CFE/ERCOT INTERCONNECTION STUDY

DECEMBER 19, 2003

Final

CFE/ERCOT Interconnection Study

Chapter 1. Executive Summary

The Comisión Federal de Electricidad (CFE) and the Electric Reliability Council of Texas (ERCOT) have a long history of emergency assistance across the México/United States border. This report continues that tradition by performing a contemporary analysis of the CFE and ERCOT transmission systems to determine the short-term (Phase I) and long-term (Phase II) opportunities for interconnections. Such interconnections will afford increased transmission capacity along the border and facilitate international electricity trade and mutual emergency support.

The study is separated into phases as follows:

> Phase 1: immediate consideration of support to the ERCOT transmission system along the Texas border where older inefficient generation is no longer economical to operate. In addition, synchronous ties may allow new block load support in remote areas where lengthy transmission additions are required. Phase 1 alternatives leverage the existing interconnections and infrastructure and do not require lengthy regulatory review.
> Phase II: will evaluate opportunities for long-term interconnections that can support additional economic transactions and emergency assistance between CFE and ERCOT. Phase II studies will not be constrained by infrastructure limitation, and they are likely to involve new transmission improvements for higher transfer capabilities.

In both phases, both high voltage synchronous and asynchronous transmission interconnections will be considered, but the primary effort is focused on asynchronous interconnections that allow the scheduling of power transfer between the electrical grids. Typically these asynchronous interconnections are implemented with High Voltage Direct Current (HVDC) ties since they afford significant reliability and flexibility to both electrical grids.

This report is being released at the midpoint of the study, following the analysis of short-term interconnections and prior to the consideration of long-term interconnections envisioned in Phase II. The study found that opportunities exist at the Matamoros/-Brownsville, Reynosa/McAllen, Nuevo Laredo/Laredo, and Acuña/Del Rio areas to provide support between the electrical grids. **Particularly, the benefits of mutual support are recognized to be of immediate value at Acuña on the CFE transmission system and Laredo and McAllen on the ERCOT transmission system**. Both CFE and ERCOT will follow through with proposals to facilitate these interconnections that, once reviewed by the appropriate governmental, regulatory, and stakeholder organizations, could be implemented over the next one to three years. The next steps for these short-term recommendations are:

1. ERCOT to complete economic evaluations to determine if additional benefits can be achieved from HVDC ties as alternatives to RMR services in south Texas,
2. CFE and ERCOT to develop system support services agreement,
3. ERCOT to ensure that ERCOT protocols support and facilitate transactions over CFE/ERCOT interconnections,

4. Transmission Service Providers (TSPs) to complete transmission upgrades to support and build the CFE/ERCOT interconnections,
5. TSPs to proceed with the applicable presidential permits for the CFE/ERCOT interconnections

The Phase II study and report has commenced and will provide insights into future long-term interconnections. Together, both reports will provide the framework necessary to build efficient and cost effective transmission interconnections that will serve CFE and ERCOT in a manner that is mutually beneficial. Because of the broad policy and economic impacts that larger bulk transmission interconnections will have on the CFE and ERCOT power systems, involvement by the Public Utilities Commission of Texas (PUCT) and the Secretaría de Energía (SENER) in Phase II is recommended.

Chapter 2. Introduction

(a) Potential Benefits of New CFE/ERCOT Interconnections

The Comisión Federal de Electricidad (CFE) and the Electric Reliability Council of Texas (ERCOT) have identified a mutual benefit in conducting a contemporary study of possible interconnections between their respective electrical grids. The reliability of both systems will improve through the interconnections using available transmission lines and the advantages of new technology allowing better control of the interchange of power and better control of reactive power and voltage along the border. Asynchronous interconnections between CFE and ERCOT offer effective and rapid support for emergency conditions in the border areas. In addition, synchronous ties may allow new block load support in remote areas where lengthy transmission additions are required.

While the advantages of interchange of electric energy between México and the United States have existed since the inception of electric utilities, unique opportunities have become evident as Texas deregulates its generation market. Generating units once considered valuable due to their strategic location from a reliability perspective, are now relegated to retirement due to the availability of new efficient combined cycle power stations recently constructed as a direct result of deregulation of electric energy in Texas. With ample generation reserves in Texas, the capacity value that once allowed these older less efficient generators to remain active to meet peak load conditions has evaporated and the full cost of operating these units is exposed to market competition. Transmission projects that were once considered too costly to justify strictly as an alternative to generation redispatch, can now be considered in light of the full cost of the generator's operation in addition to the incremental energy cost of its inefficiency.

Electric power systems inherently operate as a grid, but the periphery of the grid has the greatest exposure to reliability shortcomings. For this reason, the integrated resource planning process consistently located generators close to load centers at the edge of the grid to improve power system security in these areas. However, this process no longer controls the addition and location of new generation. With the addition of new more economic generation in the Texas market, old generators are being relegated to retirement due to their inefficiency making them unavailable to continue providing system security. Thus an opportunity exists whereby the periphery of the ERCOT grid can obtain a direct benefit from interconnection with the CFE grid.

With the technology currently available, interconnections between the close geographic regions yet isolated transmissions systems of CFE and ERCOT can uniquely and cost effectively displace inefficient units and provide economic reliability enhancements to meet local load growth needs. Given the significant and mounting operating cost of the inefficient units in today's market, a new urgency exists to develop innovative and timely alternatives such as asynchronous interconnections between CFE and ERCOT as a means to mitigate these generation costs, provide mutual emergency support and allow for economic transactions.

(b) Goal of the CFE/ERCOT Interconnection Study

The study will be conducted in two phases. Phase I will identify short-term opportunities to improve the emergency assistance between the CFE and ERCOT systems. The overall goal of Phase I is to examine opportunities for mutual emergency support and develop cost-effective alternatives to uneconomic reliability services utilizing existing ties and infrastructure. Making use of existing facilities shortens regulatory review and allows projects to be expedited.

The follow-up study, Phase II, will consider future locations for significant economic transactions. This phase will follow with the expectation that bulk transmission improvement plans for the CFE and ERCOT systems along the México/United States border will mature and allow serious consideration of economic transfers of sufficient magnitude that cross-border energy trade would be positively impacted. Bulk transmission additions, both along the border and between the border and the energy markets of each grid, will be analyzed to determine the extent of transactions that would be possible between economic resources that are available in the respective markets and electric energy consumers seeking new energy suppliers. It is expected that Phase II will be completed by year end 2004.

While the deregulation of the ERCOT energy market has created an urgency to evaluate asynchronous ties between ERCOT and CFE, the goal of the study extends well beyond these immediate possibilities. Both CFE and ERCOT have had repeated requests to determine the viability of various sizes and locations of High Voltage Direct Current (HVDC) ties. Unlike generation or load, HVDC ties must be analyzed for both power injection and power withdrawal. Further, this impact is not limited to a single electric grid, but impacts both grids simultaneously. As a result, such requests to consider HVDC ties between CFE and ERCOT require extensive coordinated study. The goal of these interconnection studies is to provide a road map for both synchronous and asynchronous interconnections that will provide all interested parties with viable options for interconnections based on the collaborative efforts of CFE and ERCOT.

Chapter 3. Background

(a) History of CFE/ERCOT Interconnections

The level of exchanges of electric energy between México and the United States has been influenced by a variety of geographic, economic and political factors. In 1905 México and the United States began electricity exchanges. These were few and of minor extent. Early interconnections consisted of low voltage lines, which were constructed in order to serve the sparsely populated areas of the bordering towns of Northern México and the Southwestern portions of the United States since these areas were far from any major sources of electricity in either México or the United States. Privately owned utilities in both México and the United States often met the demand on the other side of the border.

In 1937 CFE was created by the Mexican government to provide generation, transmission, and distribution of electric energy in those areas not served by existing private utility companies within México. Beginning in 1960, the Federal Government of México purchased (through Compañia de Luz y Fuerza del Centro) the shares of those main private utility companies and today still has total control of all electrical generation, transmission, and distribution facilities in México.

Demographic and economic conditions throughout the middle of the 20th century led to a significant increase in electric energy transactions between México and the United States in the regions near the México-United States border. Between 1977 and 1984, however, México/United States energy exchanges decreased as a result of major CFE transmission reinforcements. Since 1984, net electricity exports from México to the United States increased significantly with the signing of a 220-megawatt firm power purchase agreement between CFE and SDG&E and SCE.

In 1967, the Western Systems Coordinating Council (WSCC), one of the present ten NERC reliability councils, was formed in the United States to promote bulk power system reliability through coordinated planning and operation. The establishment of this regional council, along with the founding of ERCOT in 1970, has facilitated the regional coordination of electric energy exchanges between utilities in the United States and CFE. In April 1985, CFE became a member of WSCC.

Within the WSCC region, México and the United States share a common border of 1310 kilometers (810 miles.) The service area of the United States member utilities of WSCC encompasses approximately 4.1 million square kilometers (1.6 million square miles). The United States members of WSCC that border México are located in the States of California, Arizona, New México and a small portion of Texas. CFE electric systems, which border the WSCC portion of the México-United States border, are located in the States of Baja California, Sonora, and Chihuahua.

CFE and ERCOT share a common border of 1200 kilometers (750 miles). However, American Electric Power Texas Central Company (AEP-TCC), formerly Central Power and Light, and American Electric Power Texas North Company (AEP-TNC) formerly West Texas Utilities are the only ERCOT members with electric interconnections with CFE. The CFE electric systems along this common border are in the States of Chihuahua, Coahuila, Nuevo Leon, and Tamaulipas.

(b) Past CFE/ERCOT Interconnection Studies

In February 1979, the President of the Estados Unidos Mexicanos, Lic. Jose Lopez Portillo, and the President of the United States of America, Jimmy Carter, agreed that México and the United States would undertake a joint study to analyze the possibilities of increasing the international electricity exchanges between the two countries. Subsequently, responsibility to organize and coordinate a study of the border area in both countries, and to present a report, was jointly assigned to the United States Department of Energy (DOE) and to the Dirección de Energía de México (DEM) through the Comisión Federal de Electricidad.

The study culminated in the publication of a report in May 1980, which provided background on the history of past exchanges and the characteristics of the United States and Mexican electric systems, a summary of possible opportunities for future trade, incentives to encourage utilities to develop that trade, and suggestions for procedures to remove obstacles and constraints, both legal and technical.

The 1980 study contained several recommendations and suggestions for increasing the amount of electricity trade and cooperation between CFE and the United States utilities. Some of these recommendations were short-term actions with obvious near-term benefits. Other recommendations involved longer term actions designed to establish a pattern of cooperation between the two countries. Although many of the short-term suggestions were implemented, most of the long-term suggestions contained in the 1980 study were not accomplished.

During regularly scheduled energy discussions between México and the United States in July 1989, it was suggested that the two countries revisit the issue of enhanced electricity trade because 10 years had elapsed since the first study. This second study culminated in the publication of a report in March 1991. The responsibility to organize and coordinate the updated study again was jointly assigned to DOE and to México albeit in 1989 to the Secretaría de Energía, Minas e Industria Paraestatal (SEMIP) but again through CFE. However, for the development of this second study, the group was further divided into a "Western" group and an "Eastern" group each composed of representatives from United States regional electric utilities and CFE.

The opportunities identified by the Eastern group included establishment of a permanent interconnection between ERCOT and CFE and the possibility of joint participation in development of generating units by CFE and interested ERCOT utilities.

Opportunities identified by the Western group included increasing the bi-directional transfer capability between southern California and Baja California Norte; establishing a major transmission interconnection between Arizona and CFE's Noroeste region; increasing the transfer capability between the New México-West Texas and the CFE Norte regions through a direct current tie and construction of 345-kilovolt alternating current transmission lines; and pursuing the possibilities of firm capacity sales, economy transactions, seasonal diversity exchanges, and emergency assistance between United States utilities and CFE.

In addition, the study also generally identified other opportunities for expanded trade within the electricity spectrum. Included in the general opportunities were increased electricity exports from the United States to serve the growing maquiladora market in Mexican border cities; technology development and transfer; equipment sales and support by United States manufacturers; exchanges of fuel for electric power; and development of independent power producers as direct exporters of electric power to México. The 1980 report showed that prior to 1977 the bulk of the energy flow to México was via the Western region while the bulk of energy flow to the United States was via the Eastern region. Since 1984 the bulk of energy transfers between the two countries has been in the west.

Although the 1990 study pointed out a number of potential opportunities that the México and United States utilities may choose to explore, it was noted that any decision to pursue specific projects would depend upon the need for and economics of those projects. Further, the study recommended that regulators at all levels consider policies to increase coordination and review among all relevant parties so that unnecessary delays in planning and constructing needed facilities are avoided. The 1990 study strongly recommended that utilities should communicate with Federal and State regulatory agencies early in, and throughout, the planning process so that future plans may address concerns likely to arise during the formal regulatory proceedings.

The 1990 study pointed out that the United States Section of the International Boundary and Water Commission (IBWC) currently had under study a potential project for a low-head hydroelectric generation facility on the Rio Grande River, which could provide another opportunity to increase transmission capacity and international electricity trade.

The 1990 study cited the following potential benefits that may be provided by increased transfers of electricity between México and the United States.

- Increased planning, operational, and reliability efficiencies
- Reduced environmental impacts through avoidance or deferral of new generating facilities
- Reduced electric rates to consumers in both countries
- Support for economic development, especially in border regions of both countries
- Opportunities for United States investment in generating facilities located in México
- Opportunities for expansion of trade in United States electrical generation technology and fuels used in electricity generation.

In order to achieve these benefits, however, the 1990 study highlighted a number of impediments that must be overcome. The 1990 study highlighted the means for overcoming potential problems.

- Evaluation and resolution of reliability and technical constraints

- Improved communication and cooperating in planning, construction and operation of electric utility systems on both sides of the border
- Evaluation of the environmental impact of increased electricity trade
- Exploration of potential opportunities for United States financial investment in generation facilities located in México
- Exploration of opportunities for increased trade in fuels and electrical technology.

Especially relevant to the current study, the 1990 study specifically stated a summary of CFE/ERCOT opportunities that could increase electricity trade.

- Permanent interconnections between CFE and ERCOT would have to be accomplished through asynchronous HVDC interconnections or by isolating portions of the CFE system and interconnecting with ERCOT through AC ties.
- These interconnections could lead to opportunities such as joint unit participation by CFE and interested ERCOT utilities as well as additional emergency agreements between CFE and ERCOT utilities.

(c) Development of Energy Market in México

CFE is the entity in México responsible for the operation and dispatch of the national electric system. CFE is also responsible for the planning and expansion of the electric system, generation, transmission, distribution, and selling of electric energy all of which is considered a public service. The Energy Regulatory Commission (CRE) is in charge of monitoring that CFE generation dispatch is accomplished as established by the law.

In 1992, changes to the public energy law (Public Service Energy Law) resulted in the development of private generators that sell energy to CFE through bilateral long-term agreements and private generators that form partnerships for self-supply. The self-supply can be local (inside the fence) or distant in which case an agreement is signed with CFE for transmission services. The excess of the self-supply partnerships can be sold to CFE in auction hour-by-hour during the day or provided to the system and paid based on the marginal cost of the real dispatch of energy.

By law, CFE as control operator oversees generation dispatch using the transmission grid for the public service. The CFE-owned power plants and the private plants that have contracts with CFE to deliver energy will be dispatched in ascending order of either the variable price or the proposed price until the demand is satisfied. Exceptions are only allowed for security and emergency conditions including force majeure that could affect the electric service via interruption, restriction, or considerable damage.

Based on the hourly regional and system demand, the generation dispatch will be done considering

- Operation restrictions of the generating units (starting and stopping times, minimum and maximum operating limits, efficiency and fuel, etc.)
- Transmission system restrictions (maximum load per line or group of lines)

- Restrictions in the rivers and water storage (minimum and maximum levels)
- Environmental restrictions
- Energy prices
- Availability and pricing of used fuels

As a result, the generation dispatch will produce the marginal hourly generation cost considering the following:

- The variable operating cost and maintenance
- Cost of the fuels used like coal, fuel oil, natural gas, or diesel
- Transportation
- Water costs
- Chemical products
- Lubricants
- Ash handling of consumed materials

(d) Public Utility Commission of Texas Project No. 20948

The Public Utility Commission of Texas (PUCT) Project No. 20948, initiated in October 1999 and completed in February 2000 ("*Investigations of Issues Relating to Open-Access Interconnections Between ERCOT and México"),* outlines the benefits of new transmission interconnections with México.

Many industry participants, ranging from the Battelle Institute to Duke Energy to South Texas Electric Cooperatives to the U. S. Department of Energy, concurred that the development of new electrical interconnections between CFE and ERCOT is not only in the best interest of consumers of both systems, but also would allow creation of a power market to trade power across international borders. The Project report recommended the creation of four new 150 MW asynchronous ties located at Brownsville, McAllen, and Laredo on the México/United States border that would be open-access interconnections scheduled by the Independent System Operator (ISO). The following are some of the findings of the Project.

Because the existing lines have been used only for emergency services, capacity is limited. Upgrading these existing interconnections and developing new asynchronous ties to México improves reliability of electric service to both the ERCOT and México grids while also opening opportunities to reduce the cost of energy.

Reliability benefits would be better achieved, the project participants concurred, by multiple 150 to 300 MW ties than by a single large traditional 1000 MW tie. Additionally, multiple ties address the intentions of the Public Utility Commission of Texas (PUCT) for Project # 20948 to promote open-access lines as a preferred means of interconnecting with other power grids by addressing the regulatory, economic and political issues surrounding such interconnections.

CFE had made clear their interest in exploring the possibility of adding additional interconnections with ERCOT because of expected strong economic growth along the border between 2000 and 2008. The northern border area of México is experiencing an average annual electric load growth of 7%.

Project # 20948 participants believed, that due to the broad benefits to each grid, each system should own a comparable capacity in HVDC ties in order to arrive at an equitable share in the costs of CFE/ERCOT asynchronous interconnections. Also, the project participants concurred that all reasonable asynchronous tie capital equipment, operation and maintenance expenses incurred by the ERCOT transmission providers are to be included in ERCOT transmission cost of service (TCOS) rates. The benefits, as well, are shared between the two grids. For example, ties between two grids create the capability for one grid to provide power to the other in the event of an emergency.

(e) Current Need for Mitigation of Reliability Must Run Generation

Retail competition is strong in Texas. It has spurred significant investment in new, more efficient generation, while displacing older less efficient power plants. Retiring these older plants (or generating 'units' within a plant) is not always a simple process because certain generation units may reduce or eliminate the need for transmission line additions when they are physically located at transmission constrained points in the electric grid. Retiring these units may have an immediate and significant adverse impact on the reliability of the grid.

Certain owners of generation plants have attested to ERCOT that some of their units are uneconomic to remain in service and will be unavailable unless ERCOT requires them for Reliability Must Run (RMR) service.[1] A generation owner is eligible for RMR status in ERCOT when its continued operation is necessary to support the reliability of the ERCOT transmission grid. In the Rio Grande Valley, AEP announced in Fall 2002 plans to mothball several steam plants including La Palma (259 MW) in San Benito, TX (northwest of Brownsville, TX) and J.L. Bates (183 MW) in Mission, TX (west of McAllen, TX). In addition, the Laredo Plant (172 MW) in Laredo, TX, is on the list of plants announced by AEP that are planned to be mothballed. All three of these plants continue to be operated by AEP under RMR agreements with ERCOT.

RMR service is contracted for up to 12 months, and ERCOT administers the agreement so as to minimize the use of such units as much as practicable. Since these units are generally older and less efficient, minimizing their use ensures that more economic resources are deployed to serve the needs of Texas consumers. ERCOT allocates the total cost of running the RMR units pro-rata to the load serving entities in ERCOT. A credit is then calculated and allocated to load serving entities (also pro-rata) based on the market value of the energy produced by the RMR units and the ERCOT spot price for balancing energy. The difference between the gross

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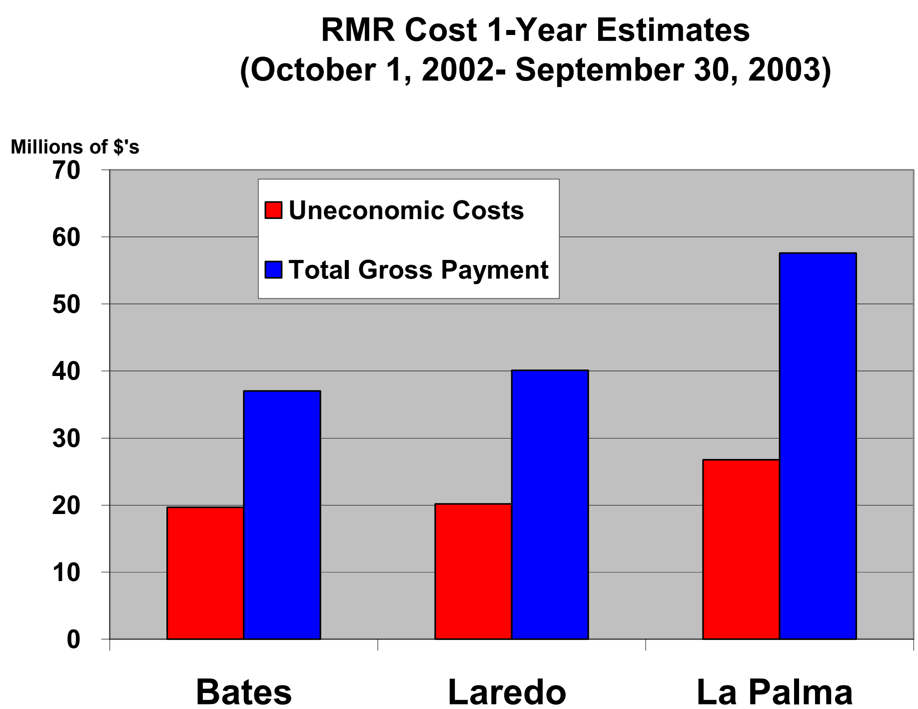
[1] *The ERCOT Protocols define an RMR unit as a generation resource operated under the terms of an annual agreement with ERCOT that would not otherwise be operated except that they are necessary to provide voltage support, stability or management of localized transmission constraints under first contingency criteria where market solutions do not exist.*

payments to RMR unit owners and the ERCOT spot market value is referred to as the 'uneconomic' cost of running RMR units.

The RMR units in the Valley and Laredo represent 614 MW, or forty six percent of the 1,341 MW currently in RMR contracts. The annual uneconomic portion of the total costs of RMR service is estimated at $125 Million for the ERCOT region. Approximately fifty four percent (or $68 Million) of these expenses are related to the units in the border cities. The following graph shows the total payment and uneconomic costs for La Palma, Bates and Laredo.



Earlier this year, the ERCOT Board of Directors approved a revision to the ERCOT Protocols requiring ERCOT staff to investigate possible alternatives to RMR contracts. The new Protocol language states:

> ***"No later than 90 days following the execution of an RMR Agreement, ERCOT shall report to the Board and post on the MIS a list of feasible alternatives that may, at a future time, be more cost-effective than the continued renewal of the existing RMR Agreement. Through the normal ERCOT System planning process, ERCOT shall develop a list of potential alternatives to the service provided by the RMR Unit. At a minimum, the list of potential alternatives that ERCOT shall consider include, but are not limited to, construction of new or expansion of existing transmission facilities, installation of voltage control devices, solicitation or auctions for interruptible Load from Retail Electric Providers, or extension of the existing RMR Agreement on an annual basis. If a cost-effective alternative to the service provided by the RMR Unit is identified, ERCOT shall provide a proposed timeline to study and/or implement the alternative."***

New transmission lines in South Texas and HVDC interconnections between CFE and ERCOT at Laredo and the Rio Grande Valley are feasible alternatives for the elimination of the RMR contracts in the area, and they are being considered along with other projects. ERCOT staff is working on developing a final recommendation to the ERCOT Board of Directors.

