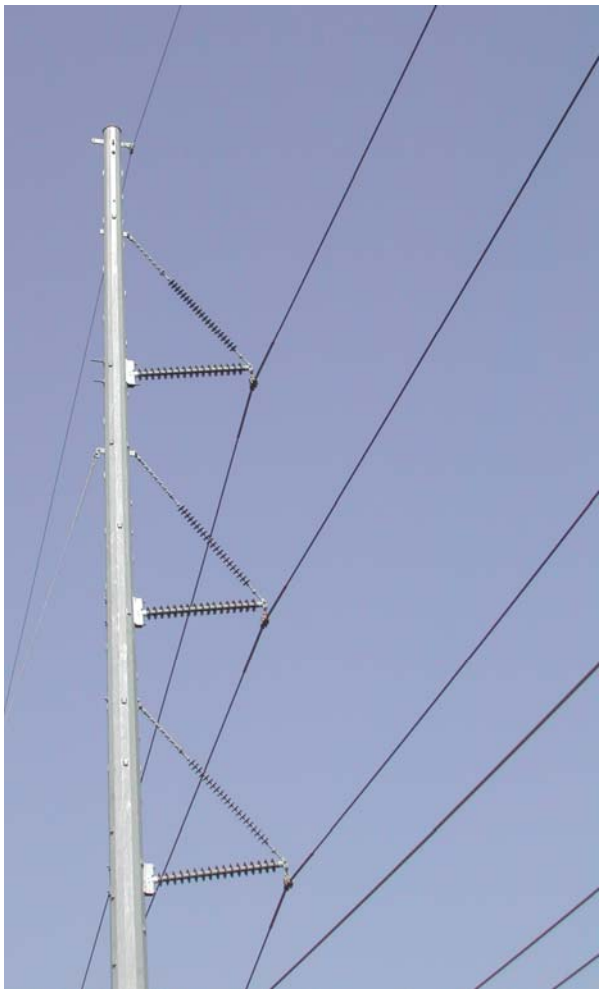
SPP Southwest Power Pool



Ozark Transmission Study

SPP ENGINEERING DEPARTMENT,
PLANNING SECTION

June, 2007

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1. EXECUTIVE SUMMARY

The objective of the Ozark Transmission Study is to develop a long range transmission expansion plan for North Arkansas and South Missouri.

A meeting was held for stakeholders at Southwest Power Pool (SPP) in February, 2006 to discuss transmission expansion alternatives in the Ozark sub-region of SPP. This was precipitated mainly due to high load growth in this region. A study scope was developed through stakeholder collaboration and posted in the study's Internet accessible eRoom. Upgrade projects were also developed through the input of stakeholders. These upgrades were developed into two upgrade options. Both options were tested with a full AC N-1 contingency analysis, a transfer analysis and an economic screening. During the course of the study, some additional runs were requested to determine the impact of proposed new generation in the area and of proposed transmission reinforcements in the area. Overall results showed little difference between the two plans but favored Plan B for lower cost, increased transfer capability and greater economic benefit.

2. INTRODUCTION

A. Background

A meeting was held for stakeholders at Southwest Power Pool (SPP) in February, 2006, to discuss transmission expansion alternatives in the Ozark sub-region of SPP. At this meeting, the stakeholders determined the need for a long range expansion plan due to the rapid load growth and due to the difficulties of building new transmission lines through the Ozark Mountain area.

B. Scope Development

After the initial meeting, SPP prepared a Scope Document and posted it to the project eRoom for stakeholders to review and provide feedback. After incorporating feedback, the final scope of the study was prepared, and posted to the eRoom at https://project1.eroom.net/eRoom/SouthwestPowerPool-RTO-OATT/SPP-ExpansionPlan/0_3066.

The study began by creating models representing medium and heavy loading in the study area, as well as creating models limiting hydro generation to low water levels and with all hydro generation off. N-1 Contingency Analysis would then be performed on these models to determine the extent of violations in the area. Stakeholders would provide possible solutions. SPP would then incorporate the solutions and provide results back to the stakeholders. An economic screening was to be performed using MARKETSYM to screen potential economic projects provided by stakeholders.

3. STUDY METHODOLOGY

A. Models

i. General

The models for the Ozark Transmission Study were derived from the 2006 Expansion Plan. 2016 Summer Peak models (Scenarios 0-4) from the 2006 Expansion Plan were developed into four sets of models which are outlined in the table below.

Models Descriptions	Model Names	Load Level Year
Medium Load	*M	2021
Heavy Load	*H	2026
Hydro Low Water Level	*HL	2016
Hydro Off	*HO	2016

ii. Load Levels

The Medium Load and Heavy Load models were created by increasing load levels by 5 and 10 year's worth of load growth, respectively. These models are not intended to represent the years 2021 and 2026, but rather a general load level in the study area. Generation to power the load was provided by units within SPP first. Any generation shortfall was compensated for by scaling back loads in areas remote from the study area. Load growth percentages were provided by the transmission owners and are summarized in the table below.

Subsystem	Name	Annual Growth Rate	Subsystem	Name	Annual Growth Rate
Zone 131	AECI NW	2.10%	Bus 99806	Clinton West	2.50%
Zone 132	Northeast	1.90%	Bus 99822	Marshall	2.50%
Zone 133	Central	3.30%	Bus 99847	Botkinburg	3.00%
Zone 134	KAMO-MO	2.10%	Bus 99799	Bee Branch	2.75%
Zone 135	KAMO-OK	2.10%	Bus 99807	Clinton Industrial	3.00%
Zone 136	Sho-Me	2.70%	Bus 99519	Quitman	3.00%
Zone 137	M&A	2.20%	Zone 190	AEPW Fayetteville	2.60%
Area 540	MIPU	1.00%	Zone 212	AECC Fayetteville	3.75%
Area 515	SPA	1.00%	Zone 441	Aurora-Republic	2.00%
Bus 52646	Glencoe	2.25%	Zone 444	Joplin	1.50%
Bus 52650	Norfork	2.50%	Zone 445	Webb City	2.10%
Area 523	GRDA	2.00%	Zone 446	Neosho	2.50%
Area 546	SPRM	2.10%	Zone 447	Ozark	3.00%
Zone 161	EES North	1.00%	Zone 449	Hollister	2.50%
Bus 99832	Osage Creek	3.00%			

iii. Vars Added

The Heavy Load cases were relatively unstable in the base cases. To allow them to solve, capacitors had to be added to the models. The additional Vars affect the base case contingency results. The capacitors added are listed in the table below. Note that these capacitors were removed from the model when the upgrades were added. Therefore, the final results are not affected.

Area	Bus Number	Bus Description	Added Capacitors
AEPW	53136	Eureka springs	160 MVar
	53176	Tontitown	200 MVar
	53193	E. Fayetteville	30 MVar
	53157	S. Fayetteville	42 MVar
AECI	96127	Clever	60 MVar
	96129	Washburn	36 MVar
	96718	Clevenger Cove	6 MVar
	96726	Riverdale	96 MVar
	96727	Roark	12 MVar
	97161	Logan	162 MVar

iv. Hydro Generation Levels

For the hydro generation cases, generation at the hydro plants was decreased and generation from outside the study area was brought in to supply the load. Low Water generation levels are listed in the table below.

Plant	Low Water Generation
Beaver	1 x 40MW
Bull Shoals	2 x 40MW
Dardanelle	2 x 35MW
Table Rock	2 x 40MW
Norfork	1 x 30MW
Greer's Ferry	1 x 40MW
Ozark	2 x 20MW

B. Reliability Analysis

An N-1 Contingency Analysis of selected multi-terminal outages and all single-element outages 65kV and above was performed using PTI's PSS/E program. This analysis was performed on the base case models described in section 3.A above. The following subsystems were monitored for violations on lines 65kV and above:

- Areas: MIPU, SPA, GRDA, and SPRM
- Zones: EES North (161), AEPW Fayetteville (190), AECC Fayetteville (212)

- AECI Zones 131-137
- EDE Zones 441, 444-447, and 449

Maps were created showing the violations reported. These maps, along with Excel files of the violations, were posted to the eRoom for stakeholder review and were presented during a WebEx meeting on December 7, 2006. Various upgrades were proposed by SPP and by stakeholders. These proposed solutions were then refined and divided into two upgrade options: Option A and Option B. Additional upgrades were developed to solve most major problems in the study area. The upgrades are mostly 161kV and up and concentrate on solving overloads of lines 161kV and greater, and overloads of transformers 345kV and greater. Some major problems did still exist outside the study area. Refer to Appendix A - Major Issues Identified for a list of the major issues identified in the base cases and fixed by the upgrades. Maps and details of the upgrades were posted in the eRoom and were presented in a WebEx meeting on April 19, 2007.

C. Planned Generation and Upgrades

During the course of the study, some additional runs were requested to determine the impact of proposed new generation in the area and of anticipated transmission reinforcements in the area. N-1 contingency analyses were run for both of these requests and spreadsheets of the results were posted to the eRoom for stakeholder review.

D. Transfer Capability

Upgrade options A and B were screened using PTI's MUST program (see Appendix B - MUST Solution Settings) via calculation of First Contingency Incremental Transfer Capability (FCITC) DC import and export capability to the following identified subsystems:

- Ozark
  - Areas: MIPU, SPA, GRDA, and SPRM
  - Zones: EES North (161), AEPW Fayetteville (190), AECC Fayetteville (212)
  - AECI Zones 131-137
  - EDE Zones 441, 444-447, and 449
- East
  - AMRN
  - LGEE
  - TVA
- North
  - MEC
  - NPPD
  - OPPD
- Wind
  - SUNC
  - SPS
- Outsideworld
  - All non-SPP areas
- SPP, AMRN, ENTR, SPS, WR

Transfer directions and test levels used were as listed in the table below:

Transfer Direction	Test Level
AMRN > OZARK	8,000 MW
ENTR > OZARK	8,000 MW
SPS > OZARK	5,000 MW
WR > OZARK	6,000 MW
EAST > SPP	8,000 MW
ENTR > SPP	10,000 MW
NORTH > SPP	2,700 MW
OUTSIDEWORLD > SPP	40,000 MW
SPP > EAST	13,000 MW
SPP > ENTR	13,000 MW
SPP > NORTH	9,000 MW
SPP > OUTSIDEWORLD	13,000 MW
WIND > EAST	5,000 MW

For all MUST runs, most export participation points were selected via scale for export (i.e., Pmax-Pgen). Due to the high generation levels in the models, as mentioned in section 3.A.ii above, the AMRN, SPS, WR, and Wind export subsystems did not have much generation left to export. Therefore "scale all load" was used for these. All import points were selected via scale for import (i.e., Pgen-Pmin). Generators excluded by the NERC IDC (e.g., nuclear units) were excluded from import. A 3% distribution factor cut-off was used to eliminate noise and to lessen the focus on local area problems. All facilities 161kV and above for SPP and first tier control areas were monitored. Selected multi-terminal outages and single 161kV and above contingencies for SPP and first tier control areas were simulated. All flowgates were excluded from the results since their ratings would not be valid so far into the future. All the input and output files associated with this screening analysis were posted on the eRoom.

