ERCOT Requirements to Integrate Entergy Texas, Inc. into ERCOT

Phase III Study Report

ERCOT

System Planning

December 5, 2008

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Executive Summary

In December 2006, Electric Reliability Council of Texas, Inc. (ERCOT) completed the report "ERCOT Requirements to Integrate Entergy Gulf States – Texas Into ERCOT: Phase II Study Report" as part of the proceedings in Docket No. 33687 at the Public Utility Commission of Texas (PUCT). Subsequent to completion of this report, the PUCT requested that the Southwest Power Pool (SPP) conduct an analysis similar to the one conducted by ERCOT, and requested that ERCOT update its Phase II Study to match the input assumptions from the SPP analysis. This report (Phase III Study) documents the results of this additional analysis.

As described in this report, ERCOT has identified the minimum set of projects that would be necessary to serve load in the combined ERCOT/ETI region in adherence with relevant NERC and ERCOT reliability criteria. These projects are described in the following list:

1. Extend the existing ERCOT 345-kV Kuykendahl – King line into the existing Entergy Porter substation and install one 345-kV/138-kV 800 MVA autotransformer at Porter.
2. Build one new single-circuit 345-kV line on new towers from the existing ERCOT Roans Prairie substation to the existing Entergy Grimes substation.
3. Build a new 345-kV substation (Quarry) near the county line between Houston and Walker Counties in the existing Entergy line from Grimes to Crockett. Install an asynchronous 100 MW tie at Quarry between the bus and the line to Crockett.
4. Build a new 345-kV line from Quarry to existing Entergy Rivtrin substation.
5. Split the existing 500-kV bus at Entergy Hartburg substation and install a 244-MW asynchronous tie.
6. Install a 583-MW asynchronous tie at the 230-kV bus at the existing Entergy Hartburg substation.
7. Install a 230-kV line from the existing Entergy Hartburg substation to the existing Entergy Sabine substation.
8. Rebuild the existing Entergy 69-kV line from Fawil to City of Kirbyville as a 138-kV line and tie to existing Entergy/JNEC 138-kV Kirbyville substation.
9. Rebuild the existing Entergy 138-kV line between the Porter and Oakridge substations.
10. Upgrade the existing Entergy 138-kV line between the Navasota and Longmire substations.
11. Upgrade the existing 69-kV lines from the Sour Lake to Dome substations, the Dome to Batson substations, and the Gallier to Elizabeth substations.
12. Close the existing 138-kV tie between the Oncor (ERCOT) substation Etoile and the DETEC (Entergy) substation Etoile.

13. Close the existing normally open 138-kV switch between the Entergy Speedway station and Entergy College Station tap point.
14. Add 20-MVA 138-kV capbanks at the Entergy Dobbins and Navasota substations.
15. Upgrade the existing 138-kV line connecting the Porter and Tamina substations.

The aggregate cost of these reliability projects is estimated to be $488,672,000.

In addition, ERCOT has identified a set of additional projects that will minimize the overall system cost (the net cost of annual system production costs and transmission upgrade costs). These projects are described in the following list:

1. Add a second 500-kV/230-kV 800-MVA autotransformer at the Hartburg substation.
2. Add a second circuit from the Hartburg to Sabine substations on separate towers.
3. Close the Dayton-Crosby 138-kV line and upgrade the line to a rating of 531 MVA.
4. Construct a new substation at Canal, tapping the 345-kV line connecting the Cedar and N Belt substations on Ckt # 99 in the CenterPoint service territory.
5. Add one 345-kV/230-kV 600-MVA autotransformer at the China substation.
6. Add two 500-kV/345-kV 800-MVA autotransformers at the Cypress substation.
7. Construct a 345-kV line from the Cypress to China substations and from the China to Canal substations.

The total cost for these economic-driven projects is $287,414,000. As modeled, they will result in annual production cost savings of $55 million, which is more than 16.5% of the capital cost of the upgrades, the current ERCOT criteria for recommending economic transmission projects.

ERCOT Requirements to Integrate Entergy Texas, Inc. into ERCOT

Phase III Study Report

1. Introduction

In December 2006, Electric Reliability Council of Texas, Inc. (ERCOT) completed the report "ERCOT Requirements to Integrate Entergy Gulf States – Texas Into ERCOT: Phase II Study Report" (Phase II Study). The Phase II Study was submitted on December 29, 2006, to the Public Utility Commission of Texas (PUCT) in Docket No. 33687 as part of the document "Application of Entergy Gulf States, Inc.'s for Transition to Competition (TTC) Plan." On October 24, 2007, the PUCT abated this docket so that Entergy Texas, Inc. (ETI; formerly known as Entergy Gulf States, Inc.) could request the Southwest Power Pool (SPP) to conduct an analysis similar to the one conducted by ERCOT and documented in the Phase II Study. On May 23, 2008, the PUCT issued a further order accepting SPP's schedule for completing the requested study, and directing ERCOT to update its Phase II Study to match the input assumptions from the SPP analysis. This report (Phase III Study) documents the results of this additional analysis.

2. Purpose

The goal of the Phase III Study is to indicate the transmission projects that are needed to integrate the ETI region into ERCOT in a reliable and efficient manner while meeting pre-existing contractual requirements, similar to the Phase II Study. The analysis conducted by ERCOT in late 2006 has been updated to match certain input assumptions being utilized in a parallel study being conducted by SPP. These input assumptions include: fuel prices, transmission equipment costs, unit efficiency estimates, load forecasts, and emission allowance prices.

