ERCOT Independent Review of AEPSC Corpus Chrisi Area Improvements Project

Version 1.1

Document Revisions

Date	Version	Description	Author(s)
10/29/2009	1.0	Final draft	Matt Kelly, Anuj Dixit
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Corpus Christi Area Improvements

1. Introduction

American Electric Power Service Corporation (AEPSC) submitted a proposal for transmission improvements in the Corpus Christi area in order to solve several existing reliability issues and to relieve constraints due to additional generation interconnecting within the area.

There are two areas in need of transmission system upgrades in order to remain secure during maintenance outages of transmission equipment, the first of which is the Industrial 69 kV System along the Corpus Christi Ship Channel that serves both residential and large industrial customers. The second area is the Airline/North Padre Island 69 kV System that consists of a 46 mile transmission line that runs the length of North Padre Island, from Aransas Pass to Naval Base substation, with the majority of the load in the southern portion of the system. A large portion of the load in both of these areas is made up of high load factor customers.

In 2008 the Nueces Bay Energy Center plant and the Barney Davis Energy Center plant signed interconnection agreements adding approximately 360 MW of capacity at 138 kV to each area. The total generation capacity at Nueces Bay will be 696 MW and the total at Barney Davis will be 1036 MW. Additional transmission upgrades will be necessary to accommodate the increased generating capacity at both of these facilities.

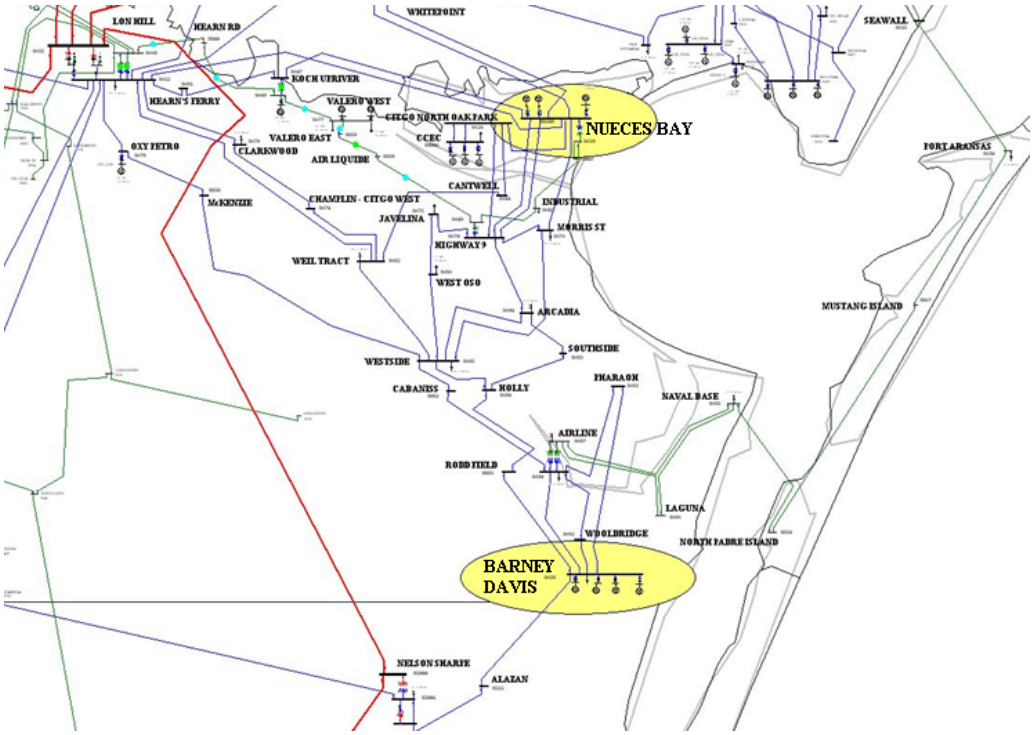

Figure I: PowerWorld Oneline Diagram of Corpus Christi Transmission System

AEPSC proposed a set of reliability and constraint projects and submitted the project set for RPG Review and comment. An ERCOT Independent Review was initiated to study the need for the proposed projects and assess alternative upgrades in the Corpus Christi area.

2. Model Setup

The Steady State Working Group (SSWG) 2009 fall peak and 2014 summer peak cases were used for the reliability analysis. These cases were created in October 2008 and updated in June 2009. Since these cases were created by the SSWG, some of the upgrades that were proposed by AEPSC were already modeled in the cases. The cases were modified to remove these projects, creating base cases that represent the current topology of the existing network with the appropriate adjustments for interconnecting Gila substation. These modifications are summarized below.

Modifications to 2009 fall peak case:

1. Relocate Hearn Road substation into the Lon Hill – Koch Upriver 69 kV line, 0.46 miles from Lon Hill substation.
2. Reconfigure Nueces Bay substation such that it has the following connections:
    a. 138 kV line to Lon Hill substation.
    b. Two 138 kV lines to Whitepoint substation.
    c. 138 kV line to Citgo North Oak Park substation.
    d. 138 kV line to Morris Street substation.
    e. 138 / 69 kV autotransformer.
    f. Nueces Bay Energy Center unit #7 operating at 100% output capability.
3. Reconfigure Gila substation such that it has the following connections:
    a. 138 kV line to Koch Upriver substation.
    b. 138 kV double circuit to Highway 9 substation.
    c. Nueces Bay Energy Center units #8 and #9 operating at 100% output capability.
4. Place Barney Davis Energy Center units #2 - #4 in-service and operate units #2 – #4 at 100% output capability for total output of 696 MW.

Modifications to 2014 summer peak case:

1. Locate Nueces Bay – Highway 9 (Circuit 2) 138 kV line into Gila substation, and take Gila – Highway 9 (Circuit 3) out of service.
2. Take Champlin (Citgo West) – Air Liquide – Weil Tract 138 kV line and Air Liquide 138 / 69 kV autotransformer out of service.
3. Remove upgrades on Lon Hill – Hearn Road – Koch Upriver 69 kV line, Lon Hill – Hearn's Ferry – Koch Upriver 138 kV line, and Koch Upriver 138 / 69 kV autotransformer.
4. Remove upgrade on Koch Upriver – Valero West – Valero East – Air Liquide – Highway 9 69 kV line.