E. Economic Screening

For the economic screening, Henwood's PROSYM/MARKETSYM package was used in conjunction with PowerWorld's OPF package. Runs were made in AC mode so that the effect of losses would be accurately captured. SPP and first tier 100kV and above elements under normal conditions and flowgates taken from the SPP Available Flowgate Capacity (AFC) process were monitored. Additional flowgates that were identified in the transfer capability screening were also monitored, as appropriate. Full runs were made for 2011 Summer only since this was for screening purposes. Production Cost Savings (i.e., Production Cost = Dispatch Cost + Violation Cost) for Plans A and B were compared. Violation Costs are used as a surrogate for Transmission Loading Relief.

Every other hour of a typical week was used for the PROSYM run. A base MARKETSYM run was made. The Optimal Power Flow area for the run included SPP and first tier companies. Then a change case was created for each plan. A MARKETSYM run was made for each change

case. Comparing the base to the change case, the total production cost savings was extracted. A ten-year savings estimate was then made by calculating the savings over the period. The present worth of the future savings over a ten-year period was then calculated using an 8% discount rate.

SPP believes the results of this analysis to be very conservative. The analysis did not attempt to capture the benefit to load. Additionally, the analysis ignores incremental impacts of unit recommitment which may be possible after an upgrade. In reality, units would be recommitted based on a large increase in transfer capability across the system. Expensive units needed for security would be displaced by lower cost resources, if available. This benefit is not captured in this analysis. Because of these reasons, the true benefits across the entire study region would be significantly greater than are stated in this Study.

4. FINDINGS

The reliability analysis showed many major overloads throughout the study area. Many of the overloads resulted from the hydroelectric plant outage cases.

The Northwest Arkansas area had many overloads in the medium-load cases, a base-case overload on the Chamber Springs – Clarksville 345kV, and voltage instability in both heavy-load and hydro outage cases. Based on the pattern of overloads in this area, it appears that large power sources are needed on the East and North sides of the area, and that additional 345kV or 500kV sources are needed to bring power into the area. The 345kV loop around Northwest Arkansas and the new lines from Arkansas Nuclear One and from Springfield are intended to address this need.

The Springfield area also had many overloads in the medium-load and hydro cases including voltage instability in the heavy-load cases. Based on the overloads in this area, it appears that a source is needed on the East side of Springfield, and reinforcements are needed between Springfield and Branson. The 345kV/500kV loop around Springfield and the line to Table Rock are intended to address this need.

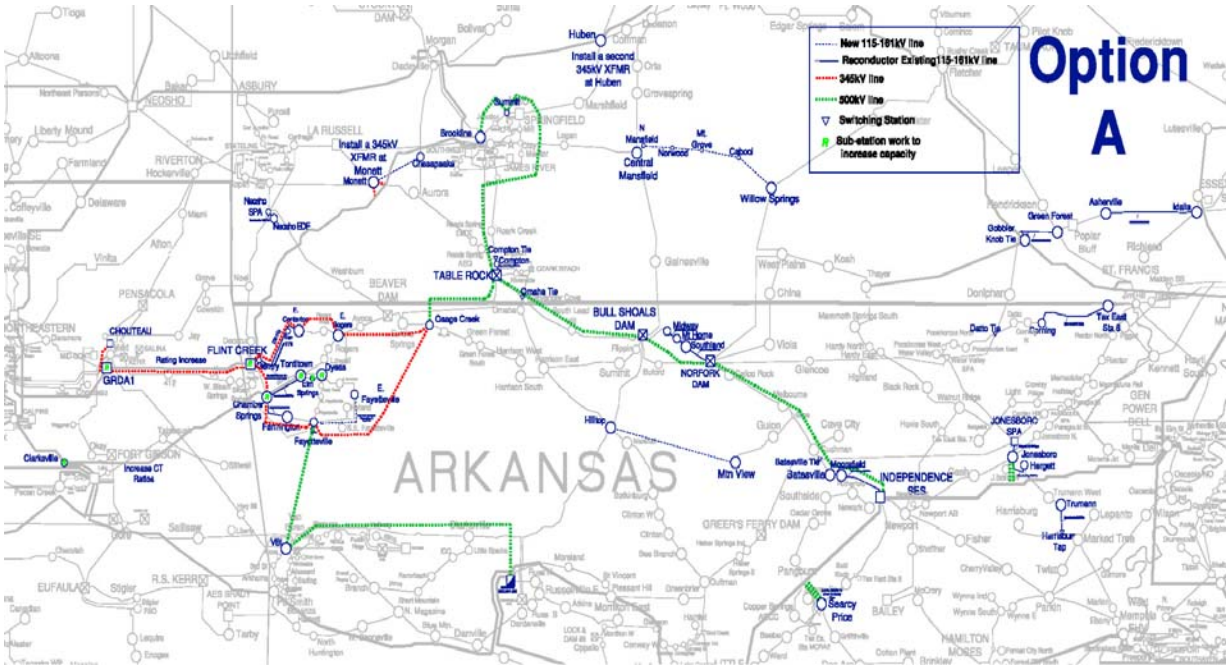
The North Central Arkansas area had many overloads in the medium-load and hydro cases. Based on these overloads and the high load levels in this area, it appears that sources are needed across this area. The 345kV/500kV line across North Central Arkansas is intended to address this need with the connection to Thayer or Independence allowing greater flow into this area. Altogether this also provides an additional source into the Northwest Arkansas area.

The Northeast Arkansas area had many overloads in the medium-load and hydro cases including voltage instability in the heavy load case. Based on the pattern of overloads in this area, it appears that additional sources are needed in both the Jonesboro and Searcy areas. Currently these high-load areas are fed by a limited number of 161kV lines. Adding a stronger source to the area would help relieve the overloads. The 500kV transformers at Jonesboro and Searcy Price are intended to address this need.

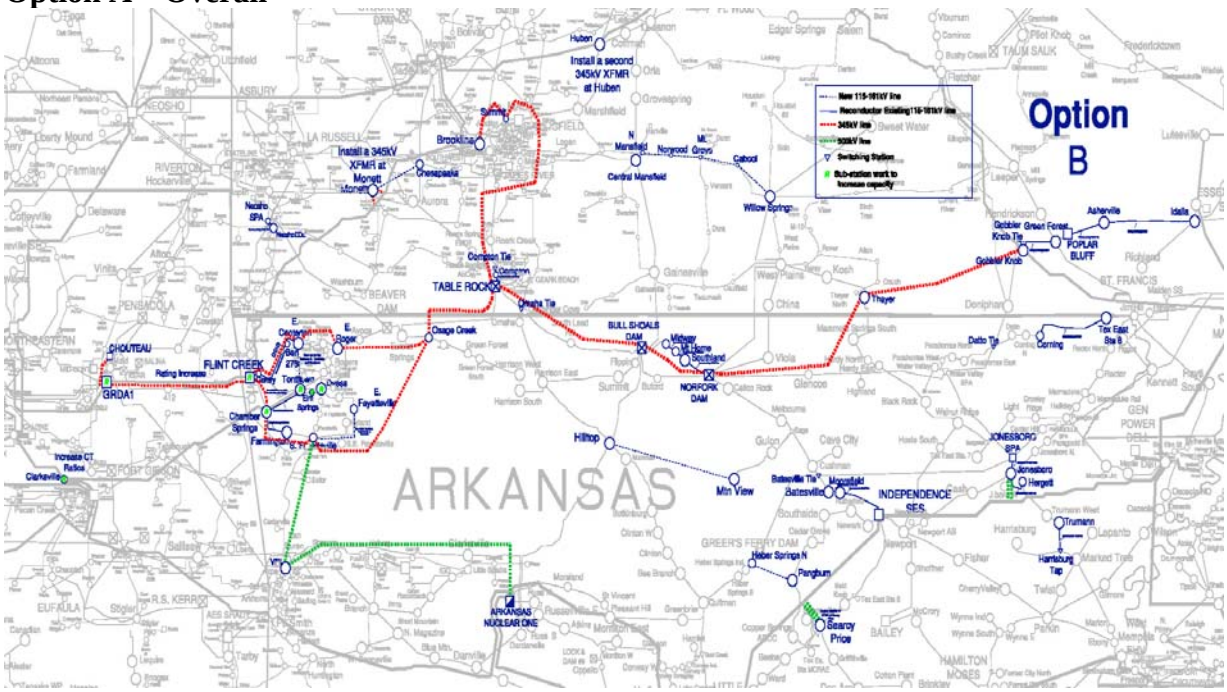
5. RESULTS OF ANALYSIS

A. Reliability Analysis

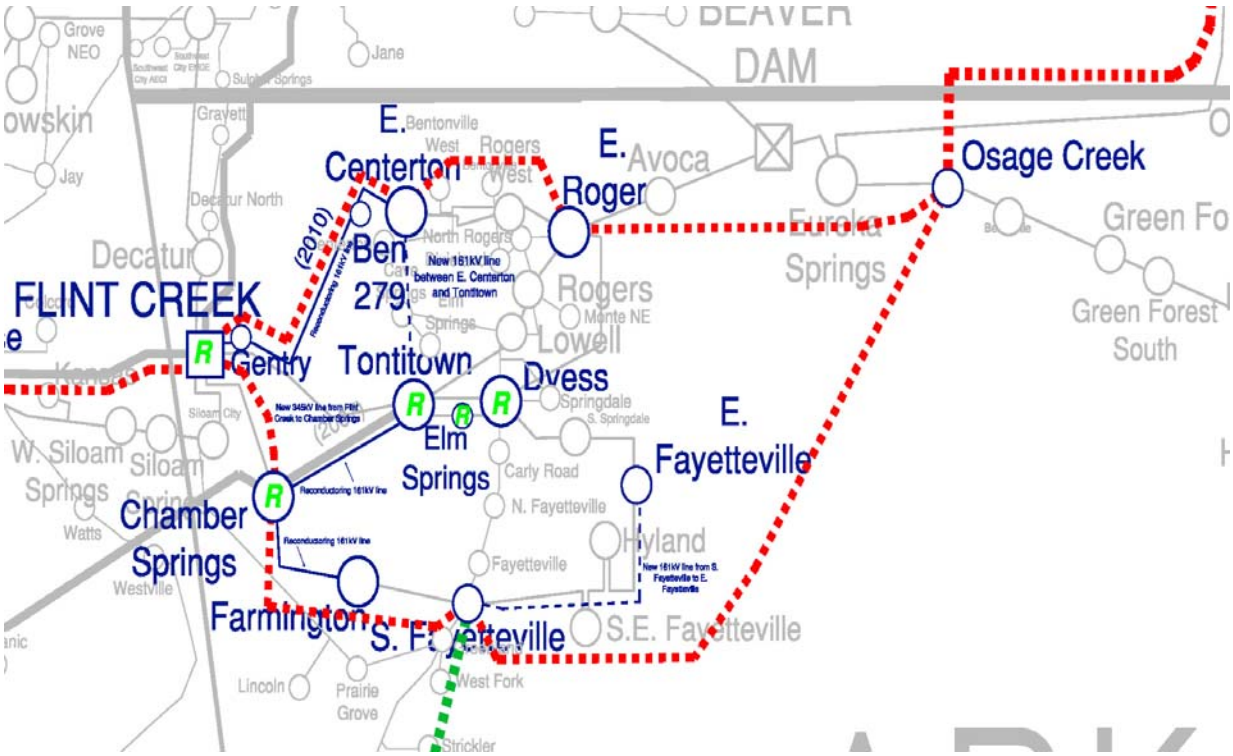
Following maps illustrate the proposed upgrades to fix overloaded lines 161kV and higher in all the scenarios studied.



