SPP Southwest Power Pool

Feasibility Study For Generation Interconnection Request GEN-2006-017

SPP Tariff Studies
(#GEN-2006-017)

November, 2006

Executive Summary

<OMITTED TEXT> (Customer) has requested a Feasibility Study for the purpose of interconnecting 300MW of generation within the control area of Missouri Public Service (d/b/a Aquila Networks – Missouri Public Service) (MIPU) in Nodaway County, Missouri. The proposed point of interconnection is a new switching station in the existing Maryville – Midway 161kV transmission line. This line is owned by MIPU. The proposed in-service date is April 30, 2008. This request is behind a prior queued request to interconnect into the same point. The prior queued request, GEN-2006-014, is also for 300MW.

Power flow analysis has indicated that for the powerflow cases studied, it is possible to interconnect the 300MW of generation with transmission system reinforcements within the local transmission systems. In order to maintain acceptable reactive power compensation, the Customer will need to install 60Mvars of 34.5kV capacitor banks in the Customer's collector substation on the 34.5kV bus. Dynamic Stability studies performed as part of the 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 requirements to interconnect the 300MW of generation at the new switching station on the Maryville – Midway 161kV line will consist of building a new 161kV ring bus substation that would be used to interconnect both GEN-2006-014 and this request. The method to interconnect one of the requests would consist of a three breaker ring bus substation with terminals to Midway, Maryville, and the generating facility. If both this request and GEN-2006-014 interconnect into the station, a fourth ring bus terminal will be required. It is assumed that obtaining all necessary right-of-way for the new switching station will not be a significant expense.

The total minimum cost for building the three breaker 161kV ring bus substation required for stand alone interconnection is $3,500,000. If the prior queued request signs an Interconnection Agreement, the cost for the incremental interconnection facilities for this request is $800,000. These costs are shown in Table 2 and Table 3. Other Network Constraints in the MIPU, Westar, and AECI transmission systems that may be verified with a transmission service request and associated studies are listed in Table 4. 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 building the 161kV line from the Customer substation into the new 161kV ring bus. This cost does not include the Customer's 161-34.5kV substation or the 60Mvar of 34.5kV capacitor banks.

In Table 5, 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 300MW of generation within the control area of Missouri Public Service (d/b/a Aquila Networks – Missouri) (MIPU) in Nodaway County, Missouri. The proposed method of interconnection is to build a new 161kV ring bus switching station in the existing Maryville – Midway 161kV line owned by MIPU. The proposed in-service date is April 30, 2008.

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.

The Customer originally requested to interconnect into the MIPU Maryville 161kV substation. This request could not be honored to due land constraints in the area of the Maryville substation. The Customer later changed the requested interconnection point to a point on the Maryville – Midway 161kV line at a point as close to Maryville as possible. This point also is the point of interconnection for a prior queued request in the SPP queue. Request GEN-2006-014 also requested interconnection into Maryville substation and subsequently changed to a point on the Maryville-Midway 161kV line.

The requirements for interconnection of the 300MW consist of building a new 161kV ring bus substation in the existing Midway – Maryville 161kV transmission line owned by MIPU. This station will have terminals to Maryville, Midway, the GEN-2006-014 substation, and the Customer substation. This 161kV substation shall be constructed and maintained by MIPU. The Customer has proposed a route of its 161kV line to serve its 161/34.5kV facilities. This interconnection request is the second to request interconnection into at this new switching station. Assuming the prior queued project progresses into an Interconnection Agreement, the incremental facilities to accommodate this Customer's request will be a fourth terminal in the 161kV ring bus at the substation. It is assumed that obtaining all necessary right-of-way for the substation construction will not be a significant expense.

The total cost for building a new 161kV 3-breaker ring switching station is estimated at $3,500,000. If the prior queued Customer drops out of the queue for any reason, this will be the cost assigned to this Request. If the prior queued Customer stays in the queue and advances to an Interconnection Agreement, the cost for adding a fourth terminal is $800,000. Other Network Constraints in the MIPU, Westar, and AECI systems that were identified are listed in Table 3. These estimates will be refined during the development of the impact study based on the final designs. This cost does not include building the 161kV facilities from the Customer substation into the new MIPU 161kV switching station. The Customer is responsible for these 161kV facilities up to the point of interconnection. This cost also does not include the Customer's 161-34.5kV substation, which should be determined by the Customer.

