SPP Southwest Power Pool

Feasibility Study For Generation Interconnection Request GEN-2006-038

SPP Tariff Studies
(#GEN-2006-038)

March, 2007

Executive Summary

<OMITTED TEXT> (Customer) has requested a Feasibility study for the purpose of interconnecting 800MW of coal fired generation within the control area of Western Farmers Electric Cooperative (WFEC) in Choctaw County, Oklahoma. The proposed point of interconnection is a new 345kV switchyard proposed for construction adjacent to the existing Hugo 138kV substation, which is owned by WFEC. The proposed in-service date is January 1, 2011.

This generation interconnection request is part of a larger project coordinated by two utilities that includes building a 400MW back-to-back DC tie, two separate 345kV switchyards that will connect separately into the Electric Reliability Council of Texas (ERCOT) and to Southwest Power Pool (SPP), and various other 345kV and 138kV improvements in the area.

The requirements to interconnect the 800MW of generation directly into the SPP transmission system consist of adding one (1) new 345kV circuit breaker and associated equipment at the proposed 345kV switchyard that is to be constructed for the installation of the 400MW DC tie. The Customer has indicated that this circuit breaker will be configured in a normally open position. This circuit breaker will only be closed under unusual circumstances.

Power flow analysis has indicated that for the powerflow cases studied, it is possible to interconnect the 800MW of generation with transmission system reinforcements within the local transmission systems.

The total minimum cost for interconnecting the proposed 800MW generation request into the SPP transmission system is estimated at $750,000. These costs are shown in Table 1 and Table 2. Other Network Constraints in the American Electric Power – West (AEPW), Oklahoma Gas and Electric (OKGE), Southwestern Public Service Company (SPS), and WFEC transmission systems that may be verified with a transmission service request and associated studies are listed in Table 3. These 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 (TSR), this list of Network Constraints will be refined and expanded to account for all Network Upgrade requirements. This cost does not include any of the 345kV and 138kV improvements that are being undertaken by the transmission owning utilities for the HVDC interconnection.

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.

Introduction

<OMITTED TEXT> (Customer) has requested a Feasibility study for the purpose of interconnecting 800MW of coal fired generation within the control area of Western Farmers Electric Cooperative (WFEC) in Choctaw County, Oklahoma. The proposed point of interconnection is a new 345kV switchyard proposed to be built adjacent to the existing Hugo 138kV substation, which is owned by WFEC. The proposed in-service date is January 1, 2011.

Interconnection Facilities

The primary objective of this study is to identify the system problems associated with connecting the plant into 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.

This generation interconnection request is a small portion of a larger interconnection project that will encompass an 800MW coal fired power plant, a 400MW back-to-back DC tie, a 345kV switchyard to be primarily interconnected to the Electric Reliability Council of Texas (ERCOT), and a 345kV switchyard to be interconnected primarily to the Southwest Power Pool (SPP). On the SPP side of the interconnection, other network upgrades are planned such as a 345/138kV autotransformer connecting to the existing Hugo 138kV substation and a new 345kV line to Valliant.

The interconnection study coordination of the 400MW back-to-back DC tie is being conducted by the transmission owning utilities with oversight from SPP and ERCOT. The primary configuration of the facility has the 800MW generation facility interconnected into the ERCOT switchyard. Energy from the facility will be normally delivered to SPP via the DC tie. However, due to the request of the Customer, a normally open 345kV circuit breaker will be installed in parallel with the DC tie. This circuit breaker would only be closed in the case that either the ERCOT grid or the SPP (Eastern Interconnection) grid has suffered some sort of situation in which a “Black Start” is required. Because of this normally open circuit breaker, there is the possibility that the generating facility could be interconnected directly into the SPP transmission system.

The requirements for interconnection of the 800MW generating facility will consist of installing the 345kV normally open circuit breaker and associated equipment in the switchyard. The circuit breaker, when closed, will connect the Eastern Interconnection to the ERCOT grid and would only be closed under unusual circumstances.