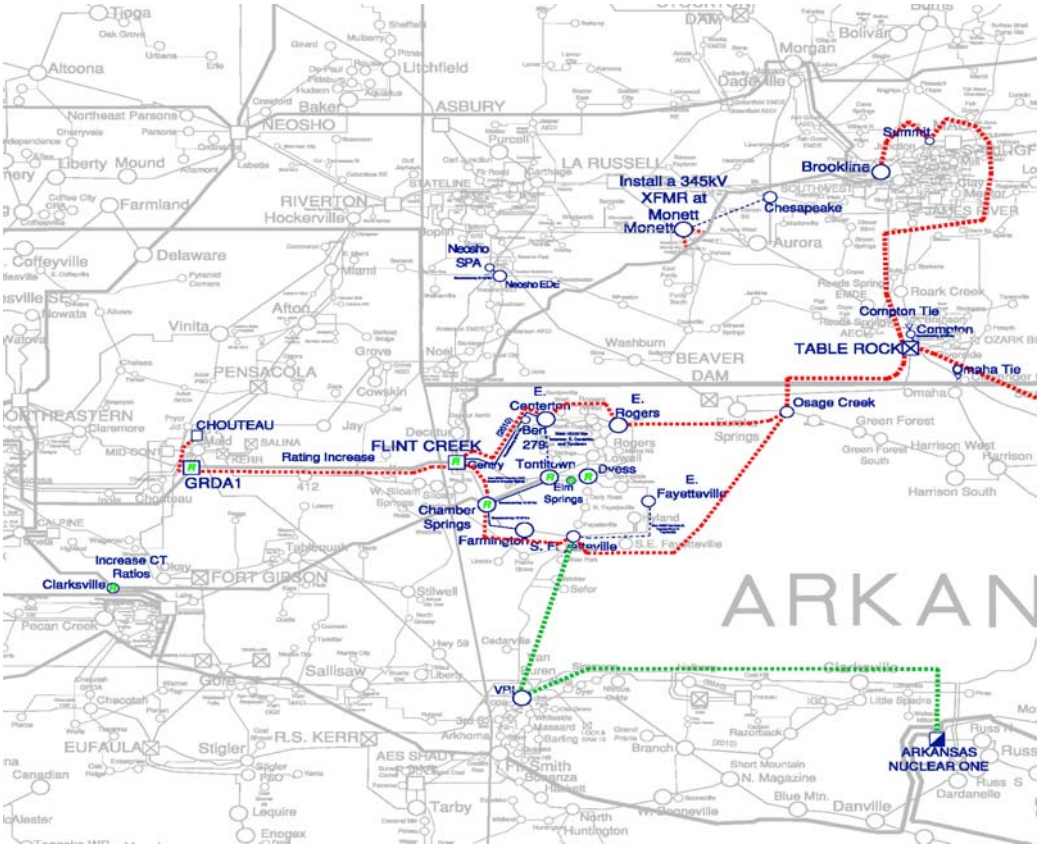
Option A – Overall



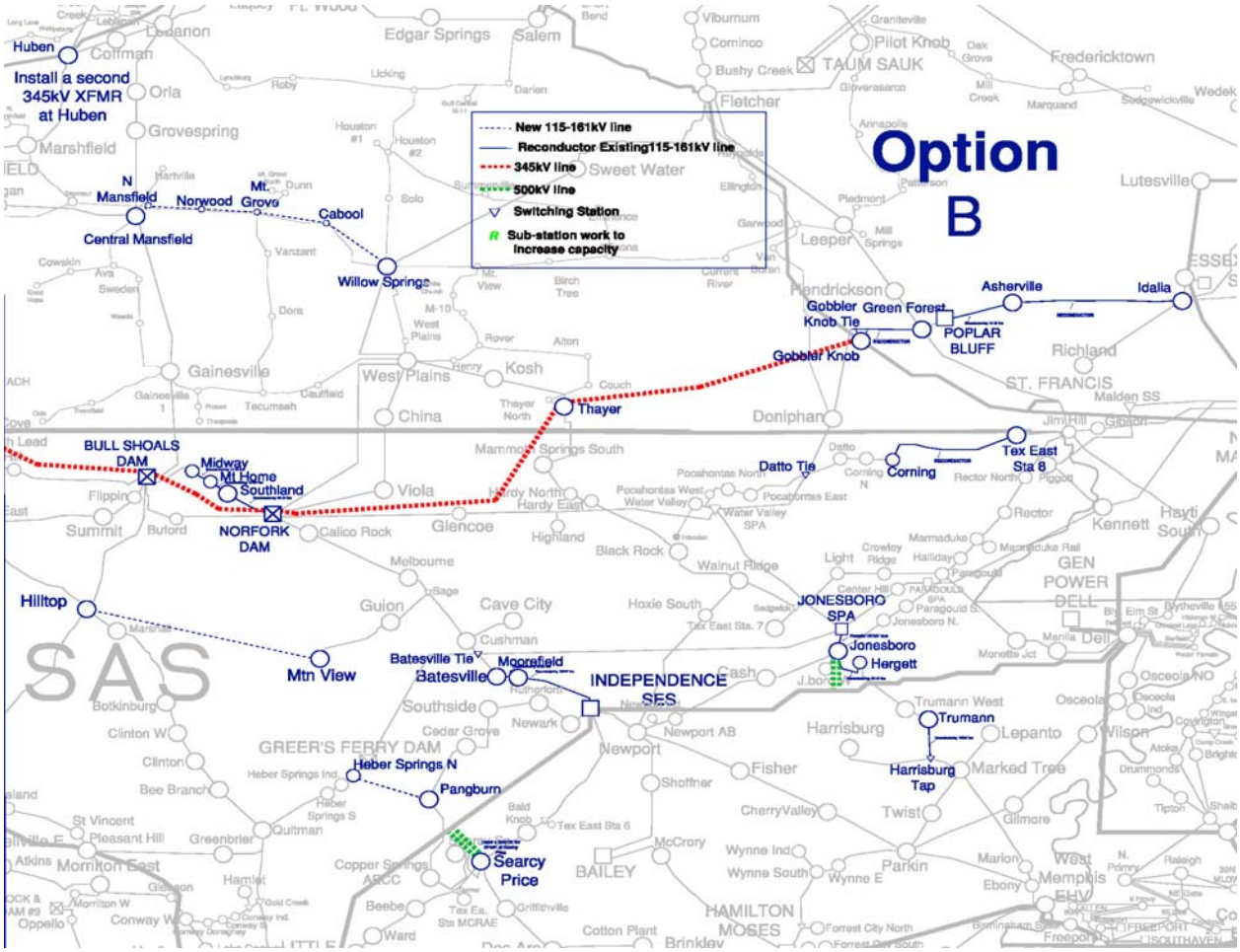
Option B – Overall



Option B – Northwest Arkansas Region



Option B –Missouri/Oklahoma/Arkansas Region



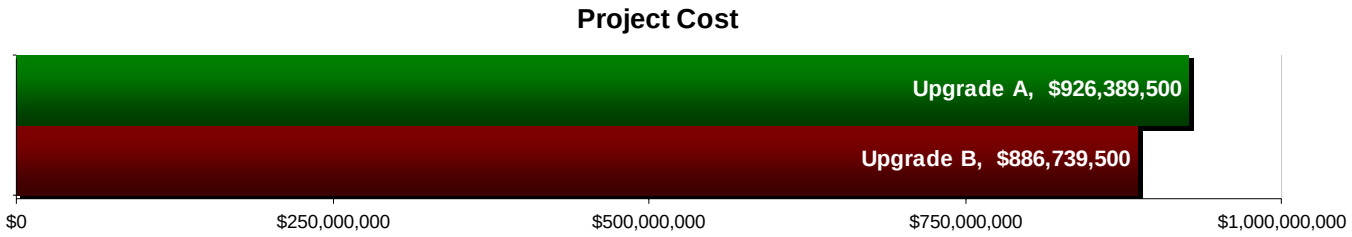
Option B –Southeast Missouri / Northeast Arkansas Region

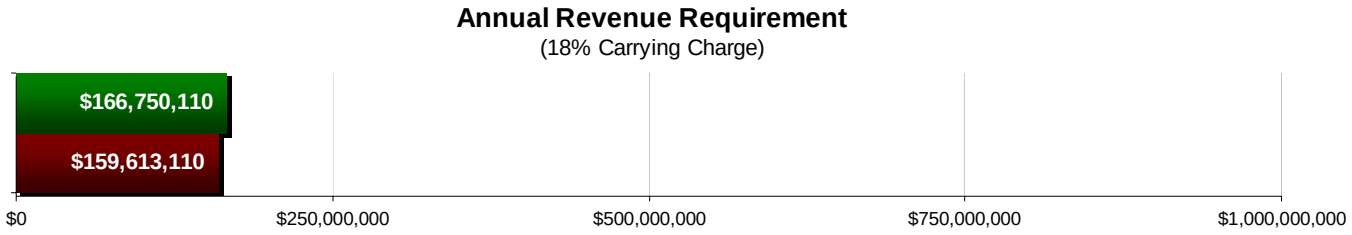
Following is a table listing the proposed upgrades to fix overloaded lines 161kV and higher in all the scenarios studied.

Upgrades Common to Both Options A & B	Upgrades Common to Both Options A & B
Northwest Arkansas	**Southeast Missouri**
ANO - S Fayetteville 500kV	Datto 161kV Tie
E Centerton - Osage Creek - S Fayetteville - Chamber Springs 345kV	Corning - TX Eastern 8 115kV Reconductor
Flint Creek - Chouteau 345kV	Gobbler Knob 161kV Tie
GRDA1 - Flint Creek 345kV rating increase	Green Forest - Gobbler Knob 161kV Reconductor
Tontitown - Elm Springs 161kV rating increase	Asherville - Idalia 161kV Reconductor
Tontitown - Dyess 161kV rating increase	**Northeast Arkansas**
Clarksville - Chamber Springs 345kV increase CT	Jonesboro 500/161kV Transformer
Chamber Springs - Tontitown 161kV Reconductor	Jonesboro - Jonesboro SPA 161kV Rebuild
Flint Creek - Chamber Springs 345kV	Jonesboro - Hergett 161kV Reconductor
Flint Creek - E Centerton 161kV Reconductor	Harrisburg Tap - Truman 161kV Reconductor
S Fayetteville to E Fayetteville 161kV	Batesville 161kV Tie
Chamber Springs - Farmington 161kV Reconductor	
Southwest Missouri	
Neosho SPA - Neosho EDME 161kV Reconductor	
Monett 345/161kV Transformer	
Monett - Chesapeak 161kV	**Upgrades to Option A Only**
Compton 161kV Tie	Brookline - Summit - Table Rock - Osage Creek 500kV
Compton Tie - Table Rock 161kV Reconductor	Table Rock - Bull Shoals - Norfork - Independence 500kV
Omaha 161kV Tie	
South Central Missouri / North Central Arkansas	
Huben 345/161kV Transformer	
Willow Springs - Mansfield 161kV	**Upgrades to Option B Only**
Norfork - Midway 161kV Reconductor	Brookline - Summit - Table Rock - Osage Creek 345kV
Hilltop – Mountain View 161kV	Table Rock - Bull Shoals - Norfork - Thayer - Gobbler Knob 345kV
Batesville N - ISES 161kV Reconductor	E Centerton - Tontitown 161kV
Searcy Price 500/161kV Transformer	Asherville - Poplar Bluff 161kV Reconductor
Searcy Price 161/115kV Transformer	Heber Springs N - Pangburn 161kV

The table at right summarizes the total quantities and costs of upgrades by transformers and line voltage. As noted before, these upgrades do not fix all problems. They focus on solving larger problems inside the study area. Option A includes a total of 7,060 MVA of autotransformers, while Option B includes 6,660 MVA. This compares to 3,845 MVA total increased area load for the Heavy Load cases. Relative cost of the two upgrade options is graphed below. Annual revenue requirements based on an 18% carrying charge rate are also shown below.