(f) State of Technology for Asynchronous Interconnections

Transmission systems integrate generation with the distribution systems that serve customer load. Within a transmission system, all generators are synchronized (produce the same frequency of Alternating Current) to allow the shared delivery of power to the load. In North America, there are four transmission systems that operate synchronously, Eastern United States/Canada, Western United States/Canada/México[2], Texas, and México. Given the magnitude of each of these synchronous interconnections and the need to limit power transfers between the systems, only asynchronous interconnections are presently used between these systems.

Asynchronous ties provide transmission capacity between non-synchronous electrical systems and allow an operator to control the direction and the quantity of energy flow during normal and emergency conditions without interruptions. However, synchronous ties require interruptions of the energy flow when they are built to connect non-synchronous electrical systems. Moreover, asynchronous ties can be constructed at any power rating; thereby closely matching the desired transfer capability, whereas the synchronous ties, due to their lesser controllability require several interconnections to achieve the same capability as the asynchronous ties. This may result in higher cost and lower reliability in a large interconnected system. The historical interconnection policies of utilities in Texas have been to utilize asynchronous interconnections to provide for energy transfer between the ERCOT and Southwest Power Pool grids.

Many of the emerging or available “high” technology devices are designed to “alter” or control voltage and the current flow in order to better optimize the transmission facilities. Two current forms of technology that can be used to interconnect asynchronous systems are: traditional High Voltage Direct Current (HVDC) and Flexible AC Transmission System-Voltage Sourced Converters (FACTS-VSC).

High Voltage DC Transmission (HVDC)

HVDC, a well-established technology, is often an economical way to interconnect certain power systems which are situated in different regions separated by long distances or those which have different frequencies or incompatible phase angle. HVDC involves power conversion of Alternating Current (AC) to Direct Current (DC) at one end and power conversion of DC to AC at the other end. In general, HVDC represents conversion equipment sizes in the range of a hundred megawatts to a few thousand megawatts. Worldwide, more than 50 projects have been completed for a total transmission capacity of about 50,000 MW.

[2] Includes the Baja Peninsula in northwest México

HVDC technology is often used to transmit power over long distance through overhead transmission lines or through submarine cables. Another major application of HVDC consists of tying together two adjacent asynchronous systems when synchronous AC interconnection is impossible or impractical. Back-to-Back (BtB) HVDC is used when the phase angle difference, due to variation of load between two adjacent systems or when the frequencies of two asynchronous systems are different. In this application, the DC converters are connected BtB in the same terminal building, and there are no DC transmission lines.

There are many electrical systems in the world that have incompatible phase angles, and some of these asynchronous grids are linked together via BtB ties. For example, the Oklaunion BtB tie, which links the AEP-TNC (ERCOT) system with the AEP Public Service Company of Oklahoma (Southwest Power Pool), provides an opportunity to take advantage of excess generation and the economy of generation dispatch between two regions. The success of this DC tie prompted the installation of Welsh BtB linking Oncor (ERCOT) with AEP Southwestern Electric Power (Southwest Power Pool). Figure A below shows the location of the BtB links in North America.

Flexible AC Transmission System-Voltage Sourced Converters (FACTS-VSC)

Traditional HVDC employs line commutated current sourced converters and requires reactive power from filters, shunt capacitors, or series capacitors to operate. FACTS-VSC, which uses gate turn off thyristor capability, however, can control power flow and also provide dynamic voltage regulation to the system during normal and emergency conditions. Also, FACTS-VSC technology (e.g., Static Var Compensator, Unified Power Flow Controllers, Static Synchronous Compensator, etc) can provide a reliability benefit by controlling the magnitude of one of the terminal's voltages. Another advantage of FACTS-VSC type ties is their capability to generate reactive support increasing the tie capacity in a weak system. Finally, black start capability can also be provided by the FACTS-VSC devices due to their ability to generate support from the energized system to the one experiencing a blackout.

A recent advance in the application of FACTS-VSC devices was the installation of the first asynchronous tie between México and United States using two converting stations "back-to-back" in the existing 138 kV transmission interconnection between Eagle Pass and Piedras Negras. The capacity of this tie is 36 MW. The technology and controls used here have allowed this station to operate for dynamic voltage support for both systems. This project was first placed in operation in 2001 and declared commercial in 2002. To date this facility has been used primarily to provide voltage support with virtually no real power exchange between Mexico and the United States.

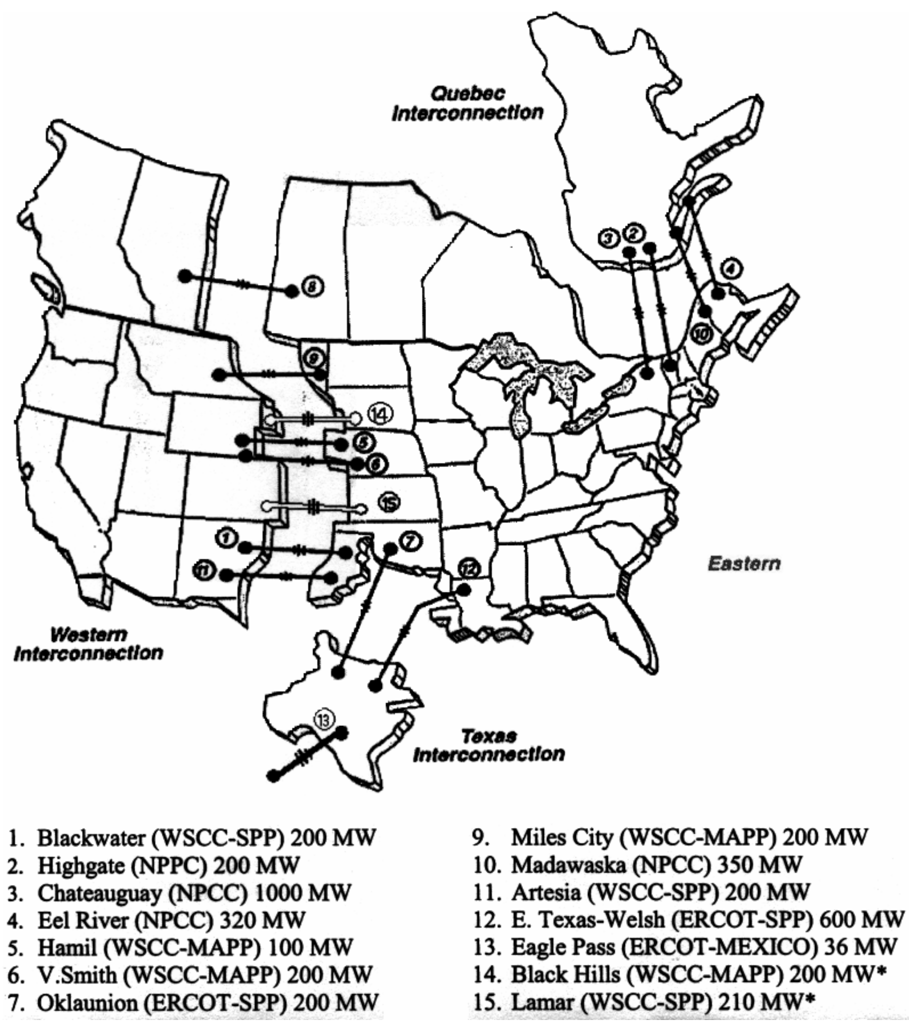


Figure A: In-Service Asynchronous Interconnections

FACTS technology, in particular Voltage Sourced Converters (VSC), is in its infancy, having been introduced less than a decade ago. This new technology, which is built on HVDC experience, has not yet caught the wide attention of the power industry due to its high cost compared with the other types of static controllers. FACTS devices have not yet gained sufficient experience to determine whether they have the same high availability/reliability records as HVDC technology. As a result, their application has been limited across the world. This may change in the future when the mature VSC systems demonstrate high availability and the initial purchase price becomes more competitive.

Chapter 4. México/United States Border Power System Infrastructure

(a) Existing CFE and ERCOT Transmission Interconnections

There are six areas within ERCOT that are located along the United States border with México. Theses areas include the East Valley, West Valley, Laredo, Eagle Pass, Falcon, and Presidio. Each area has an existing interconnection that allows for block over transfer of load between the ERCOT and the CFE grids. AEP-TCC and AEP-TNC own virtually all of the ties, with Brownsville Public Utility Board (BPUB) owning an 18.5% interest in the Brownsville 138/69 kV transmission interconnection. Both AEP-TCC and AEP-TNC operate all of the interconnections under the coordination and supervision of ERCOT. In 2001 AEP-TCC placed into operation a 36 MVA HVDC tie in the existing Eagle Pass to Piedras Negras 138 kV transmission interconnection. This is the only tie currently capable of transferring power between ERCOT and CFE without the need to disconnect and block over the loads being served. A list of these interconnections is shown in Table 4.1 and an ERCOT map showing the six areas is included in Figure B.

Table 4.1 Existing CFE and ERCOT Interconnections

Area	*U.S. Terminal ERCOT*	*México Terminal CFE*	*Voltage kV*	*Length Kilometers AEP-TCC*	*CFE*	*Capacity* MW*
1	Brownsville, Texas**	Matamoros, Tamaulipas	69	.96	2.09	101
1	Brownsville, Texas**	Matamoros, Tamaulipas	138	.23	2.09	202
2	Frontera, Texas***	Cumbres, Tampaulipas	138	≈ 1		
3	Laredo, Texas	Nuevo Laredo, Tamaulipas	138	.48	6.1	150
4	Eagle Pass, Texas****	Piedras Negras, Coahuila	138	2.14	4.67	36
4	Amistad Dam	Amistad, Coahuila	12.47	≈ 2		2
5	Falcon Dam, Texas	Presa Falcon, Tamaulipas	138	0	.488	150
6	Presidio, Texas	Ojinaga, Chihuahua	12.47	≈ 1		4

*Does not represent the actual transfer capability of the interconnection
**Double circuit structure with BPUB owning 18.52% of .23 km from Military Highway to México/United States border
***The US portion of the Frontera to Cumbres 138 kV transmission line is privately owned and operated and is not connected to the ERCOT grid
****36 MW asynchronous HVDC tie, primary function is voltage and emergency backup power support. A bypass of the HVDC allows for 150 MW Block Load Transfer

The existing interconnections are of small capacity and are used exclusively for emergency conditions. The operation of the interconnections is limited because in most cases blocking load is required. The permanent interconnection of the systems is not feasible because the CFE and ERCOT systems have not been designed to operate in an interconnected and synchronous fashion. Significant adverse reliability impacts would result if an attempt were made to tie the systems together unless large transmission improvements were made.

(b) ERCOT Transmission System

Over the past several years, substantial changes to the power grid have occurred in the Lower Rio Grande Valley (Valley). There are 1776 MW of new Independent Power Producer (IPP) generation in-service, and 443 MW of old generation that is currently under RMR service agreements with ERCOT. All of the new Independent Power Producer (IPP) generation has been located on the west side of the Valley near the cities of Edinburg and Mission. Several 138 and 69 kV transmission line improvements have been completed to interconnect new IPP generation to the grid. In order to increase the Valley transfer capability to import/export power, series capacitors have been installed on both of the 345 kV transmission lines interconnecting the Valley to Corpus Christi which is where the AEP-TCC 345 kV grid connects to the rest of ERCOT. A 150 Mvar STATCOM was installed on the east side of the Valley at Military Highway to provide dynamic voltage support during transmission contingencies.

Electric load is growing at a rate of over 4% per year. Of the current Valley peak load of 1800 MW, half of the load, 900 MW, is located in the western end of the Valley around the cities of Edinburg and Mission. AEP-TCC, Magic Valley Electric Cooperative (MVEC), and Sharyland Utilities (SLU) currently serve this load in the west Valley. AEP-TCC and MVEC currently serve about 300 MW of load in the middle portion of the Valley area, while on the east side of the Valley AEP-TCC, MVEC and BPUB serve 600 MW of load.

Several transmission system improvements have been competed or will be completed by the end of 2003 in the Laredo, Falcon, and Eagle Pass areas. A 150 Mvar STATCOM was installed at Laredo Power Plant to provide dynamic voltage support for loss of one of the four 138 kV transmission lines that serve the Laredo area. The rebuild of the 138 kV transmission line from Laredo to Falcon down to the west Valley will be completed at the end of 2003. When completed, this line will carry power out of the Valley to the Laredo area. A new North Laredo Switching Station was placed into service creating a 138 kV loop around the Laredo area. In Laredo, 172 MW of generation is under study for RMR status which would otherwise be mothballed. As mentioned previously, a 36 MW HVDC tie was constructed in Eagle Pass. It consists of two 36 Mvar VSCs placed in a Back-to-Back configuration. This first of its kind facility provides independent dynamic voltage support to both the AEP-TCC and CFE grids instantaneously as well as the ability to transfer real power in either direction. Load in the Laredo and Eagle Pass areas is growing at a rate of over 4 % per year.

AEP-TCC has numerous planned 138 kV grid enhancements planned for service by peak 2005. In the west side of the Valley, all of the 138 kV transmission paths from North Edinburg to South McAllen and Mission will have been reconductored. This includes two MVEC paths as well as a SLU high capacity path between Frontera and South McAllen substations. Studies are also progressing for submittal to ERCOT for a new 345 kV transmission line from North Edinburg to Frontera. An existing 69 kV path connecting the west and east sides of the Valley will be converted to 138 kV increasing west to east transfer capability. In the east side of the Valley, the La Palma to Rio Hondo 138 kV transmission line is proposed to be rebuilt to 700 MVA capacity, and a second 600 MVA autotransformer will be installed at Rio Hondo. In addition to the transmission line improvements, over 150 Mvar of reactive support will be installed in the Valley.

In the Eagle Pass area, a 150 MVA phase shifting transformer will be installed at Hamilton Road substation near Del Rio, Texas to regulate the power between the AEP-TCC and AEP-TNC systems. Over 750 MW of wind generation has been installed in West Texas and under high exports some of the wind generation flows to the AEP-TCC system overloading the 138 kV transmission line from Sonora to Hamilton Road. In addition to the transmission line improvements, over 400 Mvar of reactive support will be installed in the Laredo and Eagle Pass areas to compensate for the possible shut down of generation due to market conditions. Studies are also progressing for submittal to ERCOT for a new 345 kV transmission line from San Miguel to Laredo and Laredo to Frontera.

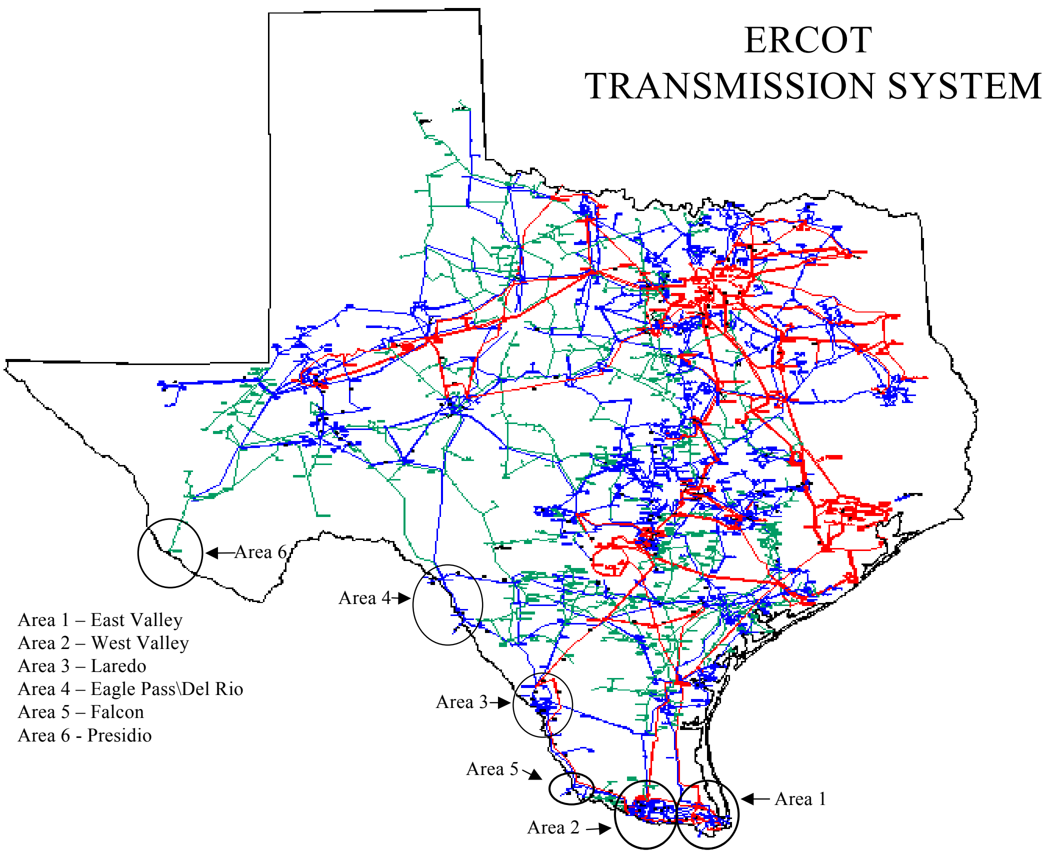


Figure B. ERCOT Study Areas for CFE – ERCOT Transmission Interconnections

(c) CFE Transmission System

In the last few years, the CFE transmission system in the northeast area and along the border with Texas has been reinforced, specifically from Matamoros, Tamaulipas to Piedras Negras, Coahuila. Today the CFE system along the border with Texas is more robust than the corresponding ERCOT transmission system.

According to the Electric System Prospectus and the Electric Market Development Study, in order to satisfy the electric demand from 2002 to 2011 in the Nuevo Leon and Tamaulipas States, additional capacity of 3,711 MW will be installed--specifically in the areas of Reynosa, Matamoros, Nuevo Laredo, Monclova, Saltillo, and Monterrey. These new IPPs will be built between 2005 and 2010.

The new generation capacity in the Reynosa and Matamoros areas--specifically the combined cycle Rio Bravo II added in 2002 and the combined cycle Rio Bravo III planned for 2004, both located in Anahuac—makes it necessary to increase the transmission capacity between Reynosa and Monterrey with two transmission lines one each at 230 kV and 400 kV. Today, they have a firm capacity of 200 MW.

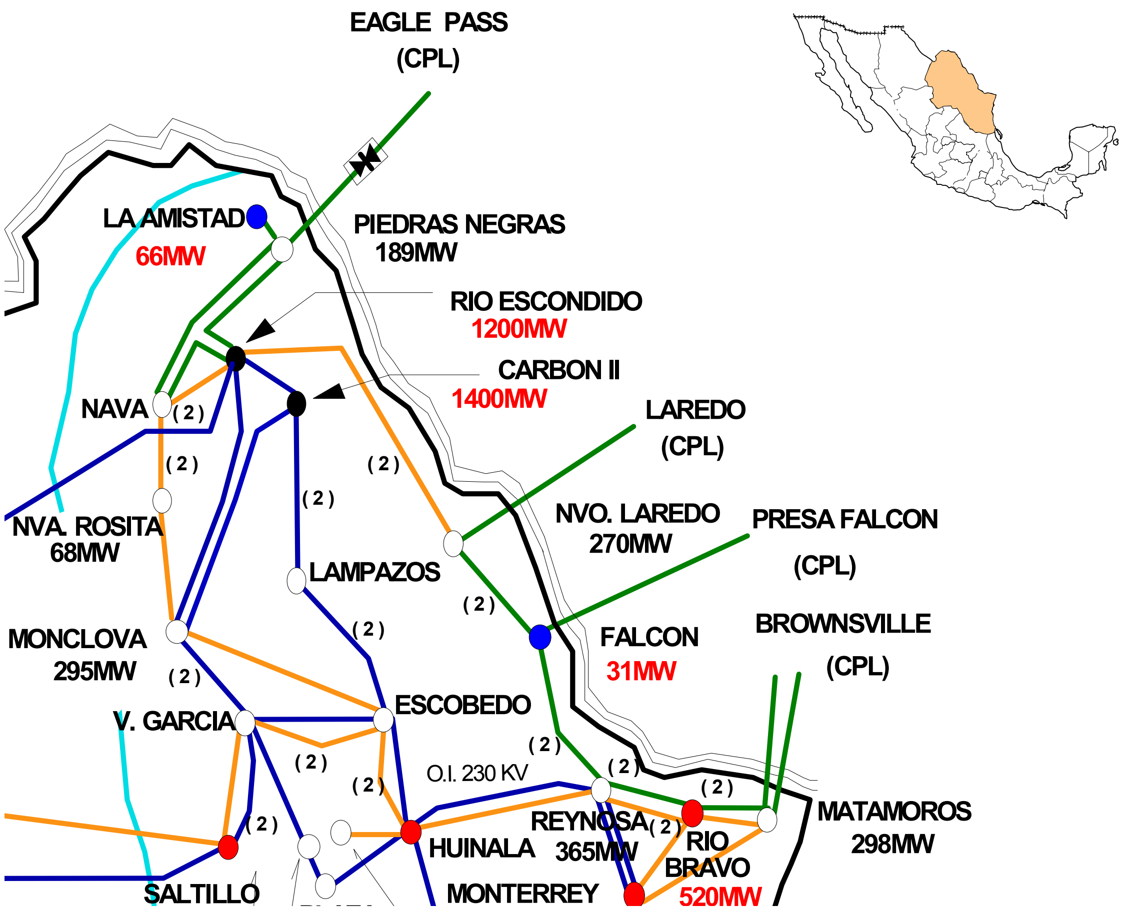


Figure C. CFE Map with CFE – ERCOT Transmission Interconnections

(d) United States Border Region Generation Reserves

Generation within ERCOT is now deregulated and the operation of the generators is dependent upon market conditions. Older generation facilities that cannot compete in the new market are being shut down. Currently those that are required for the reliability of the transmission system have signed RMR contracts with ERCOT. ERCOT is developing an RMR exit strategy to determine what transmission improvements would be required to allow this generation to be shut down. This RMR exit strategy includes a comparison of the cost of required transmission to the cost of the RMR contract. ERCOT will recommend options to the ERCOT Board. However, not all of the units along the México and United States Border region are RMR units. The existing ERCOT generation located along the México and United States border, the number of units in each area, and their status are shown in Table 4.2.

Table 4.2 ERCOT Generation facilities along the México and United States Border

Area	*Location*	*# Of Units*	*Size MW*	*Status*
1	Harlingen	3	259	RMR
1	Brownsville	4	80	NOIE*
2	North Edinburg	6	1513	Market
2	Mission	3	523	Market
2	Mission	2	183	RMR
3	Laredo	3	172	RMR
4	Eagle Pass	2	6	Shut Down
4	Del Rio	2	66	Market
5	Falcon	3	34.5	Market

*Non Opt In Entity as defined in ERCOT protocols

(e) México Border Region Planning Reserves

During the last five years, in the northeast area of CFE, the annual average energy growth rate has been 6.6%. The estimated growth rate for the 2002-2008 timeframe is 6.5%. The demand surpassed 5558 MW in 2001 and is expected to surpass 8633 MW in 2008.

Industrial users make up the demand in the northeast region. 2001 electricity sales by user class were: 36% for mid-size companies; 34% for large industries; and 29% for residential, commercial and service industries. Agricultural pumping uses 1% in this area.