The total cost for installing this 345kV normally open circuit breaker is estimated at $750,000. This cost does not include either 345kV switchyard required by the interconnection of the DC tie, nor does it include the cost of the 345/138kV autotransformer or other 345kV and 138kV facilities that the transmission owning utility(ies) has plans to construct for the installation of the DC tie.

Network Constraints in the American Electric Power West (AEPW), Oklahoma Gas and Electric (OKGE), Southwestern Public Service Company (SPS) and WFEC transmission systems that were identified when injecting 800MW into the 345kV bus are listed in Table 3. These network constraints were based on an Energy Resource (ER) interconnection service in which the 800MW are injected at the Point of interconnection and the energy is absorbed throughout the SPP footprint.

The costs of interconnecting the facility to the WFEC transmission system are listed in Tables 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.

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

Table 1: Direct Assignment Facilities

FACILITY	ESTIMATED COST (2007 DOLLARS)
Customer – 345kV circuit breaker and associated equipment	$750,000
Total	**$750,000**

*Note: *Estimates of cost to be determined by Customer.*

Table 2: Required Interconnection Network Upgrade Facilities

FACILITY	ESTIMATED COST (2006 DOLLARS)
None	*
Total	*****

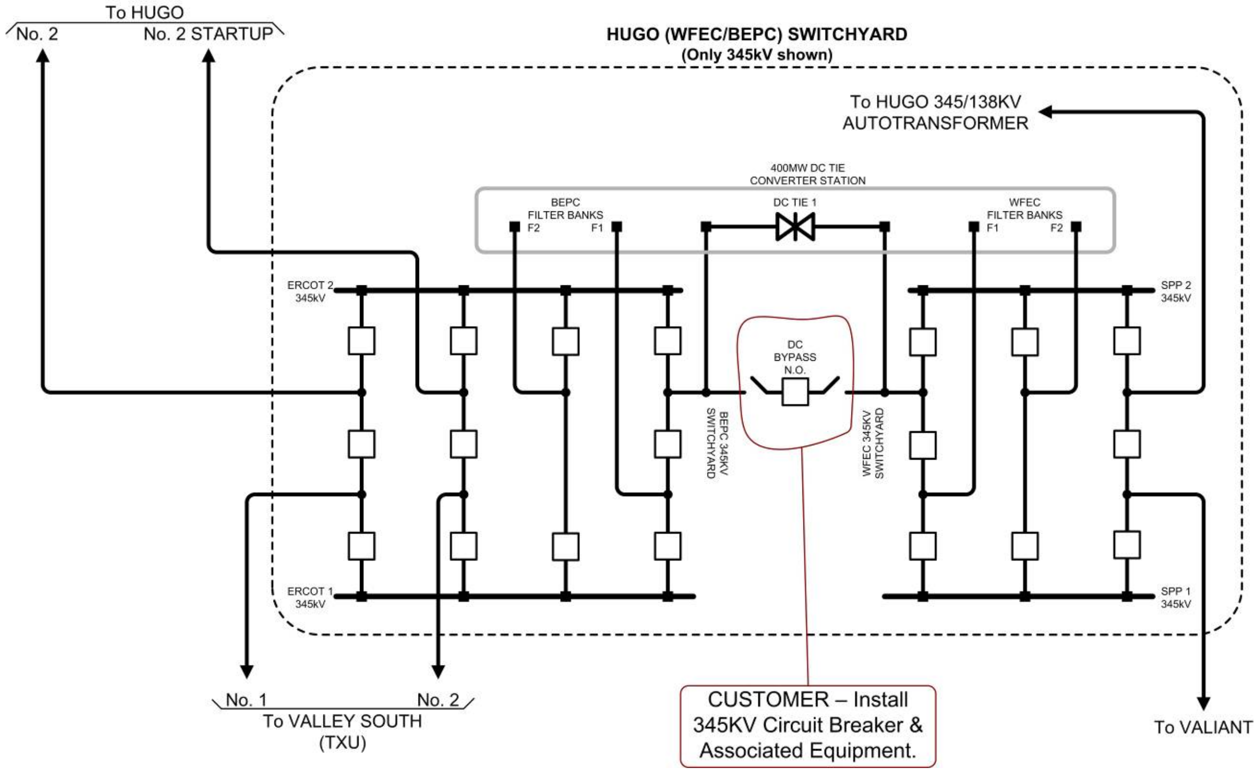

Figure 1: Proposed Interconnection
(Final substation design to be determined)