Upgrade Type	Option A		Option B	
	Qty	Cost	Qty	Cost
Autotransformers	20	$181,395,000	19	$171,195,000
115kV Lines	20mi.	$ 7,500,000	20mi.	$ 7,500,000
161kV Lines	206mi.	$101,934,500	238mi.	$116,244,500
345kV Lines	168mi.	$176,950,000	390	$409,400,000
500kV Lines	350mi.	$458,610,000	152mi.	$182,400,000
Total Cost		**$926,389,500**		**$886,739,500**





A more detailed cost estimate of the upgrade projects can be found in Appendix C - Cost Estimates. These costs are based on today's best estimated cost, and are listed in the "Generic Costs" table at right. Appendix A - Major Issues Identified lists the major issues which were fixed by these upgrades. There are some facilities in Central Missouri that are still unsolved. These facilities were considered to be outside the study area; however, they are noted in the list.

Generic Costs	
Upgrade	**Cost**
115 - 161 kV Breakers (2)	$750,000
115-138 kV Line/mile	$375,000
161 kV Line/mile	$450,000
230 kV Line/mile	$562,500
345 kV Breakers (2)	$1,500,000
345 kV Line/mile	$1,000,000
500 kV Line/mile	$1,200,000
69 kV Line/mile	$300,000
765 kV Line/mile	$1,500,000
Bulk Transformer	$7,500,000
Capacitors per Mvar	$27,000
Replace CTs	$50,000
Switch or Terminal Jumper	$75,000
Wavetrap	$150,000
Transformers per MVA	$15,000

B. Transfer Capability

The FCITC results showed that there were some facilities that limited some paths to zero transfer capability. All zero-FCITC limits were skipped until valid positive FCITCs were found. The limits which were skipped are:

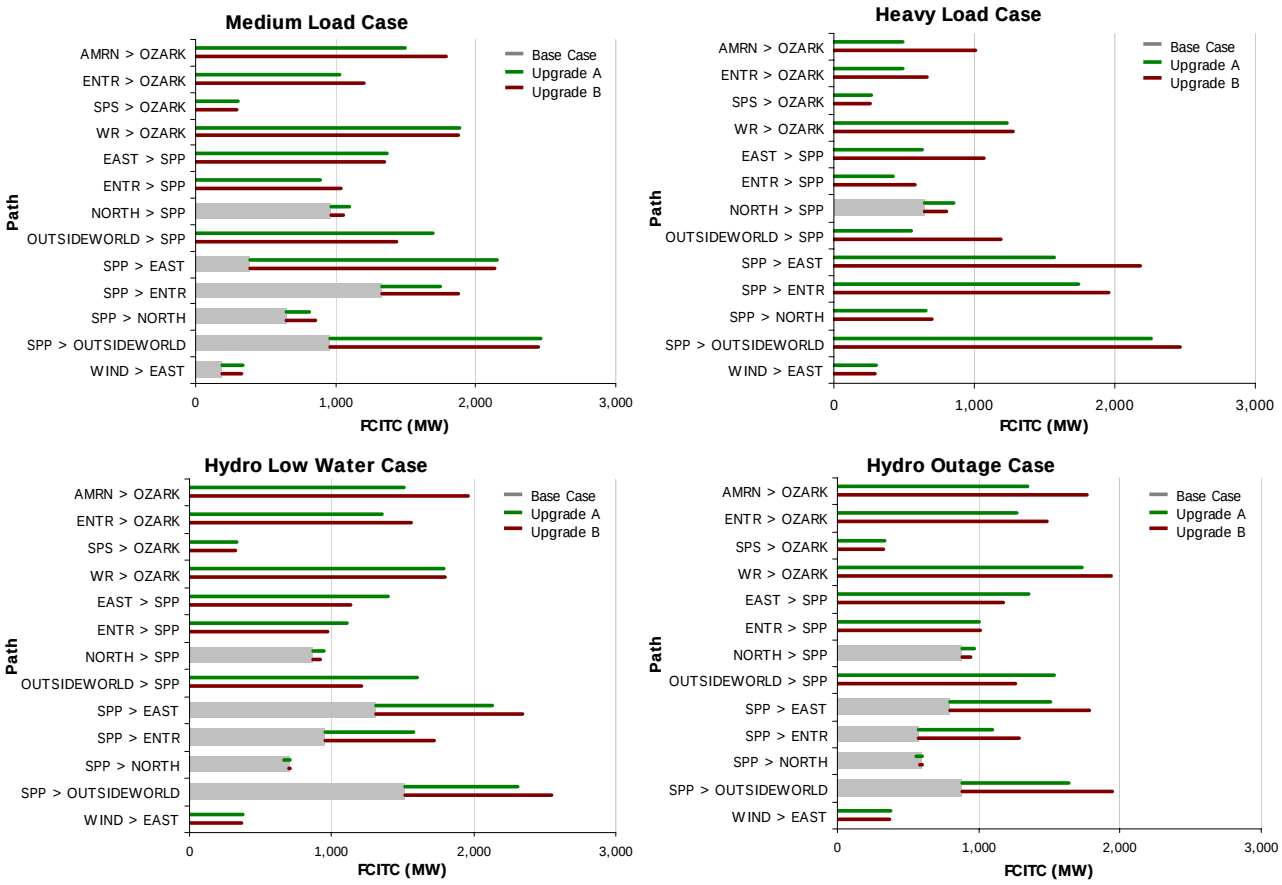
- Iatan – St Joe 345kV
- Midway – St Joe 161kV
- Maryville – Nodaway 161kV

These occurred in the paths: Wind > East, SPS & WR > Ozark, SPP > East & North & Outsideworld. They would likely be relieved by the proposed Iatan – Nashua 345kV project.

Following is a summary table of the FCITC results for the two upgrade options.

Path	FCITC											
	Heavy			Medium			Hydro Low			Hydro Outage		
	Base Case	Upgrade A	Upgrade B	Base Case	Upgrade A	Upgrade B	Base Case	Upgrade A	Upgrade B	Base Case	Upgrade A	Upgrade B
AMRN > OZARK	0	491	1011	0	1494	1794	0	1507	1961	0	1343	1764
ENTR > OZARK	0	487	667	0	1029	1198	0	1357	1561	0	1270	1486
SPS > OZARK	0	266	260	0	300	295	0	332	326	0	332	326
WR > OZARK	0	1229	1279	0	1888	1874	0	1789	1798	0	1730	1937
EAST > SPP	0	634	1068	0	1363	1349	0	1400	1133	0	1356	1178
ENTR > SPP	0	422	576	0	890	1034	0	1111	969	0	999	1008
NORTH > SPP	644	854	805	969	1094	1059	868	948	922	882	966	940
OUTSIDEWORLD > SPP	0	554	1192	0	1693	1434	0	1605	1209	0	1530	1257
SPP > EAST	0	1566	2185	390	2149	2131	1312	2131	2344	799	1507	1779
SPP > ENTR	0	1741	1960	1327	1747	1873	959	1578	1719	577	1099	1286
SPP > NORTH	0	655	700	648	814	855	712	664	696	600	555	586
SPP > OUTSIDEWORLD	0	2263	2468	956	2466	2448	1518	2306	2550	880	1639	1944
WIND > EAST	0	300	293	187	339	333	0	375	369	0	377	370

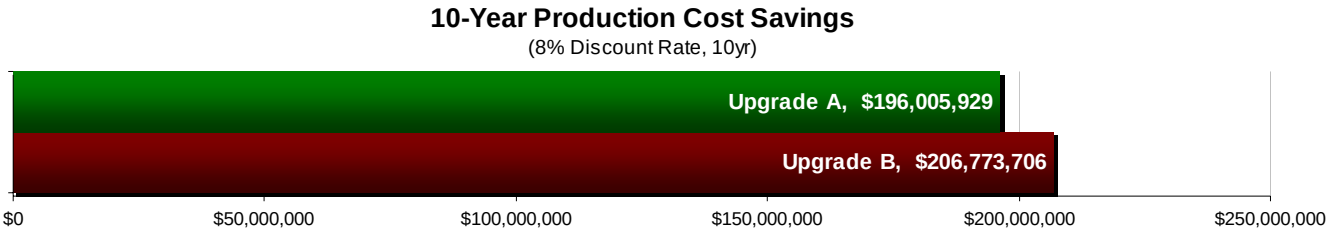
The graphs below show the FCITC for each of the upgrade cases. This visually shows the transfer capability benefits of one plan versus the other.



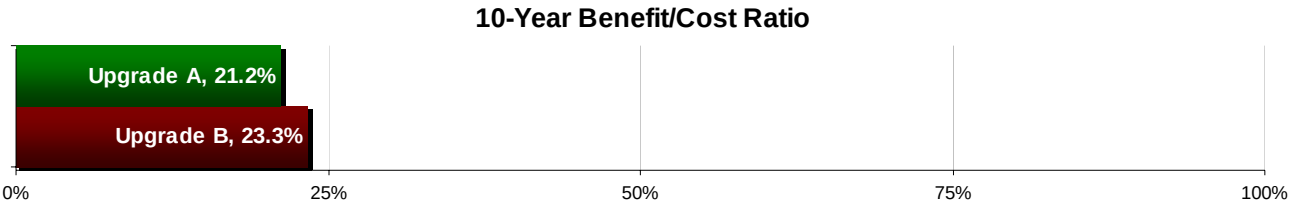
As can be seen in these graphs, upgrade options A and B exhibit similar transfer capability with option B being slightly better in most cases.

C. Economic Screening

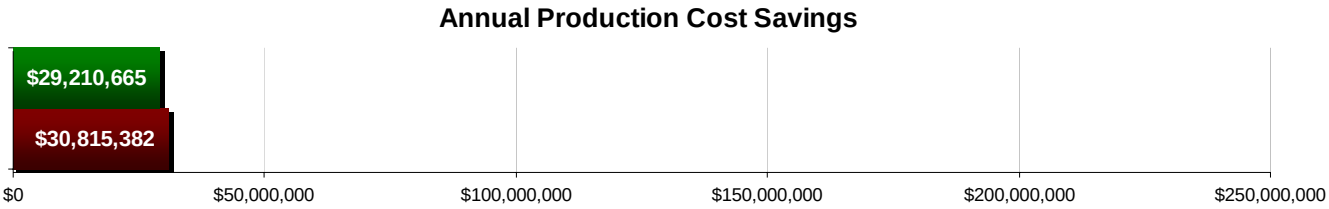
The following graph shows the production cost savings for both options. The savings is a ten-year savings calculated with an 8% discount rate. The savings comparisons are for upgrade option A minus the base and for upgrade option B minus the base case.