The costs of interconnecting the facility to the MIPU 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.

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 (2006 DOLLARS)
Customer – 161-34.5 kV Substation facilities.	*
Customer – 161kV transmission line facilities between Customer facilities and MIPU 161kV switching station	*
Customer - Right-of-Way for Customer facilities.	*
Customer – 34.5kV, 60MVAR capacitor bank(s) in Customer substation	*
Total	*****

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

Table 2: Required Interconnection Network Upgrade Facilities (assuming prior queued project withdraws)

Facility	ESTIMATED COST (2006 DOLLARS)
MIPU – Build 161kV, 3-breaker ring bus switching station. Station to include breakers, switches, control relaying, high speed communications, all structures and metering and other related equipment	$3,500,000
Total	**$3,500,000**

Table 3: Required Interconnection Network Upgrade Facilities assuming prior queued project stays in the queue)

Facility	ESTIMATED COST (2006 DOLLARS)
MIPU – Add 161kV line and breaker terminal to the ring bus switching station built initially for request GEN-2006-014	$800,000
Total	**$800,000**

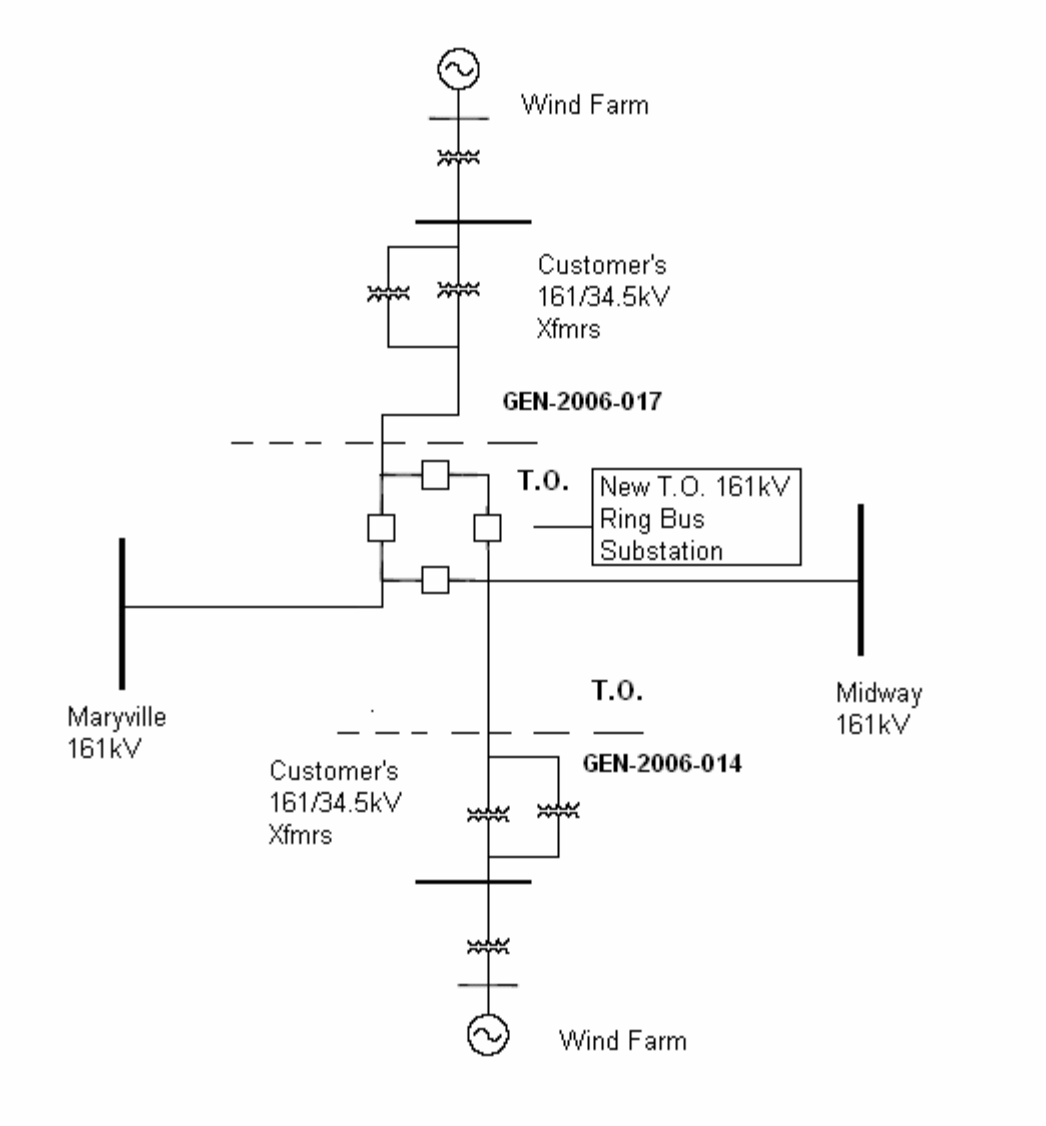

Figure 1: Proposed Interconnection
(Final substation design to be determined

Powerflow Analysis

A powerflow analysis was conducted for the facility using modified versions of the 2008 & 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 April 30, 2008. 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 300MW and location, additional criteria violations will occur on the existing MIPU, Associated Electric Cooperative Inc (AECI), and Westar (WERE) transmission systems under steady state and contingency conditions in the peak seasons.