3. Methodology

A. Topology

The 2012 transmission topology from the most recently completed Five-Year Plan for ERCOT was used to represent the ERCOT system. ETI provided a 2012 case of its system, which included all existing and approved future transmission projects in the ETI region. These two topologies were combined in a single case, and the resulting model was used as the base case for all analyses in this study. All generating units in ERCOT and the ETI region that are in service or had signed interconnection agreements as of July 1, 2008 with in-service dates prior to the summer of 2012 were included in the

model input data. The entire Cottonwood generating facility (approximately 1,250 MW) is included in the base case analysis of the ERCOT-ETI region.

The ETI region would be separated from the Eastern Interconnect in the following locations:

1. A new substation (Quarry) on the existing 345-kV circuit connecting the Grimes and Crockett substations. The two lines (Grimes to Quarry in ERCOT, and Quarry to Crockett in SPP) are connected using a 100-MW asynchronous tie.
2. New asynchronous tie capacity is installed at the Hartburg bus to connect the ERCOT system with the Eastern Interconnect. The existing Hartburg substation and the 500-kV line connecting this substation with the Cypress substation will become part of the ERCOT system. A new substation will connect the new asynchronous tie with the existing 500-kV circuits north towards Mount Olive and east to Roy S. Nelson, which will remain in the Eastern Interconnect.
3. The 138-kV circuit between the Bon Wier to Cooper substations is opened.
4. The 138-kV circuit between the Newton Bulk to Leach substations is opened.
5. The 230-kV circuit between the Sabine to Big Three substations is opened.
6. The 138-kV circuit between the Orange to Toomey substations is opened.
7. The 138-kV circuit between the Orange to Hollywood substations is opened.

B. Modeling Tools

Steady-state powerflow contingency analysis was conducted using PSS/E™ (Version 30) and PSS/MUST™ (Version 8.3). Economic analysis was conducted using UPlan™ (Version 7.4), which models an 8,760-hour annual security-constrained unit-commitment and economic-dispatch (SCUC-ED) using a DC approximation to AC power-flows. PowerTech, Inc. analyzed transient stability using Transient Security Assessment Tool™ (TSAT).

C. Input Assumptions

The purpose of the Phase III Study is to update the analysis presented in the Phase II ERCOT/Entergy Integration Study with certain new input assumptions. The input assumptions that were updated were those that had changed significantly during the time that had elapsed since the Phase II Study and/or that needed to be consistent with those used in the analysis conducted contemporaneously by SPP in order for the results of those analyses to be comparable. Based on discussions between ERCOT and SPP, a set of input assumptions covering fuel prices, transmission equipment costs, unit efficiency estimates, load forecasts, and emission allowance prices was developed. The natural gas

price forecast for the base case analysis was an annual average $7/MMBtu (nominal). The results of economic analysis using a delivered natural gas price of $11/MMBtu are provided in Section 7. The monthly natural gas price pattern was provided to ERCOT by SPP's consultants. Delivered coal prices were evaluated to ensure they were consistent between the two studies.

The peak load forecast in 2012 for the ETI region was 4,696 MW. The load shape for the ETI region was developed to be consistent with weather assumptions used for the adjacent portions of the ERCOT region. Loads for the remainder of ERCOT were the same as used in the 2012 case of the most recently completed ERCOT Five-Year Plan.

The capacities of the asynchronous ties included in the case adjacent to the Hartburg and Quarry substations were determined based on information regarding existing long-term power contracts and/or ownership of existing generation provided to ERCOT. These capacities were provided to ERCOT by representatives of ETI. The capacity of the asynchronous tie at Quarry was set at 100 MW due to reliability needs of the SPP system on the line that extends northeast from Quarry to the Crockett substation. However, this tie was modeled as a potential source of 50 MW into the ERCOT system. The capacity of the Hartburg asynchronous tie was set at 827 MW for the base case. A change case was evaluated with the Hartburg asynchronous tie sized at only 244 MW. The results of this analysis are provided in Section 7.

Transmission project cost estimates for this analysis were provided by ETI and are planning-level estimates. No routing studies have been conducted as part of this analysis. The project costs were compared to those developed through other recent ERCOT studies and found to be generally consistent. These costs are listed in Table 1. In addition, ETI provided cost estimates for the three asynchronous ties considered as part of this analysis: the 100-MW asynchronous tie at the Quarry substation is estimated to cost $45 million; the 244-MW asynchronous tie on the 500-kV bus at the Hartburg substation is estimated to cost $84 million; and the 583-MW asynchronous tie on the 230-kV bus at the Hartburg substation is estimated to cost $162 million.