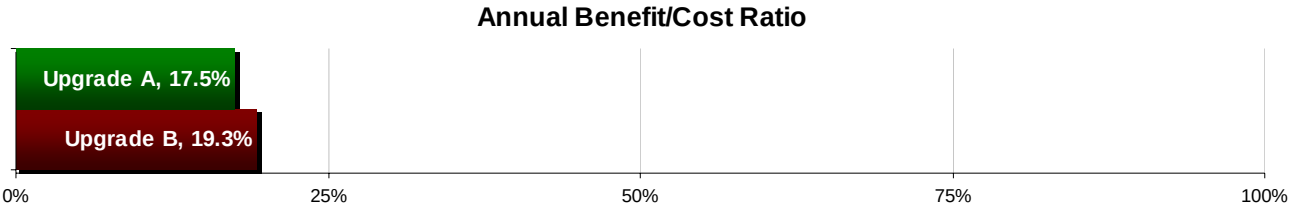


Based on this cost savings and the estimated project costs, the 10-Year Benefit/Cost ratios for the two options are shown below.



Similarly, the annual savings and Benefit/Cost ratios are shown below.





Upgrade A has a slightly lower cost savings and a slightly worse Benefit/Cost Ratio than Upgrade B.

6. RECOMMENDATIONS AND CONCLUSIONS

Upgrade Option B is the recommended transmission expansion alternative for the Ozark sub-region. Option B has economic advantages compared Option A. Option B is recommended based on its lower cost, greater transfer capability and greater production cost savings. These differences are small, but they consistently favor Option B.

During the study, there were requests for project construction phasing information. Timing of projects so far in the future is limited by the load forecast and would be very inaccurate. Generally, the loop around Northwest Arkansas is needed early. Then, the backbone line should be extended into the Springfield region. The line should then extend eastward. The line from Arkansas Nuclear One can be one of the last sections built. The Jonesboro 500/161kV transformer and most of the smaller upgrades are needed early, but the Searcy Price 500kV transformer can wait until a later time. In fact, the Searcy Price project may be replaced by another proposed project to put a 500kV transformer at Cabot. This Cabot project is currently being considered, though not committed to, by Entergy. The relief provided by many of the smaller 161kV projects would likely help to postpone the in-service date for parts of the backbone.

The Ozark Transmission Study provides a long range transmission expansion plan for the North Arkansas and South Missouri region. The upgrades evaluated in this study are intended to provide guidance for future reinforcements to the transmission system in this area.

It must be noted that analysis results are subject to change as other upgrades are added to the area.

7. APPENDICES

Appendix A - Major Issues Identified

Results –Major Issues for Upgrade Option A

Key:
Black entries were existing issues which remain and are not fixed by the upgrades
Green entries were existing issues which have been relieved due to the upgrades

NW Ark Major Issues:
Voltage instability in Hydro Outage and Heavy Load cases during Flint Creek to GRDA1 345kV line outage
And voltage instability in Heavy Load case during outage of Chamber Springs to Clarksville 345kV line outage
Chamber Springs to Farmington 161kV
Chamber Springs to Clarksville 345kV
Chamber Springs Xfmr
Flint Creek to Gentry 161kV
Gentry to Ben279 161kV
Ben279 to East Centerton 161kV
Flint Creek to Tontitown 161kV
Chamber Springs to Tontitown 161kV
Tontitown to Dyess 161kV
Tontitown to Elm Springs 161kV
Elm Springs to Dyess 161kV
Dyess to S. Springdale 161kV
E. Fayetteville to Hyland 161kV
Hyland to S.E. Fayetteville 161kV
S.E. Fayetteville to S. Fayetteville 161kV
E. Rogers to Avoca to Beaver Dam 161kV
Beaver Dam to Eureka Springs to Osage Creek 161kV

SW MO Major Issues:
Beaver Dam to Washburn to Neosho(SPA) 161kV
Riverton to Oronogo Jct 161kV
Stateline to Joplin 161kV
Carthage to Atlas Junction 161kV
La Russell to Monett 161kV
Tipton Ford to Monett 161kV
Monett to Aurora 161kV
Aurora to Reeds Spring 161kV

W MO Major Issues:
Clinton to Osceola 161kV
Osceola to Collins 161kV
Collins to Stockton Dam 161kV

Central MO Major Issues:
Camdenton to Whispering Oaks 161kV
Whispering Oaks to Huben 161kV
Huben Transformer
Apache Tap to Barnett 161kV
Barnett to Eldon 161kV
Franks to Ft. Wood 161kV
Salem Transfromer
Sullivan to Pea Ridge138kV

S MO Major Issues:
Voltage Instability in Heavy Load case during outage of Brookline to Morgan 345kV
Springfield to La Russell 161kV
Table Rock to Nixa 2 to Springfield 161kV
Battlefield AECI to Clever 161kV
Brookline to Springfield 161kV
Springfield to Nixa 161kV
Nixa to Jamesville161kV
Jamesville to Riverdale 161kV
Brookline Transformer
Southwest to Battlefield 161kV
Battlefield to Main 161kV
Huben to Marshfield 161kV

N AR Major Issues:
Harrison East to Hilltop 161kV
Harrison East to Summit 161kV
Flippin to Bull Shoals 161kV
Bull Shoals to Midway 161kV
Mt Home to Southland 161kV
Southland to Norfork 161kV
Norfork to Calico Rock 161kV
Calico Rock to Melbourne 161kV
Melbourne to Sage 161kV
Greer's Ferry to Jonesboro SPA 161kV
Norfork to Glencoe 161kV
Glencoe to Water Valley 161kV

NE AR Major Issues:
Voltage Instability in Heavy Load case during outage of Independence SES to Moorefield 161kV
Greer's Ferry to Jonesboro SPA 161kV
Independence SES to Moorefield 161kV
Moorefield to Batesville 161kV
Southside to Rutherford 161kV
Newport to Newport Ind. 161kV
Newport Ind. to Newport AB 161kV
Newport AB to Cash 161kV
Hoxie South to Walnut Ridge 161kV
Jonesboro SPA to Jonesboro 161kV
Jonesboro to Hergett 161kV
Hergett to Trumann West 161kV
Trumann West to Trumann 161kV
Trumann to Harrisburg Tap 161kV
Harrisburg Tap to Marked Tree 161kV
Jonesboro to Jonesboro N. 161kV
Jonesboro N. to Paragould S 161kV
Paragould S to Paragould 161kV
Paragould to Monett Jct. 161kV
Monett Jct. to Manila 161kV
Manila to Dell 161kV
Datto to Corning N to Corning to Tex East Sta 8 to Jim Hill 115kV

SE MO Major Issues:
Kosh to Thayer 161kV
Poplar Bluff to Asherville 161kV
Asherville to Idalia 161kV

Results – Major Issues for Upgrade Option B

Key:
Black entries were existing issues which remain and are not fixed by the upgrades
Green entries were existing issues which have been relieved due to the upgrades

NW Ark Major Issues:
Voltage instability in Hydro Outage and Heavy Load cases during Flint Creek to GRDA1 345kV line outage
And voltage instability in Heavy Load case during outage of Chamber Springs to Clarksville 345kV line outage
Chamber Springs to Farmington 161kV
Chamber Springs to Clarksville 345kV
Chamber Springs Xfmr
Flint Creek to Gentry 161kV
Gentry to Ben279 161kV
Ben279 to East Centerton 161kV
Flint Creek to Tontitown 161kV
Chamber Springs to Tontitown 161kV
Tontitown to Dyess 161kV
Tontitown to Elm Springs 161kV
Elm Springs to Dyess 161kV
Dyess to S. Springdale 161kV
E. Fayetteville to Hyland 161kV
Hyland to S.E. Fayetteville 161kV
S.E. Fayetteville to S. Fayetteville 161kV
E. Rogers to Avoca to Beaver Dam 161kV
Beaver Dam to Eureka Springs to Osage Creek 161kV

SW MO Major Issues:
Beaver Dam to Washburn to Neosho(SPA) 161kV
Riverton to Oronogo Jct 161kV
Stateline to Joplin 161kV
Carthage to Atlas Junction 161kV
La Russell to Monett 161kV
Tipton Ford to Monett 161kV
Monett to Aurora 161kV
Aurora to Reeds Spring 161kV

W MO Major Issues:
Clinton to Osceola 161kV
Osceola to Collins 161kV
Collins to Stockton Dam 161kV

Central MO Major Issues:
Camdenton to Whispering Oaks 161kV
Whispering Oaks to Huben 161kV
Huben Transformer
Apache Tap to Barnett 161kV
Barnett to Eldon 161kV
Franks to Ft. Wood 161kV
Salem Transfromer
Sullivan to Pea Ridge138kV

S MO Major Issues:
Voltage Instability in Heavy Load case during outage of Brookline to Morgan 345kV
Springfield to La Russell 161kV
Table Rock to Nixa 2 to Springfield 161kV
Battlefield AECI to Clever 161kV
Brookline to Springfield 161kV
Springfield to Nixa 161kV
Nixa to Jamesville161kV
Jamesville to Riverdale 161kV
Brookline Transformer
Southwest to Battlefield 161kV
Battlefield to Main 161kV
Huben to Marshfield 161kV

N AR Major Issues:
Harrison East to Hilltop 161kV
Harrison East to Summit 161kV
Flippin to Bull Shoals 161kV
Bull Shoals to Midway 161kV
Mt Home to Southland 161kV
Southland to Norfork 161kV
Norfork to Calico Rock 161kV
Calico Rock to Melbourne 161kV
Melbourne to Sage 161kV
Greer's Ferry to Jonesboro SPA 161kV
Norfork to Glencoe 161kV
Glencoe to Water Valley 161kV

NE AR Major Issues:
Voltage Instability in Heavy Load case during outage of Independence SES to Moorefield 161kV
Greer's Ferry to Jonesboro SPA 161kV
Independence SES to Moorefield 161kV
Moorefield to Batesville 161kV
Southside to Rutherford 161kV
Newport to Newport Ind. 161kV
Newport Ind. to Newport AB 161kV
Newport AB to Cash 161kV
Hoxie South to Walnut Ridge 161kV
Jonesboro SPA to Jonesboro 161kV
Jonesboro to Hergett 161kV
Hergett to Trumann West 161kV
Trumann West to Trumann 161kV
Trumann to Harrisburg Tap 161kV
Harrisburg Tap to Marked Tree 161kV
Jonesboro to Jonesboro N. 161kV
Jonesboro N. to Paragould S 161kV
Paragould S to Paragould 161kV
Paragould to Monett Jct. 161kV
Monett Jct. to Manila 161kV
Manila to Dell 161kV
Datto to Corning N to Corning to Tex East Sta 8 to Jim Hill 115kV

SE MO Major Issues:
Kosh to Thayer 161kV
Poplar Bluff to Asherville 161kV
Asherville to Idalia 161kV

Appendix B - MUST Solution Settings

MUST CHOICES IN RUNNING FCITC DC ANALYSIS

CONSTRAINTS/CONTINGENCY INPUT OPTIONS

1. AC Mismatch Tolerance – 2 MW
2. Base Case Rating – Rate A
3. Base Case % of Rating – 100%
4. Contingency Case Rating – Rate B
5. Contingency Case % of Rating – 100%
6. Base Case Load Flow – PSS/E
7. Convert branch ratings to estimated MW ratings – No
8. Contingency ID Reporting – Labels & Events
9. Maximum number of contingencies to process - 80000