Issues concerning the feasibility of this request pertain to the 161kV line that the Customer intends to interconnect to. The Maryville – Midway 161kV line has an emergency rating of 182 MVA, which would limit the export of 300MW as well as the 300MW from the prior queued project from the interconnection point. Mitigation of this constraint as well as the other network constraints in Table 4 will be addressed when the Customer requests transmission service for this facility under the SPP OATT.

In Table 5, 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.

In order to maintain a zero reactive power flow exchanged at the point of interconnection, additional reactive compensation is required at the point of interconnection. The Customer will be required to install 60Mvar of capacitor banks in their substation on the 34.5kV buses in the Customer substation. Dynamic Stability studies performed as part of the 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. 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 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 MIPU, Westar (WERE), Kansas City Power & Light (KCPL), NPPD, OPPD, and AECI were applied and the resulting scenarios analyzed. This satisfies the 'more probable' contingency testing criteria mandated by NERC and the SPP criteria.

Table 4: Network Constraints

NETWORK CONSTRAINTS
MIPU - 'ALABAMA5 161 - LAKE ROAD 161KV CKT 1'
MIPU - 'ALABAMA5 161 - NASHUA 161KV CKT 1'
AECI - 'CLRNDA 5 161 - CRESTON5 161 161KV CKT 1'
MIPU – MEC - 'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'
AECI - 'FAIRPORT - NODAWAY 161KV CKT 1'
MIPU - 'G06-14 161 - MARYVILLE 161KV CKT 1'
WERE - 'JARBALO JUNCTION SWITCHING STATION - STRANGER CREEK 115KV CKT 1'
MIPU – AECI - 'MARYVILLE - MARYVILLE 161KV CKT 1'
AECI - 'MARYVILLE - SKIDMORE 69KV CKT 1'
AECI - 'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1'
MIPU - MIDWAY - ST JOE 161KV CKT 1'
AECI - 'MOBERLY TAP - THOMAS HILL 161KV CKT 1'

