Feasibility Study
For
Generation Interconnection Request
GEN-2007-041

SPP Tariff Studies
(#GEN-2007-041)

May, 2008

Executive Summary

<OMITTED TEXT> (Customer) has requested a Feasibility Study for the purpose of interconnecting 600 MW of wind generation within the control area of Southwestern Public Service Company (SPS) located in Texas County, Oklahoma. The proposed interconnection point is on the proposed Hitchland 345 kV substation, owned by SPS. The proposed in-service date is December, 2010.

Power flow analysis has indicated that for the powerflow cases studied, it is possible to interconnect the 600 MW of generation with transmission system reinforcements within the local transmission system. The need for reactive compensation for this interconnection request will be evaluated in the Impact Study based on the wind turbine manufacturer and type requested by the Customer. Dynamic Stability studies performed as part of the System Impact Study will provide additional guidance as to whether the required reactive compensation can be static or a portion must be dynamic (such as a SVC).

The requirement to interconnect the 600 MW of wind generation on the proposed Hitchland 345kV substation consists of adding a new 345 kV circuit-breaker and line terminal at Hitchland. The new substation will be constructed and maintained by SPS. The Customer did not propose a specific route for the 345 kV line extending to serve its 345/34.5 kV collection facilities. It is assumed that obtaining all necessary right-of-way for the new transmission line to serve its facilities will not be a significant expense.

It has been determined that GEN-2007-041 along with the prior queued projects in the area cannot be interconnected without the addition of the following proposed 345kV lines; 1) Comanche – Wichita, 2) GEN-2003-013 – Woodward, 3) a double circuit 345kV line from Hitchland – Woodward, 4) a double circuit 345kV line from Woodward – Northwest, 5) 345kV circuit from Woodward – Comanche. The GEN-2003-013 – Woodward 345kV line has been assigned to the Customer for GEN-2006-049. A 345kV circuit from Hitchland – Woodward has been assigned to GEN-2006-044. The Comanche – Wichita 345kV line has been assigned to the Customer for GEN-2005-012. The second Hitchland – Woodward 345kV line and Woodward - Comanche 345kV line have been assigned to the Customer for GEN-2007-041 (the Study Customer). The second Woodward – Northwest 345kV line has also been assigned to the study Customer. Withdrawal or suspension of any prior queued projects in the local area will require a restudy to evaluate the new assignees of such network upgrades.

The total minimum cost for building the required facilities for this 600 MW of generation is $262,000,000. These costs are shown in Tables 1 and 2. This cost does not include building the 345 kV line from the Customer 345/34.5 kV collector substation into the point of interconnection. This cost also does not include the Customer's 345/34.5 kV collector substation or possible need for reactive compensation. Network constraints in the Southwestern Public Service Company (SPS) transmission systems that were identified are shown in Table 3.

These Network constraints will have to be verified with a Transmission Service Request (TSR) and associated studies. Network Constraints are in the local area of the new generation when this generation is sunk throughout the SPP footprint for the Energy Resource (ER) Interconnection request. With a defined source and sink in a Transmission Service Request, this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements.

In Table 4, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer for future analyses including the determination of lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. If the loading of a facility is higher, the level of ATC will be lower.

There are several other proposed generation additions in the general area of the Customer's facility. It was assumed in this preliminary analysis that not all of these other projects within the SPS control areas will be in service. Those previously queued projects that have advanced to nearly complete phases were included in this Feasibility Study. In the event that another request for a generation interconnection with a higher priority withdraws, then this request may have to be re-evaluated to determine the local Network Constraints.

The required interconnection costs listed in Tables 1 and 2 and other upgrades associated with Network Constraints do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request through Southwest Power Pool's OASIS.

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Introduction

<OMITTED TEXT> (Customer) has requested a Feasibility Study for the purpose of interconnecting 600 MW of wind generation within the control area of Southwestern Public Service Company (SPS) located in Texas County, Oklahoma. The proposed interconnection point is on the proposed Hitchland 345 kV substation, owned by SPS. The proposed in-service date is December, 2010.

Interconnection Facilities

The primary objective of this study is to identify the system problems associated with connecting the generation to the area transmission system. The Feasibility and other subsequent Interconnection Studies are designed to identify attachment facilities, Network Upgrades and other Direct Assignment Facilities needed to accept power into the grid at the interconnection receipt point.