MUST CALCULATION OPTIONS

1. Phase Shifters Model for DC Linear Analysis – Constant flow for Base Case and Contingencies
2. Report Base Case Violations with FCITC – Yes
3. Maximum number of violations to report in FCITC table - 80000
4. Distribution Factor (OTDF and PTDF) Cutoff – 0.03
5. Maximum times to report the same elements – 1 {eliminate voluminous repeats}
6. Apply Distribution Factor to Contingency Analysis – Yes
7. Apply Distribution Factor to FCITC Reports – Yes
8. Minimum Contingency Case flow change – 0 MW
9. Minimum Contingency Case Distribution Factor change – 0.0
10. Minimum Distribution Factor for Transfer Sensitivity Analysis – 0.0

Appendix C - Cost Estimates

Project Costs - Option A (500kV)				
Project Name	Item	Qty	Unit Cost	Total Cost
AECI Willow Springs to Mansfield 161				
Willow Springs - Cabool 161kV	161 kV Line/mile	14.4	$ 450,000	$ 6,480,000
Cabool - Mt. Grove 161kV	161 kV Line/mile	9.6	$ 450,000	$ 4,320,000
Mansfield Central - Mansfield North 161kV	161 kV Line/mile	4	$ 450,000	$ 1,800,000
Mansfield North - Norwood 161kV	161 kV Line/mile	8.4	$ 450,000	$ 3,780,000
Mt. Grove - Norwood 161kV	161 kV Line/mile	9.1	$ 450,000	$ 4,095,000
161kV Breaker at Willow Springs	115 - 161 kV Breakers 2	1	$ 750,000	$ 750,000
161kV Breaker at Mansfield Central	115 - 161 kV Breakers 2	1	$ 750,000	$ 750,000
Mt. Grove Substation 56MVA, 161/69kV				
Transformer	XF per MVA	56	$ 15,000	$ 840,000
Breakers	115 - 161 kV Breakers 2	1.5	$ 750,000	$ 1,125,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 3,915,000
Norwood Substation 20MVA, 161/13.8kV				
Transformer	XF per MVA	20	$ 15,000	$ 300,000
Breakers	115 - 161 kV Breakers 2	1.5	$ 750,000	$ 1,125,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 3,375,000
Cabool Substation 20MVA				
Transformer	XF per MVA	20	$ 15,000	$ 300,000
Breakers	115 - 161 kV Breakers 2	1.5	$ 750,000	$ 1,125,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 3,375,000
Subtotal				$ 32,640,000
2007_EAI_Upgrade_Corning_TXEastern8_115kV	115-138 kV Line/mile	20	$ 375,000	$ 7,500,000
2010_EAI_New_Hilltop_MtView_161kV	161 kV Line/mile	35	$ 450,000	$ 15,750,000
2009 New Monett - Chesapeak 161kV	161 kV Line/mile	15	$ 450,000	$ 6,750,000
Monett XFMR 345-161				
Transformer (400MVA)	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000

Ozark Transmission Study

Clarksville - Chamber Springs 345 increase CT	Replace CTs	0	$ 50,000	$ -
Tontitown - Dyess 161 rating increase				
Replace CTs	Replace CTs	2	$ 50,000	$ 100,000
Jumpers	switch or terminal jumper	2	$ 75,000	$ 150,000
Subtotal				$ 250,000
Tontitown - Elm Springs 161 rating increase				
Replace CTs	Replace CTs	2	$ 50,000	$ 100,000
Jumpers	switch or terminal jumper	2	$ 75,000	$ 150,000
Subtotal				$ 250,000
GRDA1 - Flint Creek 345 rating increase				
Breakers	345 kV Breakers 2	2	$ 1,500,000	$ 3,000,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 4,350,000
Chamber Springs - Tontitown 161 Reconductor		0	$ -	$ -
Flint Creek - Chouteau 345				
Flint Creek - GRDA1	345 kV Line/mile	43.9	$ 1,000,000	$ 43,900,000
GRDA1 - Chouteau	345 kV Line/mile	2.2	$ 1,000,000	$ 2,200,000
Chouteau XFMR				
Transformer	XF per MVA	392	$ 15,000	$ 5,880,000
Breaker	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,080,000
Subtotal				$ 56,180,000
E Centerton - Chamber Springs 345				
E Centerton - E Rogers	345 kV Line/mile	9	$ 1,000,000	$ 9,000,000
E Rogers - Osage Creek	345 kV Line/mile	32	$ 1,000,000	$ 32,000,000
Osage Creek - S Fayetteville	345 kV Line/mile	50	$ 1,000,000	$ 50,000,000
S Fayetteville - Chamber Springs	345 kV Line/mile	17	$ 1,000,000	$ 17,000,000
E Rogers XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000

S Fayetteville XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Osage Creek XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Subtotal				$ 138,600,000
ANO - S Fayetteville 500				
ANO - Van Buren 500	500 kV Line/mile	72	$ 1,200,000	$ 86,400,000
Van Buren - S Fayetteville	500 kV Line/mile	50	$ 1,200,000	$ 60,000,000
South Fayetteville XFMR				
Transformer	XF per MVA	560	$ 15,000	$ 8,400,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 12,600,000
Van Buren XFMR				
Transformer	XF per MVA	560	$ 15,000	$ 8,400,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 12,600,000
Subtotal				$ 171,600,000
Brookline to Osage Creek 500				
Brookline - Summit	500 kV Line/mile	56	$ 1,200,000	$ 67,200,000
Summit - Table Rock	500 kV Line/mile	8	$ 1,200,000	$ 9,600,000
Table Rock - Osage Creek	500 kV Line/mile	28	$ 1,200,000	$ 33,600,000
Brookline XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000

Summit XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Table Rock XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Osage Creek XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Subtotal				$ 151,200,000
TABLEROCK-ISES_500KV				
Table Rock - Bull Shoals	500 kV Line/mile	47.5	$ 1,200,000	$ 57,000,000
Bull Shoals - Norfork	500 kV Line/mile	24	$ 1,200,000	$ 28,800,000
Norfork - ISES	500 kV Line/mile	64.3	$ 1,200,000	$ 77,160,000
Bull Shoals XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Norfork XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Brookline & ISES Terminal Equipment	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Brookline & ISES Terminal Equipment	switch or terminal jumper	8	$ 75,000	$ 600,000
Subtotal				$ 186,210,000
Chamber Springs - Farmington 161 Reconductor	161 kV Line/mile	10	$ 450,000	$ 4,500,000

Flint Creek - Chamber Springs 345				
Flint Creek - Chamber Springs 345	345 kV Line/mile	14	$ 1,000,000	$ 14,000,000
Breakers	345 kV Breakers 2	3	$ 1,500,000	$ 4,500,000
Subtotal				$ 18,500,000
S Fayetteville to E Fayetteville 161	161 kV Line/mile	12	$ 450,000	$ 5,400,000
Neosho SPA - Neosho EDME 161 Reconductor	161 kV Line/mile	1.7	$ 450,000	$ 765,000
Omaha Tie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
BatesvilleTie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
Jonesboro500Tie				
Extend 500kV lines to Jonesboro Substation	500 kV Line/mile	20	$ 1,200,000	$ 24,000,000
Transformer	XF per MVA	560	$ 15,000	$ 8,400,000
Breakers	345 kV Breakers 2	2	$ 1,500,000	$ 3,000,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	10	$ 75,000	$ 750,000
Jumpers	switch or terminal jumper	20	$ 75,000	$ 1,500,000
Subtotal				$ 37,800,000
SearcyPrice500Tie				
Extend 500kV lines to Searcy Price Substation	500 kV Line/mile	10	$ 1,200,000	$ 12,000,000
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	2	$ 1,500,000	$ 3,000,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	10	$ 75,000	$ 750,000
Jumpers	switch or terminal jumper	20	$ 75,000	$ 1,500,000
Subtotal				$ 23,400,000
GobblerKnobTie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
Datto Tie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
Compton Tie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
Compton Tie - Table Rock 161 Reconductor	161 kV Line/mile	1	$ 450,000	$ 450,000
Norfork - Midway 161 Reconductor	161 kV Line/mile	12	$ 450,000	$ 5,400,000
Batesville N - ISES 161 Reconductor	161 kV Line/mile	20	$ 450,000	$ 9,000,000
Jonesboro - Jonesboro SPA 161 Rebuild	161 kV Line/mile	0.5	$ 450,000	$ 225,000
Jonesboro - Hergett Reconductor	161 kV Line/mile	3	$ 450,000	$ 1,350,000
Harrisburg Tap - Truman 161 Reconductor	161 kV Line/mile	7	$ 450,000	$ 3,150,000
SearcyPriceXFMR 161-115		100		
Transformer	XF per MVA	100	$ 15,000	$ 1,500,000
Switches	switch or terminal jumper	2	$ 75,000	$ 150,000
Jumpers	switch or terminal jumper	2	$ 75,000	$ 150,000
Subtotal				$ 1,800,000
Asherville - Idalia 161 Reconductor	161 kV Line/mile	22	$ 450,000	$ 9,900,000
Green Forest - Gobbler Knob 161 Reconductor	161 kV Line/mile	6.21	$ 450,000	$ 2,794,500
Flint Creek - E Centerton 161 Reconductor	161 kV Line/mile	14.5	$ 450,000	$ 6,525,000

Huben Transformer				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Switches	switch or terminal jumper	2	$ 75,000	$ 150,000
Jumpers	switch or terminal jumper	4	$ 75,000	$ 300,000
Subtotal				$ 6,450,000
Total Option A				$ 926,389,500
Additional Cost Information				
10-Year Production Cost Savings (8%, 10yr.)				$ 196,005,929
Benefit/Cost Ratio				21.2%
Annual Revenue Requirement (18% carrying charge)				$ 166,750,110
Annual Production Cost Savings				$ 29,210,665
Benefit/Cost Ratio				17.5%

Project Costs - Option B (345kV)				
Project Name	Item	Qty	Unit Cost	Total Cost
AECI Willow Springs to Mansfield 161				
Willow Springs - Cabool 161kV	161 kV Line/mile	14.4	$ 450,000	$ 6,480,000
Cabool - Mt. Grove 161kV	161 kV Line/mile	9.6	$ 450,000	$ 4,320,000
Mansfield Central - Mansfield North 161kV	161 kV Line/mile	4	$ 450,000	$ 1,800,000
Mansfield North - Norwood 161kV	161 kV Line/mile	8.4	$ 450,000	$ 3,780,000
Mt. Grove - Norwood 161kV	161 kV Line/mile	9.1	$ 450,000	$ 4,095,000
161kV Breaker at Willow Springs	115 - 161 kV Breakers 2	1	$ 750,000	$ 750,000
161kV Breaker at Mansfield Central	115 - 161 kV Breakers 2	1	$ 750,000	$ 750,000
Mt. Grove Substation 56MVA, 161/69kV				
Transformer	XF per MVA	56	$ 15,000	$ 840,000
Breakers	115 - 161 kV Breakers 2	1.5	$ 750,000	$ 1,125,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 3,915,000
Norwood Substation 20MVA, 161/13.8kV				
Transformer	XF per MVA	20	$ 15,000	$ 300,000
Breakers	115 - 161 kV Breakers 2	1.5	$ 750,000	$ 1,125,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 3,375,000
Cabool Substation 20MVA				
Transformer	XF per MVA	20	$ 15,000	$ 300,000
Breakers	115 - 161 kV Breakers 2	1.5	$ 750,000	$ 1,125,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 3,375,000
Subtotal				$ 32,640,000
2007_EAI_Upgrade_Corning_TXEastern8_115kV	115-138 kV Line/mile	20	$ 375,000	$ 7,500,000
2010_EAI_New_Hilltop_MtView_161kV	161 kV Line/mile	35	$ 450,000	$ 15,750,000
2009 New Monett - Chesapeak 161kV	161 kV Line/mile	15	$ 450,000	$ 6,750,000
Monett XFMR 345-161				
Transformer (400MVA)	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000