5. Remove upgrade on Westside – McKenzie 138 kV line.
6. Take Barney Davis – Westside 138 kV line out of service.
7. Take Barney Davis – Nelson Sharpe 138 kV line out of service.

The reliability analysis was performed using PowerWorld Simulator 14 and PSS-MUST. The economic analysis was performed in UPLAN Altos using the ERCOT 2009 Five-Year Transmission Plan cases. The UPLAN Altos cases were adjusted to have the same topology as the modified SSWG cases above. The appropriate SSWG contingency lists were used to test for pre-contingency and post-contingency security.

3. Transmission Improvements

AEPSC studied the Corpus Christi area and the Nueces Bay and Barney Davis interconnection requests in a systematic manner. The analysis for ERCOT's Independent Review was divided into the following three parts.

1. Interconnection upgrades defined as projects to interconnect the additional units at Nueces Bay Energy Center.
2. Reliability upgrades defined as projects to alleviate pre or post-contingency security violation overloads that cannot simultaneously be resolved with a change in the generation dispatch.
3. Economic upgrades defined as projects to alleviate pre or post-contingency overloads that can be resolved by a change in the generation dispatch but that allow a more economic dispatch.

3.1. Interconnection Upgrades

The Barney Davis substation is being expanded to accommodate for Barney Davis Energy Center with no proposed alternatives. Therefore, the interconnection of the Barney Davis Energy Center was not studied as part of this review.

Nueces Bay Energy Center consists of two new 180 MW natural gas combustion turbines, units 8 and 9, mechanically connected as a combined cycle plant with an existing 336 MW steam turbine, unit 7.

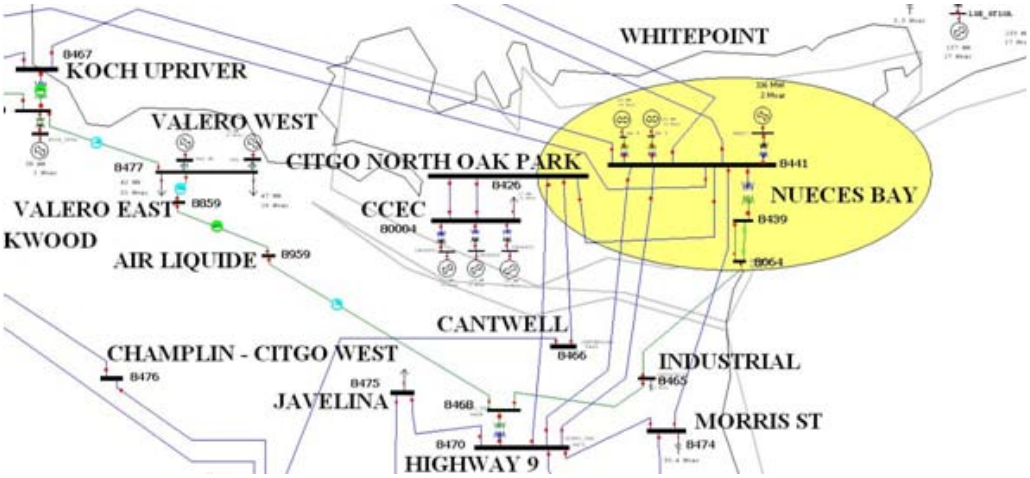

Figure II: Oneline Diagram of Nueces Bay Energy Center

The following four alternatives were studied to interconnect Nueces Bay Energy Center.

3.1.1. **Option I1**

In Option I1 all three units of the Nueces Bay Energy Center were interconnected to Nueces Bay 138 kV substation prior to the Gila substation addition that was assumed in the base cases.

All 696 MW of generation connected to Nueces Bay 138 kV substation, along with the existing local generation, caused the fault current to exceed the 63 kA fault interrupting capability of Nueces Bay substation. Solving this fault current issue would involve adding two new 138 kV terminals at Nueces Bay, and also replacing eighteen 138 kV breakers. Additionally, several nearby substations would be required to be rebuilt and three underwater cables would have to be replaced.

After considering the space constraints to install the new equipment as well as the associated cost, this alternative was determined to be neither feasible nor cost effective.

3.1.2. **Option I2**

Option I2 entails creating a new 138 kV substation, Gila, adjacent to the Nueces Bay 138 kV substation. Unit 7 was connected at Nueces Bay and units 8 and 9 were connected to Gila. The 138 kV line to Koch Upriver and the 138 kV double-circuit to Highway 9 were relocated to terminate into Gila instead of Nueces Bay. An additional connection to Gila was required in order to avert a potential transient stability issue identified during the Nueces Bay interconnection study. A project to install a series reactor between the Nueces Bay and Gila 138 kV substations was briefly studied. However, AEPSC performed a short circuit analysis and calculated that in order to keep fault currents within limits this alternative would require a 95-ohm series reactor. This would not solve the stability issue and therefore was not considered as a viable option.

3.1.3. **Option I3**

Option I3 involves an additional project for the interconnection of Gila substation as an alternative to installing the series reactor:

- Prior to relocating both circuits of the double circuit Nueces Bay to Highway 9 138 kV transmission line into the new Gila substation, only relocate Nueces Bay to Highway 9 circuit #1 138 kV transmission line into the new Gila substation and leave circuit #2 connected to Nueces Bay.
- Build a new Gila to Highway 9 circuit #3 138 kV transmission line such that Rate B is 470 MVA.

The total cost of this alternative is $52.06 million, which includes the cost of relocating Nueces Bay to Koch Upriver into Gila substation.

3.1.4. Option I4

Option I4 includes the Gila substation as configured in Option I2, but the following project was submitted in place of the series reactor:

- Relocate Nueces Bay to Whitepoint Circuit #2 138 kV transmission line into the new Gila substation.