The effective installed capacity in the area is 6065 MW (as of December 31, 2001) and is comprised of 43% coal-fired, 18% combined cycle, 29% conventional thermal, 8% gas turbine, and 2% hydroelectric.

In 2008 the generation capacity in the area will be 13,391 MW and will be comprised of 19% coal-fired, 67% combined cycle, 10% conventional thermal, 3% gas turbine, and 1% hydroelectric.

Retirement, capacity requirements, and self-supply for the northeast area are provided in the following three tables:

Table 4.3 Northeast Area Capacity Retirement Schedule

Capacity Retirement Schedule	***Unit***	***Type***	***MW***	***Month***	***Area***
2006					
San Jerónimo	3 & 4	Steam	75	Nov	NE
Altamira	1	Steam	150	Nov	NE
2007					
Arroyo Del Coyote	1 & 2	GT	24	April	NE
Altamira	2	Steam	150	Nov	NE
Total			399		

Table 4.4 Capacity Requirement Schedule

Capacity Requirement Schedule						
	Status	***Type***	***Gross MW***	***Net MW***	***Month***	***Area***
2002						
Río Bravo II	In-Service	CC	495	479	Jan	NE
Monterrey III	In-Service	CC	449	435	April	NE
Altamira II	In-Service	CC	495	481	May	NE
2003						
Altamira III & IV	In-Service	CC	1066	1035	Oct	NE
2004						
Rio Bravo	Under Construction	CC	512	495	April	NE
2005						
Rio Bravo IV	Under construction	CC	546	527	April	NE
2006						
Altamira V	In 2003 Bid Process	CC	1057	1026	Nov	NE
2007						
Tamazunchale	In 2004 Bid Process	CC	1046	1016	Feb	NE
2008						
Tamazunchale II	In 2005 Bid Process	Undetermined	1046	1016	April	NE
Sub-Total			**6,712**			
Plus capacity installed prior to 2002	…………	……………..	**6,065**			
Plus Self-Supply	…………	……………..	**1,013**			
Less retirements	…………	……………..	**399**			
TOTAL			**13,391**			

Table 4.5 Self-Supply Schedule

Self-Supply Schedule	*Status*	*Type*	*MW*	*Month*	*Area*
2003					
Tractebel (Enron)	In-service	CC	228	Jan	NE
Iberdrola E. M. (Peg) + BioEnergía	In-service	CC	325	April	NE
T. del Golfo + Peñoles	Under Construction		460	Nov-Dec	NE
Total			1,013		

Given that the minimum required reserve margin is 27%, as established in the planning criteria of CFE, reserve studies of the 2003-2008 period for the area show excess capacity. This excess capacity will be exported to other areas of the National Interconnected System (SIN), specifically to the west and to the south. The following table shows the estimated demand and installed capacity for each year of this period.

Table 4.6 Northeast México Area Demand and Capacity Forecast

Demand and Capacity Forecast	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*
Demand	5,733	6,216	6,691	7,216	7,673	8,216
Installed Capacity	9,629	10,141	10,687	11,519	12,391	13,437

Chapter 5. Study Assumptions

(a) ERCOT Power Flow Cases and Criteria

Each year ERCOT produces two sets of power flow cases covering a six-year period. The first set of cases, Data Set A, covers a one year time period that includes winter, spring, summer, and fall cases. The second set of cases, Data Set B, covers the remaining five year period and includes both minimum and maximum load periods for summer and winter. The ERCOT 2005 and 2008 minimum and maximum summer load flow cases were selected to perform the first phase of the CFE/ERCOT Interconnection study. These cases were created in 2002 and have been modified to include completed transmission improvements and to reflect known schedule changes. For this phase of the study, the scope has been limited to determining the import and export capabilities for power transfers from a single point within a given area on the ERCOT grid. This included existing CFE and ERCOT 138 kV and 69 kV transmission interconnections as well as possible new 138 kV transmission interconnections. The second phase of the study will focus on the inter area transfer capabilities as well as large bulk power transfers between CFE and ERCOT.

ERCOT has adopted the NERC Planning Standards and has added two more stringent requirements. The first treats double circuit lines longer than 0.5 miles as a single contingency and the second considers any single generating unit unavailable for Category B contingencies.

(b) CFE Power Flow Cases and Criteria

The generation and transmission projects designed to provide electric energy as a public service are developed as an integrated plan for the National Electric System in which generation and transmission capacities are defined along with the dates for commercial operation of such projects.

Every year, as a result of several technical and economic studies, the electric plan is updated to include electrical system installations and locations for the next ten years. Then, once evaluated, the plan is used as a reference to cover the additional capacity needed in the electric system for the service of the public.

The benefits from the expansion of the main electric system are related to one or more of the following attributes.

- Safety
- Quality
- Reliability, and
- Economic operation

Based upon these attributes, planning and design criteria are established and applied to the design of the transmission grid of the CFE electrical system.

(c) ERCOT Generation Dispatch

As mentioned previously, the generation within ERCOT is fully deregulated and it is impossible to predict the status of the generation at any given time in the future. This is complicated by older generation facilities announcing at anytime that they will shut down due to ERCOT market conditions. Given this unpredictability, the studies determined the import and export capabilities with and without entire generation facilities as well as shut down of the current RMR units. The different generation dispatch scenarios studied for each area in the 2005 and 2008 load flow cases are shown below in Tables 5.1 through 5.5.

Table 5.1 ERCOT Generation Scenarios for Area 1 – East Valley

Generation Scenario	***Edinburg Area 2***		***Mission Area 2***		***Mission RMR Area 2***		***Harlingen RMR Area 1***		***Brownsville Area 1***	
	# of Units	***Status***	***# of Units***	***Status***	***# of Units***	***Status***	***# of Units***	***Status***	***# of Units***	***Status***
1	6	On	3	On	2	On	2	On	4	On
2	6	On	3	On	2	On	2	Off	4	On
3	6	On	3	On	2	Off	2	Off	4	On
4	6	On	3	On	2	Off	2	Off	2	On

Table 5.2 ERCOT Generation Scenarios for Area 2 – West Valley

Generation Scenario	***Edinburg Area 2***		***Mission Area 2***		***Mission RMR Area 2***		***Harlingen RMR Area 1***		***Brownsville Area 1***	
	# of Units	***Status***	***# of Units***	***Status***	***# of Units***	***Status***	***# of Units***	***Status***	***# of Units***	***Status***
1	6	On	3	On	2	On	2	On	4	On
2	6	On	3	On	2	Off	2	On	4	On
3	6	On	3	Off	2	Off	2	On	4	On
4	3	On	3	On	2	Off	2	On	4	On
4	6	On	3	On	2	Off	2	Off	4	On

Table 5.3 ERCOT Generation Scenarios for Area 3 - Laredo

Generation Scenario	*Edinburg Area 2 # of Units*	*Status*	*Mission Area 2 # of Units*	*Status*	*Mission RMR Area 2 # of Units*	*Status*	*Falcon Area 5 # of Units*	*Status*	*Laredo Area 3 # of Units*	*Status*
1	6	On	3	On	2	On	2	Off	3	On
2	6	On	3	On	2	Off	2	Off	3	On
3	6	On	3	Off	2	Off	2	Off	3	On
4	6	On	3	Off	2	Off	2	Off	3	Off
5	6	On	3	On	2	Off	2	Off	3	Off

Table 5.4 ERCOT Generation Scenarios for Area 4 – Eagle Pass

Generation Scenario	*Laredo Area 3 # of Units*	*Status*	*Eagle Pass Area 4 # of Units*	*Status*	*Amistad Area 4 # of Units*	*Status*
1	3	On	3	Off	2	On
2	3	Off	3	Off	2	On
3	3	Off	3	Off	2	Off
4	3	On	3	Off	2	Off

Table 5.5 ERCOT Generation Scenarios for Area 5 – Falcon

Generation Scenario	*Edinburg Area 2 # of Units*	*Status*	*Mission Area 2 # of Units*	*Status*	*Mission RMR Area 2 # of Units*	*Status*	*Falcon Area 5 # of Units*	*Status*	*Laredo Area 3 # of Units*	*Status*
1	6	On	3	On	2	On	2	Off	3	On
2	6	On	3	On	2	On	2	Off	3	Off

(d) CFE Generation Dispatch

The northeast area of the CFE electric system is an important source of generation capacity for México comprised almost 100% of thermal energy including coal-fire generation, conventional thermal, combined cycle and other technologies. The following table shows the generation dispatch used in this study for 2005 and 2008 for the northeast area. This is a typical dispatch for the area under operating conditions of maximum, average, and minimum demand.

Table 5.6 CFE Generation Scenarios

Plant	*Generation Dispatch (MW)*					
	Summer 2005			*Summer 2008*		
	Maximum Demand	*Average Demand*	*Minimum Demand*	*Maximum Demand*	*Average Demand*	*Minimum Demand*
	MW	*MW*	*MW*	*MW*	*MW*	*MW*
AMISTAD CH	1x33			1x33		
CARBÓN II	4x329	4x329	4x250	4x329	4x329	4x250
FALCÓN CH	1x9			1X9		
HUINALA	4x60 120	1x60 30	1x60 30	4x60 120	1x60 30	1x60 30
MONTERREY PV	5x70	5x50	5x50	5x70	5x50	5x50
RÍO ESCONDIDO	4x282	4x282	4x225	4x282	4x282	4x225
RÍO BRAVO PV	1x22 1x282	1x22 1x180	1x22 1x180	1x22 1x282	1x22 1x180	1x22 1x180
HUINALA TG	141	141	141	141	141	141
RÍO BRAVO TG	154	154	154	154	154	154
MONTERREY CC1	1x489	1x489	1x489	1x489	1x489	1x489
SALTILLO CC1	1x248	1x248	1x248	1x248	1x248	1x248
RÍO BRAVO CC1	1x495	1x495	1x495	1x495	1x495	1x495
MONTERREY CC2	1x486	1x486	1x486	1x486	1x486	1x486
PEGI CC1	1x244	1x244	1x244	1x244	1x244	1x244
ALCALI CC	1x228	1x228	1x228	1x228	1x228	1x228
PEGI CC2	1x244	1x244	1x244	1x244	1x244	1x244
RÍO BRAVO CC2	1x495	1x495	1x495	1x495	1x495	1x495
RÍO BRAVO CC3	1x525	1x525	1x525	1x525	1x525	1x525

(e) United States Border Region ERCOT Load Profiles

On October 1 of each year, every Distribution Service Provider (DSP) within ERCOT is required to submit to ERCOT the Annual Load Data Request (ALDR), which details the load data for every point of delivery. The ALDR contains the summer and winter peak loads and a five-year forecast. The loads in the 2005 and 2008 load flow cases were based on the ERCOT ALDR produced in October 2001. The load for the Valley area is divided into Area 1 – East Valley, Area 2 – West Valley, and is shown in Table 5.7. The load for Area 3 - Laredo, Area 4 - Eagle Pass and Area 6 - Presidio are shown in Table 5.8.

Table 5.7 ERCOT 2005 and 2008 Peak Load For Area 1 and Area 2

		ERCOT Transmission Service Provider				
Area	***Year***	***AEP-TCC***	***MVEC***	***SLU***	***BPUB***	***Total***
1	2005	450 MW	74 MW	-	271 MW	795 MW
1	2008	493 MW	100 MW	-	299 MW	892 MW
2	2005	977 MW	231 MW	52 MW	-	1260 MW
2	2008	1108 MW	314 MW	88 MW	-	1510 MW

Table 5.8 ERCOT 2005 and 2008 Peak Load For Area 3, Area 4, and Area 6

		ERCOT Transmission Service Provider				
Area	***Year***	***AEP-TCC***	***MEC****	***RGEC*****	***AEP-TNC***	***Total***
3	2005	398 MW	10 MW	-	-	408 MW
3	2008	439 MW	11 MW	-	-	450 MW
4	2005	179 MW	-	2 MW	-	181 MW
4	2008	194 MW	-	2.1 MW	-	196.1 MW
6	2005	-	-	.1 MW	6.1 MW	6.2 MW
6	2008	-	-	.1 MW	7.5 MW	7.6 MW

**Medina Electric Cooperative load along the border area.*

***Rio Grande Electric Cooperative load along the border area.*

(f) México Border Region Northeast Load Profiles

According to the Electric Market Development Study, the northeast area has had an historic growth (1991 – 2000) of electricity demand of 5.4% per year. It is forecast that in the equivalent period (2001-2010) growth of the electricity demand will be 6.5% per year.

The annual load growth forecasts for the Nuevo Laredo, Reynosa, and Matamoros areas in the 2003-2012 period will be, respectively, 6.3%, 9.5%, and 6.9%. The following table shows the forecasts of MW demand in the relevant consumption zones of the northeast region.

Table 5.9 CFE 2003 and 2012 Forecast of MW Demand

Zone	*Year*									
	2003	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*
Piedras Negras	205	217	229	241	254	267	282	296	311	327
Nuevo Laredo	240	251	264	279	296	315	336	360	386	415
Reynosa	372	394	421	450	482	518	556	600	648	701
Matamoros	289	301	317	339	363	390	420	453	491	533
Monterrey	2935	2959	3041	3153	3300	3490	3730	4015	4369	4802

(g) ERCOT Planned Transmission Upgrades

In addition to the transmission improvements mentioned in Chapter 4, several 345 kV and 138 kV transmission system improvements will be completed or under construction between 2005 and 2008. The majority of these transmission improvements are located in the West Valley, Laredo, and Eagle Pass areas and must proceed through several approval processes before they can be constructed. Transmission line projects requiring new right-of-way must be submitted to ERCOT transmission planning for its review and approval before they are submitted to the PUCT for its consideration in the form of a Certificate of Convenience and Necessity (CCN) application. All 345 kV projects and RMR mitigation projects require ERCOT transmission planning review and approval, and ERCOT board approval before they are submitted to the PUCT for its consideration. Transmission line improvements utilizing existing right-of-way will normally require less regulatory review than projects requiring new right-of-way. If new right-of-way consists of expanding existing easement widths for the rebuild to a higher voltage transmission line, then expedited approval could potentially be obtained through consent from impacted landowners. If a new transmission line is constructed on a new easement, then expedited approval is only possible if no intervention occurs, and the PUCT staff recommends approval. When new right-of-way is required a routing study and an environmental impact study must be performed and filed along with the CCN application. If impacted landowners challenge the CCN application, it could take up to a year for the PUCT to rule on the CCN application. Table 5.10 shows several 345 kV projects that will be under construction during this time period as well as major 138 kV transmission system improvements to be completed by 2008. The transmission improvements that are expected to be completed by 2008 have been modeled in the 2008 load flow case. All in-service dates assume expedited approval from ERCOT and the PUCT.

Table 5.10 Major ERCOT Transmission Improvements 2005 to 2008

Area	*Project*	*Length Miles*	*Voltage kV*	*Projected In-Service Date****
2	West McAllen to South McAllen	3.3	138	6/1/2006
2	Bates to Roma	44	138	6/1/2006
2	North Edinburg to Frontera**	22	345	6/1/2008
2	Mission area 150 MW HVDC Tie with CFE*		138	1/1/2006
3	Laredo to San Miguel**	110	345	6/1/2009
3	Frontera to South McAllen**	12	345	6/1/2010
2/3	Laredo to Frontera**	110	345	6/1/2010
3	Laredo150 MW HVDC Tie with CFE*		138	1/1/2006
4	Asherton to Eagle Pass	61	138	6/1/2006
4	Hamilton Road to Uvalde	68	138	5/1/2007
4	Castroville to Uvalde**	52	138	6/1/2008

*Requires ERCOT Transmission Planning and Board approval if project is determined to be the best solution for relieving RMR.

**Requires ERCOT Transmission Planning, ERCOT Board Approval, and PUCT approval.

***The in-service date assumes and expedited approval from ERCOT and the PUCT, and all right-of-way issues can be resolved expeditiously.

(h) CFE Planned Transmission Upgrades

CFE in its expansion process has scheduled the construction of the following transmission lines.

Table 5.11 CFE New Transmission Line Construction

Project	*KV*	*Circuit*	*Projected Start Date*
LT Aeropuerto-Villa de Garcia (Reynosa) (Monterrey)	400	2	May 2004
Carbon II - Arroyo del Coyote (Nuevo Laredo)	400	1	April 2006

In addition, there are also transmission improvements scheduled to reinforce the transmission capabilities between the north and south. This will allow an increased interchange of energy between the interconnected CFE and ERCOT systems.

Table 5.12 CFE Transmission Line Improvements

Project	***KV***	***Circuit***	***Projected Start Date***
LT Saltillo - Cañada (Coahuila) (Aguascalientes)	400	2	May 2004
CEV en Cañada (Aguascalientes)	400		September 2006

Chapter 6. Potential Near-Term CFE/ERCOT Interconnections

Utilizing the 2005 and 2008 load flow cases, the import and export limits were determined for all of the existing CFE/ERCOT interconnection locations. Additional locations were studied and, if deemed viable on both sides of the México and United States border, were included as possible near-term CFE/ERCOT interconnections. The import and export limits for each of the existing locations are shown in Tables 6.1 through 6.4 and the import and export limits for each of the new locations are shown in Tables 6.5 through 6.8. A map of the six study areas for the CFE/ERCOT system is shown in Figure D.

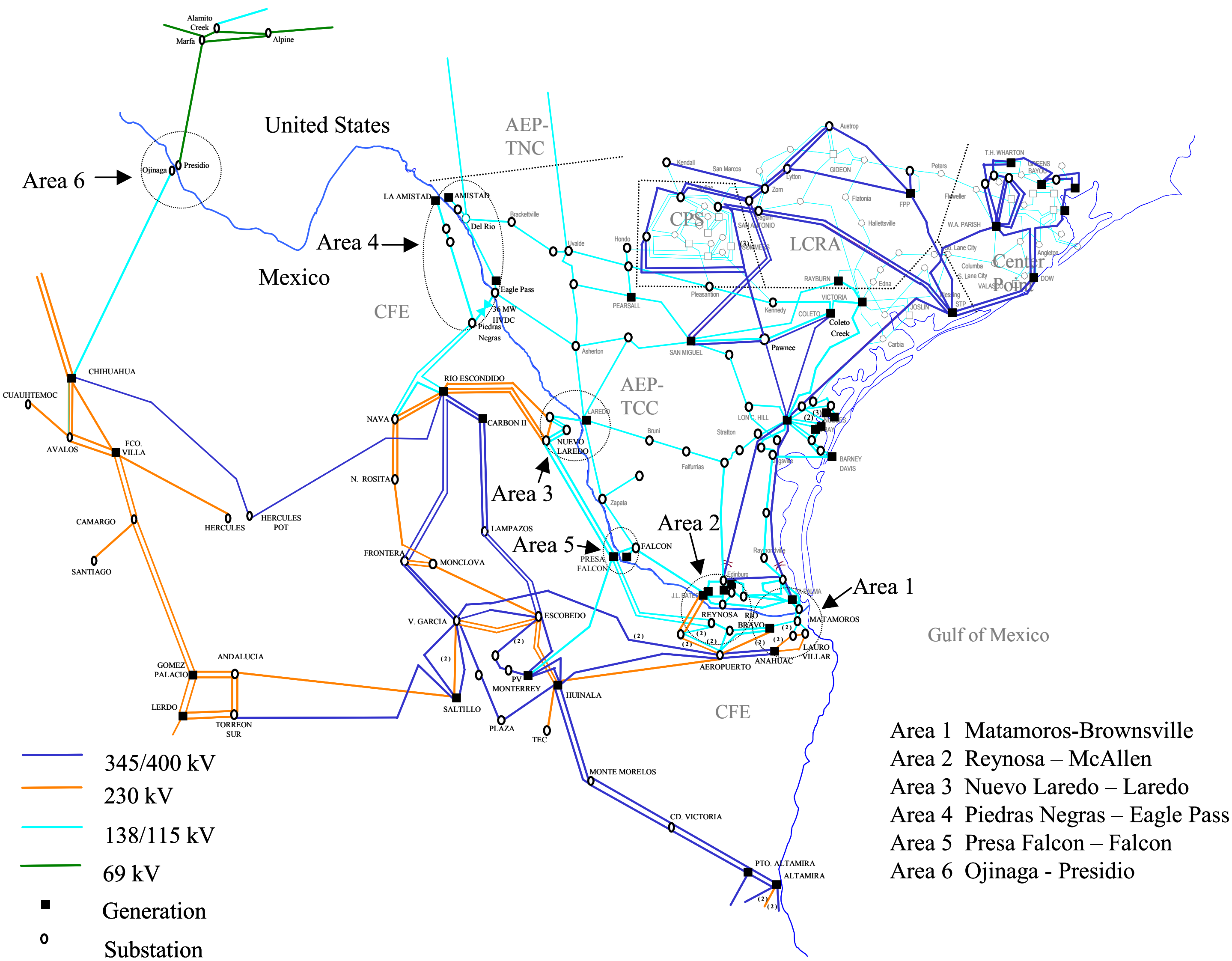


Figure D. CFE and ERCOT Systems along the México and United States Border

Table 6.1 Existing Interconnections 2005 Peak Power Transfers

			2005	
Area	ERCOT Terminal	CFE Terminal	CFE to ERCOT	ERCOT to CFE
1	Military Highway 138 kV	Matamoros 138 kV	90 MW	125 MW
3	Laredo 138 kV	Industrial 138 kV	20 MW	0 MW
4*	Eagle Pass 138 kV	Piedras Negras 138 kV	50 MW/ 36 MW	25 MW/30 MW
5	Falcon 138 kV	Presa Falcon 138 kV	50 MW	96 MW
6	Presidio 12.47	Ojinaga 12.47	3 MW	3 MW
*Power Transfer through Block Load Transfer / Power Transfer through HVDC Tie				

Table 6.2 Existing Interconnections 2008 Peak Power Transfers

			2008	
Area	ERCOT Terminal	CFE Terminal	CFE to ERCOT	ERCOT to CFE
1	Military Highway 138 kV	Matamoros 138 kV	40 MW	150 MW
3	Laredo 138 kV	Industrial 138 kV	150 MW	0 MW
4*	Eagle Pass 138 kV	Piedras Negras 138 kV	50 MW/ 36 MW	25 MW/30 MW
5	Falcon 138 kV	Presa Falcon 138 kV	50 MW	90 MW
6	Presidio 12.47	Ojinaga 12.47	3 MW	3 MW
*Power Transfer through Block Load Transfer / Power Transfer through HVDC Tie				

Table 6.3 Existing Interconnections 2005 Off Peak Power Transfers

			2005	
Area	ERCOT Terminal	CFE Terminal	CFE to ERCOT	ERCOT to CFE
1	Military Highway 138 kV	Matamoros 138 kV	200 MW	125 MW
3	Laredo 138 kV	Industrial 138 kV	100 MW	0 MW
4*	Eagle Pass 138 kV	Piedras Negras 138 kV	50 MW/ 36 MW	25 MW/30 MW
5	Falcon 138 kV	Presa Falcon 138 kV	50 MW	96 MW
6	Presidio 12.47	Ojinaga 12.47	3 MW	3 MW
*Power Transfer through Block Load Transfer / Power Transfer through HVDC Tie				

Table 6.4 Existing Interconnections 2008 Off Peak Power Transfers

			2008	
Area	ERCOT Terminal	CFE Terminal	CFE to ERCOT	ERCOT to CFE
1	Military Highway 138 kV	Matamoros 138 kV	170 MW	150 MW
3	Laredo 138 kV	Industrial 138 kV	300 MW	0 MW
4*	Eagle Pass 138 kV	Piedras Negras 138 kV	50 MW/ 36 MW	25 MW/30 MW
5	Falcon 138 kV	Presa Falcon 138 kV	50 MW	90 MW
6	Presidio 12.47	Ojinaga 12.47	3 MW	3 MW
*Power Transfer through Block Load Transfer / Power Transfer through HVDC Tie				