Clarksville - Chamber Springs 345 increase CT	Replace CTs	0	$ 50,000	$ -
Tontitown - Dyess 161 rating increase				
Replace CTs	Replace CTs	2	$ 50,000	$ 100,000
Jumpers	switch or terminal jumper	2	$ 75,000	$ 150,000
Subtotal				$ 250,000
Tontitown - Elm Springs 161 rating increase				
Replace CTs	Replace CTs	2	$ 50,000	$ 100,000
Jumpers	switch or terminal jumper	2	$ 75,000	$ 150,000
Subtotal				$ 250,000
GRDA1 - Flint Creek 345 rating increase				
Breakers	345 kV Breakers 2	2	$ 1,500,000	$ 3,000,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 4,350,000
Chamber Springs - Tontitown 161 Reconductor		0	$ -	$ -
Flint Creek - Chouteau 345				
Flint Creek - GRDA1	345 kV Line/mile	43.9	$ 1,000,000	$ 43,900,000
GRDA1 - Chouteau	345 kV Line/mile	2.2	$ 1,000,000	$ 2,200,000
Chouteau XFMR				
Transformer	XF per MVA	392	$ 15,000	$ 5,880,000
Breaker	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,080,000
Subtotal				$ 56,180,000
E Centerton - Chamber Springs 345				
E Centerton - E Rogers	345 kV Line/mile	9	$ 1,000,000	$ 9,000,000
E Rogers - Osage Creek	345 kV Line/mile	32	$ 1,000,000	$ 32,000,000
Osage Creek - S Fayetteville	345 kV Line/mile	50	$ 1,000,000	$ 50,000,000
S Fayetteville - Chamber Springs	345 kV Line/mile	17	$ 1,000,000	$ 17,000,000
E Rogers XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
S Fayetteville XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000

Osage Creek XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Subtotal				$ 138,600,000
ANO - S Fayetteville 500				
ANO - Van Buren 500	500 kV Line/mile	72	$ 1,200,000	$ 86,400,000
Van Buren - S Fayetteville	500 kV Line/mile	50	$ 1,200,000	$ 60,000,000
South Fayetteville XFMR				
Transformer	XF per MVA	560	$ 15,000	$ 8,400,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 12,600,000
Van Buren XFMR				
Transformer	XF per MVA	560	$ 15,000	$ 8,400,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 12,600,000
Subtotal				$ 171,600,000
Brookline to Osage Creek 345				
Brookline - Summit	345 kV Line/mile	56	$ 1,000,000	$ 56,000,000
Summit - Table Rock	345 kV Line/mile	8	$ 1,000,000	$ 8,000,000
Table Rock - Osage Creek	345 kV Line/mile	28	$ 1,000,000	$ 28,000,000
Brookline				
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 4,050,000
Summit XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000

Table Rock XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Osage Creek				
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 4,050,000
Subtotal				$ 120,500,000
GOBBLER KNOB - TABLEROCK_345KV				
Table Rock - Bull Shoals	345 kV Line/mile	47.5	$ 1,000,000	$ 47,500,000
Bull Shoals - Norfork	345 kV Line/mile	24	$ 1,000,000	$ 24,000,000
Norfork - Thayer	345 kV Line/mile	55	$ 1,000,000	$ 55,000,000
Thayer - Gobbler Knob Conversion	345 kV Breakers 2	2	$ 1,500,000	$ 3,000,000
Bull Shoals XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Norfork XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Thayer XFMR				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	8	$ 75,000	$ 600,000
Jumpers	switch or terminal jumper	16	$ 75,000	$ 1,200,000
Subtotal				$ 10,200,000
Table Rock & Gobbler Knob Terminals	345 kV Breakers 2	1.5	$ 1,500,000	$ 2,250,000
Table Rock & Gobbler Knob Terminals	switch or terminal jumper	8	$ 75,000	$ 600,000
Subtotal				$ 162,950,000

Chamber Springs - Farmington 161 Reconductor	161 kV Line/mile	10	$ 450,000	$ 4,500,000
Flint Creek - Chamber Springs 345				
Flint Creek - Chamber Springs 345	345 kV Line/mile	14	$ 1,000,000	$ 14,000,000
Breakers	345 kV Breakers 2	3	$ 1,500,000	$ 4,500,000
Subtotal				$ 18,500,000
S Fayetteville to E Fayetteville 161	161 kV Line/mile	12	$ 450,000	$ 5,400,000
Neosho SPA - Neosho EDME 161 Reconductor	161 kV Line/mile	1.7	$ 450,000	$ 765,000
Omaha Tie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
BatesvilleTie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
Jonesboro500Tie				
Extend 500kV lines to Jonesboro Substation	500 kV Line/mile	20	$ 1,200,000	$ 24,000,000
Transformer	XF per MVA	560	$ 15,000	$ 8,400,000
Breakers	345 kV Breakers 2	2	$ 1,500,000	$ 3,000,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	10	$ 75,000	$ 750,000
Jumpers	switch or terminal jumper	20	$ 75,000	$ 1,500,000
Subtotal				$ 37,800,000
SearcyPrice500Tie				
Extend 500kV lines to Searcy Price Substation	500 kV Line/mile	10	$ 1,200,000	$ 12,000,000
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Breakers	345 kV Breakers 2	2	$ 1,500,000	$ 3,000,000
Wavetrap	Wavetrap	1	$ 150,000	$ 150,000
Switches	switch or terminal jumper	10	$ 75,000	$ 750,000
Jumpers	switch or terminal jumper	20	$ 75,000	$ 1,500,000
Subtotal				$ 23,400,000
GobblerKnobTie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
Datto Tie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
Compton Tie	115 - 161 kV Breakers 2	2	$ 750,000	$ 1,500,000
Compton Tie - Table Rock 161 Reconductor	161 kV Line/mile	1	$ 450,000	$ 450,000
Norfork - Midway 161 Reconductor	161 kV Line/mile	12	$ 450,000	$ 5,400,000
Batesville N - ISES 161 Reconductor	161 kV Line/mile	20	$ 450,000	$ 9,000,000
Jonesboro - Jonesboro SPA 161 Rebuild	161 kV Line/mile	0.5	$ 450,000	$ 225,000
Jonesboro - Hergett Reconductor	161 kV Line/mile	3	$ 450,000	$ 1,350,000
Harrisburg Tap - Truman 161 Reconductor	161 kV Line/mile	7	$ 450,000	$ 3,150,000
SearcyPriceXFMR 161-115		100		
Transformer	XF per MVA	100	$ 15,000	$ 1,500,000
Switches	switch or terminal jumper	2	$ 75,000	$ 150,000
Jumpers	switch or terminal jumper	2	$ 75,000	$ 150,000
Subtotal				$ 1,800,000
Asherville - Idalia 161 Reconductor	161 kV Line/mile	22	$ 450,000	$ 9,900,000
Green Forest - Gobbler Knob 161 Reconductor	161 kV Line/mile	6.21	$ 450,000	$ 2,794,500
Flint Creek - E Centerton 161 Reconductor	161 kV Line/mile	14.5	$ 450,000	$ 6,525,000
Asherville - Poplar Bluff 161 Reconductor	161 kV Line/mile	11.8	$ 450,000	$ 5,310,000
E Centerton - Tontitown 161	161 kV Line/mile	10	$ 450,000	$ 4,500,000
Heber Springs N to Pangburn 161	161 kV Line/mile	10	$ 450,000	$ 4,500,000

Huben Transformer				
Transformer	XF per MVA	400	$ 15,000	$ 6,000,000
Switches	switch or terminal jumper	2	$ 75,000	$ 150,000
Jumpers	switch or terminal jumper	4	$ 75,000	$ 300,000
Subtotal				$ 6,450,000
Total Option B				$ 886,739,500
Additional Cost Information				
10-Year Production Cost Savings (8%, 10yr.)				$ 206,773,706
Benefit/Cost Ratio				23.3%
Annual Revenue Requirement (18% carrying charge)				$ 159,613,110
Annual Production Cost Savings				$ 30,815,382
Benefit/Cost Ratio				19.3%

SPP
Notification to Construct

415 N. McKinley, 140 Plaza West
Little Rock, AR 72205-3020
501-614-3220 • Fax: (501) 666-0376
P. Jay Caspary
Director, Engineering

SPP-NTC-20000

February 13, 2008

Matthew McGee
212 E. 6th St.
Tulsa, OK 74119

RE: Transmission System Upgrade Notification to Construct Approved Appendix B projects in 2008-2017 SPP Transmission Expansion Plan

Dear Mr. McGee,

During the January 29, 2008 meeting, the Southwest Power Pool (SPP) Board of Directors approved and directed the network upgrades listed below be constructed. As a result, based on Section IX.4 of Attachment O of the OATT, SPP is notifying American Electric Power to move forward with the development of the following upgrades/mitigations to alleviate associated reliability concerns:

Project ID: 107
Project Name: Line - E Rogers - Avoca 161 kV
Required In-Service Date: 6/1/2008
Estimated Project Cost: $720,000

> **Upgrade ID:** 10132
> **Upgrade Description:** Install 3% impedance reactor set at East Rogers on 161 kV line to Avoca REC.
> **Upgrade Justification:** To address the overload of the Dyess to Elm Springs161 kV overload for an outage of Dyess to Tontitown 161 kV; Also defers the need for the Flint Creek to East Centerton by four years.

Project ID: 110
Project Name: XFR - Pryor Junction 138/69 kV
Required In-Service Date: 6/1/2008
Estimated Project Cost: $1,829,100

Upgrade ID: 10137
Upgrade Description: Upgrade Pryor Junction 138/69 kV transformer; Ratings A=133 and B=146
Upgrade Justification: To address the overload of the Pryor Junction 138/69 kV transformer for the outage of Inola tap to Catoosa 138 kV for the outage of Inola tap to Choutes 138 kV.

Project ID: 217
Project Name: Line - Tap N. Huntington - Waldron 69 kV
Required In-Service Date: 6/1/2008
Estimated Project Cost: $400,000

Upgrade ID: 10276
Upgrade Description: Reconnect the Huntington 69 kV station from the North Huntington-Midland 69 kV line to the North Huntington-Waldron 69 kV line.
Upgrade Justification: Relieves overloading on N. Huntington - Huntington - Midland REC 69 kV.

Project ID: 230
Project Name: Line - Broken Bow - Craig Junction 138 kV
Required In-Service Date: 6/1/2008
Estimated Project Cost: $8,900,000

Upgrade ID: 10295
Upgrade Description: Reconductor Broken Bow to Craig Junction 138 kV; Rebuild 7.66 miles of 3/0 CW CU with 795 ACSR
Upgrade Justification: To address the overload due to Loss of Craig Junction - Mountain River 138 kV or Mountain River - BBDAM TP4 138 kV.

Project ID: 218
Project Name: Line - Huntington - N Huntington 69 kV
Required In-Service Date: 6/1/2009
Estimated Project Cost: $ 20,000

Upgrade ID: 10277
Upgrade Description: Upgrade CT at North Huntington on N Huntington to Huntington Waldron 69 KV
Upgrade Justification: To address the overloading of Huntington-Midland REC 69 kV from the outage of AES-Tarby 161 kV or Cavanal-Poteau 69 kV.