Powerflow Analysis

A powerflow analysis was conducted for the facility using modified versions of the 2011 summer and winter peak, and 2016 summer peak models. 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 January, 2011. The available seasonal models used were through the 2016 Summer Peak of which is the end of the current SPP planning horizon.

The analysis of the Customer's project indicates that, given the requested generation level of 800MW and location, additional criteria violations will occur on the existing AEPW, OKGE, SPS, and WFEC transmission systems under steady state and contingency conditions in the peak seasons.

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.

There are several other proposed generation additions in the general area of the Customer's facility. These local projects that were previously queued were assumed to be in service in this Feasibility Study. Those 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 I hereafter referred to as NERC Table I) 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 American Electric Power West (AEPW), Midwest Energy (MIDW), Oklahoma Gas and Electric (OKGE), Southwestern Public Service Company (SPS), Sunflower Electric Power Corporation (SUNC), West Plains (WEPL), 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.

Table 3: Network Constraints

AREA	ELEMENT
AEPW	ANTLERS TAP - MCGEE CREEK TAP 69KV CKT 1
AEPW	ANTLERS TAP - VALLEY TIMBER 69KV CKT 1
AEPW	ATOKA - LANE 69KV CKT 1
AEPW	BETHEL - NASHOBA 138KV CKT 1
AEPW	CLAYTON - NASHOBA 138KV CKT 1
AEPW	CLAYTON - SARDIS 138KV CKT 1
AEPW	HUGO - VALLEY TIMBER 69KV CKT 1
AEPW	LANE - MCGEE CREEK TAP 69KV CKT 1
AEPW	LONE OAK - SARDIS 138KV CKT 1
AEPW	PATTERSON - SOUTH NASHVILLE 138KV CKT 1
AEPW	WILKES 138/21.0KV TRANSFORMER CKT 1
AEPW	WILKES 138/21.0KV TRANSFORMER CKT 2
AEPW-ENTR	FULTON - PATMOS 115KV CKT 1
AEPW-ERCOT	OKLAU2 - OKLAUNION 345KV CKT 1
AEPW-WFEC	HUGO - VALLIANT 138KV CKT 1
MULTIPLE	SPPSPSTIES
OKGE	BROWN - EXPLORER TAP 138KV CKT 1
OKGE	BROWN TAP - EXPLORER TAP 138KV CKT 1
OKGE	PECAN CREEK (PECANCK1) 345/161/13.8KV TRANSFORMER CKT 1
OKGE-WFEC	RUSSETT - RUSSETT 138KV CKT 1
SPS	NICHOLS STATION 230/115KV TRANSFORMER CKT 1
SPS	NICHOLS STATION 230/115KV TRANSFORMER CKT 2
SPS	TUCO INTERCHANGE (TUCO XX4) 345/230/13.2KV TRANSFORMER CKT 1
SWPA-AEPW	BETHEL - BROKEN BOW 138KV CKT 1
SWPA-OKGE	BROWN - BROWN 138KV CKT 1
SWPA-WFEC	BROWN - RUSSETT 138KV CKT 1
SWPA-WFEC	LANE - TUPELO 138KV CKT 1
WFEC	BENNINGTON - DURANT 138KV CKT 1
WFEC	BENNINGTON - UNGER 138KV CKT 1
WFEC	COLBERT4 - KIERSEY 138KV CKT 1
WFEC	DURANT - SCOLEMN4 138KV CKT 1
WFEC	FROGVILLE - HUGO POWER PLANT 138KV CKT 1
WFEC	FROGVILLE - WEST BANK 138KV CKT 1
WFEC	GEN-2006-38 - HUGO 345/138KV TRANSFORMER CKT 1
WFEC	UNGER - WEST BANK 138KV CKT 1
AEPW	*American Electric Power - West*
ENTR	*Entergy*
ERCOT	*Electric Reliability Council of Texas*
MULTIPLE	*AEPW, ERCOT, SPS, SUNC*
OKGE	*Oklahoma Gas and Electric*
SPS	*Southwestern Public Service Company*
SWPA	*Southwestern Power Administration*
WFEC	*Western Farmers Electric Cooperative*
SUNC	*Sunflower Electric Power Corporation*