Table 6.5 New Interconnections 2005 Peak Power Transfers

Area	ERCOT Terminal	CFE Terminal	2005 CFE to ERCOT	 ERCOT to CFE
1	Loma Alta 138 kV	Lauro Villar 138 kV	80 MW	125 MW
1	Loma Alta 138 kV	Lauro Villar 230 kV	300 MW	125 MW
2	South McAllen 138 kV	Anzalduas 138 kV	0 MW	150 MW
2	Railroad 138 kV	Cumbres 138 kV	215 MW	300 MW
2	Bates 138 kV	Cumbres 138 kV	215 MW	300 MW
2	Bates 138 kV	Cumbres 230 kV	270 MW	300 MW
3	Laredo 138 kV	Industrial 230 kV	20 MW	0 MW
4	Amistad 138 kV	Amistad 138 kV	50 MW	36 MW*
* Amistad Dam or Eagle Pass HVDC injecting power into ERCOT grid				

Table 6.6 New Interconnections 2008 Peak Power Transfers

Area	ERCOT Terminal	CFE Terminal	2008 CFE to ERCOT	 ERCOT to CFE
1	Loma Alta 138 kV	Lauro Villar 138 kV	150 MW	100 MW
1	Loma Alta 138 kV	Lauro Villar 230 kV	300 MW	100 MW
2	South McAllen 138 kV	Anzalduas 138 kV	165 MW	300 MW
2	Railroad 138 kV	Cumbres 138 kV	110 MW	300 MW
2	Bates 138 kV	Cumbres 138 kV	110 MW	300 MW
2	Bates 138 kV	Cumbres 230 kV	190 MW	300 MW
3	Laredo 138 kV	Industrial 230 kV	150 MW	0 MW
4	Amistad 138 kV	Amistad 138 kV	50 MW	100 MW

Table 6.7 New Interconnections 2005 Off Peak Power Transfers

Area	ERCOT Terminal	CFE Terminal	2005 CFE to ERCOT	 ERCOT to CFE
1	Loma Alta 138 kV	Lauro Villar 138 kV	155 MW	150 MW
1	Loma Alta 138 kV	Lauro Villar 230 kV	300 MW	150 MW
2	South McAllen 138 kV	Anzalduas 138 kV	0 MW	200 MW
2	Railroad 138 kV	Cumbres 138 kV	300 MW	200 MW
2	Bates 138 kV	Cumbres 138 kV	300 MW	300 MW
2	Bates 138 kV	Cumbres 230 kV	300 MW	300 MW
3	Laredo 138 kV	Industrial 230 kV	100 MW	0 MW
4	Amistad 138 kV	Amistad 138 kV	70 MW	36 MW*
* Amistad Dam or Eagle Pass HVDC injecting power into ERCOT grid				

Table 6.8 New Interconnections 2008 Off Peak Power Transfers

Area	ERCOT Terminal	CFE Terminal	2008 CFE to ERCOT	2008 ERCOT to CFE
1	Loma Alta 138 kV	Lauro Villar 138 kV	185 MW	150 MW
1	Loma Alta 138 kV	Lauro Villar 230 kV	300 MW	150 MW
2	South McAllen 138 kV	Anzalduas 138 kV	270 MW	300 MW
2	Railroad 138 kV	Cumbres 138 kV	300 MW	300 MW
2	Bates 138 kV	Cumbres 138 kV	300 MW	300 MW
2	Bates 138 kV	Cumbres 230 kV	300 MW	300 MW
3	Laredo 138 kV	Industrial 230 kV	300 MW	0 MW
4	Amistad 138 kV	Amistad 138 kV	60 MW	150 MW

(a) ERCOT Results for Brownsville – Matamoros Area

Two locations within the Brownsville - Matamoros area were identified for HVDC interconnections. Exports for the two locations are dependent on the completion of the La Palma to Rio Hondo 138 kV rebuild by peak of 2005. Otherwise the exports for 2005 will be 0 MW for both peak and off-peak conditions. The two locations are the existing Military Highway to Matamoros 138 kV interconnection and a second possible interconnection between Loma Alta and Lauro Villar. Both locations are shown below in Figure E.

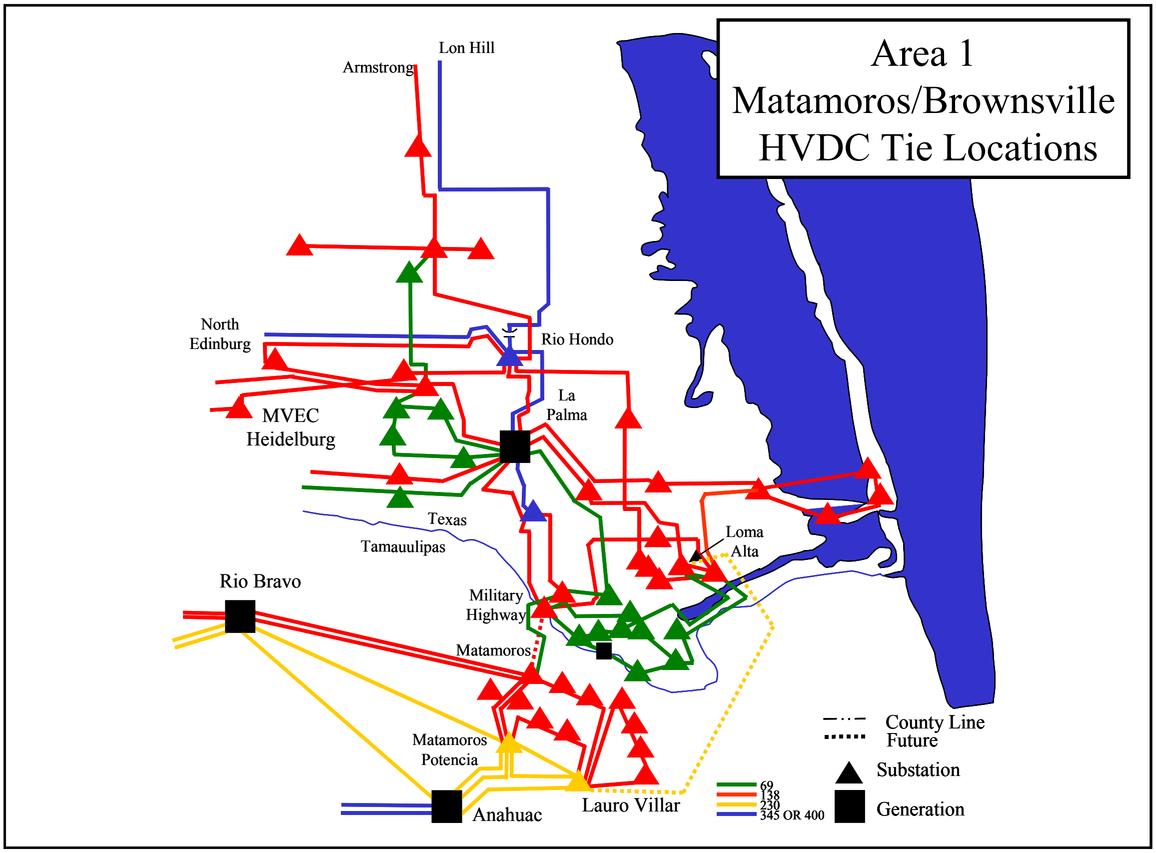


Figure E. Possible HVDC Tie Locations between CFE and ERCOT - Area 1

The first location is the existing 138 kV Military Highway to Matamoros transmission line. The ERCOT side is capable of exporting a maximum of 125 MW to CFE at peak. The limiting element is the La Palma to Military Highway 138 kV transmission line for the outage of the Military Highway to Union Carbide 138 kV transmission line. During off peak, ERCOT is capable of exporting up to 200 MW or 100% of the normal rating of the existing Military Highway to Matamoros 138 kV transmission line. For both peak and off-peak system conditions, the ERCOT side is capable of importing up to 150 MW. The limitation is due to the overload of one of the two Military Highway138/69 kV autotransformers for loss of the other autotransformer. To maintain imports and exports, additional 138/69 kV transformation is required at Military Highway for 2008. The combined CFE and ERCOT transfer limits for 2005 and 2008 are shown in Tables 6.1 through 6.4 and maps of the 2005 and 2008 CFE/ERCOT system are shown in Figures F and G.

The second possible HVDC interconnection is between the PUB Loma Alta 138 kV substation on the ERCOT side and the Lauro Villar 230/138 kV substation on the CFE side. There is currently no transmission interconnection between México and the United States at this location. The CFE side of the HVDC terminal has the ability to connect to CFE at either 138 kV or 230 kV while the ERCOT side must be connected at 138 kV. The ERCOT side is capable of exporting a maximum of 125 MW to CFE at peak. The limiting element is the La Palma to Los Fresnos 138 kV transmission line for the contingency outage of the La Palma to Military

Highway 138 kV transmission line. During off peak conditions, ERCOT is capable of exporting up to 150 MW due to the same limiting element at peak. For both peak and off-peak system conditions, the ERCOT side is capable of importing up to 150 MW limited by the overload of one of the Loma Alta 138/69 kV autotransformers for loss of the other autotransformer. To maintain imports and exports, additional 138/69 kV transformation is required at Loma Alta for 2008. The combined CFE and ERCOT transfer limits for 2005 and 2008 are shown in Tables 6.5 through 6.8 and maps of the 2005 and 2008 CFE/ERCOT system are shown in Figures F and G.

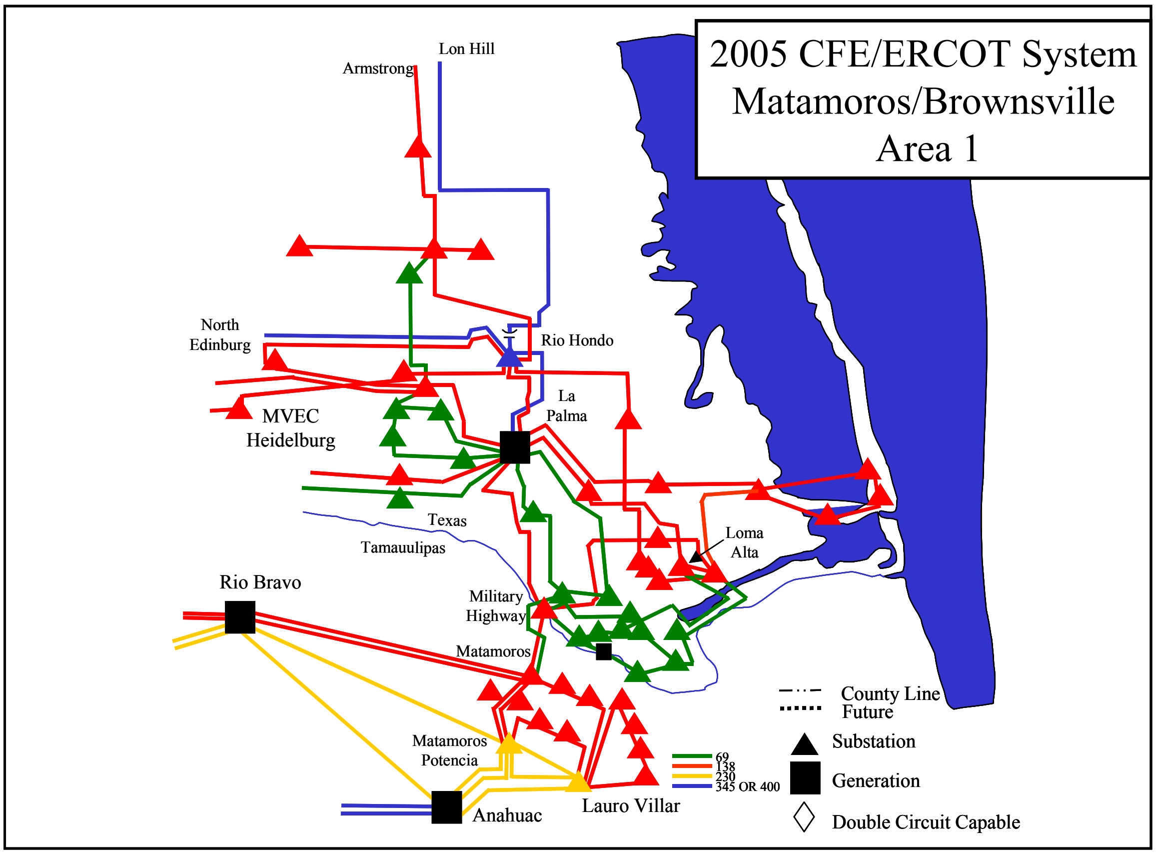


Figure F. CFE/ERCOT 2005 System - Area 1

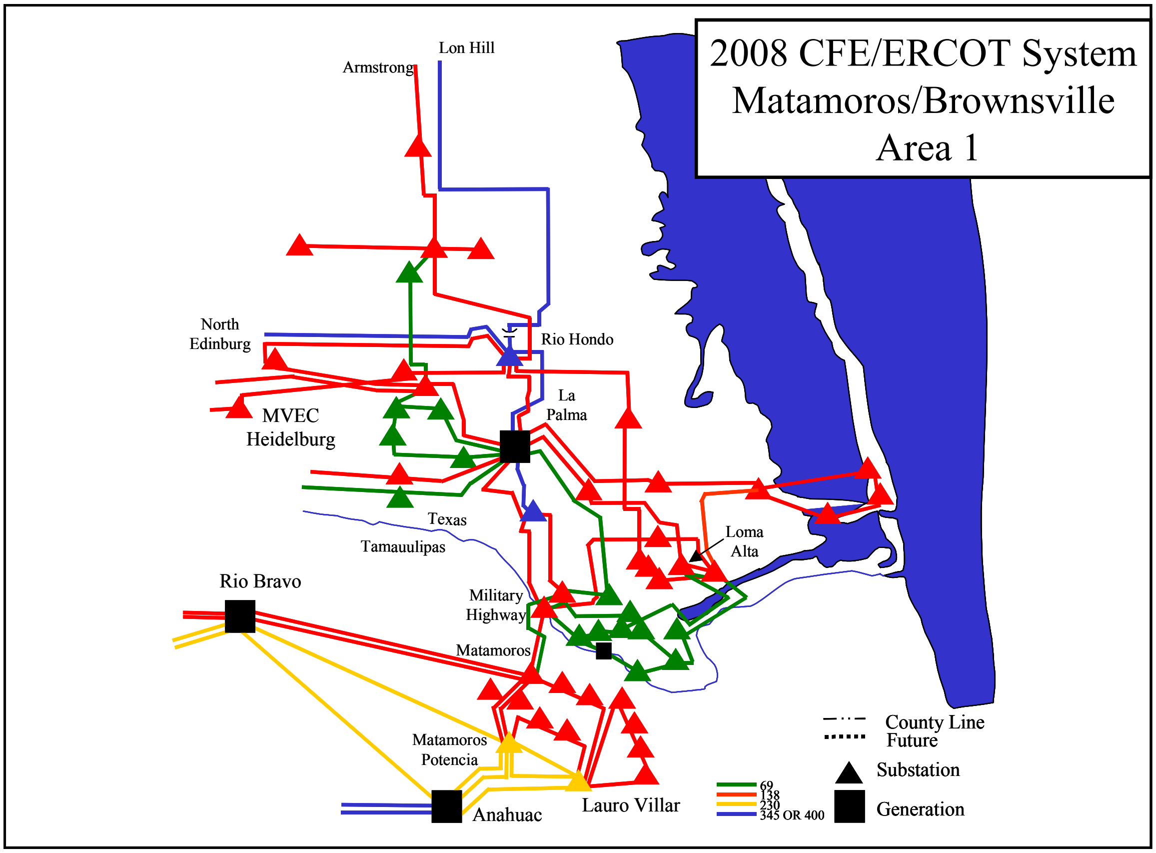


Figure G. CFE/ERCOT 2008 System - Area 1

(b) CFE Results for Brownsville – Matamoros Area

The 2005 studies conclude that CFE could import up to 190 MW. The export capacity during the peak demand period is 90 MW and during the minimum demand period is 240 MW. For export from CFE to ERCOT, reactive support of 15 MVAR would be required in the Matamoros (138 kV, 7.5 MVAR) and Sendero Nacional (138 kV, 7.5 MVAR) substations.

The 2008 studies conclude that the maximum value of import energy to the CFE electric system is 300 MW. The export capacity during peak demand is 40 MW and during minimum demand period is 200 MW.

A new interconnection was considered between the CFE Lauro Villar substation and Loma Alta substation in the ERCOT electric system. The power transfer was simulated at 138 kV with a conductor of 795 ACSS and at 230 kV with a conductor of 900 ACSS. The study concludes that for 2005, CFE could export, during the peak demand period, 80 MW at 138 kV and 300 MW at the 230 kV Both transactions would require reactive support of 7.5 MVAR at 138 kV and 22.5 MVAR at 230 kV in the Oriente substation; and 15 MVAR at 138 kV in the Lauro Villar substation. During minimum demand operating conditions, it is possible to export 175 MW at 138 kV and 300 MW at 230 kV.

In 2008, CFE could import, during the peak demand period, 300 MW at 138 kV and 230 kV. The maximum export would be 150 MW at 138 kV and 300 MW at 230 kV. Both import and export at these voltage levels will require reactive support:

- 7.5 MVAR in the Oriente substation
- 15 MVAR in the Llano Grande substation in the 138 kV interconnection
- Oriente substation 230kV, 2 x 7.5 MVAR
- Llano Grande substation 230 kV x 7.5 MVAR

(c) ERCOT Results for McAllen – Reynosa Area

Three locations were identified as possible HVDC interconnections between CFE and ERCOT. None of the three locations on the ERCOT side have existing transmission interconnections with CFE except for a privately owned 138 kV transmission line on the US side of the border at the Frontera Power Plant. CFE owns this line from the border to the termination point at the CFE Cumbres substation. Transfers between CFE and ERCOT are affected by the status of generation in the Mission area. The three possible locations for HVDC ties in Area 2 are the Bates to Cumbres, Railroad to Cumbres, and the South McAllen to Anzalduas interconnections, which are shown below in Figure H.

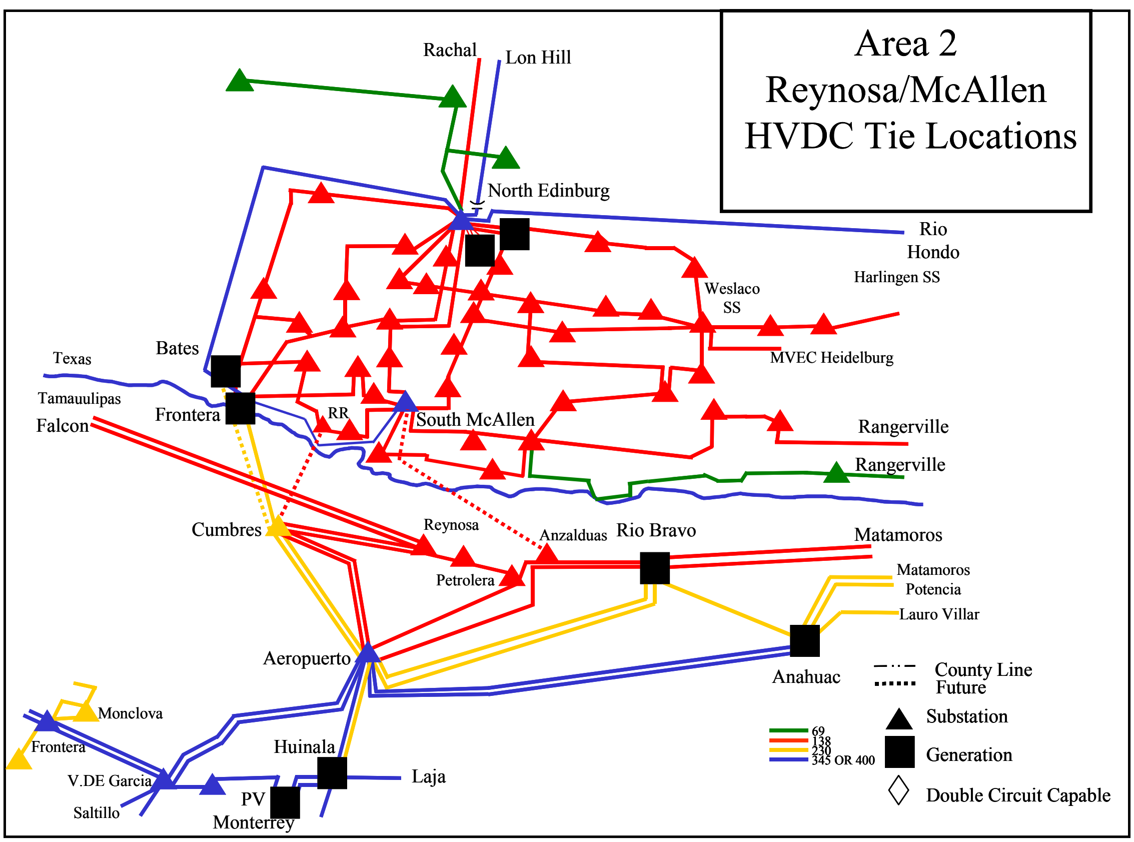


Figure H. Possible HVDC Tie Locations between CFE and ERCOT - Area 2

The first possible location for a HVDC tie is between the AEP-TCC South McAllen 138 kV substation on the US side and a new CFE Anzalduas 138 kV substation on the México side. At peak, the ERCOT side is capable of exporting a maximum of 150 MW with Mission generation in-service. There is 0 MW export capability if Mission generation is less than 250 MW at peak load conditions. The limiting element is the West McAllen to South McAllen 138 kV transmission line for the 138 kV contingency outage of the Pharr to Polk transmission line. During off peak conditions, ERCOT is capable of exporting a maximum of 300 MW with Mission generation in-service or 0 MW with no Mission generation. Imports from CFE are a function of the amount of generation on the West Side of the Valley. The West Side of the Valley is capable of supporting up to 2000 MW of generation. With West Side generation at 1700 MW, ERCOT can support up to a 300 MW import from CFE for both peak and off peak load conditions.

The second possible location for a HVDC tie is located at the SLU Railroad 138 kV substation. At peak, the ERCOT side is capable of exporting a maximum of 150 MW with Mission generation in-service. There is 0 MW export capability if Mission generation is less than 250 MW at peak load conditions. The limiting element is the West McAllen to South McAllen 138 kV transmission line for the contingency outage of the Pharr to Polk 138 kV transmission line. During off peak conditions, ERCOT is capable of exporting a maximum of 300 MW with Mission generation in-service or 0 MW with no Mission generation. ERCOT can support up to a 300 MW import from CFE for both peak and off peak load conditions for the reasons mentioned for the South McAllen location.

The third possible location for a HVDC tie is between the AEP-TCC Bates 138 kV substation on the US side and the CFE Cumbres 230/138 kV substation on the México side. The tie would utilize the existing CFE double circuit transmission line from Cumbres up to the border, which has the capability of operation at 400 kV, 230 kV, or 138 kV. At peak, the ERCOT side is capable of exporting a maximum of 300 MW with Mission generation greater than 500 MW. The limiting element is the West McAllen to South McAllen 138 kV transmission line for the contingency outage of the Pharr to Polk 138 kV transmission line. During off peak conditions, ERCOT is capable of exporting a maximum of 400 MW with Mission generation greater than 500 MW. ERCOT can support up to a 300 MW import from CFE for both peak and off peak load conditions for the reasons mentioned for the South McAllen location. The combined CFE and ERCOT transfer limits for 2005 and 2008 are shown in Tables 6.5 through 6.8 and maps of the 2005 and 2008 CFE/ERCOT system are shown in Figures I and J.