AEPSC estimated that the total cost of this alternative is approximately $39.71 million, which includes the cost of the aforementioned projects necessary for the interconnection of Gila substation.

3.1.5. Comparison

The first two alternatives that involved either connecting all three units of Nueces Bay Energy Center to Nueces Bay 138 kV substation or installing a 95-ohm series reactor between Nueces Bay and Gila 138 kV substations were both determined to not be viable options.

A congestion analysis was performed in UPLAN Altos on Options I3 and I4 revealing no difference in the two projects. Both projects were able to allow for full export of power from Nueces Bay Energy Center in the study model. Option I3 would require new right-of-way (ROW) and a Certificate of Convenience and Necessity (CCN) which could delay implementation of this project. Option I4 had a lower project cost by $12.35 million.

Therefore, Option I4 is the preferred alternative for the Nueces Bay interconnection.

3.2. Reliability Upgrades

ERCOT studied the reliability portion of this project in two parts. First, by identifying reliability concerns based on maintenance outages and second, by identifying summer peak reliability concerns. Since maintenance outages typically do not occur during the summer peak, the latest fall peak case available at the time of study, the 2009 fall peak case, was used for this analysis. The 2014 summer peak case was used for the summer peak reliability analysis.

3.2.1. Maintenance Outage Reliability

AEPSC identified several reliability concerns due to scheduled transmission maintenance outages in the project submittal. ERCOT performed power flow analyses on the 2009 fall peak case assuming scheduled maintenance outages on identified autotransformers in the area in order to verify such concerns and identify additional reliability problems. Generation re-dispatch and system adjustments, such as switching series reactors in and out of service, were considered to relieve any overloads observed in the model.

3.2.1.1. **Base Case**

An AC Contingency Analysis was performed on the 2009 fall peak base case to identify any overloads prior to studying the scheduled transmission maintenance outages. The results of this study are attached in Appendix A.

All overloaded elements in the 2009 fall peak case are listed in Table I below.

Overloaded Element	Most Limiting Contingency	Scheduled Maintenance Outage
Barney Davis – Alazan – Nelson Sharpe 138 kV Line	Holly – Rodd Field 138 kV Line Airline – Cabaniss 138 kV Line	None

Table I: Overloads in the 2009 Fall Peak Case

The overloaded element identified in Table I can be solved by re-dispatching the following local generation to the specified output levels:

- Barney Davis Energy Center to output a total of 300 MW.

While a reduction in the Barney Davis Energy Center dispatch is necessary to relieve the identified constraints, ERCOT is not recommending a specific dispatch level.

The AC Contingency Analysis was rerun with the change in generation dispatch and is attached in Appendix B. There were no longer any overloaded elements in the case.

Since the aforementioned overloads were identified in the base case, the re-dispatch of Barney Davis Energy Center to output a total of 300 MW was applied to all the studies of scheduled transmission maintenance outages.

3.2.1.2. **Airline Autotransformer Maintenance Outage**

An AC Contingency Analysis was performed while assuming a scheduled maintenance outage on the Airline 138 kV / 69 kV autotransformer #1. The results of the study are attached in Appendix C.

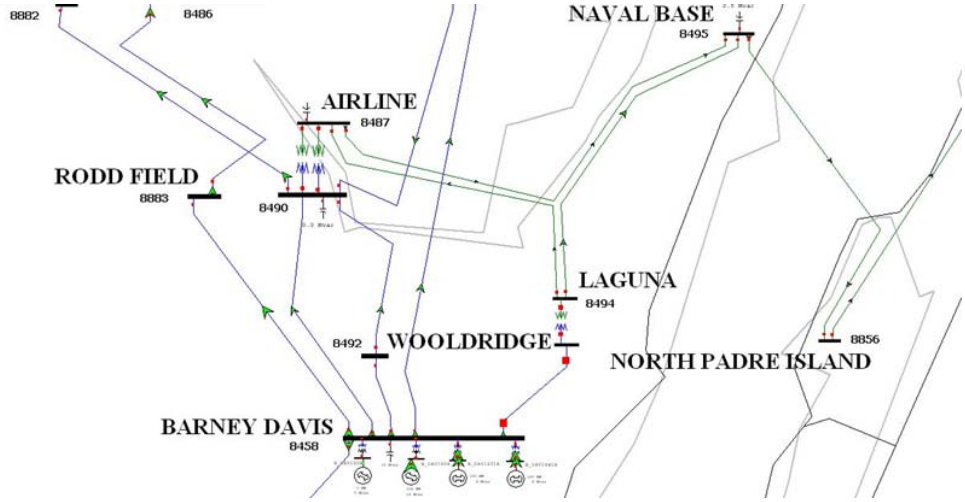

Figure III: Oneline Diagram of Airline Autotransformers

All overloaded elements resulting from the maintenance outage are listed in Table II below.

Overloaded Element	Most Limiting Contingency	Scheduled Maintenance Outage
Aransas Pass – Seawall – Port Aransas – Mustang Island 69 kV Line	Airline 138 kV / 69 kV Autotransformer #2	Airline 138 kV / 69 kV Autotransformer #1

Table II: Overloads Due to Scheduled Maintenance Outage of Airline Autotransformer #1

The maintenance outage and contingency that resulted in the overload identified in Table II was studied further in PowerWorld Simulator 14. The contingency caused the case to not converge, and therefore could not be solved by re-dispatching local generation.

The following alternatives were studied to solve this reliability concern:

a) Option M1

- Convert Airline load to 138 kV and add two new 138 kV terminals.
- Convert Naval Base substation load to 138 kV, install a 138 kV / 69 kV autotransformer, and add three new 138 kV terminals.
- Convert the Airline to Naval Base 69 kV line to 138 kV.

b) Option M2

- Construct a new 3.3 mile 138 kV transmission line from Barney Davis to Laguna.
- Construct a new Laguna 138 kV bus and install a new 138 kV / 69 kV autotransformer at Laguna.

