results of the N-1 and G-1+N-1 contingency analyses are summarized below.

---

3 N-1 contingency analysis under the prior outage of a 345/138 kV transformer
4 See ERCOT Market Notice W-A102513-01 Notification of Suspension of Operations for CPS Energy (RE), CALAVERS_JTD1 and CALAVERS_JTD2
**N-1 Result**
- Overload of Skyline-Marion 345 kV line (~16 miles, 105%)
- Overload of McCarty Ln-Henne-Comal 138 kV line (~14.2 miles, 106–109%)
- Heavy flow on Comal-Loop 337 138 kV line (98%)
- Heavy flow on Zorn 345/138 kV transformer T1 (99%)
- Heavy flow on Clear Springs 345/138 kV transformer T1 (99.5%)

**G-1+N-1 Result**
- Worst G-1: JK Spruce 2 G-1 causes the most severe impact on the system
- Overload of Skyline-Marion 345 kV line (~16 miles, 118–131%)
- Overload of Marion-Clear Springs 345 kV line (~8.5 miles, 111–123%)
- Overload of Hill Country-Marion 345 kV line (~26.7 miles, 99–108%)
- Overload of Zorn-Marion 345 kV line (~18 miles, 99–110%)
- Overload of Clear Springs 345/138 kV transformer (107–111%)
- Overload of McCarty Lane-Henne-Comal-Loop 337-Gpi Switch 138 kV lines (~19.8 miles, 118–132%)
- Overload of Henne-Zorn 138 kV line (~6.5 miles, 101–106%)
- Heavy flow on Zorn 345/138 kV T1 transformer (98–99%)

ERCOT also performed the X-1+N-1 contingency analysis for the outage of each 345/138 kV transformer defined in Section 3.2.4. The X-1+N-1 analysis identified additional overloads of 345/138 kV transformers in the area in addition to the 345 and 138 kV line overloads. However, most of the overloads found under the X-1+N-1 conditions are generally less severe than those identified in the G-1+N-1 contingency analysis. The results of the X-1+N-1 contingency analysis are summarized below.

**X-1+N-1 Result**
- Skyline-Marion and Marion-Clear Springs 345 kV lines were overloaded up to 113.6% and 104.7% respectively.
- Overloads of Henne-Comal 138 kV line (up to 130.3%), Henne-McCarty Lane 138 kV line (up to 121.6%), Coma-Loop 337-Gpi Switch 138 kV line (up to 104.3%, 101.6%), and Henne-Zorn 138 kV line (up to 130.7%)
- Clear Springs or Zorn transformer outage condition appears to provide the most severe impact
- Overloads of Clear Springs 345/138 kV transformer (101–109%) under various X-1+N-1 conditions
- Overloads of Zorn 345/138 kV transformers (100–112%) under Clear Springs, Zorn, Marion or Skyline X-1+N-1 condition
- Overload of Marion 345/138 kV transformer (104%) under Clear Springs X-1+N-1 condition

The overall study results (overloaded and experiencing heavy flows) are summarized in Table 4.1.
No voltage violation was found in the study area under the N-1, G-1+N-1 and X-1+N-1 contingency conditions.

Figure 4.1 shows the map of all the system problems identified under the N-1, G-1+N-1 and X-1+N-1 analyses. The detailed results of the reliability analyses can be found in Appendix A.
Table 4.1: Thermal overload or heavy flow issues identified in the area