Table 1: Estimated Generic Costs of Transmission Equipment

Component	Cost (Million $; 2012)
500-kV Single Circuit on Double Circuit towers/Mile	2.31
500-kV Double Circuit/Mile	2.89
345-kV Single Circuit on Double Circuit towers/Mile	2.02
345-kV Double Circuit/Mile	2.53
230-kV Single Circuit/Mile	1.18
138-kV Single Circuit/Mile	1.05
500-kV Breaker	3.00
345-kV Breaker	2.50
230-kV Breaker	1.80
138-kV Breaker	1.25
500/345-kV 800 MVA Autotransformer	12.60
500/230-kV 800 MVA Autotransformer	12.00
345/230-kV 800 MVA Autotransformer	11.40
345/138-KV 800 MVA Autotransformer	10.80
230/138-KV 400 MVA Autotransformer	6.00
138/69-KV 100 MVA Autotransformer	2.25
4-Breaker 500-kV Ring Substation	12.00
4-Breaker 345-kV Ring Substation	10.00
4-Breaker 230-kV Ring Substation	7.50
4-Breaker 138-kV Ring Substation	5.00

D. Analysis

Using the base case developed for this project, the minimum set of projects required to reliably serve load in the combined ERCOT/ETI system was developed. Reliability of the system was evaluated using AC-contingency analysis under peak-load, steady-state conditions, and in all hours of the year using SCUC-ED analysis. For this study, a set of contingencies were defined using ERCOT Category B Contingencies Assumptions (see Section 5 of the ERCOT Operating Guides). These contingencies include:

1. All single line or single transformer contingencies and all multi-line contingencies which are defined as two lines sharing the same tower of 0.5 mile or more;

2. Include all single generator contingencies;
3. Combination of 1) and 2) above (note that to reduce the number of contingency runs; selected essential generators in the study area were analyzed. This method is only used to determine reliability projects.)

Following completion of the reliability analysis, additional projects were developed based on evaluation of transmission line congestion remaining in the combined ERCOT/ETI system. Typically, transmission projects that significantly reduce congestion will result in improvements in system efficiency (defined as reductions in overall system production costs). By analyzing system efficiency with and without proposed transmission projects, the benefits of these projects can be compared to the estimated project costs. Projects that are expected to result in greater system efficiency gains than the resulting increase in annual transmission revenue requirements charged to consumers are considered to be cost-effective. Based on previous analysis, average first-year revenue requirements charges for transmission projects in ERCOT are approximately 16.5% of the project's estimated capital cost. As such, a transmission project is considered economic if the reduction in system production costs (i.e., increase in system efficiency) is greater than 16.5% or 1/6 of the capital cost of the project.

Although economic projects are not required to maintain system reliability, they provide significant system benefits by allowing the most efficient generation to serve load. In addition, as load grows over time, inefficient generation often becomes insufficient to limit flows on congested transmission lines. When this happens, what was considered an economic transmission upgrade becomes needed to maintain system reliability.

By evaluating a number of potential transmission projects, a cost-effective set of projects that maximize the cost-effectiveness (the net of transmission costs and system efficiency) of the system was developed. Following completion of this economic project analysis, each project included in the reliability or economic set of projects was evaluated individually to ensure that each project was required and recommended.

E. Scenario Analysis

In order to evaluate the robustness of the transmission solutions under different potential future conditions, several scenarios were developed as change cases. These change cases include: $11/MMBtu gas price; removal of the 583-MW asynchronous tie at 230-kV bus at the Hartburg substation; Cottonwood generator remaining in the Eastern Interconnect; the addition of an independent transmission project connecting the Cottonwood generation to the ERCOT system; and the addition of the wind generation included in the CREZ scenario ordered by the PUCT in Docket No. 33672, Commission Staff's Petition for Designation of Competitive Renewable Energy Zones. The

recommended reliability projects in each of these change cases were found to be the same as those selected for the base case. The results of economic project analysis for each of these change cases are described in Section 7.

4. Minimum Reliability Projects

Based on the methodology described in Section 3, the following projects have been determined to be required to reliably integrate the ETI region into ERCOT.