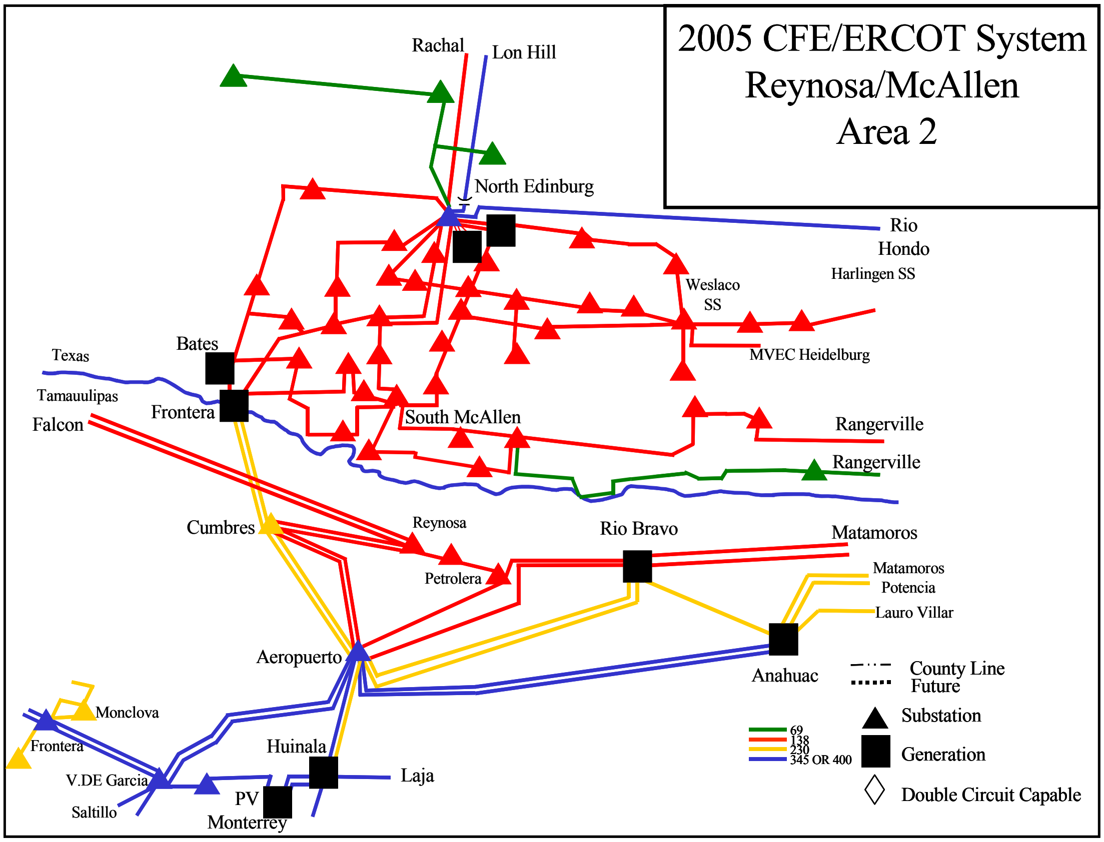


Figure I. CFE/ERCOT 2005 System - Area 2

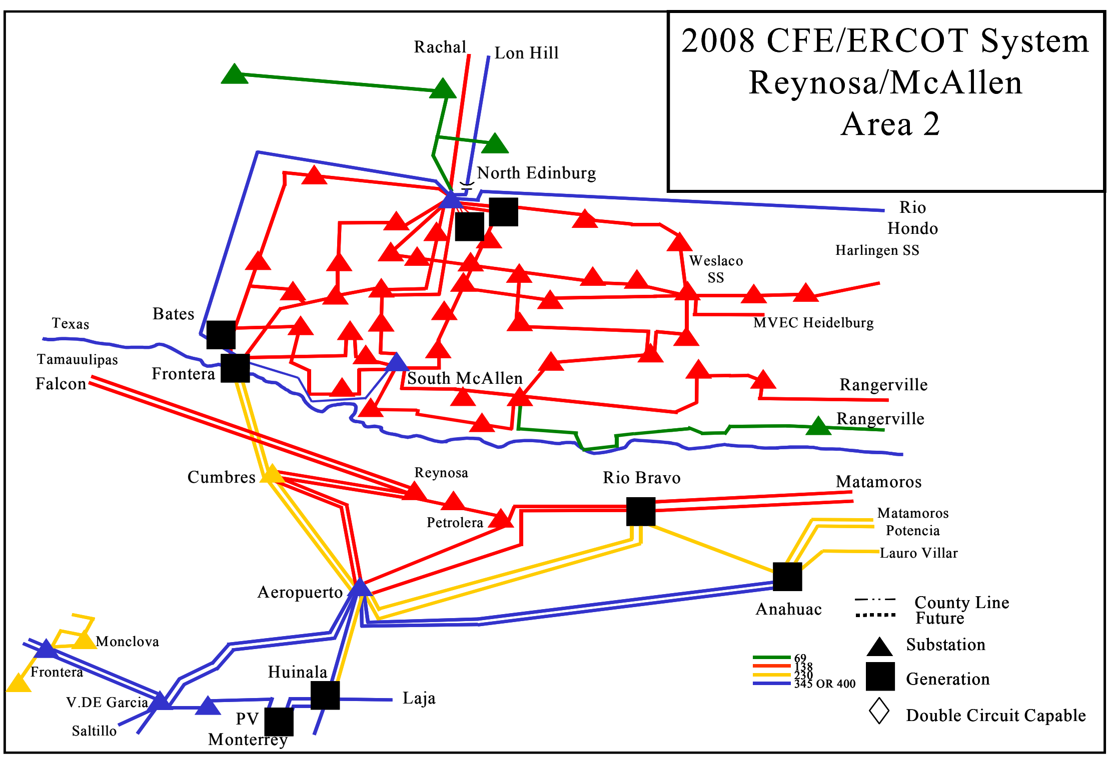


Figure J. CFE/ERCOT 2008 System - Area 2

(d) CFE Results for McAllen – Reynosa Area

Reynosa has one interconnection between the CFE and ERCOT electric systems. From the Cumbres substation to the border, CFE has a double circuit 400 kV transmission line with one circuit operating at 138 kV. This circuit connects to a single 138 kV transmission line from the border to the Frontera Generation power plant.

Under maximum demand operation in 2005, the study reveals that CFE can export up to 215 MW and would require 7.5 MVAR of reactive support in both Cumbres and Jarachina substations. CFE could export up to 300 MW for average and minimum demand operations.

The studies show the maximum import from CFE electric system will be 300 MW for both 2005 and 2008. In 2008, under maximum demand operation, CFE can export up to 110 MW and would require reactive support of 7.5 MVAR in the 138 kV Cumbres and the Jarachina substations. In 2008, under the average and minimum demand operations, CFE could export 295 MW to the ERCOT system.

For the year 2008, a new interconnection is proposed with a single 795 ACSS 138 kV circuit between South McAllen substation and a new Anzalduas Maniobras substation that CFE is going to build as part of the same project.

With this option, CFE could import 225 MW during maximum demand periods, 205 MW during average demand periods, and 190 MW during minimum demand periods. In order to import 320 MW for any operating condition, it will be necessary to change conductors on the transmission line between Reynosa-Anzalduas and Anzalduas-Anzalduas Maniobras to 795 ACSS.

The values for exports are 160 MW during maximum demand periods, 270 MW during average demand periods, and 295 MW during minimum demand periods. To accommodate these exports, the installation of reactive capacity of two 7.5 MVAR at each of the Petrolera and Piolet 138 kV substations will be required.

(e) ERCOT Results for the Laredo – Nuevo Laredo Area

The Laredo area transmission system is capable of serving up to 450 MW of load with no local generation in-service. The peak load in 2003 reached 408 MW and the area has an annual load growth of 4%. There is an existing 138 kV transmission line connecting the AEP-TCC Laredo Power Plant 138 kV substation to the CFE 230/138 kV Industrial substation. The 138 kV transmission line is currently capable of 150 MW at 100% of the normal rating. The possible location for a HVDC tie is in the existing interconnection between AEP-TCC and CFE, which is shown below in Figure K.

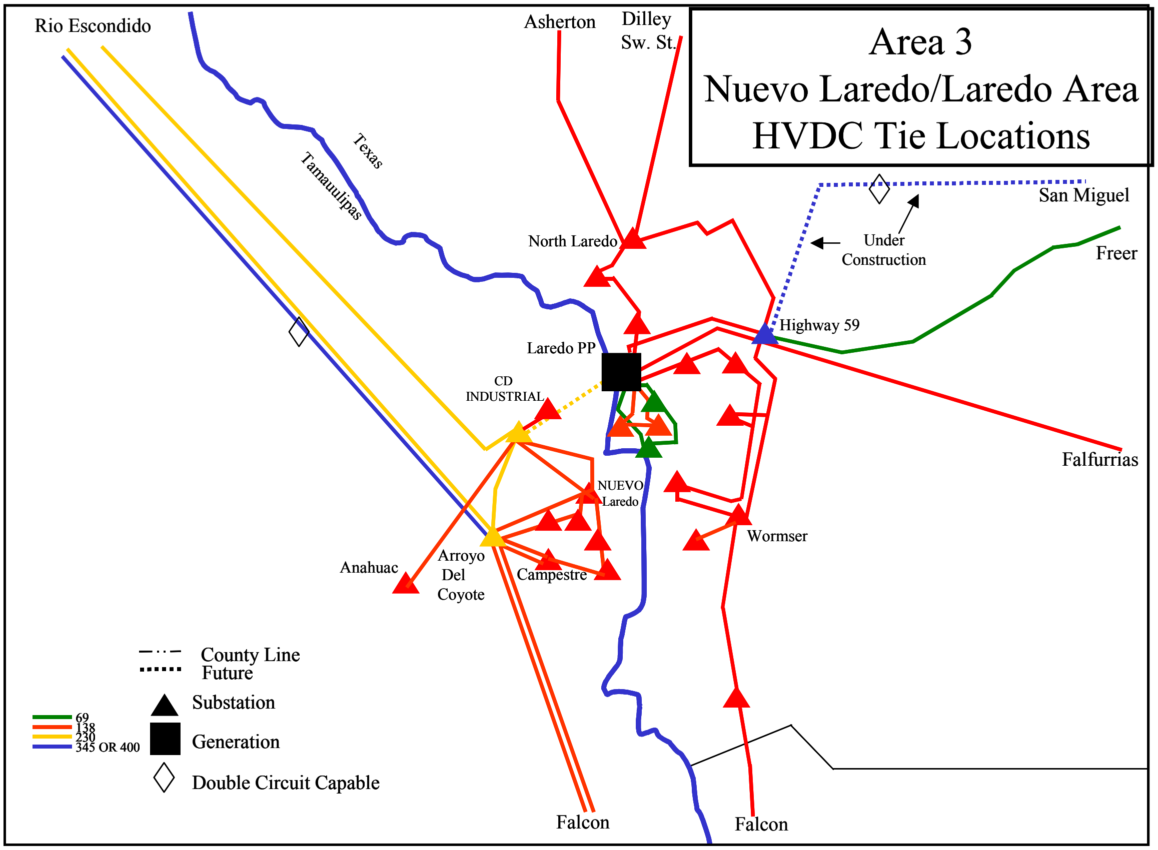


Figure K. Possible HVDC Tie Locations between CFE and ERCOT - Area 3

If a HVDC tie were constructed at this location, the .2 miles of line on the ERCOT side would be reconductored to 795 ACSR and the CFE side could be connected at either 138 kV or 230 kV. The Laredo area has 0 MW transfer capability from ERCOT to CFE for peak and off peak load conditions and can only supply emergency and backup power to CFE. The Laredo area can support up to 450 MW of transfers from CFE to ERCOT for both peak and off peak conditions. Significant transmission improvements are currently under review for the Laredo area that will increase transfer capability from ERCOT to CFE. These improvements are also discussed in further detail in Chapter 7. The combined CFE and ERCOT transfer limits for 2005 and 2008 are shown in Tables 6.1 through 6.4 for the existing 138 kV interconnection and in Tables 6.5 through 6.8 for a new 230 kV interconnection, and maps of the 2005 and 2008 CFE/ERCOT system are shown in Figures L and M.

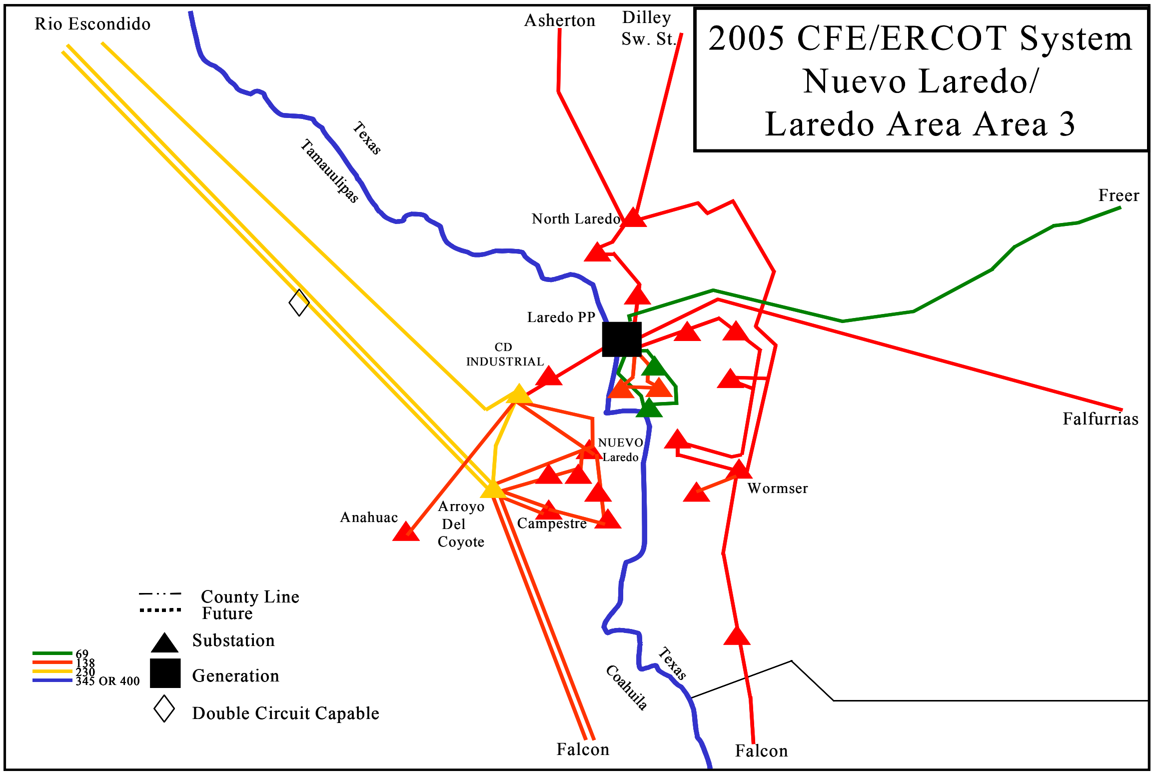


Figure L. CFE/ERCOT 2005 System - Area 3

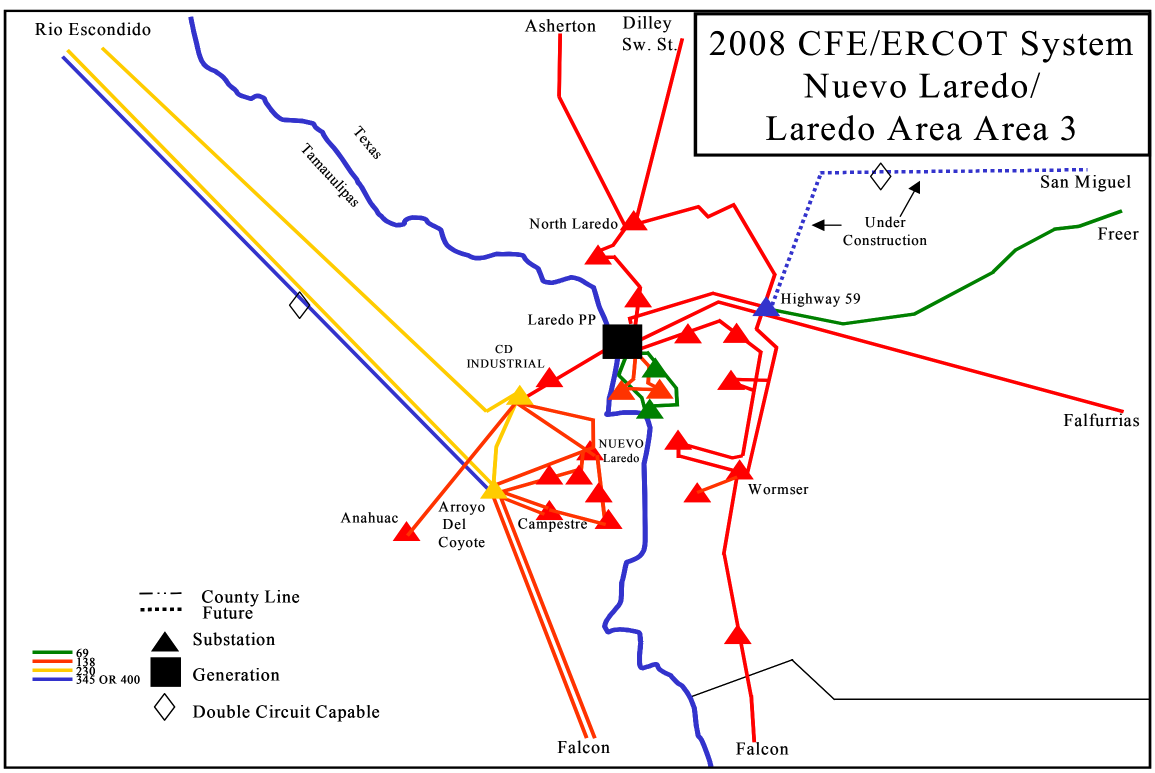


Figure M. CFE/ERCOT 2008 System - Area 3

(f) CFE Results for the Laredo – Nuevo Laredo Area

In this area there is an interconnection between the CFE and the AEP-TCC electric system at 138 kV between Ciudad Industrial and Laredo substations.

The studies show that for 2005 CFE could import up to 300 MW if the conductor is changed from ACSR to ACSS. For 2008, the studies show that the maximum value to import under the demands of the maximum, average, and minimum operating conditions is 300 MW.

For export from CFE to ERCOT reactive support of 7.5 MVAR will be required in the Ciudad Industrial substation (138 kV, 7.5 MVAR) and in the Arroyo del Coyote substation (138 kV, 2 x 7.5 MVAR).

(g) ERCOT Results for the Eagle Pass/Del Rio - Piedras Negras/Acuña Area

The Eagle Pass and Piedras Negras area has an existing 36 MW HVDC tie located at the AEP-TCC Eagle Pass substation. The HVDC facility was installed to provide voltage support and emergency power to the 50 MW Eagle Pass load for loss of one of the two 138 kV transmission lines into Eagle Pass. The switching arrangement was designed to maintain the ability to block load for emergencies. The study identified a second possible 138 kV interconnection between Del Rio, Texas and Acuña, Coahuila. Both locations are shown below in Figure N.

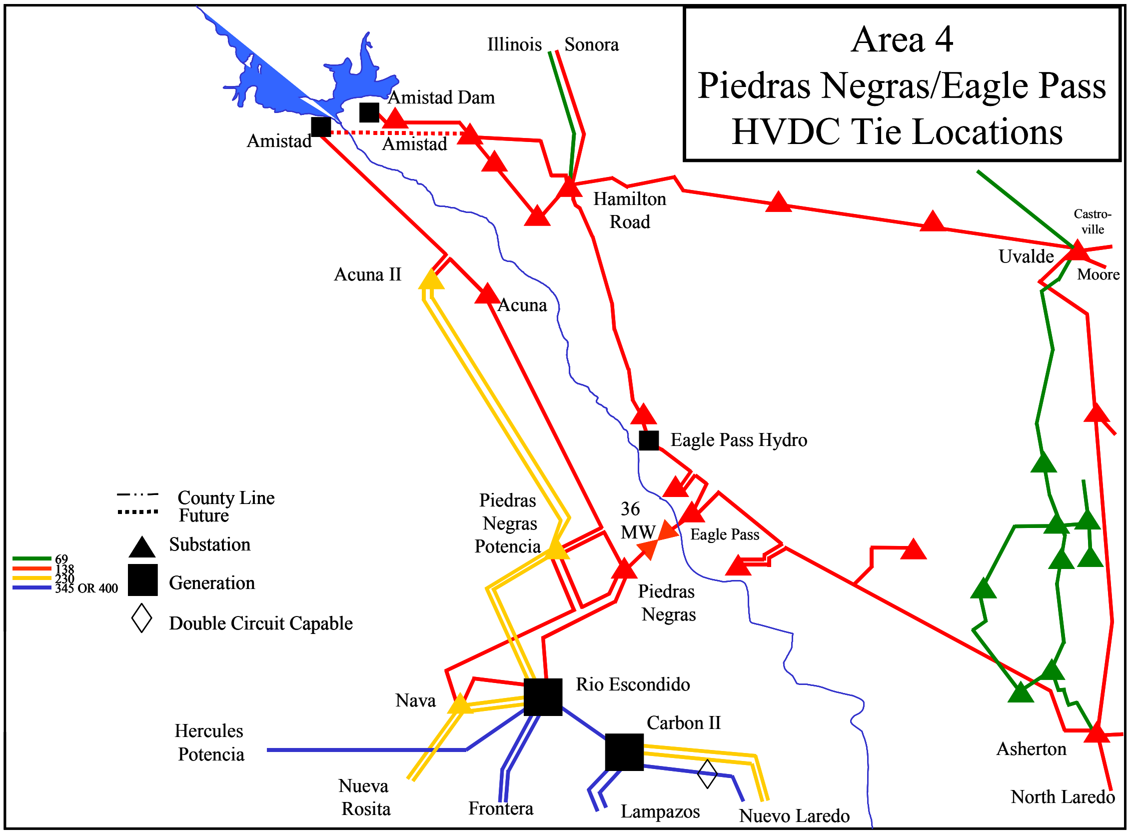


Figure N. Possible HVDC Tie Locations between CFE and ERCOT - Area 4

In 2005, the Eagle Pass area has 0 MW transfer capability from ERCOT to CFE at peak load conditions, but can supply emergency backup power with both 138 kV transmission lines into Eagle Pass in-service. Loss of either 138 kV transmission line causes low voltage at Eagle Pass and the BTB-HVDC Tie will automatically and instantaneously provide reactive support sacrificing the power transfer. The limiting element is the Asherton to Eagle Pass 138 kV transmission line for the contingency outage of the Eagle Pass to Hamilton Road 138 kV transmission line. Imports into Eagle Pass from CFE are limited to 35 MW due to over voltage conditions in the area. There are planned transmission line improvements for the Eagle Pass and Del Rio areas, which will not be completed until 2008. Unless significant transmission improvements are completed into Eagle Pass, this 138 kV interconnection will not be capable of supporting greater transfers in either direction.