<table>
<thead>
<tr>
<th>345 and 138 kV Facilities with Overload or Heavy Flow</th>
<th>Worst Percent (%) Loading under N-1, G-1+N-1 and X-1+N-1 Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Bus</td>
<td>To Bus</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Skyline</td>
<td>Marion</td>
</tr>
<tr>
<td>Marion</td>
<td>Clear Springs</td>
</tr>
<tr>
<td>Hill Country</td>
<td>Marion</td>
</tr>
<tr>
<td>Zorn</td>
<td>Marion</td>
</tr>
<tr>
<td>Clear Springs</td>
<td>Clear Springs</td>
</tr>
<tr>
<td>Zorn</td>
<td>Zorn</td>
</tr>
<tr>
<td>Zorn</td>
<td>Zorn</td>
</tr>
<tr>
<td>Zorn</td>
<td>Zorn</td>
</tr>
<tr>
<td>Marion</td>
<td>Marion</td>
</tr>
<tr>
<td>Hill Country</td>
<td>Hill Country</td>
</tr>
<tr>
<td>Hill Country</td>
<td>Hill Country</td>
</tr>
<tr>
<td>Henne</td>
<td>Comal</td>
</tr>
<tr>
<td>Henne</td>
<td>McCarty Lane</td>
</tr>
<tr>
<td>Loop 337</td>
<td>Gpi Switch</td>
</tr>
<tr>
<td>Comal</td>
<td>Loop 337</td>
</tr>
<tr>
<td>Henne</td>
<td>Zorn</td>
</tr>
<tr>
<td>Merida</td>
<td>Westside</td>
</tr>
</tbody>
</table>

* Adjusting the tap setting would reduce the percent loading on the Hill Country T2 to below 95% under the worst contingency condition.
5. Project Options

ERCOT considered two options: Option A involving the construction of a new 345 kV line and Option B involving the upgrades of the existing lines identified as overloaded. These two options are described as follows.

- **Option A**
  - Reconfigure the existing Hill Country-Elm Creek/Marion and Skyline-Marion/Elm Creek 345 kV double-circuit lines to form Hill Country-Marion double circuit and Skyline-Elm Creek double circuit. The Elm Creek-Skyline 345...
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The Hill Country-Marion 345 kV double circuit and the Hill Country-Marion 345 kV double circuit are expected to have a minimum emergency rating of 1077 MVA and 1104 MVA, respectively.

- Construct a new Zorn-Marion 345 kV line5 (approximately 21 miles) with an emergency rating of at least 1959 MVA.
- Add a second 345/138 kV transformer at Clear Springs with an emergency rating of at least 525 MVA.
- Add a second 345/138 kV transformer at Marion with an emergency rating of at least 525 MVA.
- Upgrade the existing Cibolo-Schertz 138 kV line6 (approximately 3.6 miles) with an emergency rating of at least 477 MVA.
- The construction cost estimated for Option A is approximately $86 million in 2019 dollars.

- Option B
  - Reconfigure the existing Hill Country-Elm Creek/Marion and Skyline-Marion/Elm Creek 345 kV double-circuit lines to form Hill Country-Marion double circuit and Skyline-Elm Creek double circuit. The Elm Creek-Skyline 345 kV double circuit and the Hill Country-Marion 345 kV double circuit are expected to have a minimum emergency rating of 1077 MVA and 1104 MVA, respectively.
  - Loop the existing Marion-Zorn 345 kV line into Clear Springs and upgrade the Marion-Clear Springs double circuit 345 kV (8.5 miles) with an emergency rating of at least 1959 MVA.
  - Upgrade several existing 138 kV lines; McCarty Ln-Henne (6.6 miles) with an emergency rating of at least 477 MVA, Henne-Comal double circuit (7.6 miles) with an emergency rating of at least 477 MVA, Comal-Loop337-GPI Switch (5.6 miles) with an emergency rating of at least 789 MVA, GPI Switch-EC Monhinweg-Parkway7 (10.6 miles) with an emergency rating of at least 435 MVA, and Henne-Zorn 138 kV line (6.5 miles) with an emergency rating of at least 435 MVA.8
  - Add a fourth 345/138 kV transformer at Zorn with an emergency rating of at least 525 MVA.
  - Add a second 345/138 kV transformer at Clear Springs with an emergency rating of at least 525 MVA.
  - The construction cost estimated for Option B is approximately $130 million in 2019 dollars.

The two options are illustrated in Figures 5.1 and 5.2.

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5 Portion of the new line between Zorn and Clear Springs will utilize the open position on the existing double circuit capable Gillesland Creek-Clear Springs transmission line, and the remaining portion of the new line will be built on the new double circuit capable structure.

6 Upgrading the Cibolo-Schertz 138 kV line is included in Option A since the 138 kV line is found overload due to other upgrades in Option A.