Table 4: Contingency Analysis

OVERLOADED ELEMENT	SEASON	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
2011 Summer Peak Model					
BETHEL - BROKEN BOW 138KV CKT 1	11SP	107	183	0	PITTSBURG - VALLIANT 345KV CKT 1
BETHEL - NASHOBA 138KV CKT 1	11SP	107	177	0	PITTSBURG - VALLIANT 345KV CKT 1
CLAYTON - NASHOBA 138KV CKT 1	11SP	107	175	0	PITTSBURG - VALLIANT 345KV CKT 1
CLAYTON - SARDIS 138KV CKT 1	11SP	107	172	0	PITTSBURG - VALLIANT 345KV CKT 1
LONE OAK - SARDIS 138KV CKT 1	11SP	107	169	0	PITTSBURG - VALLIANT 345KV CKT 1
TUCO INTERCHANGE (TUCO XX4) 345/230/13.2KV TRANSFORMER CKT 1	11SP	560	114	0	GEN:51442 1
BETHEL - BROKEN BOW 138KV CKT 1	11SP	88	130	73	BASE CASE
BROWN - BROWN 138KV CKT 1	11SP	143	120	177	PITTSBURG - VALLIANT 345KV CKT 1
BROWN - RUSSETT 138KV CKT 1	11SP	96	139	187	PITTSBURG - VALLIANT 345KV CKT 1
HUGO - VALLEY TIMBER 69KV CKT 1	11SP	48	139	195	PITTSBURG - VALLIANT 345KV CKT 1
ANTLERS TAP - VALLEY TIMBER 69KV CKT 1	11SP	48	139	198	PITTSBURG - VALLIANT 345KV CKT 1
BETHEL - NASHOBA 138KV CKT 1	11SP	88	124	224	BASE CASE
RUSSETT - RUSSETT 138KV CKT 1	11SP	96	137	242	PITTSBURG - VALLIANT 345KV CKT 1
CLAYTON - NASHOBA 138KV CKT 1	11SP	88	122	270	BASE CASE
CLAYTON - SARDIS 138KV CKT 1	11SP	88	118	358	BASE CASE
LANE - TUPELO 138KV CKT 1	11SP	203	121	441	PITTSBURG - VALLIANT 345KV CKT 1
LONE OAK - SARDIS 138KV CKT 1	11SP	88	115	450	BASE CASE
GEN-2006-38 - HUGO 345/138KV TRANSFORMER CKT 1	11SP	500	168	476	GEN-2006-36 - VALLIANT 345KV CKT 1
FULTON - PATMOS 115KV CKT 1	11SP	159	115	511	PITTSBURG - VALLIANT 345KV CKT 1
HUGO - VALLIANT 138KV CKT 1	11SP	394	142	514	GEN-2006-36 - VALLIANT 345KV CKT 1
BROWN TAP - EXPLORER TAP 138KV CKT 1	11SP	143	111	524	PITTSBURG - VALLIANT 345KV CKT 1
BROWN - EXPLORER TAP 138KV CKT 1	11SP	152	110	530	PITTSBURG - VALLIANT 345KV CKT 1
FROGVILLE - HUGO POWER PLANT 138KV CKT 1	11SP	324	110	588	PITTSBURG - VALLIANT 345KV CKT 1
PECAN CREEK (PECANCK1) 345/161/13.8KV TRANSFORMER CKT 1	11SP	370	104	595	CLARKSVILLE - MUSKOGEE 345KV CKT 1
FROGVILLE - WEST BANK 138KV CKT 1	11SP	324	109	613	PITTSBURG - VALLIANT 345KV CKT 1
UNGER - WEST BANK 138KV CKT 1	11SP	324	107	653	PITTSBURG - VALLIANT 345KV CKT 1
BENNINGTON - UNGER 138KV CKT 1	11SP	324	106	663	PITTSBURG - VALLIANT 345KV CKT 1
WILKES 138/21.0KV TRANSFORMER CKT 2	11SP	216	103	685	PITTSBURG - VALLIANT 345KV CKT 1
WILKES 138/21.0KV TRANSFORMER CKT 1	11SP	216	103	685	PITTSBURG - VALLIANT 345KV CKT 1
BENNINGTON - DURANT 138KV CKT 1	11SP	324	104	717	PITTSBURG - VALLIANT 345KV CKT 1
DURANT - SCOLEMN4 138KV CKT 1	11SP	324	101	771	PITTSBURG - VALLIANT 345KV CKT 1
2011 Winter Peak Model					
BETHEL - BROKEN BOW 138KV CKT 1	11WP	107	158	58	PITTSBURG - VALLIANT 345KV CKT 1
BETHEL - NASHOBA 138KV CKT 1	11WP	107	153	119	PITTSBURG - VALLIANT 345KV CKT 1
CLAYTON - NASHOBA 138KV CKT 1	11WP	107	151	138	PITTSBURG - VALLIANT 345KV CKT 1
CLAYTON - SARDIS 138KV CKT 1	11WP	107	149	166	PITTSBURG - VALLIANT 345KV CKT 1
LONE OAK - SARDIS 138KV CKT 1	11WP	107	146	204	PITTSBURG - VALLIANT 345KV CKT 1