The requirement to interconnect the 600 MW of wind generation on the proposed Hitchland 345kV substation consists of adding a new 345 kV circuit-breaker and line terminal at Hitchland. The new substation will be constructed and maintained by SPS. The Customer did not propose a specific route for the 345 kV line extending to serve its 345/34.5 kV collection facilities. It is assumed that obtaining all necessary right-of-way for the new transmission line to serve its facilities will not be a significant expense.

With the addition of this interconnection request, there are approximately 2,280 MW of wind generation on the 345kV line from Lamar – Finney – Potter. There are also approximately 1,000 MW of wind generation on the 115kV and 230kV transmission systems that are connected at Hitchland. It was determined that a base case powerflow model could not be created to include the Customer's interconnection request without the addition of 1) Comanche – Wichita, 2) GEN-2003-013 – Woodward, 3) a double circuit 345kV line from Hitchland – Woodward, 4) a double circuit 345kV line from Woodward – Northwest, 5) 345kV circuit from Woodward – Comanche. The Customer is being assigned some of these Network Upgrades.

Other Network Constraints in the Southwestern Public Service Company transmission systems that were identified are shown in Table 3. With a defined source and sink in a Transmission Service Request (TSR), this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements.

A preliminary one-line drawing of the interconnection and direct assigned facilities are shown in Figure 1.