Both options solved the reliability needs and both provide similar long-term benefits. The total cost of Option M1 is $21.5 million, while the total cost of Option M2 is $15.1 million. Option M2 is the preferred option since it has the lower total project cost.

Option M2 was modeled in the case and the AC Contingency Analysis was rerun. The results of the study are attached in Appendix D. There were no longer any overloaded elements in the study case with Airline Autotransformer #1 on maintenance outage.

3.2.1.3. **Highway 9 Autotransformer Maintenance Outage**

An AC Contingency Analysis was performed while assuming a scheduled maintenance outage on the Highway 9 138 kV / 69 kV autotransformer. The results of the study are attached in Appendix E.

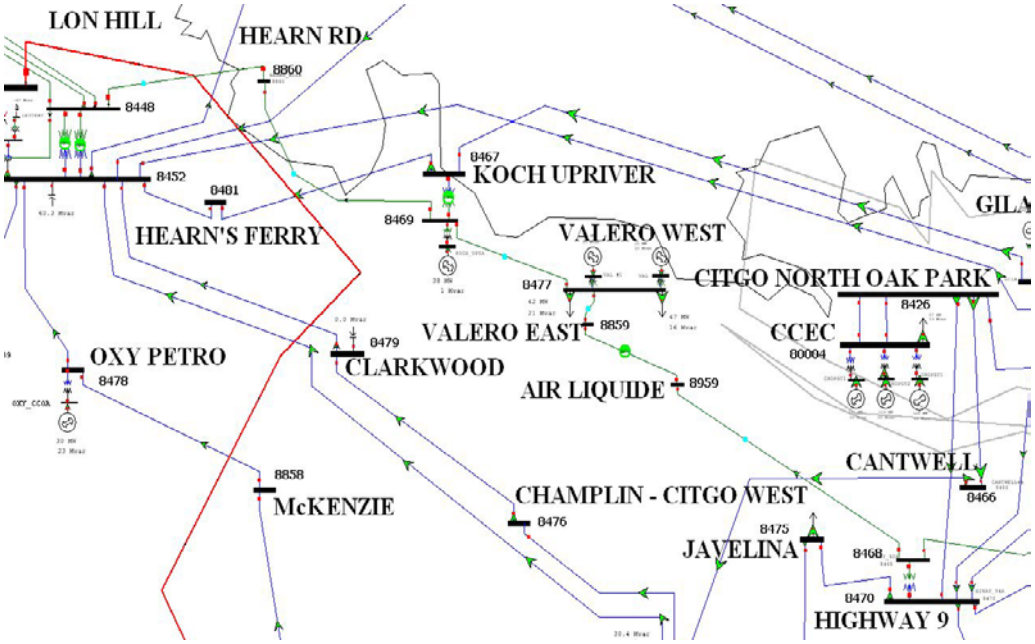

Figure IV: Oneline Diagram of Industrial Area

All overloaded elements resulting from the maintenance outage are listed in Table III below.

Overloaded Element	Most Limiting Contingency	Scheduled Maintenance Outage
Nueces Bay – Industrial – Highway 9 69 kV Line	Koch Upriver – Valero West 69 kV Line	Highway 9 138 kV / 69 kV Autotransformer
Koch Upriver 138 kV / 69 kV Autotransformer	Lon Hill – Hearn Road 69 kV Line	
Koch Upriver – Valero West 69 kV Line	Nueces Bay 138 kV / 69 kV Autotransformer	

Table III: Overloads Due to Scheduled Maintenance Outage of Highway 9 Autotransformer

The overloaded elements identified in Table III can be solved by re-dispatching the following local generation to the specified output levels:

- Corpus Christi Energy Center to output a total of 225 MW.
- Nueces Bay Energy Center to output a total of 0 MW.
- Valero West units #1 and #2 to output 25 MW each.
- Nueces Bay to Industrial series reactor placed out of service.

It should be noted that there may be other generation re-dispatch levels that solve the constraints and ERCOT is not recommending a specific dispatch level for these conditions.

The AC Contingency Analysis was rerun with the changes in generation dispatch and is attached in Appendix F. There were no longer any overloaded elements in the case.

3.2.1.4. **Lon Hill Autotransformer Maintenance Outage**

An AC Contingency Analysis was performed while assuming a scheduled maintenance outage on the Lon Hill 138 kV / 69 kV autotransformer #1. The results of the study are attached in Appendix G.

All overloaded elements resulting from the maintenance outage are listed in Table IV below.

Overloaded Element	Most Limiting Contingency	Scheduled Maintenance Outage
Koch Upriver 138 kV / 69 kV Autotransformer	Cantwell – Weil Tract 138 kV Line Highway 9 – Air Liquide 69 kV Line	Lon Hill 138 kV / 69 kV Autotransformer #1

Table IV: Overloads Due to Scheduled Maintenance Outage of Lon Hill Autotransformer #1

The overloaded element identified in Table IV can be solved by re-dispatching the following local generation to the specified output levels:

- Nueces Bay Energy Center to output a total of 450 MW.
- Valero West units #1 and #2 to output 25 MW each.

It should be noted that there may be other generation re-dispatch levels that solve the constraints and ERCOT is not recommending a specific dispatch level for these conditions.

The AC Contingency Analysis was rerun with the changes in generation dispatch and is attached in Appendix H. There were no longer any overloaded elements in the case.

3.2.1.5. **Nueces Bay Autotransformer Maintenance Outage**

An AC Contingency Analysis was performed while assuming a scheduled maintenance outage on the Nueces Bay 138 kV / 69 kV autotransformer. The results of the study are attached in Appendix I.

All overloaded elements resulting from the maintenance outage are listed in Table V below.

Overloaded Element	Most Limiting Contingency	Scheduled Maintenance Outage
Koch Upriver 138 kV / 69 kV Autotransformer Koch Upriver – Valero West 69 kV Line	Highway 9 138 kV / 69 kV Autotransformer	Nueces Bay 138 kV / 69 kV Autotransformer

Table V: Overloads Due to Scheduled Maintenance Outage of Nueces Bay Autotransformer

The overloaded elements identified in Table V can be solved by re-dispatching the following local generation to the specified output levels:

- Corpus Christi Energy Center to output a total of 225 MW.
- Nueces Bay Energy Center to output a total of 0 MW.
- Valero West units #1 and #2 to output 25 MW each.