Table 5: Contingency Analysis (continued)

OVERLOADED ELEMENT	SEASON	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
2011 Winter Peak Model (continued)					
BROWN - RUSSETT 138KV CKT 1	11WP	96	126	370	PITTSBURG - VALLIANT 345KV CKT 1
FULTON - PATMOS 115KV CKT 1	11WP	159	115	404	PITTSBURG - VALLIANT 345KV CKT 1
RUSSETT - RUSSETT 138KV CKT 1	11WP	96	122	427	PITTSBURG - VALLIANT 345KV CKT 1
GEN-2006-38 - HUGO 345/138KV TRANSFORMER CKT 1	11WP	500	164	487	GEN-2006-36 - VALLIANT 345KV CKT 1
HUGO - VALLIANT 138KV CKT 1	11WP	394	144	490	GEN-2006-36 - VALLIANT 345KV CKT 1
BROWN - BROWN 138KV CKT 1	11WP	143	106	646	PITTSBURG - VALLIANT 345KV CKT 1
LANE - TUPELO 138KV CKT 1	11WP	203	108	660	PITTSBURG - VALLIANT 345KV CKT 1
HUGO - VALLEY TIMBER 69KV CKT 1	11WP	55	104	736	PITTSBURG - VALLIANT 345KV CKT 1
ANTLERS TAP - VALLEY TIMBER 69KV CKT 1	11WP	55	103	738	PITTSBURG - VALLIANT 345KV CKT 1
2016 Summer Peak Model					
BETHEL - BROKEN BOW 138KV CKT 1	16SP	107	186	0	PITTSBURG - VALLIANT 345KV CKT 1
BETHEL - BROKEN BOW 138KV CKT 1	16SP	88	139	0	BASE CASE
BROWN - BROWN 138KV CKT 1	16SP	143	128	0	PITTSBURG - VALLIANT 345KV CKT 1
TUCO INTERCHANGE (TUCO XX4) 345/230/13.2KV TRANSFORMER CKT 1	16SP	560	119	0	GEN:52214 1
OKLAU2 - OKLAUNION 345KV CKT 1	16SP	250	115	0	GEN:52214 1
PECAN CREEK (PECANCK1) 345/161/13.8KV TRANSFORMER CKT 1	16SP	370	114	0	CLARKSVILLE - MUSKOGEE 345KV CKT 1
BETHEL - NASHOBA 138KV CKT 1	16SP	88	133	8	BASE CASE
BETHEL - NASHOBA 138KV CKT 1	16SP	107	179	40	PITTSBURG - VALLIANT 345KV CKT 1