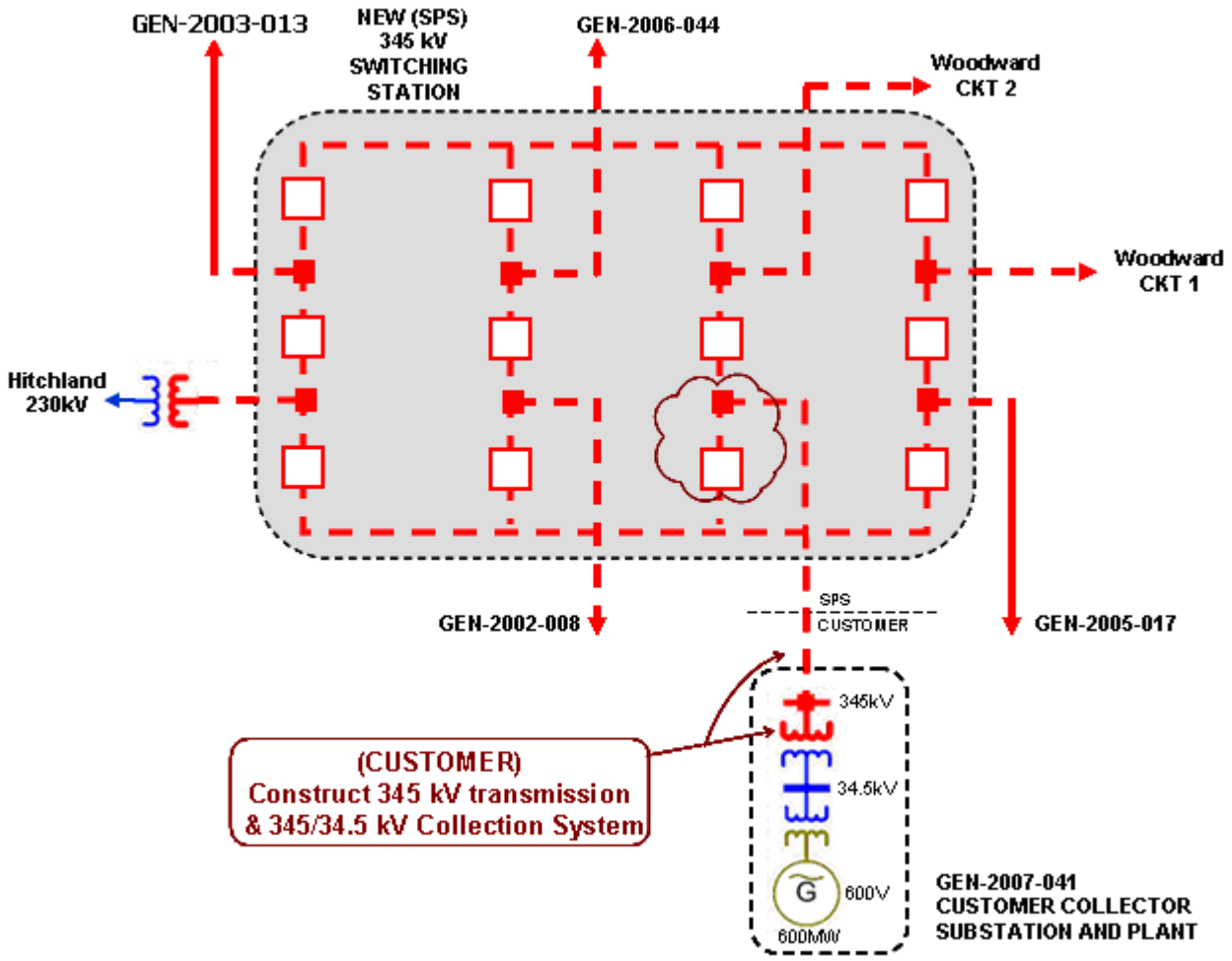

Figure 1: Proposed Method of Interconnection

(Final design to be determined)

Interconnection Estimated Costs

The minimum cost for adding a new 345 kV circuit-breaker and line terminal serving GEN-2007-041 facilities is estimated at $262,000,000. These costs are listed in Tables 1 and 2. These estimates will be refined during the development of the System Impact Study based on the final designs. This cost does not include building the Customer's 345 kV transmission line extending from the point of interconnection to serve its 345/34.5 kV collection facilities. This cost also does not include the Customer's 345/34.5 kV collector substation or the possible need for reactive compensation, all of which should be determined by the Customer. The Customer is responsible for these 345 kV – 34.5 kV facilities up to the point of interconnection.

It has been determined that GEN-2007-041 along with the prior queued projects in the area cannot be interconnected without the addition of both the proposed 345kV line from Comanche – Wichita, GEN-2003-013 – Woodward, double circuit Hitchland – Woodward, double circuit Woodward - Northwest and the proposed 345kV circuit from Woodward – Comanche. The GEN-2003-013 – Woodward 345kV line has been assigned to the Customer for GEN-2006-049. The Hitchland – Woodward 345kV line has been assigned to GEN-2006-044. The Comanche – Wichita 345kV line has been assigned to GEN-2005-012. The second circuit from Hitchland – Woodward 345kV and the second circuit from Woodward – Northwest and the Woodward - Comanche 345kV line have been assigned to the Customer for GEN-2007-041. Withdrawal or suspension of any prior queued projects in the local area will require a restudy to evaluate the new assignees of such network upgrades.

The costs of interconnecting the facility to the SPS transmission system are listed in Table 1 & 2. **These costs do not include any cost that might be associated with short circuit study results or dynamic stability study results.** These costs will be determined when and if a System Impact Study is conducted.

Table 1: Direct Assignment Facilities

FACILITY	ESTIMATED COST (2008 DOLLARS)
CUSTOMER – 345/34.5 kV substation facilities.	*
CUSTOMER – 345 kV line between Customer substation and new SPS 345 kV switching station.	*
CUSTOMER – Possible reactive compensation to be determined during impact study.	*
CUSTOMER – Right-of-Way for all Customer facilities.	*
TOTAL	*****

* *Estimates of cost to be determined.*

Table 2: Required Interconnection Network Upgrade Facilities

FACILITY	ESTIMATED COST (2007 DOLLARS)
SPS – 345 kV circuit-breaker and line terminal to be built for generation request #GEN-2007-041 on the proposed Hitchland 345 kV substation. Work to include associated switches, control relaying, high speed communications, metering and related equipment and all related structures.	$2,000,000
345kV Transmission lines from Hitchland (SPS) – Woodward (OKGE) – Northwest (OKGE)	$200,000,000
345kV Transmission Line from Woodward (OKGE) – Comanche (SUNC)	$60,000,000
TOTAL	**$262,000,000**

* *Estimates of cost to be determined.*

Powerflow Analysis

A powerflow analysis was conducted for the facility using modified versions of the 2012 summer and winter peak models and the 2017 summer peak model. The output of the Customer's facility was offset in each model by a reduction in output of existing online SPP generation. This method allows the request to be studied as an Energy Resource (ER) Interconnection request. The proposed in-service date of the generation is December, 2010. The available seasonal models used were through the 2017 Summer Peak of which is the end of the current SPP planning horizon.

Following current practice, this analysis was conducted assuming that previous queued requests in the immediate area of this interconnect request were in service. The analysis of the Customer's project indicates that, given the requested generation level of 600 MW and location, additional criteria violations will occur on the existing SPS transmission systems under steady state and contingency conditions in the peak seasons. Table 3 lists these overloaded facilities.

In Table 4, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer to determine lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. When a facility is overloaded for more than one contingency, only the highest loading on the facility for each season is included in the table.