The Del Rio area is supported by three 138 kV transmission lines and is a possible location for a new 138 kV transmission interconnection. There is an existing 12.47 kV distribution circuit crossing the border from the AEP-TCC Amistad substation. Plans are under review to convert this to 34.5 kV to provide up to 30 MW of emergency support to either the ERCOT or CFE systems in 2004. In 2005 the interconnection would be converted to 138 kV to coincide with the start of the rebuild of the Asherton to Eagle Pass and the Hamilton Road to Uvalde 138 kV transmission lines. AEP-TCC will require emergency backup support during the construction of these transmission lines, which will be completed by 2008. Del Rio has 0 MW transfer capability for peak and off peak transfers from ERCOT to CFE. Emergency transfers to CFE can occur only if all three 138 kV transmission line are in-service. Loss of any 138 kV transmission line will require terminating the transfer. The area is capable of receiving up to 80 MW of import from CFE during peak and off peak conditions. The combined CFE and ERCOT transfer limits for 2005 and 2008 are shown in Tables 6.5 through 6.8 and maps of the 2005 and 2008 CFE/ERCOT system are shown in Figures O and P.

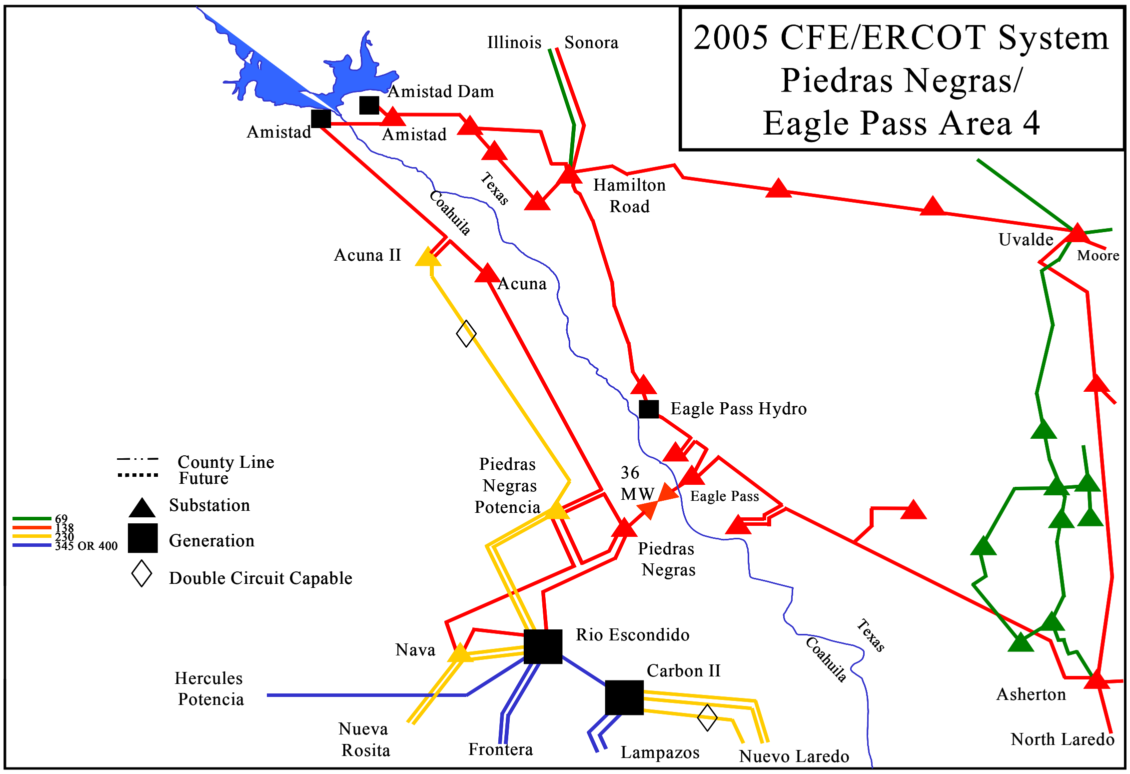


Figure O. CFE/ERCOT 2005 System - Area 4

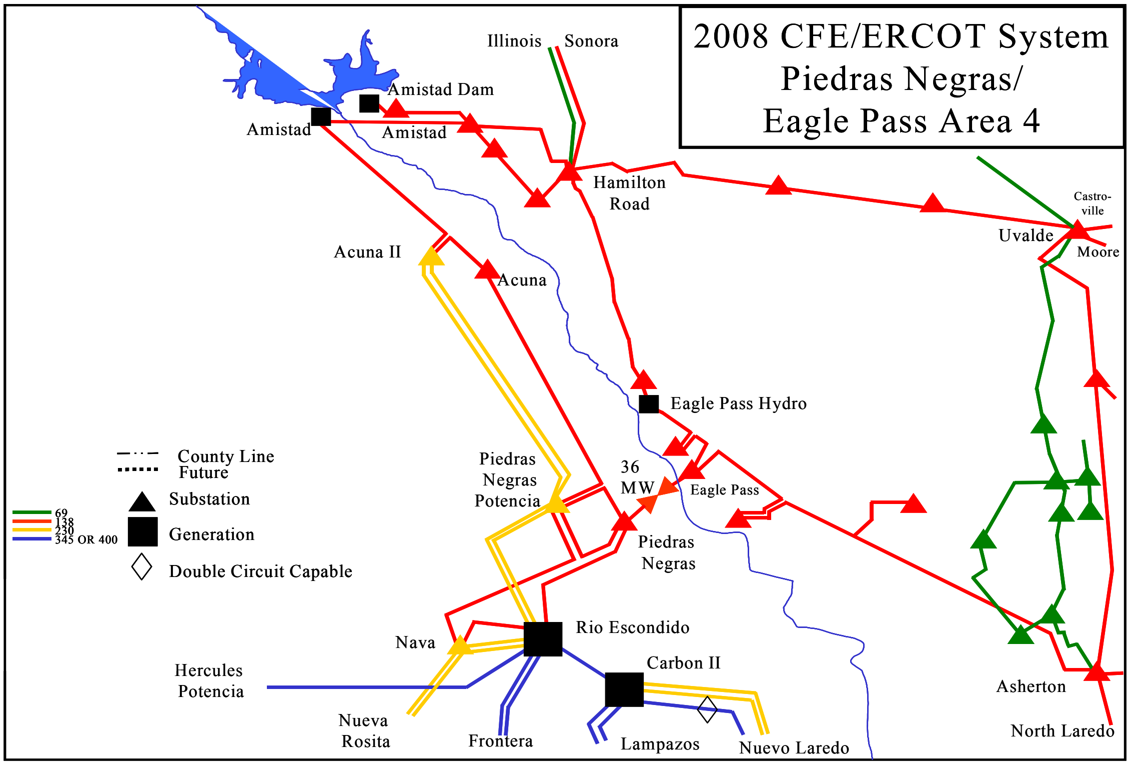


Figure P. CFE/ERCOT 2008 System - Area 4

(h) CFE Results for the Eagle Pass/Del Rio - Piedras Negras/Acuña Area

The electric demand of the area is served from the Rio Escondido 2 x 100 MVA 230/138 kV and Nava 2 x 40 MVA 230/138 kV substations.

By 2005, in the mid-term transmission plan of CFE, Piedras Negras Potencia substation should be in operation and will allow an increase in the transformation capacity of the area and a double circuit transmission line insulated at 230 kV but initially operating at 138 kV between the Piedras Negras Potencia and Acuña substations. For the short term, the studies considered the building of a new interconnection between the CFE and the AEP-TCC electric systems at 138 kV between Acuña and Del Rio substations.

The studies show that for 2005 CFE could import under maximum, average, and minimum demand operating conditions: 80, 150, and 200 MW, respectively. Export capabilities in this same year under maximum, average, and minimum demand operating conditions would be 100, 120, and 130 MW, respectively.

For exports from CFE to ERCOT, reactive support of 7.5 MVAR in Acuña (138 kV, 7.5 MVAR) and in Piedras Negras Potencia (138 kV, 2 x 7.5 MVAR) substations would be necessary.

For 2008, the studies show that CFE could import under maximum, average, and minimum demand operating conditions: 150, 200, and 230 MW, respectively. Export capabilities in this same year under maximum, average, and minimum demand operating conditions would be 90, 100, and 110 MW, respectively.

For exports from CFE to ERCOT, reactive support of 7.5 MVAR would be required in the Acuña (138 kV, 2x 7.5 MVAR) and Piedras Negras Potencia (138 kV, 7.5 MVAR) substations.

In the Amistad substation, CFE has a 12.5 MVA, 34.5/138 kV transformer and 138 kV transmission lines to Acuña II and 34.5 kV to Parque Industrial Amistad. The 34.5 kV line is approximately 20 km.

(i) ERCOT Results for the Falcon – Presa Falcon Area

The Falcon area is served by two 138 kV transmission lines and is located in a weak part of the AEP-TCC transmission system. There are no future transmission improvements planned for this area that would allow increased transfers from ERCOT to CFE during peak load conditions. Transmission improvements that are planned for the area would provide some transfer capability during off peak load conditions. The existing normally open 138 kV interconnection will continue to be utilized for emergency and backup power transfers. Until additional 345 kV transmission lines are constructed to the Valley, the Falcon 138 kV interconnection will not be capable of supporting significant power transfers in either direction. The combined CFE and ERCOT transfer limits for 2005 and 2008 are shown in Tables 6.1 through 6.4 and maps of the 2005 and 2008 CFE/ERCOT system are shown in Figures Q and R.

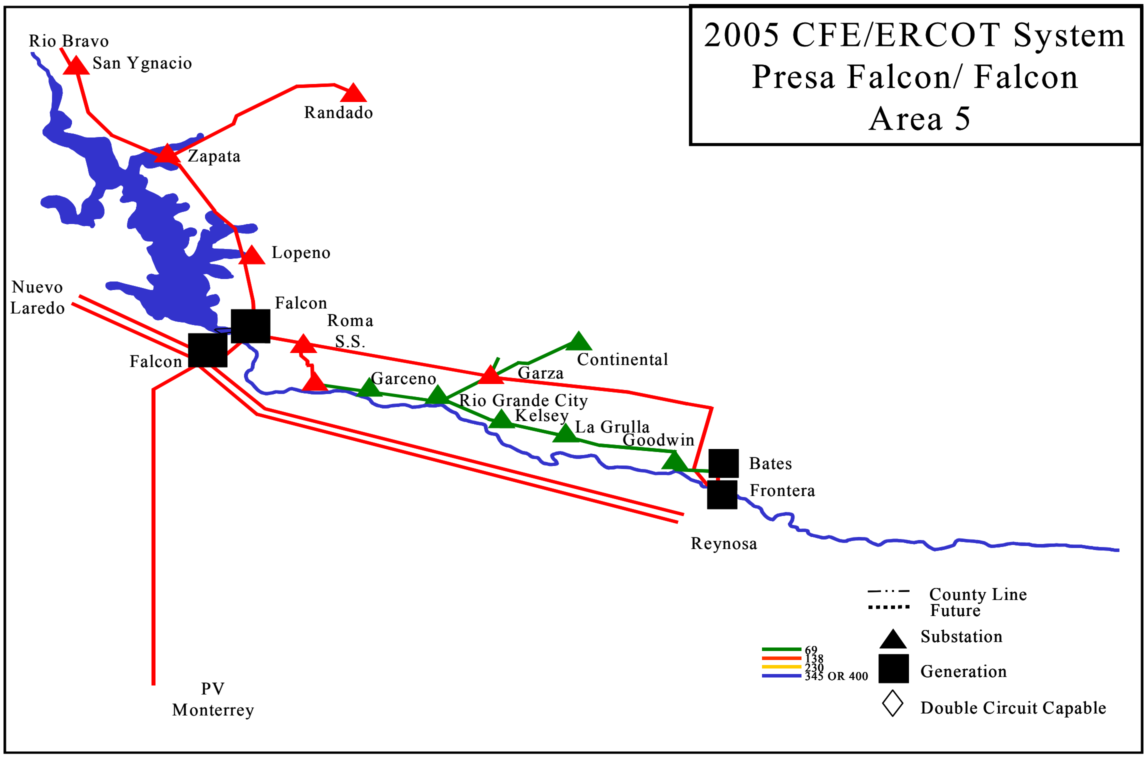


Figure Q. CFE/ERCOT 2005 System - Area 5

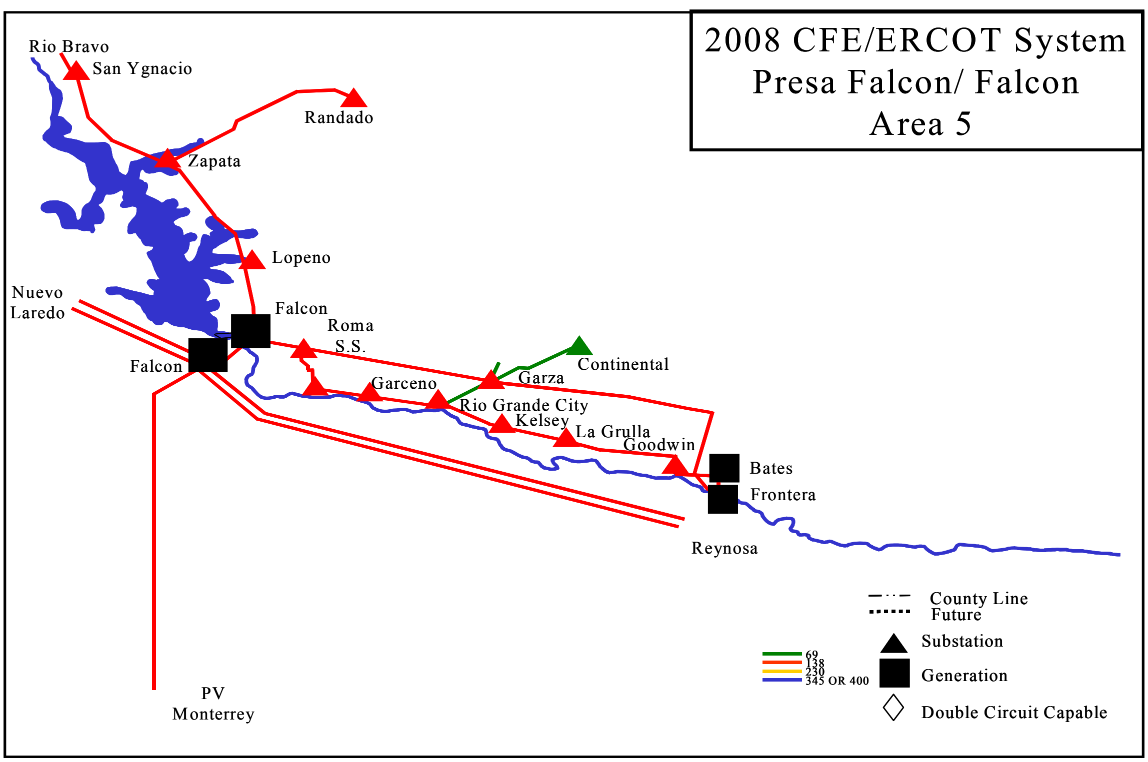


Figure R. CFE/ERCOT 2008 System - Area 5

(j) CFE Results for the Falcon – Presa Falcon Area

The studies of the CFE grid did not identify any additions to the transmission system in the area that would enable incremental bi-directional transactions between the CFE and ERCOT systems.

(k) ERCOT Results for the Presidio and Ojinaga Area

The Presidio – Ojinaga interconnection is an existing normally open 12.47 kV distribution interconnection used for emergency and backup power transfers. A 70 mile 69 kV transmission line serves Presidio and can support up to 10 MW of load. There are no transmission improvements planned in the immediate future unless there is significant load growth in Presidio or the local area. This location could support a 10 MW HVDC tie using Back-to-Back Voltage Sourced Converters to supply dynamic voltage support automatically and instantaneously. The combined CFE and ERCOT transfer limits between Presidio and Ojinaga for 2005 and 2008 are shown in Tables 6.1 through 6.4 and maps of the 2005 and 2008 CFE/ERCOT system are shown in Figures S and T.

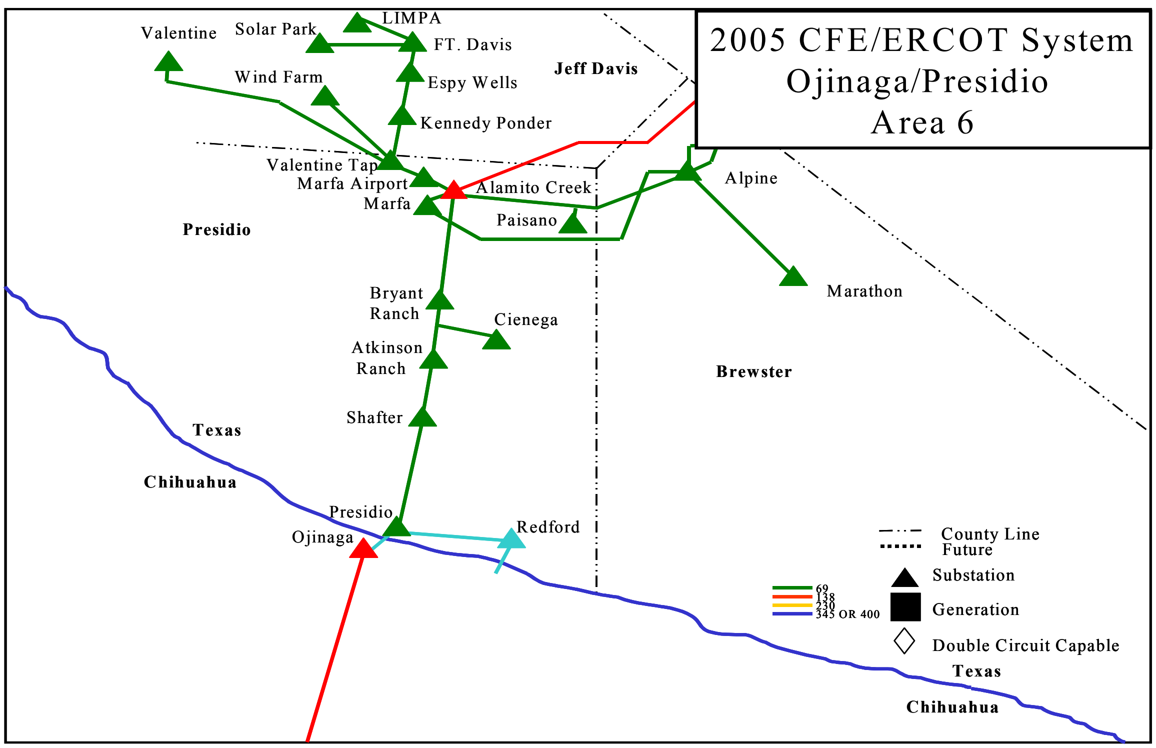


Figure S. CFE/ERCOT 2005 System - Area 6

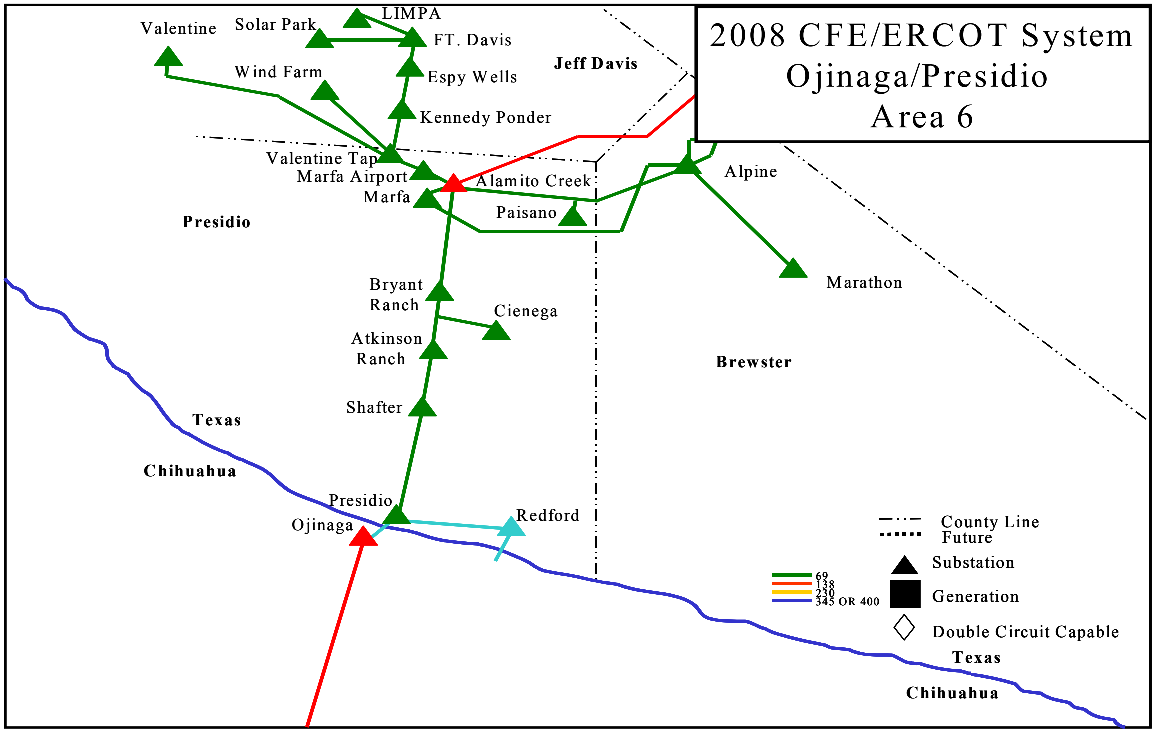


Figure T. CFE/ERCOT 2008 System - Area 6

(I) CFE Results for the Presidio and Ojinaga Area

The studies of the CFE transmission system, found no transmission additions in the area that could increment the bidirectional transactions between CFE and ERCOT systems.

Chapter 7. Potential Long-Term CFE/ERCOT Interconnections

(a) Future Locations for New or Expanded Interconnections

Four interconnections between the CFE and ERCOT systems exist today. The capacity for emergency assistance in both directions has been studied during different times of the year. The existing interconnections and their capacities are listed in Table 4.1.

The industrial, commercial and residential electrical demand on both sides of the border can benefit from services and energy transactions under the following:

- Emergency assistance
- Share and minimize reserves
- Bilateral purchases and sales
- Spot market purchases and sales

As part of the ERCOT expansion and planning process, 345 kV lines will be built parallel to the border between Nuevo Laredo and Reynosa. The enhancements to the existing CFE system will allow back-to-back converters to be built in Rio Escondido, Nuevo Laredo, and Reynosa, which in turn allows interconnections between the CFE 400 kV system and the ERCOT 345 kV system. When completed, these transmission improvements will allow significant transactions in both directions. Phase II of the interconnection studies will identify such potential.

The electric infrastructure and the electric demand growth of CFE will justify the future construction of a DC interconnection from the northern to the central and western part of Mexico. As an example, a transmission line from Aeropuerto at Reynosa, Tamaulipas, to the El Potosi substation in San Luis Potosi (approximately 400 km) and on could be built continuing with an AC interconnection from this substation to Queretaro Potencia substation or a DC interconnection from Aeropuerto and Queretaro Potencia (approximately 650 km).

(b) Study Process for Inter-Regional Power Transfer Analysis

In order to fully analyze the impact of large-scale interconnections between CFE and ERCOT, not only do the transmission systems along the border require consideration, but also the bulk transmission infrastructures within the CFE and ERCOT grids must be tested to determine transfer limitations. Multiple steps of analysis are required to determine the viability of power transfers between the electric grids. The following is an outline of the basic process.