It should be noted that there may be other generation re-dispatch levels that solve the constraints and ERCOT is not recommending a specific dispatch level for these conditions.

The AC Contingency Analysis was rerun with the changes in generation dispatch and is attached in Appendix J. There were no longer any overloaded elements in the case.

3.2.1.6. **Koch Upriver Autotransformer Maintenance Outage**

An AC Contingency Analysis was performed while assuming a scheduled maintenance outage on the Koch Upriver 138 kV / 69 kV autotransformer. The results of the study are attached in Appendix K.

All overloaded elements resulting from the maintenance outage are listed in Table VI below.

Overloaded Element	Most Limiting Contingency	Scheduled Maintenance Outage
Lon Hill 138 kV / 69 kV Autotransformer #1 Lon Hill 138 kV / 69 kV Autotransformer #2 Lon Hill – Hearn Road 69 kV Line	Highway 9 – Air Liquide 69 kV Line	Koch Upriver 138 kV / 69 kV Autotransformer
Highway 9 – Air Liquide 69 kV Line	Lon Hill – Hearn Road 69 kV Line	

Table VI: Overloads Due to Scheduled Maintenance Outage of Koch Upriver Autotransformer

The local generation could not be re-dispatched to solve all the overloaded elements. In order to identify which elements in Table VI are reliability concerns, the case was studied further in PowerWorld Simulator 14. The following changes in the local generation dispatch solve the overloads that are not reliability concerns:

- Nueces Bay Energy Center to output a total of 500 MW.
- Valero West units #1 and #2 to output 25 MW each.

It should be noted that there may be other generation re-dispatch levels that solve the constraints and ERCOT is not recommending a specific dispatch level for these conditions.

The AC Contingency Analysis was rerun with the changes in generation dispatch and is attached in Appendix L. The reliability concerns caused by the scheduled maintenance outage of Koch Upriver autotransformer are listed in Table VII below.

Overloaded Element	Most Limiting Contingency	Scheduled Maintenance Outage
Lon Hill – Hearn Road 69 kV Line	Weil Tract – Cantwell 138 kV Line Highway 9 – Air Liquide 69 kV Line	Koch Upriver 138 kV / 69 kV Autotransformer
Highway 9 – Air Liquide 69 kV Line	Lon Hill – Hearn Road 69 kV Line	

Table VII: Reliability Concerns Due to Scheduled Maintenance Outage of Koch Upriver Autotransformer

The following alternatives were studied to solve these reliability concerns:

a) Option M3

- Construct a new 1.08 mile double circuit 138 kV hairpin from the existing Citgo West to Weil Tract 138 kV transmission line.
- Construct a new 138 kV 3 breaker ring bus and install a new 138 kV / 69 kV, 220 MVA autotransformer at Air Liquide.
- Upgrade Citgo West to Weil Tract 138 kV transmission line such that Rate B is 535 MVA.

b) Option M4

- Reconductor the 0.46 mile 69 kV transmission line from Lon Hill to Hearn Road.
- Rebuild the 3.81 mile 69 kV transmission line from Highway 9 to Air Liquide to Valero East.

The total cost of Option M3 is approximately $23.8 million, while the cost of Option M4 is approximately $6.6 million. Option M3 would mitigate the need to upgrade the Lon Hill autotransformers (estimated cost of $11.8 million) as identified in section 3.2.2 of this report.

Another consideration is that Option M4 does not allow for a maintenance outage of a 138 kV / 69 kV autotransformer on the industrial 69 kV system at the same time one of the self-serve generators on the system is on forced outage or maintenance outage. This is because with an autotransformer out of service and a generator out of service the next contingency would cause thermal overloads on the system. Option M3 would resolve this constraint since it would add additional transformation to the system, but if it was implemented, the industrial customers in the area would experience high fault currents that would require an estimated $10 million to $13 million worth of upgrades on private equipment as well as the costs associated with the outages of their facilities. The industrial customers indicated their opposition to incurring these costs.

Option M4 was the preferred option since it had the lower overall cost and because no solution to the simultaneous autotransformer and generator outage condition was found that would not cause the industrial customers that would benefit from the improved reliability to have to upgrade a significant amount of equipment. This means that during times of autotransformer maintenance outage, the industrial customers on the 69 kV system may be limited on their net import of power from the system and may be subject to Mitigation

Plans during relevant autotransformers outages if these industrials have generation out of service.

Option M4 was modeled in the case and the AC Contingency Analysis was rerun. The results of the study are attached in Appendix M. There were no longer any overloaded elements in the case.

3.2.2. Summer Peak Reliability

AEPSC identified several reliability concerns due to generator forced outages. Section 5.1.4 of the ERCOT Operating Guides states that the transmission system must maintain reliability with any single generation unit unavailable and the contingency loss of a single transmission element. ERCOT performed power flow analyses on the 2014 summer peak case assuming generator forced outages on each local generation unit in order to verify such concerns and identify additional reliability problems.

3.2.2.1. Base Case

An AC Contingency Analysis was performed on the base case to identify any overloads prior to studying the generator forced outages. The results of this study are attached in Appendix N.

All overloaded elements in the 2014 summer peak case are listed in Table VIII below.

Overloaded Element	Most Limiting Contingency	Generator Forced Outage
Lon Hill 138 kV / 69 kV Autotransformer #1	Lon Hill 138 kV / 69 kV Autotransformer #2	None
Lon Hill 138 kV / 69 kV Autotransformer #2	Lon Hill 138 kV / 69 kV Autotransformer #1	
Barney Davis – Alazan – Nelson Sharpe 138 kV Line	Holly – Rodd Field 138 kV Line Airline – Cabaniss 138 kV Line	

Table VIII: Overloads in the 2014 Summer Peak Case

The overloaded elements identified in Table VIII can be solved by re-dispatching the following local generation to the specified output levels:

- Barney Davis Energy Center to output a total of 300 MW.