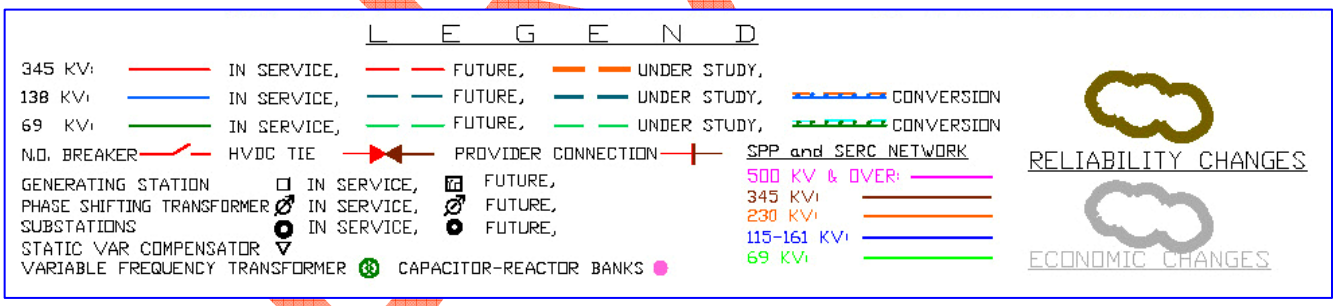
1. Extend the existing ERCOT 345-kV Kuykendahl – King line into the existing Entergy Porter substation and install one 345-kV/138-kV 800 MVA autotransformer at Porter. The length of this project is approximately 18 miles. Conductor modeled as 2-1590 ACSR, with a conductor rating of 1,793 MVA. Estimated cost: $57,410,000.
2. Build one new single-circuit 345-kV line on new towers from the existing ERCOT Roans Prairie substation to the existing Entergy Grimes substation. One circuit connecting these two substations currently exists. The length of this project is approximately 1.5 miles. The conductor rating is 1,469 MVA. Estimated cost: $8,030,000.
3. Build a new 345-kV substation (Quarry) near the county line between Houston and Walker Counties in the existing Entergy line from Grimes to Crockett. Install an asynchronous 100 MW tie at Quarry between the bus and the line to Crockett. Estimated cost: $45,000,000.
4. Build a new 345-kV line from Quarry to existing Entergy Rivtrin substation. The length of this project is approximately 11 miles. The conductor was modeled as 2-954 ACSR, with a conductor rating of 1,326 MVA. Estimated cost: $33,000,000.
5. Install a 244-MW asynchronous tie at the 500-kV bus in the Hartburg substation. Of the circuits that are currently connected to the 500-kV bus at Hartburg, the line between the Hartburg and Cypress substations will be part of the ERCOT system; the other two lines currently connected to Hartburg (to Mount Olive and to Roy Nelson) will be connected to a new 500-kV bus attached to the SERC side of the asynchronous tie. Estimated cost: $84,000,000.
6. Install a 583 MW asynchronous tie at the 230-kV bus at the existing Entergy Hartburg substation. Estimated cost: $162,000,000.
7. Install a 230-kV line from the existing Entergy Hartburg substation to the existing Entergy Sabine substation. The length of this project is approximately 23 miles. The modeled conductor is 2-954 ACSR, with a conductor rating of 884 MVA. Estimated cost: $34,380,000.
8. Rebuild the existing Entergy 69-kV line from Fawil to City of Kirbyville as a 138-kV line and tie to existing Entergy/JNEC 138-kV Kirbyville substation. The length of this line is approximately 19 miles. It was modeled as 954-ACSR, with a conductor rating of 265 MVA. Estimated cost: $16,510,000.
9. Rebuild the existing Entergy 138-kV line between the Porter and Oakridge substations. This line is approximately 9 miles; it was modeled as 2-954 ACSR, with a conductor rating of 531 MVA. Estimated cost: $5,429,000.
10. Upgrade the existing Entergy 138-kV line between the Navasota and Longmire substations. The length of this project is approximately 41 miles. It was modeled as a single 666.6 ACSR, with a new conductor rating of 206 MVA. Estimated cost: $27,827,000.
11. Upgrade the existing 69-kV lines from the Sour Lake to Dome substations, the Dome to Batson substations, and the Gallier to Elizabeth substations to a conductor rating of 140 MVA. Estimated cost: $11,586,000.
12. Close the existing 138-kV tie between the Oncor (ERCOT) substation Etoile and the DETEC (Entergy) substation Etoile. Estimated cost: $500,000.

13. Close the existing normally open 138-kV switch between the Entergy Speedway station and Entergy College Station tap point.
14. Add 20-MVA 138-kV capacitor banks at the Entergy Dobbins and Navasota substations. Estimated cost: $2,000,000.
15. Upgrade the existing 138-kV line connecting the Porter and Tamina substations to the conductor rating of 531 MVA (terminal equipment upgrade). Estimated cost: $1,000,000.
16. Open the following lines
    a. Leach – Newton Bulk
    b. Bon Wier – Cooper
    c. Orange – Toomey
    d. Orange – Hollywood
    e. Sabine – Big Three

These projects are depicted in Figure 1.

The aggregate cost of these projects required to reliably integrate the ETI region into ERCOT is $488,672,000. These costs do not include tie-back costs required on the non-ERCOT portion of the Entergy system following integration. The conductor specifications provided in the above descriptions were used for modeling and for cost estimating purposes. It is possible that the use of other conductors could provide similar system capabilities.

Legend for Figures:



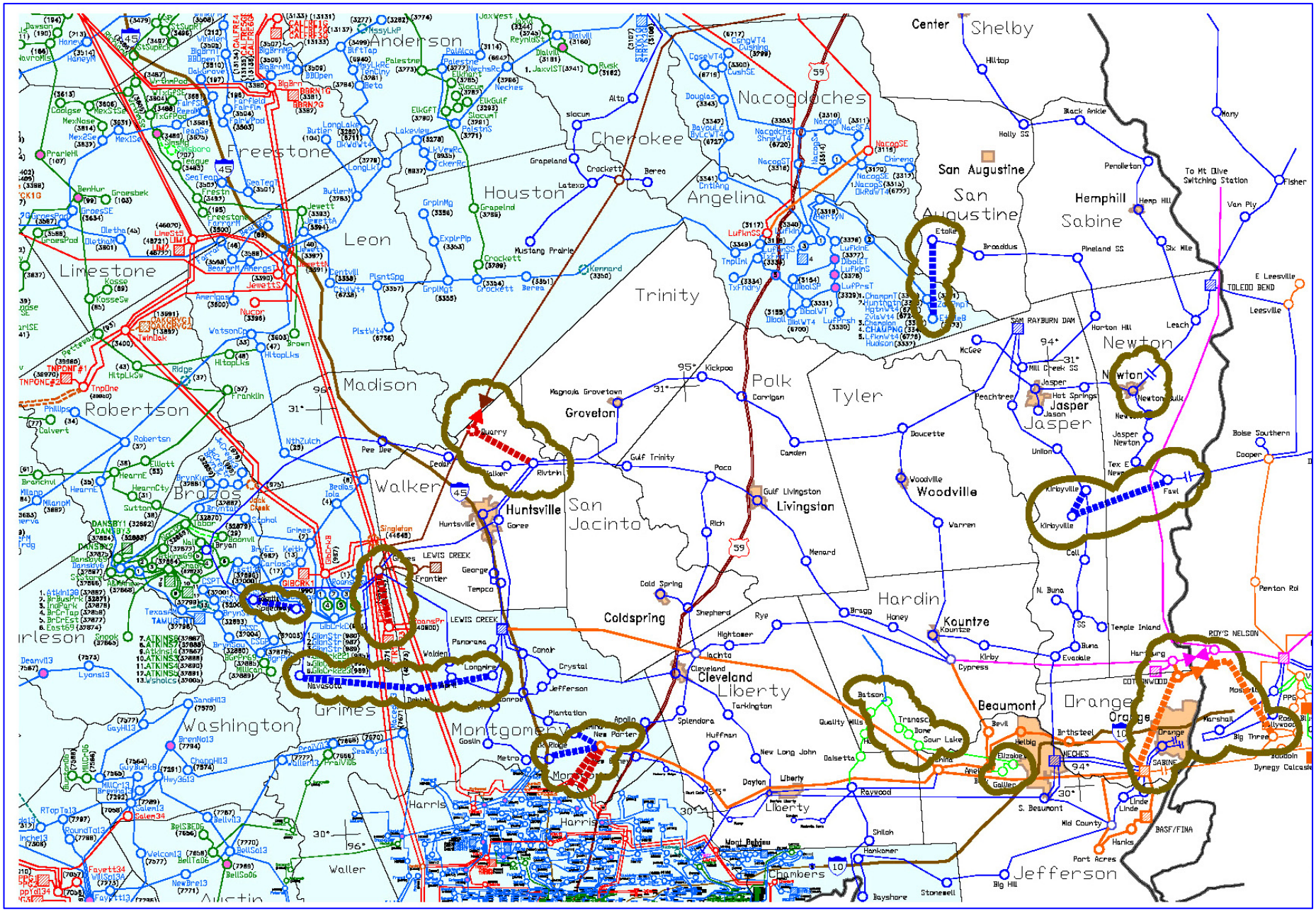


Figure 1: Minimum Reliability Projects

5. Economic Projects

With the completion of the reliability projects listed above, it is expected that the load in the integrated ERCOT – ETI system can be served while adhering to relevant NERC and ERCOT requirements for system reliability. However, in order to do so, there are periods in which less efficient generators must be utilized, in place of more efficient generation, to limit flow of power on some transmission lines. As discussed in Section 3(D), the use of less efficient generation to limit flow on transmission lines is referred to as congestion, and results in a cost to all market participants in that some of the customer load is being served with more expensive generation than would be required if the transmission system provided more transfer capacity. This system inefficiency is measured as the increased cost in fuel and variable operating expenses required to serve load and is referred to as increased system production costs. Potential transmission projects that provide sufficient reductions in system production costs to offset the increase in annual transmission charges resulting from the upgrade are typically recommended as economic projects.

As part of this Phase III Study, ERCOT has identified a set of projects that will significantly increase overall system efficiency. These projects are listed below.

1. Add a second 500-kV/230-kV 800-MVA autotransformer at the Hartburg substation. Estimated cost: $19,800,000.
2. Add a second 230-kV circuit from the Hartburg to Sabine substations on separate towers. The length of this project is approximately 21 miles. The modeled conductor is 2-954 ACSR, with a conductor rating of 1,329 MVA. Estimated cost: $30,180,000.
3. Close the Dayton-Crosby 138-kV line and upgrade the line to a rating of 531 MVA. The length of this project is approximately 19 miles. The modeled conductor is 2-954 ACSR. Estimated cost: $11,834,000.
4. Construct a new substation at Canal, tapping the 345-kV line connecting the Cedar and N Belt substations on Ckt # 99 in the CenterPoint service territory.
5. Add one 345-kV/230-kV 600-MVA autotransformer at the China substation.
6. Add two 500-kV/345-kV 800-MVA autotransformers at the Cypress substation.
7. Construct a 345-kV line from the Cypress to China substations. This line was modeled as 2-1590 ACSR, with a conductor rating of 1,785 MVA.
8. Construct a 345-kV line from the China to Canal substations. This line was modeled as 2-1590 ACSR, with a conductor rating of 1,785 MVA. The cost estimate for items 4 through 8 is $225,600,000.

These projects are depicted in Figure 2.

The aggregate cost of these projects is $287,414,000. Without these projects, the annual system production costs, as modeled, are $14,015 million. With these projects installed, the annual production costs are modeled to be $13,960 million, for an annual reduction of $55 million. This amount exceeds the current ERCOT criteria of 16.5% of project cost.