- Planning/Engineering/Operations input used to derive viable interconnection alternatives
- Generation and Transmission scenarios selected to demonstrate load carrying capability of power system
- Development of reactive plan intended to maximize transfer capability of existing transmission system
- Voltage collapse analysis to determine maximum load level sustained for each scenario

- Identification of voltage collapse root cause with dynamic stability analysis and determination of dynamic reactive requirements
- Power Flow analysis of scenarios for all NERC Criteria Category B contingencies to determine constraints due to overload and representative NERC Criteria category C&D contingencies to identify exposure to cascading outages
- Estimation and scheduling of proposed transmission alternatives

This process should determine the stressed elements of the power system and transfer limitations as a result of voltage and dynamic stability limits. The measure of the capacity of each interconnection will be the smaller of the local or bulk limitations. If cost effective system upgrades are identified that would significantly enhanced transfer capability, further analysis incorporating the upgrades will be considered.

The end product of the study is a report that quantifies the location and size of bulk asynchronous interconnections that can effectively be supported. Should these results imply that multiple synchronous interconnections would be as practical as individual asynchronous interconnections; follow-up analysis of AC tie lines will be considered.

Chapter 8. CFE/ERCOT Interconnection Applications

As discussed in the purpose and goals of this report, new and existing transmission interconnections between CFE and ERCOT have both economic and reliability applications. Reliability applications include Block Load Transfers (BLTs) over synchronous (AC) connections and emergency energy transfers over Asynchronous (DC) connections. An additional reliability application described in this section is the purchase of blocks of energy during peak conditions described in the non-Emergency support over DC ties. Economic applications include the ability to sell or buy energy from ERCOT or CFE in accordance with the tariff and protocols provisions in each region.

(a) Asynchronous Interconnection Emergency Support

HVDC ties between México and Texas can provide an opportunity for mutually-beneficial emergency assistance arrangements including energy, capacity, and voltage support to enhance the reliability of the systems operated by CFE and ERCOT. During emergency periods, CFE and ERCOT can quickly coordinate energy transfers over these HVDC ties.

Ordinarily when a generating unit is operated to maintain transmission security, it must be placed on-line a day in advance of anticipated transmission facility overloads under contingency that would result for the forecasted peak load. Further, the hourly generation schedule must anticipate the power output level necessary to relieve overloads within 15 minutes based on ramp rate of the unit. Due to the rapid ramp rate generally possible with an asynchronous interconnection, the ties may remain with zero energy transfers until continuous rating of a transmission facility is reached or the anticipated contingency overload of a transmission facility exceeds the 15 minute emergency rating. This operational characteristic of an asynchronous interconnection avoids the costly operation of inefficient generation by dispatching an asynchronous interconnection as part of a Remedial Action Plan (RAP) at the direction of the system operator upon alarm of a post contingency overload. Instructions can be executed remotely and the emergency energy ramped within the 15-minute window prescribed in the operating criteria.

Unlike generation, which could be unavailable for extended periods of time due to the complexity and availability characteristics of its components, an asynchronous interconnection can maintain adequate spares to facilitate timely recovery from component failures. For this reason ERCOT has adopted transmission planning criteria, which require that transmission facilities remain within emergency thermal and equipment voltage limits for expected generation patterns under contingency loss of a single power system element with any single generator unavailable. As such, two generators of a comparable size to a single asynchronous interconnection would be required in order to maintain the same level of compliance offered by the asynchronous interconnection.

(b) Asynchronous Interconnection Peak Load Support

When continuous ratings of a transmission facility are reached or overloads are anticipated to go beyond the 15 minute rating of a transmission facility, an asynchronous interconnection may be operated preemptively to displace load and relieve the loading condition. Peak load support is typically provided by local generation in areas where transmission lines do not have sufficient capacity to transfer power and serve the load from remote generation.

In the case of the growing energy demand in Laredo, transmission lines from the other regions of south Texas are not designed to fully and reliably serve the anticipated peak demands in the city and surroundings of Laredo. This is one reason for the need for RMR services from the Laredo Generation station during heavy demand periods. The cost associated with maintaining such services include the capacity, start-up, fuel and maintenance of the generation plant. Given the cost of running an older gas plant, generation from México that can be provided through an asynchronous interconnection may be a more cost-effective source of power for peak load support.

Incremental transmission line additions carrying power into Laredo will require a lengthy regulatory, land right-of-way acquisition and line construction schedule. An asynchronous tie in Laredo with the appropriate peak load support agreement can eliminate the need for RMR services from the Laredo Generation station while transmission additions are made. Based on the load forecast for the Laredo area and the import capability of the lines into the area, a tie with power transfer capacity of 100 MW can serve the peak load needs of Laredo through the year 2008. A larger tie can defer further the need for a transmission line addition. The asynchronous interconnection must be sized to meet both the preemptive requirements and, additionally, the post contingency power injection required by the RAP under contingency conditions.

(c) Asynchronous Interconnection Commercial Transactions

To the extent system reliability is not affected, purchases and sales of capacity and energy can be made over asynchronous ties. Commercial transactions may include the following:

- Sales from CFE to a Load Serving Entity (LSE) in ERCOT where the LSE can be a Retail Electric Provider (REP) or a Non Opt-in Entity (NOIE)
- Sales from CFE to a Qualified Scheduling Entity (QSE) in ERCOT where the QSE uses the CFE transfer to meet its load schedule requirements
- Sales from CFE to an SPP region market participant where ERCOT serves as the wheeling service provider
- Purchases by CFE from Resource Owners, QSEs or SPP market participants.

The scheduling and commercial settlements of any of the above transactions need to be made through a QSE certified in the ERCOT market. Based on the technical findings in this report, purchases by CFE will be significantly limited to off-peak conditions or when supported by local generation in Laredo and the Rio Grande Valley.

(d) Synchronous Interconnection Block Load Transfer

The purpose of block load transfers (BLTs) is to provide for load relief by transferring load normally in ERCOT to a non-ERCOT control area or transferring loads normally in non-ERCOT control areas to the ERCOT control area, in order to avoid curtailment during emergency periods. While BLTs have been used during emergency conditions at CFE and ERCOT, they have significant drawbacks. First, a BLT requires an outage of the load being transferred. In other words, each transmission operator must subject the customers being connected to the neighboring grid to a temporary loss of service in order to perform the required switching operations. Second, the coordination and physical operation are manually performed. Consequently, the time required to execute and complete such load transfer can be problematic to the operators in both regions.

For these reasons, BLTs have only been designed and executed in extreme emergency conditions. The planning criteria for both CFE and ERCOT do not provide for the use of BLTs, and therefore are not used in the options for emergency services for long-term planning purposes.

<u>ERCOT Load Transferred to CFE</u>

I. ERCOT System Emergency

In the event ERCOT has issued an Advisory or Alert, ERCOT will notify the AEP Transmission Operator (TO) to make preparations with CFE to implement a plan for possible transfer of load from ERCOT to CFE. CFE shall determine the amount of load that can be transferred. The AEP TO and CFE will coordinate plans for the transfer and determine when it is appropriate to have personnel standing by to perform the switching. The AEP TO shall notify ERCOT that preparations have been made with CFE and the amount of load the CFE transmission grid is capable of supporting. Once an ERCOT Emergency Notice has been issued, a conference call between the TO, CFE, and ERCOT shall take place to coordinate the transfer of load from ERCOT to CFE. The actual switching shall not take place until mutually agreed upon by the three parties.

> When CFE load is already connected to ERCOT, the AEP TO and CFE shall make the appropriate arrangements to transfer this load back to the CFE transmission grid. CFE shall determine if any ERCOT load can be transferred in addition to the CFE load.
>
> CFE load being served by ERCOT may be load shed after all attempts have been made by ERCOT to increase generation and trip interruptible loads to stabilize the transmission grid in the event of an emergency.

II. Local ERCOT Area Emergency

In the event the AEP TO has a localized problem on the transmission grid that prevents it from reliably serving the load, ERCOT and the AEP TO shall define the support requirements and at the same time begin to make arrangements with CFE for the transfer of load to the CFE transmission grid. The AEP TO shall notify CFE that it needs to transfer load and CFE shall determine the amount of load they can support. The AEP TO, CFE, and ERCOT will coordinate plans for the transfer and determine when it is appropriate to have personnel standing by to perform the switching. The actual switching will not take place until mutually agreed upon by the three parties. The TO will notify ERCOT on the arrangements made with CFE so that the appropriate QSEs can be notified.

When CFE load is already connected to ERCOT, the TO and CFE shall make the appropriate arrangements to transfer this load back to the CFE transmission grid. CFE shall determine if any ERCOT load can be transferred in addition to the CFE load. The AEP TO and CFE will coordinate plans for the transfer and determine when it is appropriate to have personnel standing by to perform the switching.

CFE load being served by ERCOT may be load shed after all attempts have been made by ERCOT to increase generation and trip interruptible loads to stabilize the transmission grid in the event of an emergency.

<u>CFE Load Transferred to ERCOT</u>

In the event CFE requires assistance, CFE will notify the AEP TO and QSE that it wants to transfer load from the CFE transmission grid to the ERCOT transmission grid or how much power CFE would need from the local DC tie to support the local load needs. CFE shall make arrangements with their QSE for the generation and then coordinate with the AEP TO for the load transfer or the load being served across the DC tie. ERCOT and the AEP TO shall determine the maximum amount of load that the ERCOT transmission grid can support and then communicate this amount to CFE. The AEP TO and CFE shall determine when it is appropriate to have personnel standing by to perform the switching. Once CFE has determined they want to proceed, CFE shall notify the AEP TO and the AEP TO will place a conference call with ERCOT to notify them that all the preparations have been made for the load transfer. The actual switching shall not take place until mutually agreed upon by the three parties.

When ERCOT load is already connected to CFE, the AEP TO and CFE shall make the appropriate arrangements to transfer this load back to the ERCOT transmission grid. The AEP TO shall determine if any CFE load can be transferred in addition to the ERCOT load.

ERCOT load connected to the CFE transmission grid will be the first load shed followed by load served by CFE if required to stabilize the transmission grid in the event of an emergency.

AEP TO and CFE shall monitor their respective transmission grids and provide as early warning as possible of system conditions that could occur which will force the transfer of load back to the system that normally serves that load. Every effort should be made to minimize the impact of the BLT to the load entities. This includes the time of day and the duration of the outage the load entities will experience when transferring from one transmission grid to the other transmission grid.

ERCOT load should only be transferred to the CFE transmission grid when ERCOT deems it necessary due to possible emergency conditions. This applies to load only and does not limit the transfer of generation from the ERCOT transmission grid to the CFE transmission grid as long as it does not affect ERCOT load.

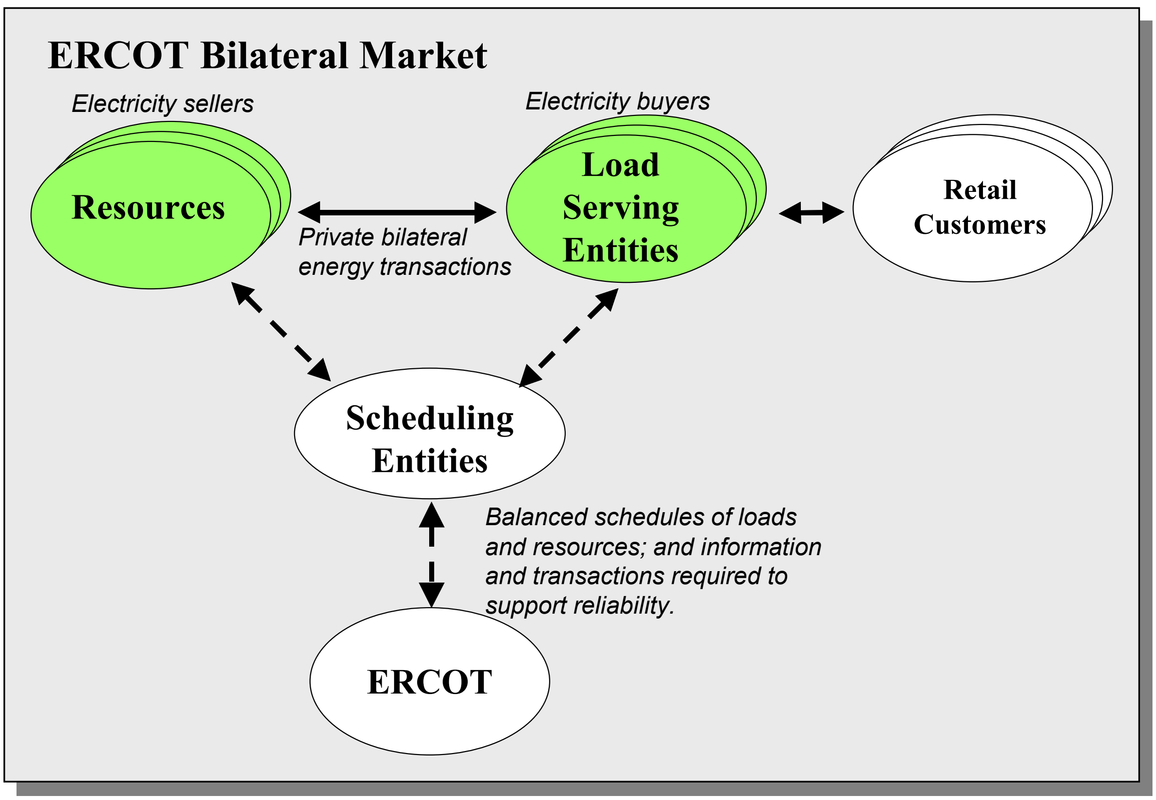
<u>Reactive Requirements</u>

Load transferred to either the CFE or ERCOT grids shall meet reactive and capacitive support requirements as provided in the ERCOT operating guidelines and CFE operating guidelines.

Chapter 9. Power Transfer Procedures across CFE/ERCOT Interconnections

(a) ERCOT Bilateral and Spot Market Sales

The ERCOT competitive retail electricity market is based on "bilateral" transactions between buyers and sellers of energy, as shown in the diagram below. Scheduling Entities provide ERCOT with balanced energy and load schedules that account for a large percentage of the requirements necessary to serve the load. The balanced schedules are a result of bilateral trades between load and resource entities. ERCOT administers a real time electricity market needed to compensate for energy imbalances that result from schedule imbalances as well as differences between the real time system requirements and the requirements anticipated in forward schedules.



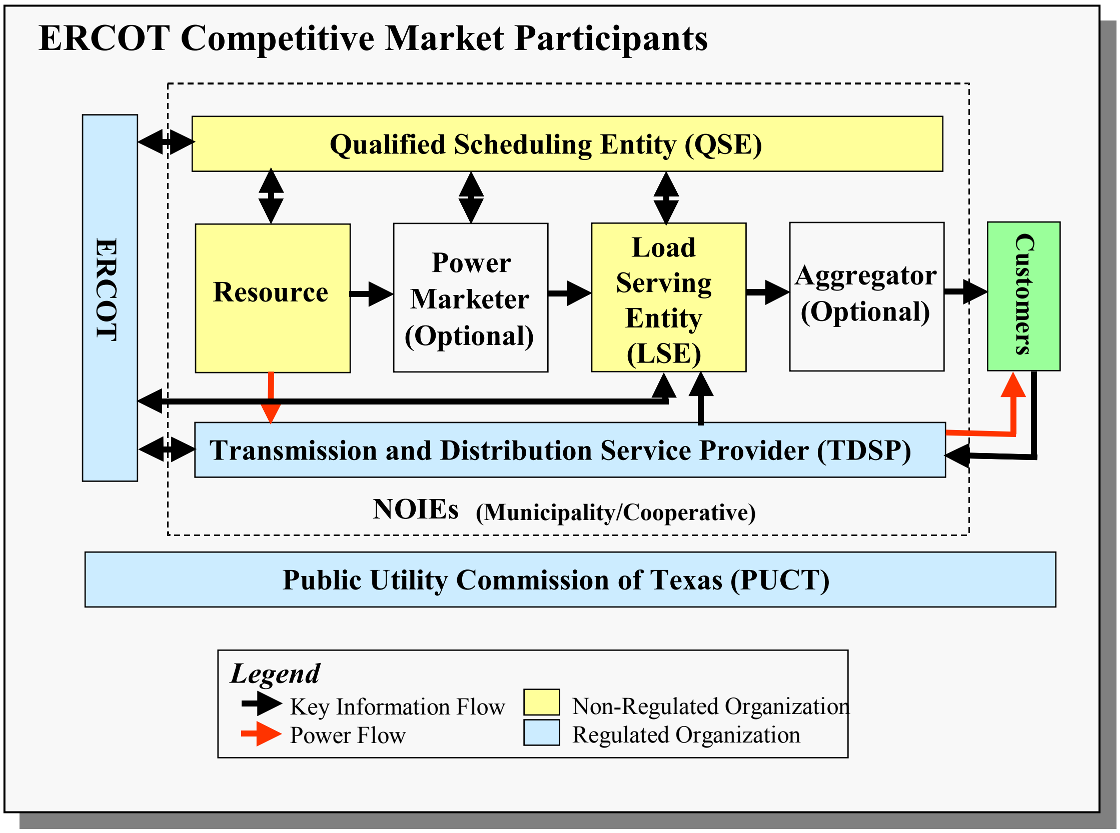
Load Serving Entities buying energy, and Resources selling energy communicate operational information such as their bilaterally arranged balanced schedules of loads and resources to ERCOT through their Qualified Scheduling Entities (QSEs). ERCOT ensures that the power grid can accommodate the schedules that were generated by the bilateral market.[3]

ERCOT makes an assessment of the ancillary services needed to accommodate the bilateral schedules including those ancillary services needed to resolve system conditions like capacity

[3] A likely exception to this protocol may apply to schedules out of Texas into México where the QSE may have to arrange for the generation needed from units near the border in order to support such schedules.

inadequacy and congestion, in order to maintain reliability. The scheduling entities are required to either provide their share of these services from their own resources or have ERCOT purchase these services from the market on their behalf. Market Participants may self provide all or part of their share of ancillary services.

The next diagram illustrates the principal market participant relationships in the ERCOT region competitive retail market. A description of these market participants follows.



Qualified Scheduling Entities (QSE) play a key role in the competitive retail market. From a market operations perspective, QSEs provide the main information interface with ERCOT. For example, market participant scheduling of energy or bidding for ancillary services must be done by a QSE. ERCOT provides instructions to the QSEs, including regulation signals, balancing instructions, and accepted bid information. QSEs relay the instructions to the appropriate market participants, as required.

The financial settlement for balancing energy and ancillary services (including emergency power) that were used by ERCOT is handled between the QSE and ERCOT. Settlement of the balancing energy is based on individual QSE load imbalance and resource imbalance. The load imbalance is the difference between each QSE's scheduled load and actual load. Resource imbalance is the difference between each QSE's scheduled energy and actual energy. The actual load and energy amounts are derived from the load and resource meter readings. For example, when a QSE's actual energy supplied from its resources is insufficient to match the scheduled energy in the balanced schedule it provided to ERCOT, that QSE is required to reimburse ERCOT for the balancing energy ERCOT procured, at the Market Clearing Price. On the other hand, if ERCOT accepts a balancing energy bid by a QSE from the ancillary services market, ERCOT pays the QSE as appropriate at the Market Clearing Price.

ERCOT arranges with a QSE to procure ancillary services through a series of markets and deploys them as needed to ensure system reliability. If the submitted schedules ultimately result in congestion of the transmission system and ERCOT redispatches the system resources to resolve the congestion, market participants pay for the redispatching or congestion costs.

In order to settle with a QSE, ERCOT aggregates load and resource data for every settlement interval. ERCOT then calculates the load imbalance as the difference between the scheduled and aggregated load data to issue the appropriate credits and/or debits to the QSE. The same comparison is made between aggregated energy supplied from the resources provided by the QSE and the scheduled energy to allocate the appropriate debits and/or credits due to the resource imbalance.

ERCOT also works with Transmission and Distribution Service Providers (TDSP), or wire companies, to manage the transmission system. A TDSP is responsible for reviewing and executing physical dispatch instructions provided by ERCOT. For example, AEP controls the East HVDC Tie and the North HVDC Tie via its EMS Interchange Scheduling System. AEP's control system sends ramping control signals to the HVDC Tie based on the energy profiles provided by the control area operators.

Resources are the only entities that can own generation or loads that can act as resources. They negotiate privately with other market participants to sell their energy, and communicate the resulting schedules to ERCOT through their QSE.

Load Serving Entities (LSE) represent either Competitive Retailers (CR) which are the only organizations authorized to sell electricity directly to retail customers who have customer choice or Non Opt-in entities which include Munis and Co-Ops where retail choice is not in place.

Other Participants may also operate in the ERCOT market. Power Marketers, who buy and sell blocks of energy, schedule that power with ERCOT through a QSE. Aggregators that acquire groups of retail customers may also operate in this market. The PUCT oversees the entire market, including customer participation matters, and monitors market activity to deal with market abuses and gaming.

(b) Transmission Service in ERCOT

Open access to the transmission grid in ERCOT is provided to all eligible transmission service customers in accordance with the ERCOT Protocols and the PUCT Substantive Rules, Chapter 25, Subchapter I, Transmission and Distribution. Transmission service standards described in this subchapter also apply to transmission service to, from, and over the direct-current interconnections between ERCOT and areas outside of ERCOT to the extent included in a Transmission Service Provider's (TSP) tariff. A Qualified Scheduling Entity (QSE) is required to administer and schedule transactions requiring transmission service.

Transmission service allows transmission service customers to deliver energy from resources to serve load obligations, using the Transmission Facilities of all of the Transmission Service Providers (TSPs) in ERCOT. ERCOT ensures the scheduling of energy and ancillary services into, out of or through the ERCOT transmission grid on behalf of all transmission service customers subject to the provisions in the ERCOT Protocols.

Section 2 of the ERCOT Protocols, which is generally consistent with PUCT Substantive Rule § 25.192 (c) (1), defines Transmission Facilities as follows:

(1) Power lines, substation, and associated Facilities, operated at 60 kV or above, including radial lines operated at or above 60 kV.

(2) Substation Facilities on the high side of the transformer, in a substation where power is transformed from a voltage higher than 60 kV to a voltage lower than 60 kV or is transformed from a voltage lower than 60 kV to a voltage higher than 60 kV.

(3) The direct current interconnections with the Southwest Power Pool (SPP), Western System Coordinating Council (WSCC), Comisión Federal de Electricidad, or other interconnections.

ERCOT provides customer metering information to the TSP so that the TSP can calculate and bill for its transmission access fees. A TSP located in ERCOT administers a 'postage stamp' tariff with a PUCT approved annual $/kW fee charged to Distribution Service Providers (DSP) in ERCOT on a monthly basis. The $/kW fee is based on the TSP's PUCT approved transmission cost of service divided by the average ERCOT coincident peak for the four summer months (4CP). The monthly rate paid by a DSP is the product of each TSP's monthly rate and the DSP's previous year's average of the 4CP demand that is coincident with the ERCOT 4CP. The investor owned DSP recover these transmission service charges from the loads through a Retail Electric Provider. A municipal utility, river authority, or electric cooperative that has not opted in to competition recovers these transmission service charges directly from its loads.

Exports from the ERCOT grid pay the same annual $/kW transmission access fee divided by 8760 and applied on an hourly energy basis. A transmission service customer using the ERCOT transmission system to export power from ERCOT is assessed a transmission service charge based on the megawatts actually exported. Billing intervals can be for a year, month, week, or hour. Revenue received from the export by a TSP is credited against the TSP's transmission cost of service.