Table 5: Contingency Analysis

ELEMENT	SEASON	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
2008 SUMMER PEAK					
'G06-14 161 - MARYVILLE 161KV CKT 1'	08sp	182	226.0	0	'BASE CASE'
'G06-14 161 - MIDWAY 161KV CKT 1'	08sp	182	354.4	0	G06-14 161 - MARYVILLE 161KV CKT 1'
'MIDWAY - ST JOE 161KV CKT 1'	08sp	182	343.0	0	G06-14 161 - MARYVILLE 161KV CKT 1'
'MOBERLY TAP - THOMAS HILL 161KV CKT 1'	08sp	372	113.5	0	'AECI-MTL10'
'G06-14 161 - MARYVILLE 161KV CKT 1'	08sp	182	330.3	0	'G06-14 161 - MIDWAY 161KV CKT 1'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1'	08sp	30	130.5	52	'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'
'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	08sp	192	151.1	69	'MARYVILLE - MARYVILLE 161KV CKT 1'
'MARYVILLE - MARYVILLE 161KV CKT 1'	08sp	200	173.2	95	'G06-14 161 - MIDWAY 161KV CKT 1'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'	08sp	50	124.2	137	'FAIRPORT - NODAWAY 161KV CKT 1'
'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	08sp	167	114.5	175	'BASE CASE'
'ALABAMA5 161 - LAKE ROAD 161KV CKT 1'	08sp	153	106.8	179	'HAWTHORN - ST JOE 345KV CKT 1'
'CLRNDA 5 161 - CRESTON5 161 161KV CKT 1'	08sp	146	104.4	235	'CRESTON5 161 - MARYVILLE 161KV CKT 1'
'MARYVILLE - SKIDMORE 69KV CKT 1'	08sp	51.2	107.0	249	'FAIRPORT - NODAWAY 161KV CKT 1'
'G06-14 161 - MIDWAY 161KV CKT 1'	08sp	182	105.0	271	'BASE CASE'
'FAIRPORT - NODAWAY 161KV CKT 1'	08sp	247.3	104.5	275	'G06-14 161 - MIDWAY 161KV CKT 1'
'FAIRPORT - NODAWAY 161KV CKT 1'	08sp	163	102.2	288	'BASE CASE'
2008 WINTER PEAK					
'G06-14 161 - MIDWAY 161KV CKT 1'	08wp	182	353.0	0	G06-14 161 - MARYVILLE 161KV CKT 1'
'MIDWAY - ST JOE 161KV CKT 1'	08wp	182	342.0	0	G06-14 161 - MARYVILLE 161KV CKT 1'
'G06-14 161 - MARYVILLE 161KV CKT 1'	08wp	182	245.0	0	'BASE CASE'
'G06-14 161 - MARYVILLE 161KV CKT 1'	08wp	182	330.1	0	'G06-14 161 - MIDWAY 161KV CKT 1'
'MARYVILLE - MARYVILLE 161KV CKT 1'	08wp	200	189.4	10	'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'
'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	08wp	192	158.1	39	'MARYVILLE - MARYVILLE 161KV CKT 1'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1'	08wp	30	116.0	176	'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'

Table 5: Contingency Analysis

ELEMENT	SEASON	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	08wp	167	110.7	207	'BASE CASE'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'	08wp	50	107.8	234	'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'
2011 SUMMER PEAK					
'G06-14 161 - MIDWAY 161KV CKT 1'	11sp	182	350.8	0	G06-14 161 - MARYVILLE 161KV CKT 1'
'MIDWAY - ST JOE 161KV CKT 1'	11sp	182	340.2	0	G06-14 161 - MARYVILLE 161KV CKT 1'
'G06-14 161 - MARYVILLE 161KV CKT 1'	11sp	182	231.0	0	'BASE CASE'
'JARBALO JUNCTION SWITCHING STATION - STRANGER CREEK 115KV CKT 1'	11sp	240	112.0	0	'CRAIG - STRANGER CREEK 345KV CKT 1'
'G06-14 161 - MARYVILLE 161KV CKT 1'	11sp	182	330.1	0	'G06-14 161 - MIDWAY 161KV CKT 1'
'MOBERLY TAP - THOMAS HILL 161KV CKT 1'	11sp	372	104.6	0	'AECI-MTL10'
'ALABAMA5 161 - LAKE ROAD 161KV CKT 1'	11sp	153	119.6	0	'HAWTHORN - ST JOE 345KV CKT 1'
'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	11sp	192	157.4	39	'MARYVILLE - MARYVILLE 161KV CKT 1'
'MARYVILLE - MARYVILLE 161KV CKT 1'	11sp	200	176.0	50	'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1'	11sp	30	124.8	82	'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'
'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	11sp	167	121.7	111	'BASE CASE'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'	11sp	50	124.4	141	'FAIRPORT - NODAWAY 161KV CKT 1'
'ALABAMA5 161 - NASHUA 161KV CKT 1'	11sp	153	108.6	142	'HAWTHORN - ST JOE 345KV CKT 1'
'MARYVILLE - SKIDMORE 69KV CKT 1'	11sp	51.2	106.3	256	'FAIRPORT - NODAWAY 161KV CKT 1'
'GOLDFLD869.0 - THOR8 69.0 69KV CKT 1'	11sp	41	210.2	273	'HOPE 8 69.0 - HOPE MD869.0 69KV CKT 1'
'HUMBLTE869.0 - THOR8 69.0 69KV CKT 1'	11sp	41	204.8	274	'HOPE 8 69.0 - HOPE MD869.0 69KV CKT 1'
'WRIGHT 5 161 161/69KV TRANSFORMER CKT 1'	11sp	83	150.9	287	'HOPE 8 69.0 - HOPE MD869.0 69KV CKT 1'
'FAIRPORT - NODAWAY 161KV CKT 1'	11sp	163	102.4	287	'BASE CASE'
'WRI MID869.0 - WRIGHT 869.0 69KV CKT 1'	11sp	83	144.3	288	'HOPE 8 69.0 - HOPE MD869.0 69KV CKT 1'
'FAIRPORT - NODAWAY 161KV CKT 1'	11sp	247.3	101.7	291	'G06-14 161 - MIDWAY 161KV CKT 1'
'EAGLGRV869.0 - WRIGHT 869.0 69KV CKT 1'	11sp	90	105.3	299	'HOPE 8 69.0 - HOPE MD869.0 69KV CKT 1'