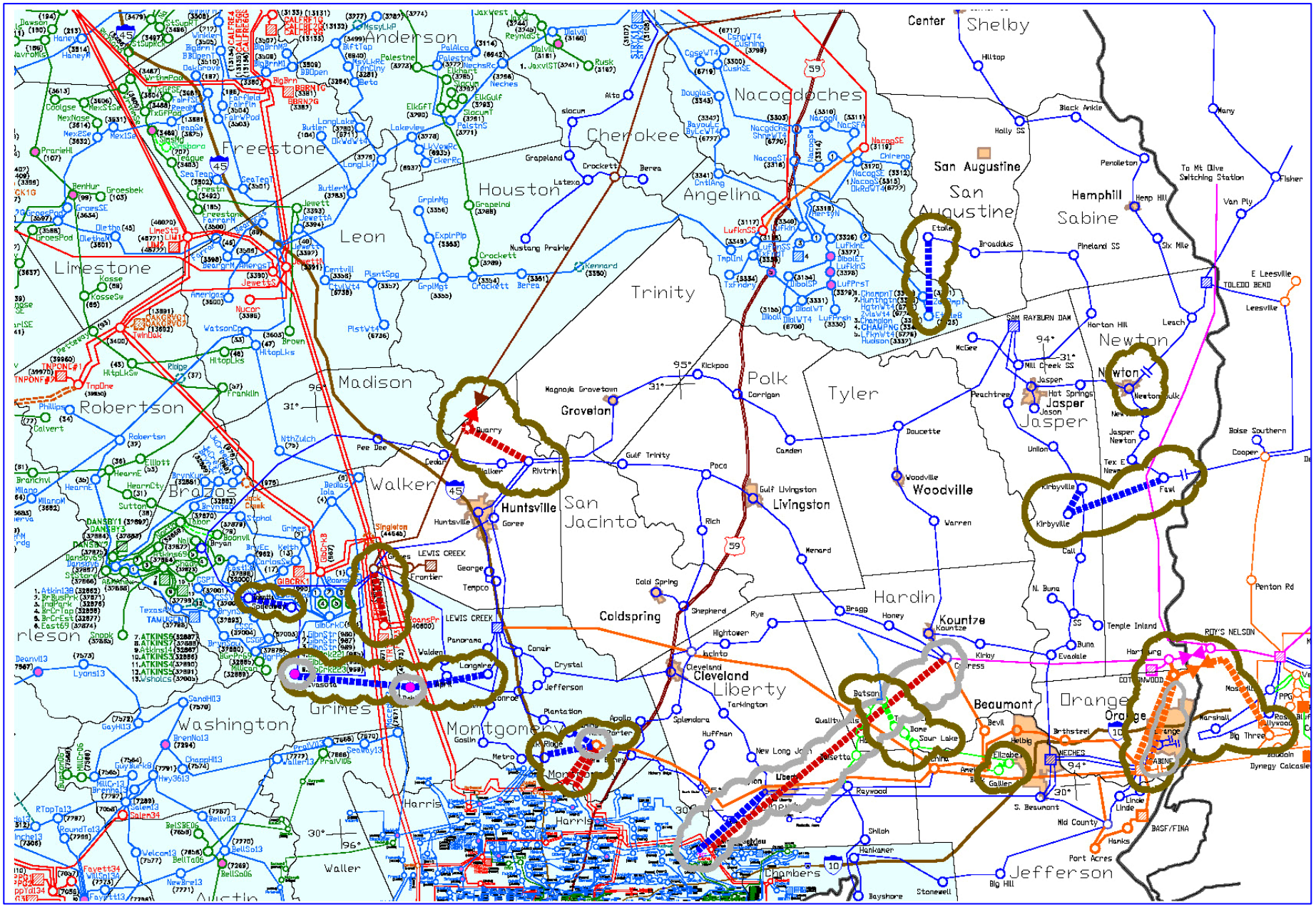


Figure 2: Reliability and Economic Projects

The previous study conducted by ERCOT included an additional 345-kV transmission line from the Entergy Cypress substation to the ERCOT Lufkin substation. This line is approximately 90 miles long, and was modeled as 2-1590 ACSR with a conductor rating of 1,785 MVA. The estimated cost of this upgrade is $182 million. In this scenario, adding this line resulted in $13 million of annual production cost savings, not enough for it to be included in the recommended set of economic projects. The likely reasons for this difference between the two studies are the increase in transmission costs and a change in the assumption regarding availability of generation brought into the ERCOT system across the asynchronous ties at the Hartburg substation. In the previous analysis, the capacity of the DC Tie at Hartburg was 300 MW, and the inflow of energy was limited to a specified schedule. In this analysis, the base case includes 827 MW of asynchronous tie capacity, and power from these ties is allowed to flow into the system whenever it is economic to do so. As a result, with additional economic power flowing into the integrated ERCOT ETI system from the east, there are fewer economic benefits resulting from power flowing south from Lufkin. As load grows in the Houston area, or if new efficient generation is developed in the northeastern area of ERCOT, it is likely that a transmission line from the Lufkin to Cypress substations would be found to be economic.

6. Stability Analysis

As in the Phase II Study, PowerTech, Inc. was selected to perform an analysis of the dynamic performance of the system in the seconds following a fault or other disturbance. This type of analysis is required to ensure that the connections between the ERCOT and ETI regions are sufficient such that the system will remain stable following an instantaneous disturbance (such as the loss of additional generation or transmission outages).

These dynamic analyses require modeling of the topology of the grid and the dynamic response of individual generators and of aggregated electrical loads (motors, lights, etc.). Due to the complexity of this analysis, PowerTech, Inc. will not complete its analysis until the first quarter of 2009. However, the findings from the Phase II Study indicated that the integrated ERCOT and ETI systems could be operated reliably with essentially the same list of reliability projects as are included in this study. As such, it is unlikely that additional transmission projects will be required in order to reliably integrate ETI into the ERCOT region.

Upon completion of the PowerTech, Inc. analysis, ERCOT will submit an update to the PUCT indicating whether any change to Phase III Study is necessary.

7. Scenario Analysis

In order to evaluate the impact of input assumptions on the results of this study, several change case scenarios were developed. The following sections describe the scenarios considered and the resulting increases in system efficiency.