7 Upgrading the GPI Switch-EC Monhinweg-Parkway 138 kV lines is included in Option B since the 138 kV lines are found overload due to other upgrades in Option B.

8 LCRA has indicated that a new parallel 138 kV path could be an alternative for these 138 kV line upgrades.
With respect to Option B, upgrades to the existing Comal-Loop 337-GPI Switch 138 kV path would leave these lines loaded in excess of 95% leaving little capacity available to serve future load growth, therefore, the more substantial upgrades to this path presented in Option B are appropriate for the evaluation of these two alternatives.
Figure 5.1: System map of Option A

- Rebuild/Upgrade existing line
- New 345 kV line
- 1X One new 345/138 kV transformer
- Modify the existing 345 kV line configuration
Rebuild/Upgrade existing line

1X One new 345/138 kV transformer

M Modify the existing 345 kV line configuration

Figure 5.2: System map of Option B
6. Evaluation of the Options

ERCOT performed contingency analyses to ensure that the two options address the identified reliability issues. ERCOT also tested approximately 193 NERC Category C and D events (e.g., multi-element outages) to understand the robustness of the two options while also comparing the planning-level cost estimates. ERCOT also compared the transmission efficiency improved by each option from a system loss perspective and considered the long-term benefit of each option.

6.1 Results of Contingency Analyses of the Options

The N-1, G-1+N-1, and X-1+N-1 contingency analyses were performed for the two selected options, and both options addressed the reliability need identified in Section 4.

6.2 Cost Comparison

As noted in Section 5, it is estimated that the cost of Option A is approximately $86 million in 2019 dollars, while the cost of Option B is approximately $130 million in 2019 dollars. The costs are based on the estimates provided by CPS Energy and LCRA TSC.

Based on these cost estimates, it is concluded that Option B is more expensive compared to Option A. In addition, Option B would also likely result in higher real-time congestion cost or other construction challenges due to outages/clearances required for the existing line upgrades.

6.3 Impact of NERC Category C and D Contingencies

NERC Category C and D contingency conditions were studied to check if each option would introduce any additional reliability issues to the system under these severe events. ERCOT tested approximately 193 NERC Category C and D events in the study area.

The results indicate that both options would improve the system reliability under the severe events compared to the base case (with no upgrade). Table 6.1 summarizes the result of the analysis.

<table>
<thead>
<tr>
<th>Options</th>
<th>Number of Unsolved Contingencies</th>
<th>Number of Thermal Loading Above 115% On 345 kV</th>
<th>Number of Low Voltage at 345 kV Buses (Below 0.9 pu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>w/o Option</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Option A</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Option B</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
6.4. System Loss Reduction

As improvements are added to a system, transmission efficiency will be improved due to decrease in the system impedance and increase in the system voltage. The transmission efficiency improved by a new line can be measured by system loss reduction.

ERCOT performed the system loss analysis for each option, using the RPG study base case (2019 summer peak condition), in order to capture the benefit of transmission efficiency improved by the two options. The amount of loss reduction is shown in Table 6.4 indicating significant loss reduction realized by each option during the peak hour.

<table>
<thead>
<tr>
<th>Option</th>
<th>System Loss Reduction (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option A</td>
<td>11.2</td>
</tr>
<tr>
<td>Option B</td>
<td>12.4</td>
</tr>
</tbody>
</table>

6.5. Overall Comparison

The comparison of the study results of Option A and Option B are summarized below.

- Both Option A and Option B address the reliability need in the study area, as identified in the 2019 RPG study base case, and meet the reliability criteria.
- Both Option A and Option B provide system loss reduction and improve system reliability under severe system conditions (NERC Category C and D contingencies) tested for the study area.
- Both options remove the 345 kV line crossing that exists on the Skyline-Marion and Hill Country-Elm Creek lines.
- Option A (~$86 million) is the least cost option compared to Option B (~$130 million). It is also expected that Option B would likely result in higher real-time congestion cost or other construction challenges due to outages/clearances required for the existing line upgrades.
7. Conclusion and Recommendation

ERCOT identified reliability criteria violations in the San Antonio area in 2019. The reliability need is primarily driven by continued load growth in the area and retirement of J.T. Deely units 1 and 2 generation inside San Antonio.