(c) Transmission Service in México

The transmission service in México is administered by CRE on a nondiscriminatory basis and provides transmission service to the self-supply associations in order of request—first come, first served. For such service, the self-supply association signs a transmission service agreement with CFE. The transmission service will be firm unless there is an emergency or force majeure that relieves either party of their given obligations.

The charge for the service is based on a methodology approved by CRE. The methodology is based on a utilization factor of the transmission and distribution system considering the flows with and without the transmission service. The rate is figured in $/kW.

(d) Transaction Scheduling of HVDC Ties

ERCOT coordinates the transfer of electrical energy to and from adjacent Non-ERCOT control areas via HVDC ties. Energy schedules over HVDC Ties between the ERCOT control area and interconnected non-ERCOT control areas are implemented in accordance with the ERCOT Protocols, North American Electric Reliability Council (NERC) scheduling protocols, and NERC operating policies and tagging requirements. Scheduling must also be in accordance with any applicable Federal Energy Regulatory Commission tariffs.

ERCOT performs schedule confirmation with the applicable interconnected non-ERCOT Control Area(s) and coordinates the approval process for the NERC tags for both the ERCOT control area and on behalf of ERCOT transmission providers.

ERCOT matches the supply (generation) and obligation (load) schedules submitted by the QSEs with interconnected non-ERCOT control area schedules obtained through the NERC scheduling process to confirm schedules and perform checkouts with adjacent interconnected non-ERCOT control areas. ERCOT will determine the linkage between interconnected non-ERCOT control area schedules and supply and obligation schedules submitted by QSEs. QSE schedules into the HVDC Tie are an obligation. QSE schedules from the HVDC Tie are a supply.

If a match does not exist between the interconnected non-ERCOT control area schedule and the QSE schedule to or from the HVDC Tie, then ERCOT will deny the interconnected non-ERCOT control area schedule with the applicable interconnected non-ERCOT control area(s). Any QSE's supply or obligation schedule indicated as being received from or delivered to a HVDC Tie that cannot be confirmed or linked by ERCOT will be declared a mismatch and set to zero.

ERCOT will confirm interconnected non-ERCOT Control Area schedule profiles with the HVDC Tie operator, who will control the tie to the schedules agreed to by both the designated Reliability Coordinator for the interconnected non-ERCOT Control Area and ERCOT.

ERCOT only performs settlement with QSEs. All entities that serve load or provide resources must be represented by a QSE for scheduling and settlement purposes. A QSE exporting from ERCOT through a HVDC Tie export schedule will include that HVDC Tie export schedule as an obligation in its balanced schedule by using the identifier field indicating the appropriate HVDC Tie. Exports from ERCOT via HVDC Ties will be treated as a load connected at transmission voltage in the settlement system and are responsible for allocated ancillary services, transmission losses, unaccounted for energy, ERCOT administrative fees, and any other applicable ERCOT fees.

A QSE importing into ERCOT through a HVDC Tie import schedule will include that HVDC Tie import schedule as a supply in its balanced schedule by using the identifier field indicating the appropriate HVDC Tie. Imports into ERCOT via HVDC Ties will be treated as generation into the congestion zone in the settlement system.

Any difference between the net of deemed meter readings at the HVDC Tie and the actual metered value at the HVDC Tie will be tracked in an Inadvertent Energy Account between ERCOT and each interconnected non-ERCOT control area. ERCOT will coordinate operation of the HVDC Tie(s) with the HVDC Tie operator such that the Inadvertent Energy Account is maintained as close to zero as possible. Corrections of inadvertent energy between ERCOT and the interconnected non-ERCOT control areas will be in accordance with the NERC scheduling protocols and the ERCOT Operating Guides.

Responsive Reserve Service can be provided through HVDC Ties. Responsive reserve service is an ancillary service that may be provided between ERCOT and Non-ERCOT control areas via HVDC Tie responses. It is designed to restore the frequency of the ERCOT system within the first few minutes following loss-of-resource contingencies or other events that causes a significant deviation from the standard frequency to.

During emergency periods, ERCOT has the authority to obtain energy over the DC Ties when transmission capacity is available across the DC Tie. The existing DC Tie between México and Texas provides an opportunity for building additional, mutually-beneficial emergency assistance arrangements including energy, capacity, and voltage support to enhance the reliability of the systems operated by CFE and ERCOT. CFE and ERCOT operators would agree upon and log capacity and energy values, and start and end times for any emergency assistance provided.

(e) Energy Transfer Procedures for HVDC Ties

Any changes in the interconnected non-ERCOT control area schedules due to a derating of the HVDC tie or other change within the NERC scheduling protocols will be communicated to ERCOT by the HVDC Tie operator or designated Reliability Coordinator for the interconnected non-ERCOT Control Area. For any interconnected non-ERCOT control area schedules that are revised during the operating period, the HVDC Tie operator will communicate to ERCOT the integrated schedule for the settlement intervals. If the HVDC Tie schedule flows as planned, then ERCOT will use schedules as the deemed meter readings for purposes of settlement. If the interconnected non-ERCOT control area schedule changes during the operating period, then ERCOT will use the changed interconnected non-ERCOT control area schedule as the deemed meter readings for purposes of settlement. ERCOT will not change the supply or obligation schedule of the QSE during the operating period[4].

Energy transfer procedures for commercial transactions via CFE/ERCOT interconnections are as follows:

a. CFE notifies the QSE to request firm or nonfirm energy, providing the import schedule and the interconnection or interconnections that will be used for the transaction.

[4] See Protocols section 4.1 for an overview of the scheduling process.

b. The QSE will communicate to CFE the availability of the energy in the time frame, MW, and price. CFE will communicate to the QSE the acceptance or rejection of the offer.
c. The CFE and ERCOT operator will analyze the feasibility of the transactions and will confirm transfer capability. CFE and ERCOT will establish, keep up to date, and agree to the limits of the transmission capacity and the operating margins to be considered for each one of the interconnections, both AC and DC.
d. If CFE accepts the transaction, a definite import schedule is established. CFE will communicate with the ERCOT operator the request for transactions and determine the priority of each one.
e. The transactions will be confirmed through the CFE and ERCOT operators. Once they have been confirmed, the transactions will become a commitment for the parties. Then, in either one of the electric systems, the commitment can only be modified or interrupted under emergency conditions or *force majeure*. Once the transaction starts, CFE will communicate with the QSE daily to give the import schedule and points of interconnection to be used.
f. The CFE Northeast Control Area (ACNE) and ERCOT operators will coordinate the necessary schedules to have the energy transaction following the established procedures.
g. The AEP-TCC operator will control and operate the HVDC tie per ERCOT instructions and shall apply the operating procedures and scheduling for the established transactions.

(f) ERCOT Protocols for Block Load Transfer

The purpose of block load transfers (BLTs) is to provide load relief by transferring load normally in ERCOT to a non-ERCOT control area or transferring loads normally in non-ERCOT control areas to the ERCOT control area, in order to avoid curtailment during emergency periods[5], or for energy purchases by CFE.

To ensure equitable treatment of both ERCOT and non-ERCOT control areas, BLTs are restricted to the following conditions[6]:

- CFE and ERCOT will agree to the operation with block load from one system to the other.
- BLTs shall only occur under a specific dispatch instruction from ERCOT.
- BLTs of load to the ERCOT control area will be treated as load in the ERCOT settlement system and will only be permitted if such transfers will not jeopardize the reliability of the ERCOT system. Under an ERCOT emergency notice, BLTs that have been implemented may be curtailed or terminated by ERCOT in order to maintain the reliability of the ERCOT system.
- BLTs of load from the ERCOT control area will be treated as a resource in the ERCOT settlement system and will only be implemented with the permission of the affected Non-ERCOT control area. Under emergency conditions, BLTs that have been implemented

[5] See Protocols section 5.6.
[6] See Protocols section 5.7 for a complete list of conditions.

may be curtailed or terminated by the Non-ERCOT control area in order to maintain the reliability of the Non-ERCOT system.

- Restoration of service to outaged customers using BLTs will be accomplished, as quickly as possible (except for CFE energy purchases) if the transfers will not jeopardize the reliability of the ERCOT system and only under specific dispatch instruction from ERCOT.

(g) Coordination of Support Service for ERCOT

CFE and ERCOT will coordinate the planned maintenance of their transmission circuits for those areas where there is a System Support Agreement so that they will be able to supply the support requirements for the peak periods of the supported area. For off peak periods CFE will coordinate with AEP Transmission Operations those planned transmission circuit outages that will significantly reduce the support to the DC ties. The intent is to establish effective coordination practices to ensure that clearances will not be scheduled on both sides of the DC ties at the same time. Scheduling times for planned transmission outages between CFE and AEP would need to be similar to ERCOT's scheduling times to make the process as efficient as possible by advanced planning of those transmission outages that reduce the emergency support to the DC ties, but in no case should non-emergency outages be scheduled without at least three days notice.

ERCOT's Transmission Outage Scheduling Approval time frame is:

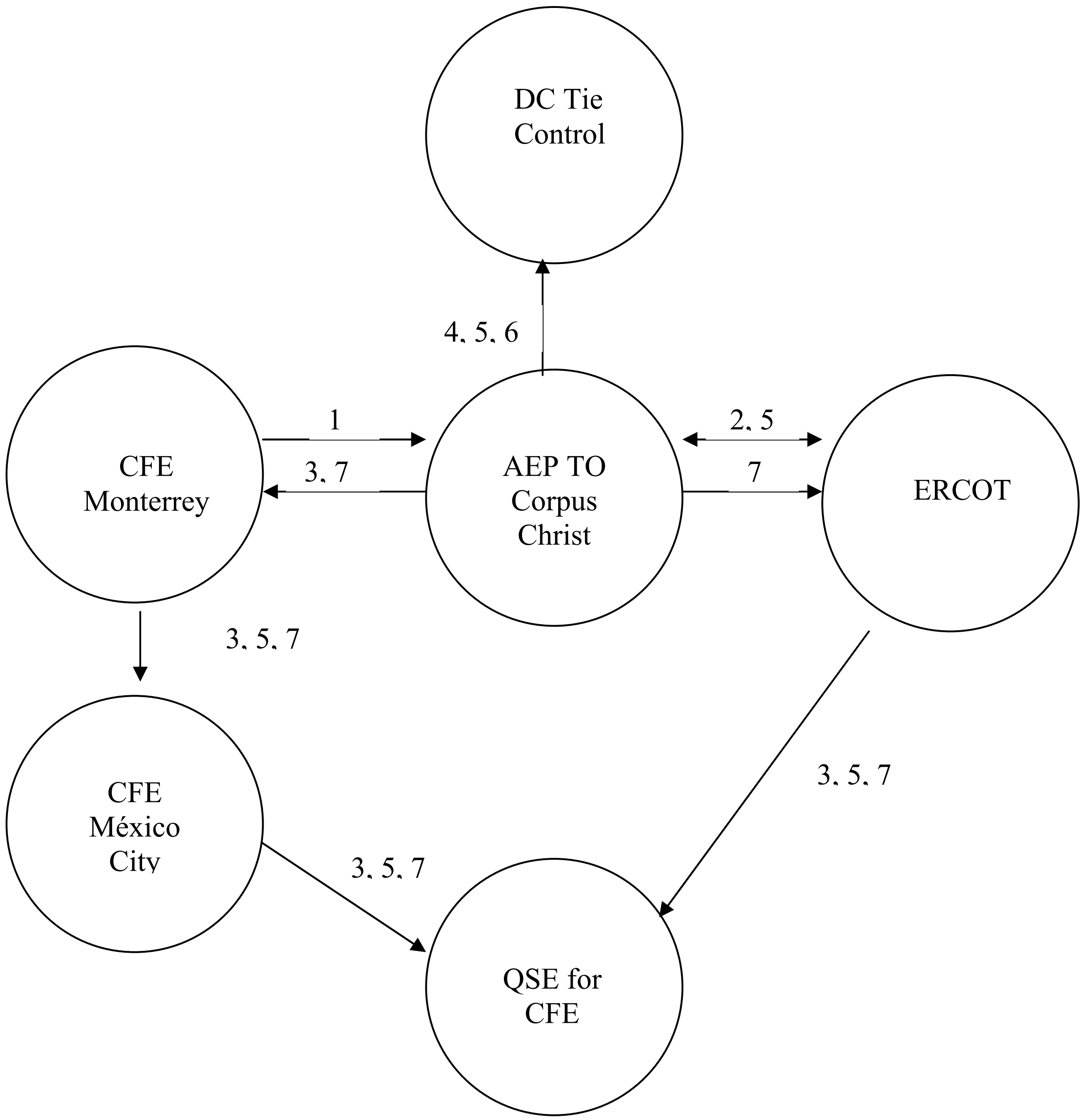
Requests for approval of proposed Outage received prior to the start of the proposed Outage as follows:	ERCOT will approve or reject no later than:
Between three and eight days	1630 hours two days prior to start of the proposed Outage
Between nine Business Days and forty- five calendar Days	Four (4) Business Days prior to the start of the proposed outage
Greater than forty-five calendar days	One month prior to the outage.

ERCOT will monitor transmission and unit outage requests and area support requirements on the ERCOT side and ask the AEP TO to work with CFE for a Remedial Action Plan (CFE scheduled energy or emergency energy) so that the scheduled ERCOT transmission outage can proceed. If the CFE support were not available for any reason, ERCOT would deny the ERCOT outage request.

No communication will be made to the QSE concerning transmission outages for the ERCOT system, but will be communicated in regards to the energy schedule requirements from ERCOT and/or CFE.

Communications between CFE, AEP TO and ERCOT should be by fax or by another electronic method and by phone for confirmation and clarification. The fax should summarize capability for support, economic energy schedules, peak shaving schedules and the total schedule. The following diagram illustrates the sequence of communication between the parties.

1. For each DC Tie where System Support is contracted, CFE will on a day ahead basis, define how much emergency help is available at the DC Tie location for both Peak Shaving and for 15 minute Emergency Response.
2. ERCOT and AEP Transmission Operations will define how much help is needed.
   - A. Peak Shaving Schedule for each hour of the day ahead (typically between 1200 and 2000 hours)
   - B. 15 minute Emergency Schedules that would be necessary for the worst contingency
3. Peak Shaving System Support Schedule needs developed by ERCOT and AEP TO are communicated to CFE by AEP TO and then onto the QSE by both CFE and ERCOT.
4. The actual Peak Shaving Schedule is entered into the DC Tie Controller. Differences between schedules and actual energy will go into the inadvertent account.
5. Current day/hour Peak Shaving Schedule changes due to missed load forecast or unit trips will be defined by ERCOT & AEP TO and then communicated to CFE. Upon approval by CFE it will be scheduled on the specific DC tie.
6. The AEP TO will (within the defined CFE maximum Emergency Support Capability for the day) adjust the DC Tie schedule to relieve the ERCOT system for contingencies that overload circuits.
7. The AEP TO will immediately communicate the changed schedule (and the expected time frame it is needed) on the DC tie to CFE and then to ERCOT. CFE and ERCOT will communicate this change to the QSE.



(h) Coordination of Support Service for CFE

In order to receive support services from ERCOT, CFE will execute the following procedures:

1. The ACNE or North Control Area (ACN) for Ojinaga/Presidio operator will contact the AEP-TCC operator to request emergency assistance providing the megawatt amount, the time, and the point of interconnection for the transaction.
2. The AEP-TCC operator will determine feasibility of the emergency assistance.
3. The AEP-TCC operator will communicate to the ACNE operator whether the request for emergency assistance has been accepted and will set the megawatts available and the schedule.

4. The ACNE operator confirms to the AEP-TCC operator that the transaction is accepted and then will start the necessary maneuvers to receive the emergency assistance following the established procedures.
5. CFE-ACNE will inform the QSE as soon as possible that an emergency assistance transaction is taking place.
6. Once that CFE can receive the emergency assistance, the ACNE operator will coordinate with the AEP-TCC operator to verify that all instructions are in place for the transaction to begin.
8. Once that the emergency is over, the ACNE operator will communicate to the AEP-TCC operator that the transaction has ended so that each of the two operators will be able to start the process to return the interconnections to pre-emergency condition.

Chapter 10. Enabling Commercial Terms Necessary for CFE/ERCOT Interconnection Transactions

(a) CFE/ERCOT System Support Agreement

An agreement for System Support between CFE and ERCOT is being negotiated. This agreement will establish the terms and conditions needed for the complete process to provide emergency support services and peak load support services described in Chapter 7. While the agreement will also establish the terms and conditions for peak load support service, this service will only be arranged from CFE to ERCOT. If required by CFE, peak load support and other firm power purchase needs will need to be arranged through a QSE operating in ERCOT.

The agreement is intended for transactions taking place at the existing DC Tie between Piedras Negras, México and Eagle Pass, Texas as well as any other DC Tie(s) as may be placed into operation between the ERCOT Interconnection and the CFE system during the term of the agreement. All scheduling will be coordinated between CFE and the appropriate QSE operating in ERCOT in accordance with the ERCOT QSE agreement and ERCOT Protocols. The commercial settlements for such transactions will also be performed by ERCOT and the appropriate QSE.

In August 2003, CFE and ERCOT executed a Load Service Entity Agreement. This agreement allows for block load transfers whereby CFE serves ERCOT-area customers through synchronous connections as described in Chapter 7. As part of this agreement, CFE has arranged for scheduling services with a QSE operating in ERCOT. For the system support services described above, CFE would have the option of continuing to use the QSE services currently in place or becoming an ERCOT QSE itself.

The CFE-ERCOT support services agreement described herewith is exclusively for emergency support and peak load services. Scheduling and bidding for other commercial energy transactions would be arranged through CFE's QSE. No transmission reservations are required for energy schedules into the ERCOT Control Area. ERCOT protocols allow QSEs to submit bilateral schedules that use the ERCOT DC ties by declaring the energy exports as a QSE obligation and energy imports as a QSE resource under ERCOT scheduling rules. Since all of the purchases and sales in and out of México are coordinated by CFE, CFE will establish curtailment priorities in the event of DC tie capacity reductions.

(b) Transmission Interconnection Agreement

There are currently executed interconnection agreements between CFE/AEP-TCC and CFE/AEP-TNC. These agreements were developed prior to the completion of the Eagle Pass/ Piedras Negras HVDC tie and served to separate transmission and energy contractual arrangements in order to reflect the functional separation of the AEP-TCC and AEP-TNC utilities. At that time, the agreement was structured to allow for the replacement of BLT interconnections with HVDC ties. Individual schedules attached to the interconnection agreement can be amended to reflect the physical change in character of each interconnection whenever the location is upgraded from a synchronous to an asynchronous interconnection.

The interconnection agreement sets out the terms and conditions for emergency operations, losses, metering, control and protection. Both security center and field operations personnel for AEP-TCC/AEP-TNC and CFE have been coordinating activities at each interconnection for decades. Most recently, efforts to place the Eagle Pass/Piedras Negras HVDC tie into commercial operation have required extensive communication between security centers and local technicians. As a result, valuable experience has been derived from the range of interactions necessary to fully implement the first asynchronous interconnection between CFE and ERCOT.

(c) DOE Presidential Permit

A United States Department of Energy (DOE) Presidential Permit is necessary for cross border interconnections between CFE and ERCOT. Permits already exist at those locations identified in Table 4.1, Existing CFE and ERCOT Interconnections. In those instances when existing interconnections are upgraded from BLT to HVDC Ties, revisions to the existing permit are necessary.

The purpose of the permit is to ensure that international interconnections are operated reliably and that they do not have adverse environmental impacts. When permits are requested, a comment period is opened to allow parties to express concerns about any negative impacts that are anticipated as a result of the requested interconnection. Border utilities are particularly aware of permit requests in order to ascertain if reliability could be degraded by potential energy transactions with CFE across requested interconnections.

Upon granting the Presidential Permit to Frontera for a private interconnection to the CFE Cumbres substation, DOE recognized the FERC and PUCT interests to allow Open Access on international interconnections. As a result, any future interconnections to CFE are to be open access consistent with asynchronous interconnections between the US transmission systems.

Chapter 11. Conclusion

(a) Governmental and Regulatory Support

Near term opportunities identified in the first phase of this study can be realized through contractual arrangements between CFE and ERCOT in the form of a System Support Agreement. By supplying energy for system support to the border areas of ERCOT, CFE can enable ERCOT to develop asynchronous interconnections that expand upon the concept of the initial HVDC tie with CFE at Eagle Pass, which is used to provide real and reactive power support to the Del Rio area of ERCOT. The implementation of asynchronous interconnections constructed in ERCOT as an alternative to transmission facilities has been accepted by the PUCT as a prudent use of regulated expenditures and recovery of such expenditures is provided for as specified in PUCT Substantive Rule § 25.192 (c)(1)(C). The cost of the Eagle Pass HVDC facilities was included and approved in Docket No. 22352; *Application of Central Power and Light Company for Approval of Unbundled Cost of Service Rate Pursuant to PURA § 39.201 and Public Utility Commission Substantive Rule § 25.344.*

It is clearly stated within PUCT Substantive Rule § 25.191(a), that the purpose of Subchapter I of the PUCT Substantive Rules is to provide transmission service that will facilitate competition in the sale of electric energy in Texas, preserve the reliability of electric service, and enhance economic efficiency in the production and consumption of electricity. Asynchronous interconnections have the potential to provide benefits beyond service reliability that address these other purposes. The PUCT Substantive Rules in Subchapter I have addressed cost recovery and billing for the current DC ties, and the current ERCOT protocols have provided some direction as well, but improvements and refinements will be required as the uses of asynchronous interconnections are expanded to enhance the development of the wholesale energy market between Texas and México. This will require ERCOT, ERCOT participants, the PUCT, and CFE to coordinate and cooperate to ensure that regulatory, as well as governmental, rules or procedures are developed and approved by the necessary entities. These rules or procedures should address: operational requirements, access to an asynchronous interconnection as well as transmission systems beyond an asynchronous interconnection, cost recovery for the owner(s) of an asynchronous interconnection, charges associated with the use of an asynchronous interconnection and transmission systems, and other similar issues that relate to the operation of an asynchronous interconnection to facilitate wholesale energy transactions.

Given the broad impacts that bulk transmission interconnections will have on the CFE and ERCOT power systems, PUCT and Secretaría de Energía (SENER) involvement in Phase II of the study is recommended. Interconnections on the order of 500 MW and 1000 MW could have significant value to the energy markets. While the cost of such interconnections is significant, the impact to the energy market is much more substantial. As has been experienced both in California and Texas, energy shortages lead to price spikes that are readily mitigated by access to other energy markets. Policy decisions of this magnitude need direct support from both regulatory and governmental bodies.

(b) Recommended Implementation of Phase I Results

The study found that opportunities exist at the Matamoras/Brownsville, Reynosa/McAllen, Nuevo Laredo/Laredo, and Del Rio/Acuña areas to provide support between the electrical grids. Particularly, the benefits of mutual support are recognized to be of immediate value at Acuña on the CFE transmission system and Laredo and McAllen on the ERCOT transmission system. Both CFE and ERCOT will follow through with proposals to facilitate these interconnections that, once reviewed by the appropriate governmental, regulatory, and stakeholder organizations, could be implemented over the next one to three years. The next steps for these short-term recommendations are:

1. ERCOT to complete economic evaluations to determine if additional benefits can be achieved from HVDC ties as alternatives to RMR services in south Texas,
2. CFE and ERCOT to develop system support services agreement,
3. ERCOT to ensure that ERCOT protocols support and facilitate transactions over CFE/ERCOT interconnections,
4. Transmission Service Providers (TSPs) to complete transmission upgrades to support and build the CFE/ERCOT interconnections,
5. TSPs to proceed with the applicable presidential permits for the CFE/ERCOT interconnections