While a reduction in the Barney Davis Energy Center dispatch is necessary to relieve the identified constraints, ERCOT is not recommending a specific dispatch level.

The AC Contingency Analysis was rerun with the change in generation dispatch and is attached in Appendix O. There were no longer any overloaded elements in the case.

Since the aforementioned overloads were identified in the base case, the re-dispatch of Barney Davis Energy Center to output a total of 300 MW was applied to all the studies of generator forced outages.

3.2.2.2. **Barney Davis Energy Center Forced Outage**

An AC Contingency Analysis was performed while assuming a forced outage on the Barney Davis Energy Center (BDEC) combined-cycle. The results of the study are attached in Appendix P.

All overloaded elements resulting from the forced outage are listed in Table IX below.

Overloaded Element	Most Limiting Contingency	Generator Forced Outage
Aransas Pass – Seawall 69 kV Line Barney Davis – Alazan – Nelson Sharpe 138 kV Line	Holly – Rodd Field 138 kV Line Airline – Cabaniss 138 kV Line	Barney Davis Energy Center Combined-Cycle
Nueces Bay – Morris Street 138 kV Line	Citgo North Oak Park – Highway 9 138 kV Line Gila – Highway 9 138 kV Line #2	
Highway 9 – Javelina 138 kV Line	Highway 9 – Arcadia 138 kV Line Morris Street – Westside 138 kV Line	
Morris Street – Westside 138 kV Line	Highway 9 – Javelina 138 kV Line Highway 9 – Arcadia 138 kV Line	

Table IX: Overloads Due to the Forced Outage of BDEC Combined-Cycle

The overloaded elements identified in Table IX can be solved by re-dispatching the following local generation to the specified output levels:

- Barney Davis Energy Center unit #1 to output 340 MW.
- Nueces Bay Energy Center to output a total of 0 MW.

It should be noted that there may be other generation re-dispatch levels that solve the constraints and ERCOT is not recommending a specific dispatch level for these conditions.

The AC Contingency Analysis was rerun with the changes in generation dispatch and is attached in Appendix Q. There were no longer any overloaded elements in the case.

3.2.2.3. **Corpus Christi Energy Center Forced Outage**

An AC Contingency Analysis was performed while assuming a forced outage on the Corpus Christi Energy Center (CCEC) combined-cycle. The results of the study are attached in Appendix R.

All overloaded elements resulting from the forced outage are listed in Table X below.

Overloaded Element	Most Limiting Contingency	Generator Forced Outage
Nueces Bay – Morris Street 138 kV Line	Citgo North Oak Park – Nueces Bay 138 kV Line	Corpus Christi Energy Center Combined-Cycle
Highway 9 – Gila 138 kV Line #1	Citgo North Oak Park – Highway 9 138 kV Line Highway 9 - Gila 138 kV Line #2	

Table X: Overloads Due to the Forced Outage of CCEC Combined-Cycle

The overloaded elements identified in Table X can be solved by re-dispatching the following local generation to the specified output levels:

- Nueces Bay Energy Center to output a total of 0 MW.

While a reduction in the Nueces Bay Energy Center dispatch is necessary to relieve the identified constraints, ERCOT is not recommending a specific dispatch level.

The AC Contingency Analysis was rerun with the changes in generation dispatch and is attached in Appendix S. There were no longer any overloaded elements in the case.

3.2.2.4. **Nueces Bay Energy Center Forced Outage**

An AC Contingency Analysis was performed while assuming a forced outage on the Nueces Bay Energy Center (NBEC) combined-cycle. The results of the study are attached in Appendix T.

There were no overloaded elements due to the forced outage of NBEC combined-cycle.

3.2.2.5. **Koch Upriver Forced Outage**

An AC Contingency Analysis was performed while assuming a forced outage on the Koch Upriver generation unit. The results of the study are attached in Appendix U.

All overloaded elements resulting from the forced outage are listed in Table XI below.

Overloaded Element	Most Limiting Contingency	Generator Forced Outage
Lon Hill 138 kV / 69 kV Autotransformer #1	Lon Hill 138 kV / 69 kV Autotransformer #2	Koch Upriver Generation
Lon Hill 138 kV / 69 kV Autotransformer #2	Lon Hill 138 kV / 69 kV Autotransformer #1	
Koch Upriver 138 kV / 69 kV Autotransformer	Highway 9 138 kV / 69 kV Autotransformer	
Highway 9 – Air Liquide 69 kV Line	Koch Upriver 138 kV / 69 kV Autotransformer	

Table XI: Overloads Due to the Forced Outage of Koch Upriver Generation

The local generation could not be re-dispatched to solve all the overloaded elements. In order to identify which elements in Table XI are reliability concerns, the case was studied further in PowerWorld Simulator 14. The following changes in the local generation dispatch solve the overloads that are not reliability concerns:

- Corpus Christi Energy Center to output a total of 250 MW.
- Nueces Bay Energy Center to output a total of 400 MW.
- Valero West units #1 and #2 to output 25 MW each.

It should be noted that there may be other generation re-dispatch levels that solve the constraints and ERCOT is not recommending a specific dispatch level for these conditions.

The AC Contingency Analysis was rerun with the changes in generation dispatch and is attached in Appendix V. The reliability concerns caused by the forced outage of the Koch Upriver generation unit are listed in Table XII below.

Overloaded Element	Most Limiting Contingency	Generator Forced Outage
Lon Hill 138 kV / 69 kV Autotransformer #1	Lon Hill 138 kV / 69 kV Autotransformer #2	Koch Upriver Generation
Lon Hill 138 kV / 69 kV Autotransformer #2	Lon Hill 138 kV / 69 kV Autotransformer #1	

Table XII: Reliability Concerns Due to the Forced Outage of Koch Upriver Generation

The following project was studied as a solution to the reliability concerns identified in Table XII:

a) Option M5

- Install new 138 kV / 69 kV autotransformers at Lon Hill to replace the two existing autotransformers.