The need for reactive compensation will be determined during the Impact Study. The need for reactive compensation will be based on the Customer's choice of wind turbine make and manufacturer. Dynamic Stability studies performed as part of the System Impact Study will provide additional guidance as to whether the reactive compensation can be static or a portion must be dynamic (such as a SVC or STATCOM). It is possible that an SVC or STATCOM device will be required at the Customer facility because of FERC Order 661A Low Voltage Ride-Through Provisions (LVRT) which went into effect January 1, 2006. FERC Order 661A orders that wind farms stay on-line for 3-phase faults at the point of interconnection even if that requires the installation of a SVC or STATCOM device.

There are several other proposed generation additions in the general area of the Customer's facility. Some of the local projects that were previously queued were assumed to be in service in this Feasibility Study. Not all local projects that were previously queued and have advanced to nearly complete phases were included in this Feasibility Study.

Powerflow Analysis Methodology

The Southwest Power Pool (SPP) criteria states that: “The transmission system of the SPP region shall be planned and constructed so that the contingencies as set forth in the Criteria will meet the applicable NERC Planning Standards for System Adequacy and Security – Transmission System Table l hereafter referred to as NERC Table l) and its applicable standards and measurements”.

Using the created models and the ACCC function of PSS\E, single contingencies in portions or all of the modeled control areas of Sunflower Electric Power Corporation (SUNC), Missouri Public Service (MIPU), Westar Energy (WERE), Kansas City Power & Light (KCPL), West Plains (WEPL), Midwest Energy (MIDW), Oklahoma Gas and Electric (OKGE), American Electric Power West (AEPW), Grand River Dam Authority (GRDA), Southwestern Public Service Company (SPS), Western Farmers Electric Cooperative (WFEC) and other control areas were applied and the resulting scenarios analyzed. This satisfies the ‘more probable’ contingency testing criteria mandated by NERC and the SPP criteria.

Powerflow Results

Table 3: Network Constraints

AREA	OVERLOADED ELEMENT
AEPW	ELDORADO - LAKE PAULINE 69KV CKT 1
AEPW	ELK CITY - CLINTON JUNCTION 138KV CKT 1
AEPW	ELK CITY (ELKCTY-6) 230/138/13.8KV TRANSFORMER CKT 1
AEPW/SPS	ELK CITY - GRAPEVINE INTERCHANGE 230KV CKT 1
OKGE	NORTHWEST - CIMARRON 345KV CKT 1
OKGE	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1
SPS	HAPPY INTERCHANGE - TULIA TAP 115KV CKT 1
SPS	PALO DURO SUB - HAPPY INTERCHANGE 115KV CKT 1
SPS	RANDALL COUNTY INTERCHANGE - PALO DURO SUB 115KV CKT 1
SPS	TULIA TAP - KRESS INTERCHANGE 115KV CKT 1
SUNC	DOBSON - PILE 115KV CKT 1
SUNC	PILE - SCOTT CITY 115KV CKT 1
SUNC/WEPL	SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1
WEPL	MULLERGREN - SPEARVILLE 230KV CKT 1
WEPL/MIDW	MULLERGREN - S HAYS6 230KV CKT 1
OKGE	WOODWARD - NORTHWEST 345KV CKT 1
OKGE	WOODWARD - NORTHWEST 345KV CKT 2
AEPW	American Electric Power West
MIDW	Midwest Energy
OKGE	Oklahoma Gas and Electric
SPS	Southwestern Public Service Company
SUNC	Sunflower Electric Power Corporation
WEPL	West Plains