A. Increased Natural Gas Price

The results provided in Sections 4 and 5 are based on an annual average forecasted delivered natural gas price of approximately $7/MMBtu. In this scenario, the same analyses were conducted using a delivered natural gas price of approximately $11/MMBtu. Based on this analysis, no changes in the reliability projects were required. An analysis of the economic projects listed in Section 5 indicates that with this elevated gas price the economic projects result in annual production cost savings of $95 million.

In addition, congestion output reports from this run were evaluated and specific projects were analyzed to determine if there were additional transmission projects that could be cost-effective. In particular, the additional circuit between the Lufkin and Cypress substations was modeled to see if it provided sufficient annual production cost savings to be included in the economic projects for this scenario. The inclusion of this line increased the production cost savings by $22 million, not enough to meet the ERCOT criteria for economic projects. Based on this analysis, no additional economic projects were identified.

B. Reduced Capacity at Hartburg Asynchronous Tie

The base case includes two asynchronous ties at the Hartburg bus: a 583-MW asynchronous tie on the 230-kV bus; and a 244-MW asynchronous tie on the 500-kV bus. A scenario was considered in which only the smaller of these two asynchronous ties was installed. Based on this analysis, no changes in the reliability projects were required. The economic projects listed in Section 5 produced production cost savings of $130 million. This scenario was also evaluated with the additional circuit between the Cypress and Lufkin substations. Adding this circuit to the set of economic projects resulted in an increase of annual production cost savings of $24. However, the Cypress to Lufkin project is estimated to cost $182 million, so this additional project would not meet the current ERCOT criteria for economic projects.

C. Full Integration of Wind Generation in the Competitive Renewable Energy Zones (CREZ)

In Docket No. 33672, the PUCT ordered the development of transmission improvements in west Texas to allow 18,456 MW of wind generation to serve load in ERCOT. For this study, the transmission improvements ordered by the PUCT have been included in the base case transmission system, but

only the wind generation projects for which there were signed interconnection agreements prior to July 1, 2008, were included. The remaining wind generation that was referenced in the Final Order on Reconsideration in Docket No. 33672 was not included in the base case for this study because it is not known how much of this wind generation will be constructed, or where this generation will be located. However, in order to provide an assessment of the potential impact from this wind generation, a scenario was evaluated in which all of the CREZ wind generation was included in the ERCOT system generation.

The transmission solutions evaluated in this scenario are the same as those described in Sections 4 and 5. The modeled production costs for the integrated ETI/ERCOT system with the reliability projects only was $12,859 million. The modeled production costs for the same system with the economic projects listed in Section 5 was $12,774 million, a production-cost reduction of $85 million per year. The modeled production cost for the system with the economic projects and the line between the Lufkin to Cypress substations was $12,650 million, for an additional $124 million in production cost savings. Based on this analysis, if a significant amount of the CREZ wind is developed, the line connecting the Lufkin to Cypress substations is likely to significantly increase the efficiency of the ERCOT system and would be recommended.

D. Cottonwood Generator Remaining in Eastern Interconnect

The 1,250 MW Cottonwood generating facility is located near the Hartburg substation in Deweyville, Texas. Even though this plant is currently interconnected to the ETI system, and serves load in the Southeastern Reliability Council (SERC) region, the owners of this plant are pursuing the option of interconnecting to the ERCOT system through the development of a new transmission line from Deweyville to a proposed Canal substation in the CenterPoint service area. In the base case of this study, the Cottonwood generator was included, but the proposed transmission line from Deweyville to Canal was not. In this and the next scenario, the impacts of the generation and the transmission line are reviewed.

Given that the Cottonwood generation facility currently serves clients in the SERC region, it is possible that this resource will remain in SERC following the possible integration of ETI into the ERCOT region. Alternatively, it is possible that this facility will have the capability to switch between the two markets based on near-term market conditions. In order to evaluate the impact of these possibilities, the economic benefits without the Cottonwood generation facility in ERCOT were modeled.

Based on this analysis, no changes in the reliability projects were required without the Cottonwood generator included in the case. Without the Cottonwood generator, the economic projects listed in Section 5 resulted in annual production cost savings of $106 million, which is sufficient for these projects to be recommended. Adding the Lufkin to Cypress line to this set of economic projects

resulted in $14 million of additional annual production cost savings, which does not meet the current criteria for economic projects.

E. Addition of Independent Transmission Line

As noted above, the owners of the Cottonwood generation facility are currently pursuing the construction of a transmission line that will connect their facility to the proposed Canal substation in the CenterPoint service area. As this proposed line to allow Cottonwood to connect into ERCOT is being considered in a separate docket (No. 34611) at the PUCT, it is possible that this line will be approved prior to consideration of the integration of ETI.

The purpose of this scenario is to determine the impacts of the construction of this line on the appropriate upgrades to connect the ETI system into ERCOT. This line was modeled as 345-kV 2-954 ACSR with a conductor rating of 1,326 MVA, connecting the Hartburg and Canal substations. The Cottonwood generator was connected to the 500-kV bus at the Hartburg substation.

Based on this analysis, assuming the line from Hartburg to Canal has been constructed, the ETI system can be reliably interconnected into ERCOT with the same list of reliability projects minus the Porter to Kuykendahl loop (project number 1 in Section 4). This change results in a savings of $57,410,000. However, the line from Hartburg to Canal has been estimated to cost $268,000,000[1] plus the cost of the Canal substation. As such, the overall cost of the line from Canal to Hartburg and the reliability projects in this scenario are estimated to be $699,632,000. The modeled production cost from this scenario with the reliability projects is $14,098 million.