CLAYTON - NASHOBA 138KV CKT 1	16SP	88	131	54	BASE CASE
CLAYTON - NASHOBA 138KV CKT 1	16SP	107	178	55	PITTSBURG - VALLIANT 345KV CKT 1
BROWN TAP - EXPLORER TAP 138KV CKT 1	16SP	143	115	82	PITTSBURG - VALLIANT 345KV CKT 1
CLAYTON - SARDIS 138KV CKT 1	16SP	107	174	86	PITTSBURG - VALLIANT 345KV CKT 1
LONE OAK - SARDIS 138KV CKT 1	16SP	107	170	119	PITTSBURG - VALLIANT 345KV CKT 1
CLAYTON - SARDIS 138KV CKT 1	16SP	88	127	149	BASE CASE
LONE OAK - SARDIS 138KV CKT 1	16SP	88	123	247	BASE CASE
HUGO - VALLEY TIMBER 69KV CKT 1	16SP	48	142	250	PITTSBURG - VALLIANT 345KV CKT 1
ANTLERS TAP - VALLEY TIMBER 69KV CKT 1	16SP	48	142	251	PITTSBURG - VALLIANT 345KV CKT 1
BROWN - RUSSETT 138KV CKT 1	16SP	96	132	272	PITTSBURG - VALLIANT 345KV CKT 1
FULTON - PATMOS 115KV CKT 1	16SP	159	124	282	PITTSBURG - VALLIANT 345KV CKT 1
RUSSETT - RUSSETT 138KV CKT 1	16SP	96	130	328	PITTSBURG - VALLIANT 345KV CKT 1
WILKES 138/21.0KV TRANSFORMER CKT 2	16SP	216	107	353	PITTSBURG - VALLIANT 345KV CKT 1
WILKES 138/21.0KV TRANSFORMER CKT 1	16SP	216	107	353	PITTSBURG - VALLIANT 345KV CKT 1
GEN-2006-38 - HUGO 345/138KV TRANSFORMER CKT 1	16SP	500	172	465	GEN-2006-36 - VALLIANT 345KV CKT 1
HUGO - VALLIANT 138KV CKT 1	16SP	394	144	519	GEN-2006-36 - VALLIANT 345KV CKT 1
LANE - TUPELO 138KV CKT 1	16SP	203	122	541	PITTSBURG - VALLIANT 345KV CKT 1
ANTLERS TAP - MCGEE CREEK TAP 69KV CKT 1	16SP	48	122	557	PITTSBURG - VALLIANT 345KV CKT 1
NICHOLS STATION 230/115KV TRANSFORMER CKT 1	16SP	150	106	575	EAST PLANT INTERCHANGE - HARRINGTON STATION 230KV CKT 1

Table 5: Contingency Analysis (continued)