Table 5: Contingency Analysis

ELEMENT	SEASON	RATE (MVA)	LOADING (%)	ATC (MW)	CONTINGENCY
2011 WINTER PEAK					
'G06-14 161 - MARYVILLE 161KV CKT 1'	11wp	182	330.0	0	'G06-14 161 - MIDWAY 161KV CKT 1'
'MIDWAY - ST JOE 161KV CKT 1'	11wp	182	334.0	0	G06-14 161 - MARYVILLE 161KV CKT 1'
'G06-14 161 - MARYVILLE 161KV CKT 1'	11wp	182	330.0	0	'BASE CASE'
'G06-14 161 - MIDWAY 161KV CKT 1'	11wp	182	344.0	0	G06-14 161 - MARYVILLE 161KV CKT 1'
CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	11wp	192	163.6	15	'MARYVILLE - MARYVILLE 161KV CKT 1'
'MARYVILLE - MARYVILLE 161KV CKT 1'	11wp	200	182.7	29	'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'
'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	11wp	167	126.3	77	'BASE CASE'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1'	11wp	30	122.9	105	'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'	11wp	50	123.4	150	'FAIRPORT - NODAWAY 161KV CKT 1'
2016 SUMMER PEAK					
'G06-14 161 - MARYVILLE 161KV CKT 1'	16sp	182	330.3	0	'G06-14 161 - MIDWAY 161KV CKT 1'
'G06-14 161 - MIDWAY 161KV CKT 1'	16sp	182	343.0	0	G06-14 161 - MARYVILLE 161KV CKT 1'
'MIDWAY - ST JOE 161KV CKT 1'	16sp	182	333.0	0	G06-14 161 - MARYVILLE 161KV CKT 1'
'G06-14 161 - MARYVILLE 161KV CKT 1'	16sp	182	236.0	0	'BASE CASE'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 1'	16sp	30	132.8	6	'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'
'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	16sp	192	160.4	26	'MARYVILLE - MARYVILLE 161KV CKT 1'
'MARYVILLE - MARYVILLE 161KV CKT 1'	16sp	200	177.2	46	'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'
'ALABAMA5 161 - LAKE ROAD 161KV CKT 1'	16sp	153	113.4	68	'HAWTHORN - ST JOE 345KV CKT 1'
'CLRNDA 5 161 - MARYVILLE 161KV CKT 1'	16sp	167	125.7	76	'BASE CASE'
'MARYVILLE (MARYVILL) 161/69/13.8KV TRANSFORMER CKT 2'	16sp	50	127.5	120	'FAIRPORT - NODAWAY 161KV CKT 1'
'MARYVILLE - SKIDMORE 69KV CKT 1'	16sp	51.2	108.2	243	'FAIRPORT - NODAWAY 161KV CKT 1'
'ALABAMA5 161 - NASHUA 161KV CKT 1'	16sp	153	101.5	275	'HAWTHORN - ST JOE 345KV CKT 1'
'FAIRPORT - NODAWAY 161KV CKT 1'	16sp	163	100.9	295	'BASE CASE'