Based on the independent review, ERCOT recommends the following facilities as the preferred option.

- Reconfigure the existing Hill Country-Elm Creek/Marion and Skyline-Marin/Elm Creek 345 kV double-circuit lines to form Hill Country-Marion double circuit and Skyline-Elm Creek double circuit. The Elm Creek-Skyline 345 kV double circuit and the Hill Country-Marion 345 kV double circuit are expected to have a minimum emergency rating of 1077 MVA and 1104 MVA, respectively.
- Construct a new Zorn-Marion 345 kV line (approximately 21 miles) with an emergency rating of at least 1959 MVA.
- Add a second 345/138 kV transformer at Clear Springs with an emergency rating of at least 525 MVA.
- Add a second 345/138 kV transformer at Marion with an emergency rating of at least 525 MVA.
- Upgrade the existing Cibolo-Schertz 138 kV line (approximately 3.6 miles) with an emergency rating of at least 477 MVA.
- The estimated cost for Option A is approximately $86 million in 2019 dollars.
8. Designated Provider of Transmission Facilities

In accordance with ERCOT Nodal Protocols Section 3.11.4.8, ERCOT staff is to designate transmission providers for projects reviewed in the RPG. The default providers will be those that own the end points of the new projects. These providers can agree to provide or delegate the new facilities or inform ERCOT if they do not elect to provide them. If different providers own the two ends of the recommended projects, ERCOT will designate them as co-providers and they can decide between themselves what parts of the recommended projects they will each provide.

The preferred solution involves constructing a new line between Zorn and Marion and installing new 345/138 kV transformers at Clear Springs and Marion substations. Since LCRA TSC owns the substations, LCRA TSC is designated as the provider of the new 345 kV line from Zorn to Marion and the new 345/138 kV transformers at Clear Springs and Marion substations. LCRA TSC has indicated that it is unlikely for the new 345 kV line to be in-service before summer peak of 2019 unless ERCOT designates the new 345 kV line critical to reliability per PUCT Substantive Rule 25.101(b)(3)(D). Since there is a reliability need to have the project in place before summer 2019, ERCOT deems this portion of the project critical to reliability.

The preferred solution also involves reconfiguration of the existing Hill Country-Elm Creek/Marion and Skyline-Marion/Elm Creek 345 kV double-circuit lines. As a result of the reconfiguration, there will be a double circuit between Hill Country and Marion and another double circuit between Skyline and Elm Creek. Therefore, based on the ownership of the substations, ERCOT designates CPS Energy and LCRA TSC as the co-providers of the Hill Country-Marion double-circuit 345 kV line, and CPS Energy as the provider of the Skyline-Elm Creek double-circuit 345 kV line.

ERCOT designates GVEC as the provider for the upgrade of the existing Cibolo-Schertz 138 kV line since GVEC owns the substations associated with the upgrades.
# Appendix A: Results of Contingency Analyses of the RPG Study Base Case and Option A

<table>
<thead>
<tr>
<th>AC Contingency Result of 2019 RPG Study Base Case (N-1 Analysis)</th>
<th>Appendix A1 - AC Contingency Result α</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Contingency Result of 2019 RPG Study Base Case (G-1+N-1 Analysis)</td>
<td>Appendix A2 - AC Contingency Result α</td>
</tr>
<tr>
<td>AC Contingency Result of 2019 RPG Study Base Case (X-1+N-1 Analysis)</td>
<td>Appendix A3 - AC Contingency Result α</td>
</tr>
<tr>
<td>AC Contingency Result of 2019 RPG Study Base Case with Option A (N-1 analysis)</td>
<td>Appendix A4 - AC Contingency Result α</td>
</tr>
<tr>
<td>AC Contingency Result of 2019 RPG Study Base Case with Option A (G-1+N-1 and X-1+N-1 analysis)</td>
<td>Appendix A5 - AC Contingency Result α</td>
</tr>
</tbody>
</table>