Table 4: Contingency Analysis

SEASON	OVERLOADED ELEMENT	RATING (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
12SP	ELK CITY (ELKCTY-6) 230/138/13.8KV TRANSFORMER CKT 1	287	134	0	HITCHLAND – WOODWARD 345KV CKT 1
12SP	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1	493	122	0	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1
12SP	NORTHWEST - CIMARRON 345KV CKT 1	717	114	0	SOONER - WOODRING 345KV CKT 1
12SP	MULLERGREN - S HAYS6 230KV CKT 1	147	115	113	CIRCLE - MULLERGREN 230KV CKT 1
12SP	MULLERGREN - SPEARVILLE 230KV CKT 1	355	113	122	HOLCOMB - SETAB 345KV CKT 1
12SP	ELK CITY - GRAPEVINE INTERCHANGE 230KV CKT 1	351	110	214	HITCHLAND – WOODWARD 345KV CKT 1
12SP	WOODWARD - NORTHWEST 345KV CKT 2	1052	104	481	WOODWARD - NORTHWEST 345KV CKT 1
12SP	WOODWARD - NORTHWEST 345KV CKT 1	1052	104	484	WOODWARD - NORTHWEST 345KV CKT 2
12SP	ELK CITY - CLINTON JUNCTION 138KV CKT 1	143	101	548	HITCHLAND – WOODWARD 345KV CKT 1
12WP	ELDORADO - LAKE PAULINE 69KV CKT 1	20	261	0	LAKE PAULINE - RUSSELL 138KV CKT 1
12WP	ELK CITY (ELKCTY-6) 230/138/13.8KV TRANSFORMER CKT 1	287	153	0	HITCHLAND – WOODWARD 345KV CKT 1
12WP	ELK CITY - GRAPEVINE INTERCHANGE 230KV CKT 1	351	130	0	TUCO INTERCHANGE (TUCO XX4) 345/230/13.2KV TRANSFORMER CKT 1
12WP	CLINTON JUNCTION - ELK CITY 138KV CKT 1	143	128	0	CLINTON AIR FORCE BASE TAP - ELK CITY 138KV CKT 1
12WP	NORTHWEST - CIMARRON 345KV CKT 1	717	113	3	ARCADIA - NORTHWEST 345KV CKT 1
12WP	SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1	336	111	237	MINGO -SETAB 345KV CKT 1
12WP	RANDALL COUNTY INTERCHANGE - PALO DURO SUB 115KV CKT 1	118	112	486	AMARILLO SOUTH INTERCHANGE - SWISHER COUNTY INTERCHANGE 230KV CKT 1
12WP	PALO DURO SUB - HAPPY INTERCHANGE 115KV CKT 1	118	112	492	AMARILLO SOUTH INTERCHANGE - SWISHER COUNTY INTERCHANGE 230KV CKT 1
12WP	HAPPY INTERCHANGE - TULIA TAP 115KV CKT 1	118	105	551	AMARILLO SOUTH INTERCHANGE - SWISHER COUNTY INTERCHANGE 230KV CKT 1
12WP	TULIA TAP - KRESS INTERCHANGE 115KV CKT 1	118	102	581	AMARILLO SOUTH INTERCHANGE - SWISHER COUNTY INTERCHANGE 230KV CKT 1
17SP	ELK CITY (ELKCTY-6) 230/138/13.8KV TRANSFORMER CKT 1	287	133	0	HITCHLAND - WOODWARD 345KV CKT 1
17SP	SPEARVILLE (SPEARVL) 345/230/13.8KV TRANSFORMER CKT 1	336	127	0	HOLCOMB - SETAB 345KV CKT 1
17SP	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1	493	127	0	NORTHWEST (NORTWST2) 345/138/13.8KV TRANSFORMER CKT 1
17SP	MULLERGREN - S HAYS6 230KV CKT 1	147	115	123	MINGO - SETAB 345KV CKT 1
17SP	MULLERGREN - SPEARVILLE 230KV CKT 1	355	113	187	MINGO - SETAB 345KV CKT 1
17SP	ELK CITY - GRAPEVINE INTERCHANGE 230KV CKT 1	351	109	230	HITCHLAND – WOODWARD 345KV CKT 1
17SP	DOBSON - PILE 115KV CKT 1	198	105	378	HOLCOMB - SETAB 345KV CKT 1
17SP	PILE - SCOTT CITY 115KV CKT 1	198	104	452	HOLCOMB - SETAB 345KV CKT 1

Note: When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this Table may be greater due to higher priority reservations. If the loading of a facility is higher, the level of ATC will be lower.

Conclusion

The minimum cost of interconnecting the Customer's interconnection request is estimated at $262,000,000 for Direct Assignment Facilities and Network Upgrades. At this time, the cost estimates for other Direct Assignment facilities including those in Tables 1 and 2 have not been defined by the Customer. In addition to the Customer's proposed interconnection facilities, the Customer may be responsible for installing reactive compensation in the Customer's substation for reactive support. As stated earlier, some but not all of the local projects that were previously queued are assumed to be in service in this Feasibility Study. These costs exclude upgrades of other transmission facilities that were listed in Table 3 of which are Network Constraints.

In Table 4, a value of Available Transfer Capability (ATC) associated with each overloaded facility is included. These values may be used by the Customer to determine lower generation capacity levels that may be installed. When transmission service associated with this interconnection is evaluated, the loading of the facilities listed in this table may be greater due to higher priority reservations. When a facility is overloaded for more than one contingency, only the highest loading on the facility for each season is included in the table.