OVERLOADED ELEMENT	SEASON	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
2016 Summer Peak Model (continued)					
LANE - MCGEE CREEK TAP 69KV CKT 1	16SP	48	118	589	PITTSBURG - VALLIANT 345KV CKT 1
SPPSPSTIES	16SP	899	102	615	BASE CASE
ATOKA - LANE 69KV CKT 1	16SP	48	116	621	PITTSBURG - VALLIANT 345KV CKT 1
FROGVILLE - HUGO POWER PLANT 138KV CKT 1	16SP	324	111	638	PITTSBURG - VALLIANT 345KV CKT 1
FROGVILLE - WEST BANK 138KV CKT 1	16SP	324	110	655	PITTSBURG - VALLIANT 345KV CKT 1
COLBERT4 - KIERSEY 138KV CKT 1	16SP	122	104	675	BROWN - KIERSEY 138KV CKT 1
NICHOLS STATION 230/115KV TRANSFORMER CKT 2	16SP	150	103	681	EAST PLANT INTERCHANGE - HARRINGTON STATION 230KV CKT 1
UNGER - WEST BANK 138KV CKT 1	16SP	324	108	684	PITTSBURG - VALLIANT 345KV CKT 1
BENNINGTON - UNGER 138KV CKT 1	16SP	324	107	691	PITTSBURG - VALLIANT 345KV CKT 1
BENNINGTON - DURANT 138KV CKT 1	16SP	324	105	730	PITTSBURG - VALLIANT 345KV CKT 1
DURANT - SCOLEMN4 138KV CKT 1	16SP	324	102	771	PITTSBURG - VALLIANT 345KV CKT 1
PATTERSON - SOUTH NASHVILLE 138KV CKT 1	16SP	118	101	787	PITTSBURG - VALLIANT 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 generation interconnection request is estimated at $750,000 for Transmission Owner's Interconnection Facilities listed in Table 1. These costs exclude upgrades of other transmission facilities by AEPW, OKGE, SPS, and WFEC listed in Table 3 of which are Network Constraints. As stated earlier, the local projects that were previously queued are assumed to be in service in this Feasibility Study.

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.

The required interconnection costs listed in Table 1 and other upgrades associated with Network Constraints listed in Table 3 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 requests transmission service through Southwest Power Pool's OASIS.

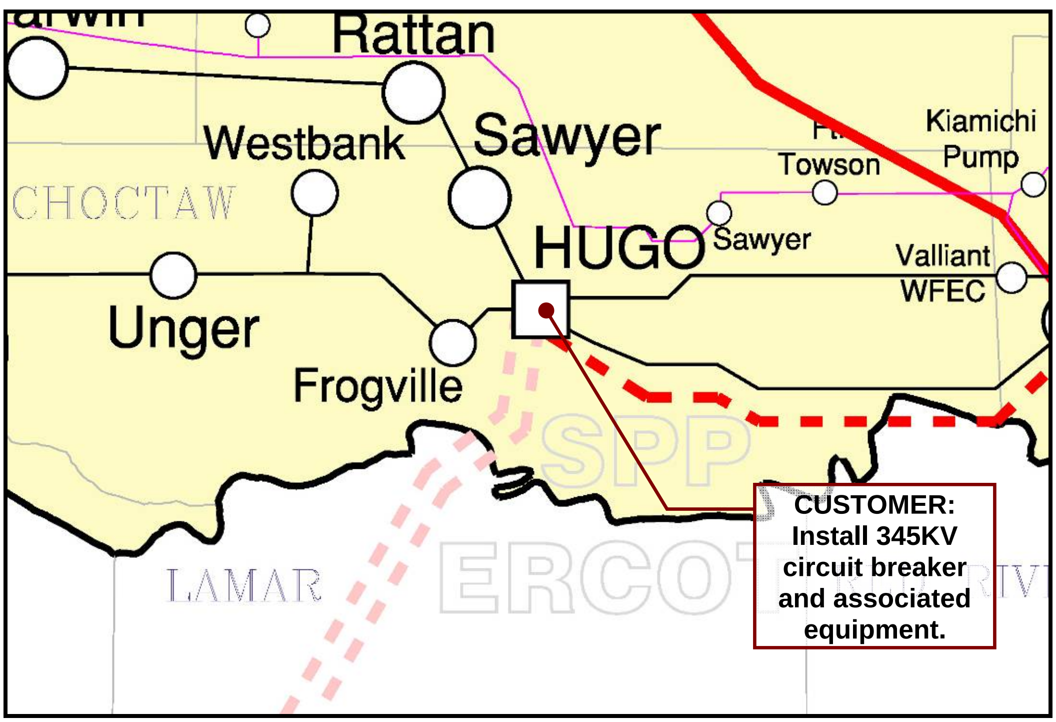

FIGURE 2. MAP OF THE LOCAL AREA