Table 5: Contingency Analysis

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 $3,500,000 for MIPU's interconnection Network Upgrade facilities listed in Table 2. If the prior queued request, GEN-2006-014, signs an Interconnection Agreement, then the incremental costs for Interconnection Facilities for this request are $800,000 as listed in Table 3. These costs exclude upgrades of other transmission facilities by MIPU, Westar, and AECI listed in Table 4 of which are Network Constraints. At this time, the cost estimates for other Direct Assignment facilities including those in Table 1 have not been defined by the Customer. In addition to the Customer's proposed interconnection facilities, the Customer will be responsible for installing 60Mvar of 34.5kV capacitors in the Customer substation for reactive support. Dynamic Stability studies performed as part of the 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).As stated earlier, the local projects that were previously queued are assumed to be in service in this Feasibility Study.

In Table 5, 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 2 and other upgrades associated with Network Constraints listed in Table 4 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.

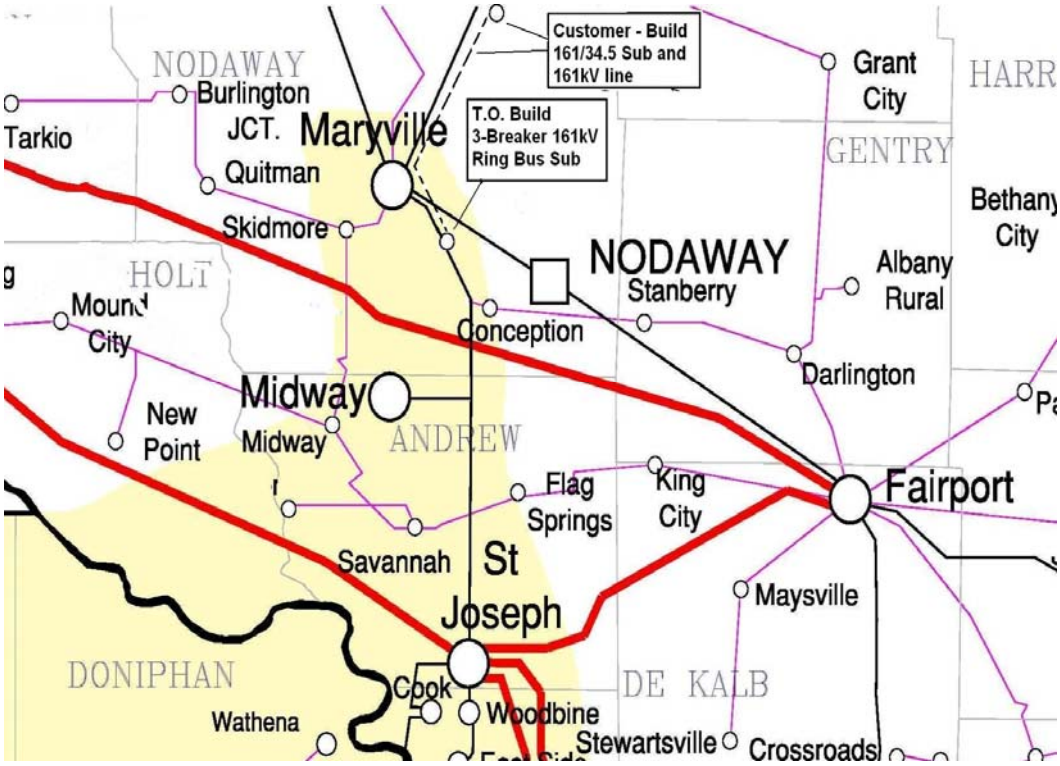

FIGURE 2. MAP OF THE LOCAL AREA