Based on an analysis of the remaining congestion in the system following incorporation of the reliability projects described above, the following economic projects would likely be recommended:

1. Extend the existing ERCOT 345-kV Kuykendahl – King line into the existing Entergy Porter substation and install one 345-kV/138-kV 800 MVA autotransformer at Porter. The length of this project is approximately 18 miles. Conductor modeled as 2-1590 ACSR, with a conductor rating of 1,793 MVA. Estimated cost: $57,410,000.
2. Add a second 500-kV/230-kV 800-MVA autotransformer at the Hartburg substation. Estimated cost: $19,800,000.
3. Add a second circuit from the Hartburg to Sabine substations on separate towers. The length of this project is approximately 21 miles. The modeled conductor is 2-954 ACSR, with a conductor rating of 1,329 MVA. Estimated cost: $30,180,000.
4. Close the Dayton-Crosby 138-kV line and upgrade the line to a rating of 531 MVA. The length of this project is approximately 19 miles. The modeled conductor is 2-954 ACSR. Estimated cost: $11,834,000.

[1] *See* Amended Application of Kelson Transmission Company, LLC for a CCN for the Proposed Canal-to-Deweyville 345 kV Transmission Line, Bates page 61, PUCT Docket No. 34611.

The total estimated cost of these economic-driven projects is $119,224,000, and with these projects included the modeled production cost from this scenario is $13,964 million. The total cost of transmission improvements (both reliability and economic) for this scenario is $818,856,000. As a comparison, the total cost of both reliability and economic-driven projects in the base case is $776,086,000, and the resulting annual modeled production cost is $13,960 million.

8. Conclusions

As described in this report, ERCOT has identified the minimum set of projects that would be necessary to serve load in the combined ERCOT/ETI region in adherence with relevant NERC and ERCOT reliability criteria. These projects are described in the following list:

16. Extend the existing ERCOT 345-kV Kuykendahl – King line into the existing Entergy Porter substation and install one 345-kV/138-kV 800 MVA autotransformer at Porter.
17. Build one new single-circuit 345-kV line on new towers from the existing ERCOT Roans Prairie substation to the existing Entergy Grimes substation.
18. Build a new 345-kV substation (Quarry) near the county line between Houston and Walker Counties in the existing Entergy line from Grimes to Crockett. Install an asynchronous 100 MW tie at Quarry between the bus and the line to Crockett.
19. Build a new 345-kV line from Quarry to existing Entergy Rivtrin substation.
20. Split the existing 500-kV bus at Entergy Hartburg substation and install a 244-MW asynchronous tie.
21. Install a 583-MW asynchronous tie at the 230-kV bus at the existing Entergy Hartburg substation.
22. Install a 230-kV line from the existing Entergy Hartburg substation to the existing Entergy Sabine substation.
23. Rebuild the existing Entergy 69-kV line from Fawil to City of Kirbyville as a 138-kV line and tie to existing Entergy/JNEC 138-kV Kirbyville substation.
24. Rebuild the existing Entergy 138-kV line between the Porter and Oakridge substations.
25. Upgrade the existing Entergy 138-kV line between the Navasota and Longmire substations.
26. Upgrade the existing 69-kV lines from the Sour Lake to Dome substations, the Dome to Batson substations, and the Gallier to Elizabeth substations.
27. Close the existing 138-kV tie between the Oncor (ERCOT) substation Etoile and the DETEC (Entergy) substation Etoile.
28. Close the existing normally open 138-kV switch between the Entergy Speedway station and Entergy College Station tap point.
29. Add 20-MVA 138-kV capbanks at the Entergy Dobbins and Navasota substations.
30. Upgrade the existing 138-kV line connecting the Porter and Tamina substations.

The aggregate cost of these reliability projects is estimated to be $488,672,000. These costs do not include tie-back costs required on the non-ERCOT portion of the Entergy system following integration.

In addition, ERCOT has identified a set of additional projects that will minimize the overall system cost (the net cost of annual system production costs and transmission upgrade costs). These projects are described in the following list:

8. Add a second 500-kV/230-kV 800-MVA autotransformer at the Hartburg substation.
9. Add a second circuit from the Hartburg to Sabine substations on separate towers.
10. Close the Dayton-Crosby 138-kV line and upgrade the line to a rating of 531 MVA.
11. Construct a new substation at Canal, tapping the 345-kV line connecting the Cedar and N Belt substations on Ckt # 99 in the CenterPoint service territory.
12. Add one 345-kV/230-kV 600-MVA autotransformer at the China substation.
13. Add two 500-kV/345-kV 800-MVA autotransformers at the Cypress substation.
14. Construct a 345-kV line from the Cypress to China substations and from the China to Canal substations.

The total cost for these economic-driven projects is $287,414,000. As modeled, they will result in annual production cost savings of $55 million, which is more than 16.5% of the capital cost of the upgrades, the current ERCOT criteria for recommending economic transmission projects. Should the Commission decide to proceed with the integration of ERCOT and ETI, ERCOT recommends that these economic projects be reviewed by the ERCOT Regional Planning Group, both to take into account any future changes in the ERCOT and Entergy systems and to ensure full stakeholder participation.