These interconnection costs do not include any cost that may be associated with short circuit or transient stability analysis. These studies will be performed if the Customer signs a System Impact Study Agreement. At the time of the System Impact Study, a better determination of the interconnection facilities may be available.

The required interconnection costs listed in Tables 1 and 2 and other upgrades associated with Network Constraints do not include all costs associated with the deliverability of the energy to final customers. These costs are determined by separate studies if the Customer submits a Transmission Service Request through Southwest Power Pool's OASIS.

Appendix A: Point of Interconnection Area Map

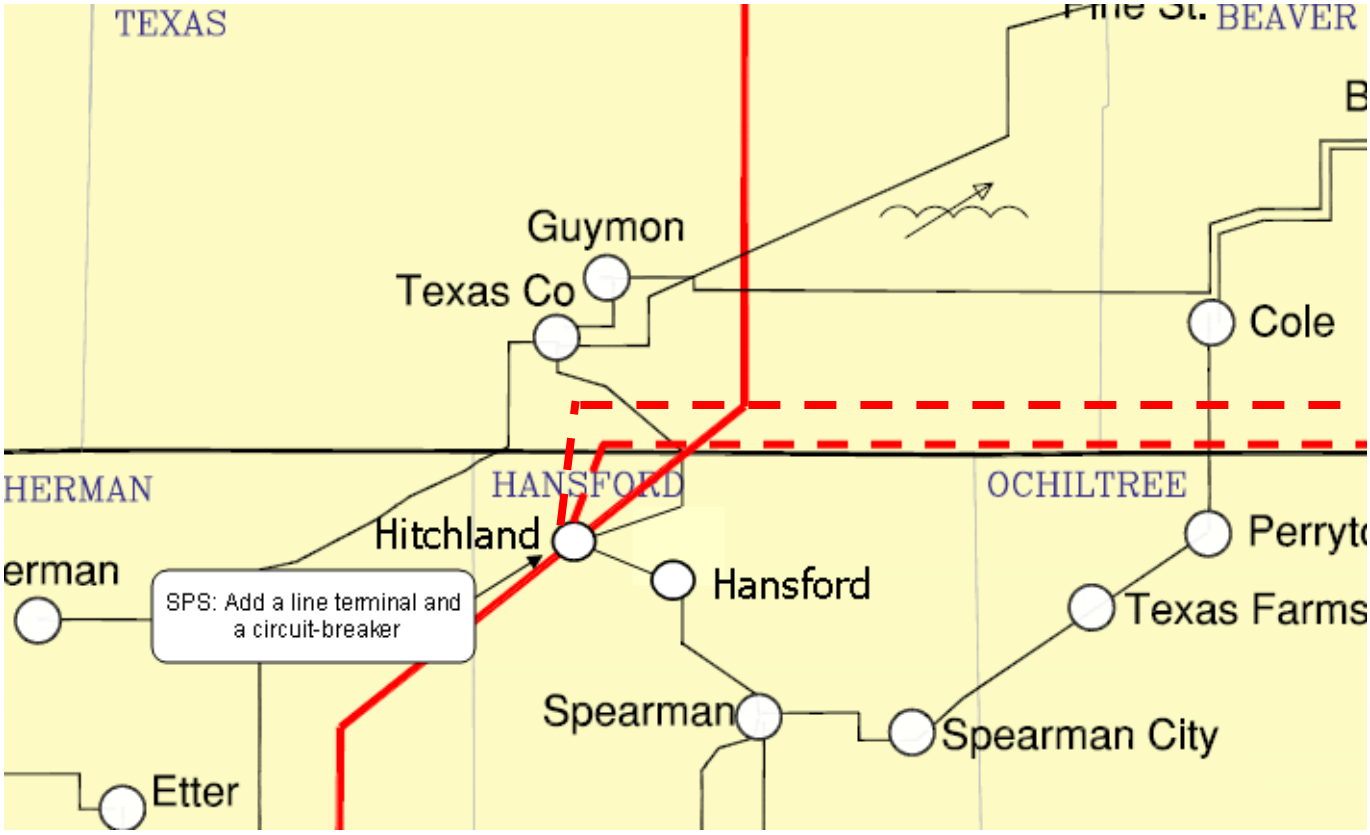

Figure 2: Point of Interconnection Area Map