This project has an estimated cost of $11.8 million and no alternatives were studied. The project was modeled in the case and the AC Contingency Analysis was rerun. The results of the study are attached in Appendix W. There were no longer any overloaded elements in the case.

3.2.2.6. **Valero West Unit #1 Forced Outage**

An AC Contingency Analysis was performed while assuming a forced outage on Valero West unit #1. The results of the study are attached in Appendix X.

All overloaded elements resulting from the forced outage are listed in Table XIII below.

Overloaded Element	Most Limiting Contingency	Generator Forced Outage
Lon Hill 138 kV / 69 kV Autotransformer #1	Lon Hill 138 kV / 69 kV Autotransformer #2	Valero West Unit #1
Lon Hill 138 kV / 69 kV Autotransformer #2	Lon Hill 138 kV / 69 kV Autotransformer #1	
Highway 9 – Air Liquide 69 kV Line	Koch Upriver – Valero West 69 kV Line	

Table XIII: Overloads Due to the Forced Outage of Valero West Unit #1

The overloaded elements identified in Table XIII can be solved by re-dispatching the following local generation to the specified output levels as follows:

- Corpus Christi Energy Center to output a total of 250 MW.
- Nueces Bay Energy Center to output a total of 400 MW.
- Valero West unit #2 to output 25 MW.

It should be noted that there may be other generation re-dispatch levels that solve the constraints and ERCOT is not recommending a specific dispatch level for these conditions.

The AC Contingency Analysis was rerun with the changes in generation dispatch and is attached in Appendix Y. There were no longer any overloaded elements in the case.

3.3. Economic Upgrades

The economic analysis was performed in UPLAN Altos using cases that were further updated to include all Direct Interconnection and Reliability upgrades. The analysis revealed significant congestion on the transmission lines exiting Barney Davis substation for multiple contingencies, and is summarized in Table XIV below.

Congested Element	Contingency
Aransas Pass – Seawall 69 kV Line	Holly – Rodd Field 138 kV Line Airline – Cabaniss 138 kV Line
Nelson Sharpe 138 kV / 69 kV Phase-Shifting Transformer	Thermal
Naval Base – North Padre Island 69 kV Line	Holly – Rodd Field 138 kV Line Airline – Cabaniss 138 kV Line

Table XIV: Local Congestion after Direct Interconnection and Reliability Upgrades

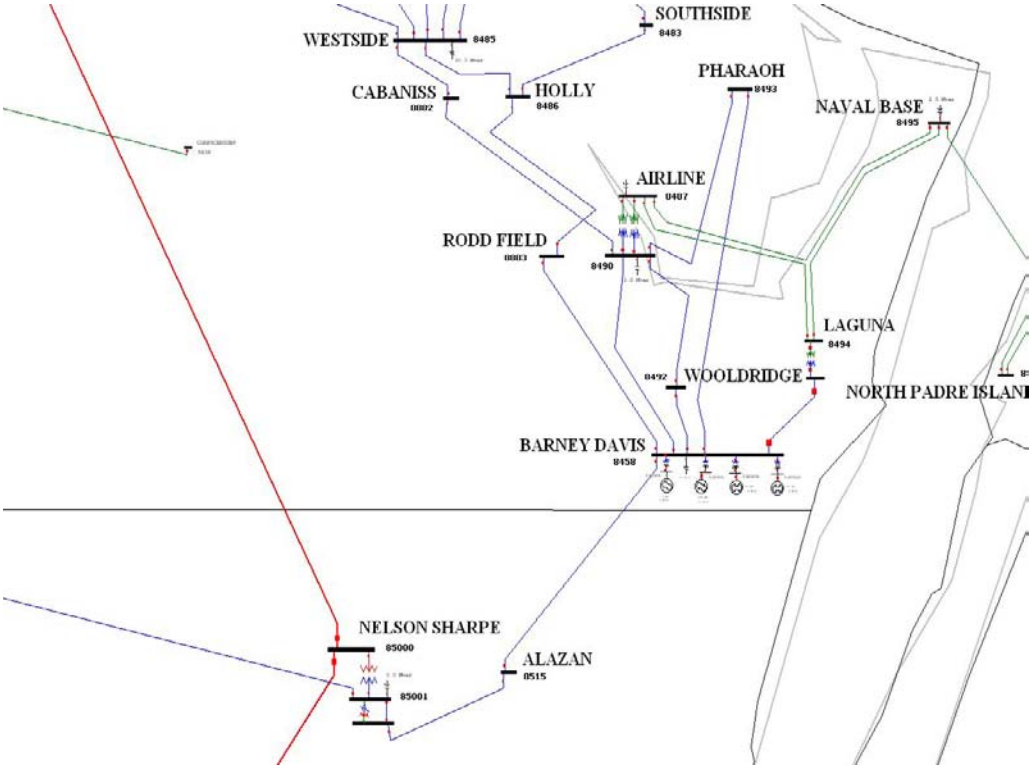

Figure V: Oneline Diagram of Transmission System Exiting Barney Davis

The following alternatives were studied to relieve the congestion out of Barney Davis substation:

a) Option E1

- Rebuild the Barney Davis – Alazan – Nelson Sharpe 138 kV transmission line such that Rate B is 717 MVA.

- Bypass the Nelson Sharpe Phase-Shifting Transformer (PST)
- Upgrade the Westside to Cabaniss terminal equipment.

b) Option E2

- Build a new 138 kV transmission line from Barney Davis to Nelson Sharpe on new right-of-way.
- Upgrade the Westside to Cabaniss terminal equipment.

The total cost of Option E1 is $26.96 million compared to Option E2 that has a total cost of $41.6 million. Congestion analysis was rerun to compare the production cost savings of the two projects, and the results are summarized in Table XV below.

Option	Production Cost Savings	Capital Cost / Production Cost Savings
E1	$14.52 Million	1.86
E2	$10.51 Million	3.96

Table XV: Production Cost Savings Summary for Economic Projects

The operation of the Nelson Sharpe PST was not optimized in the UPLAN model which is why Option E2 had a lower production cost savings. If it were optimized Option E2 would be expected to have the same or higher production cost savings as Option E1. This was analyzed in an AC case and it was found that Option E2 allowed for slightly higher transfer capability out of Barney Davis when compared to Option E1. However, when upgrades that removed all constraints in the area were tested (see below) the total production cost savings did not exceed $14.52 million. Therefore, the highest production cost savings achieved by Option E2 would be $14.52 million, the same as Option E1.

An AC FCITC study was performed on the two alternative projects in order to study the dispatch level that Barney Davis Energy Center would be constrained to while each option was being implemented. The analysis revealed that Barney Davis Energy Center would be constrained to 312 MW output capability while the Barney Davis to Alazan 138 kV transmission line is out of service being rebuilt. If the new Barney Davis – Nelson Sharpe line was being constructed, Barney Davis Energy Center would be constrained to 483 MW output capability until the upgrade project is complete.

Even though Option E2 allows Barney Davis Energy Center an increase in output capability during the implementation of the projects, the new line would be built on new right-of-way (ROW) and would require a Certificate of Convenience and Necessity (CCN). This may cause Option E2 to take longer to implement than the option to rebuild, and it is important to get the upgrades in place as soon as possible in order to relieve the heavy congestion. Furthermore, Option E1 cost approximately $14.6 million less than Option E2 and had similar performance.

After taking all of the above into consideration, Option E1 is the preferred project.

It should be noted that this did not relieve all congestion out of Barney Davis substation. Congestion was still identified on the Airline – Cabaniss 138 kV line for the contingency of either Barney Davis – Rodd Field 138 kV line or Barney Davis – Alazan 138 kV line.

The following project was studied in addition to Option E1 to relieve the remaining congestion out of Barney Davis substation:

a) Option E3

- Construct a new 19.7 mile 138 kV transmission line from Barney Davis to Westside on new ROW.
- Rebuild 10.44 miles of the McKenzie to Westside 138 kV transmission line.

This project has a total cost of $45.2 million. Economic analysis was performed on this project using a case that included Option E1. Although the analysis revealed that Option E3 did relieve the remaining congestion, no production cost savings were realized. Therefore, the additional project to relieve the remaining congestion could not be cost justified.

Option E1 entails bypassing the Nelson Sharpe PST in order to take advantage of the full capability of the rebuilt Barney Davis – Alazan – Nelson Sharpe 138 kV line. However, it may be necessary to utilize the Nelson Sharpe PST to regulate power import to the Corpus Christi area under certain operational conditions not explicitly studied in this analysis, such as the maintenance outage of the Barney Davis Energy Center plant.

4. Summary

It is recommended that the following improvements be constructed:

- Build new Gila 138 kV substation to connect the two new Nueces Bay Energy Center 180 MW combustion turbines.
- Relocate the Nueces Bay to Koch Upriver 138 kV transmission line into the new Gila substation.
- Relocate both circuits of the double circuit Nueces Bay to Highway 9 138 kV transmission line into the new Gila substation.
- Relocate Nueces Bay to Whitepoint Circuit #2 138 kV transmission line into the new Gila substation.
- Construct a new 3.3 mile 138 kV transmission line from Barney Davis to Laguna.
- Construct a new Laguna 138 kV bus and install a new 138 kV / 69 kV autotransformer at Laguna.
- Reconductor the 0.46 mile 69 kV transmission line from Lon Hill to Hearn Road.
- Rebuild the 3.81 mile 69 kV transmission line from Highway 9 to Air Liquide to Valero East.
- Install new 138 kV / 69 kV autotransformers at Lon Hill to replace the two existing autotransformers.
- Rebuild the Barney Davis – Alazan – Nelson Sharpe 138 kV transmission line such that Rate B is 717 MVA and the towers are double-circuit capable with one circuit in place.
- Upgrade the Westside to Cabaniss 138 kV line terminal equipment.

The total estimated cost of these upgrades is $100.2 million.

5. Designated Providers of Transmission Facilities

In accordance with the ERCOT Power System Planning Charter and Processes, ERCOT staff is to designate transmission providers for projects reviewed in the regional planning groups. These providers can agree to provide or delegate the new facilities or inform ERCOT if they do not elect to provide them. For the project scope recommended in this report, American Electric Power Texas Central Company is the designated provider of all transmission facilities.

6. Appendices

Appendix A	09fal1_base_cont_analysis.xls
Appendix B	09fal1_base_redispatch_cont_analysis.xls
Appendix C	09fal1_airline1_maintenance.xls
Appendix D	09fal1_airline1_maintenance_laguna_auto
Appendix E	09fal1_highway9_maintenance.xls
Appendix F	09fal1_highway9_maintenance_redispatch
Appendix G	09fal1_lonhill1_maintenance.xls
Appendix H	09fal1_lonhill1_maintenance_redispatch.xl
Appendix I	09fal1_nuecesbay_maintenance.xls
Appendix J	09fal1_nuecesbay_maintenance_redispatc
Appendix K	09fal1_kochupriver_maintenance.xls

Appendix L	 09fal1_kochupriver_ maintenance_redispa
Appendix M	 09fal1_kochupriver_ maintenance_redispa
Appendix N	 14sum1_base_cont_ analysis.xls
Appendix O	 14sum1_base_redisp atch_cont_analysis.x
Appendix P	 14sum1_bd_forced.x ls
Appendix Q	 14sum1_bd_forced_r edispatch.xls
Appendix R	 14sum1_ccec_forced .xls
Appendix S	 14sum1_ccec_forced _redispatch.xls
Appendix T	 14sum1_nb_forced.x ls
Appendix U	 14sum1_kochupriver _forced.xls
Appendix V	 14sum1_kochupriver _forced_redispatch.x
Appendix W	 14sum1_upriver_forc ed_redispatch_new_a

Appendix X	 14sum1_valw1_forced.xls
Appendix Y	 14sum1_valw1_forced_redispatch.xls