Project ID: 219
Project Name: Line - Excelsior - Excelsior Tap 161 KV
Required In-Service Date: 6/1/2009
Estimated Project Cost: $4,000,000

Upgrade ID: 10278
Upgrade Description: Convert the Excelsior station from 69 kV to 161 kV. Reconnect Excelsior station from the Midland-Excelsior 69 kV line to the Hackett REC-North Huntington 161 kV line section. Open the Midland-Excelsior 69 kV line.
Upgrade Justification: To address the overloading of Huntington-Midland REC 69 kV from the outage of AES-Tarby 161 kV or Cavanal-Poteau 69 kV. Also addresses low voltage in the area around Midland.

Project ID: 221
Project Name: Line - Hope - Fulton 115 kV
Required In-Service Date: 6/1/2009
Estimated Project Cost: $100,000

Upgrade ID: 10280
Upgrade Description: Replace conductor in Hope Substation.
Upgrade Justification: To address the overload on conductor in the Hope substation for the base case

Project ID: 225
Project Name: Line - North Magazine - Magazine REC – Danville 161 kV
Required In-Service Date: 6/1/2009
Estimated Project Cost: $25,194,800

Upgrade ID: 10286
Upgrade Description: Magazine REC – Danville 161 kV rebuild 17.96 miles of 250 Copperweld with 1272 ACSR.
Upgrade Justification: To address the overload due to Loss of Fort Smith - ANO 500 kV.
Required In-Service Date: 6/1/2009
Estimated Upgrade Cost: $17,900,000

Upgrade ID: 10289
Upgrade Description: North Magazine – Magazine REC 161 kV rebuild 7.43 miles of 250 CWC with 1272 ACSR.
Upgrade Justification: To address the overload due to Loss of Fort Smith - ANO 500 kV.
Required In-Service Date: 6/1/2009
Estimated Upgrade Cost: $7,294,800

Project ID: 227
Project Name: Line- Breaker Daingerfield - Jenkins REC 69 kV
Required In-Service Date: 6/1/2009
Estimated Project Cost: $250,000

Upgrade ID: 10291
Upgrade Description: Replace Daingerfield 69 kV Breaker # 1M90 & reset relays.
Upgrade Justification: To address the overload due to loss of Lone Star South - Pittsburg 138 kV, Petty - Chappel Hill REC 138 kV.

Project ID: 291
Project Name: Line - Bann - Lonestar Ordinance Tap 69 kV
Required In-Service Date: 6/1/2010
Estimated Project Cost: $ 25,000

Upgrade ID: 10377
Upgrade Description: Relay at Bann new limits will be 65/72 MVA summer (line conductor/Lonestar switch) and 72/72 MVA winter (Lonestar Switch)
Upgrade Justification: To address overloads at Bann-Lonestar Ordinance Tap 69 kV for New Boston-North New Boston 69 kV outage.

Project ID: 292
Project Name: Line - Greggton - Lake Lamond 69 kV
Required In-Service Date: 6/1/2010
Estimated Project Cost: $1,496,000

Upgrade ID: 10378
Upgrade Description: Reconductor Greggton - Lake Lamond 69 kV line with 1272 ACSR
Upgrade Justification: To address the loss of transformer the Purdue 138/69 kV

Project ID: 294
Project Name: Line - North Mineola - Mineola 69 kV
Required In-Service Date: 6/1/2010
Estimated Project Cost: $350,000

Upgrade ID: 10380
Upgrade Description: Replace Mineola 2 Switches & Breaker
Upgrade Justification: To address the overload due to loss of Purdue - Big Sandy 69 kV or Big Sandy- Hawkins 2 69 kV

Project ID: 297
Project Name: Line - Quitman - Westwood 69 kV
Required In-Service Date: 6/1/2010
Estimated Project Cost: $1,600,000

Upgrade ID: 10383
Upgrade Description: Reconductor Quitman - Westwood 69 kV 3.91 miles of 2/0 with 795 ACSR
Upgrade Justification: To address the overload due to loss of Grand Saline - Mineola 69 kV.

Project ID: 108
Project Name: Line - North Market - Arsenal Hill 69 kV
Required In-Service Date: 6/1/2011
Estimated Project Cost: $2,300,000

Upgrade ID: 10441
Upgrade Description: Reconductor North Market - Arsenal Hill 69 kV 2.29 Miles With 1272 ACSR
Upgrade Justification: To address the overload due to loss of Arsenal Hill - Shed Road 69 kV

Project ID: 222
Project Name: Line - Bonanza - Bonanza Tap 161 kV
Required In-Service Date: 6/1/2011
Estimated Project Cost: $100,000

Upgrade ID: 10281
Upgrade Description: Reconductor 0.1 mile Bonanza-Bonanza T line 161 kV section to 1590 ACSR.
Upgrade Justification: To address overload of Bonanza-Bonanza Tap 161 kV for the outage AES-Tarby 161 kV and other outages

Project ID: 343
Project Name: Line - Winnsboro - Magnolia Tap 69 kV
Required In-Service Date: 6/1/2011
Estimated Project Cost: $250,000

Upgrade ID: 10440
Upgrade Description: Replace 69 kV switch # 9114 @. Replace 69 kV switches @ Winnsboro. Reset cities CTs and relay settings at Winnsboro.
Upgrade Justification: To address the overload due to loss of the 138/69 kV transformer at North Mineola

Project ID: 345
Project Name: Line - Mangolia - Forest Hill 69 kV
Required In-Service Date: 6/1/2011
Estimated Project Cost: $125,000

Upgrade ID: 10442
Upgrade Description: Replace 69 kV switch at Magnolia tap new emergency limit 85 MVA
Upgrade Justification: To address the overload due to loss of 138/69 kV North Mineola transformer

Project ID: 346
Project Name: Line - Forest Hills - Quitman 69 kV
Required In-Service Date: 6/1/2011
Estimated Project Cost: $100,000

Upgrade ID: 10443
Upgrade Description: Replace 69 kV Bus & reset relays at Quitman substation
Upgrade Justification: To address the loss of 138/69 kV North Mineola transformer

Project ID: 347
Project Name: Line - Woodlawn – Baldwin 69 kV
Required In-Service Date: 6/1/2011
Estimated Project Cost: $1,700,000

Upgrade ID: 10444
Upgrade Description: Reconductor with 2.7 miles 477 ACSR 69 kV Woodlawn-Baldwin. Reset relays.
Upgrade Justification: To address the overload due to loss of Baldwin - Woodlawn - Karnack Tap 69 kV.

Project ID: 348
Project Name: Line - Dyess – Tontitown 161 kV
Required In-Service Date: 6/1/2011
Estimated Project Cost: $300,000

Upgrade ID: 10445
Upgrade Description: Replace 161 kV breaker switches and CT at Dyess.
Upgrade Justification: To address the overload due to loss of Tontitown - Elm Springs 161 kV.

Project ID: 113
Project Name: Multi - Wallace Lake - Port Robson - Red Point 138 kV
Required In-Service Date: 6/1/2012
Estimated Project Cost: $24,000,000

Upgrade ID: 10140
Upgrade Description: Convert Red Point-Haughton to 138 kV, 1590 ACSR (includes Red Point terminal & Haughton station conversion).
Upgrade Justification: To address the overload due to loss of Fort Humbug - Trichel Street 138 kV

Required In-Service Date: 6/1/2012
Estimated Upgrade Cost: $4,200,000

Upgrade ID: 10141
Upgrade Description: Convert Haughton-McDade to 138 kV, 1590 ACSR (includes McDade station conversion).
Upgrade Justification: To address the overload due to loss of Fort Humbug - Trichel Street 138 kV
Required In-Service Date: 6/1/2012
Estimated Upgrade Cost: $7,000,000

Upgrade ID: 10142
Upgrade Description: New 138 kV line from Port Robson to McDade (includes Port Robson terminal).
Upgrade Justification: To address the overload due to loss of Fort Humbug - Trichel Street 138 kV
Required In-Service Date: 6/1/2012
Estimated Upgrade Cost: $9,800,000

Upgrade ID: 10143
Upgrade Description: New 138 kV line from Wallace Lake to Finney Tap (includes Wallace Lake terminal).
Upgrade Justification: To address the overload due to loss of Fort Humbug - Trichel Street 138 kV
Required In-Service Date: 6/1/2012
Estimated Upgrade Cost: $3,000,000

Project ID: 296
Project Name: Line - Dyess - Elm Springs REC 161 kV
Required In-Service Date: 6/1/2012
Estimated Project Cost: $300,000

Upgrade ID: 10382
Upgrade Description: Rebuild / reconductor Dyess - Elm Springs REC 161 kV 5.17 miles of line with 2156 ACSR.
Upgrade Justification: To address the overload due to loss of Chamber Springs to Farmington 161 kV or Dyess - Tontitown 161 kV.

Project ID: 387
Project Name: Line - Riverside - Okmulgee 138 kV
Required In-Service Date: 6/1/2012
Estimated Project Cost: $125,000

Upgrade ID: 10505
Upgrade Description: Replace wave trap at Okmulgee.
Upgrade Justification: To address overload at Riverside Station - Okmulgee 138 kV for the outage of Riverside Station to Explorer Okmulgee 138 kV or the outage of Okmulgee - Explorer Okmulgee 138 kV.

Project ID: 388
Project Name: Line - New Boston - North New Boston 69 kV
Required In-Service Date: 6/1/2012
Estimated Project Cost: $100,000

Upgrade ID: 10506
Upgrade Description: Replace 2 sets of 69 kV of New Boston switches on terminal to North New Boston.
Upgrade Justification: To address the overload due to loss of Bann - Lone Star Ordinance Tap 138 kV.

Project ID: 389
Project Name: Line - SE Texarkana – Texarkana 69 kV
Required In-Service Date: 6/1/2012
Estimated Project Cost: $150,000

Upgrade ID: 10507
Upgrade Description: Repace 69 kV jumpers switches Texarkana 114/143 MVA
Upgrade Justification: To address the overload at SE Texarkana - Texarkana 69 kV in the base case or for the loss of the Sugar Hill 138/69 kV transformer.

Project ID: 391
Project Name: Line - Lone Star South - Pittsburg 138 kV
Required In-Service Date: 6/1/2012
Estimated Project Cost: $300,000

Upgrade ID: 10509
Upgrade Description: Replace 138 kV wavetraps at both ends. Reset CTs @ Lone Star South. Replace138 kV switches & reset relays @ Pittsburg
Upgrade Justification: To address the overload due to loss of Petty - Chapel Hill REC 138 kV.

Project ID: 392
Project Name: Line - Howell - Kilgore 69 kV
Required In-Service Date: 6/1/2012
Estimated Project Cost: $2,000,000

Upgrade ID: 10510
Upgrade Description: Howell - Kilgore 69 kV rebuild 3.49 miles of 4/0 ACSR with 795 ACSR.
Upgrade Justification: To address the overload due to loss of Greggton - Lake Lamond 69 kV.

Project ID: 106
Project Name: Line - Snyder - Altus Junction 138 kV
Required In-Service Date: 6/1/2013
Estimated Project Cost: $16,760,000

Upgrade ID: 10130
Upgrade Description: Build new Snyder to Altus Jct 138 kV line
Upgrade Justification: Identified in the 2006 STEP to address overloads for the Snyder 138/69 kV transformer for various outages including Fort Cobb-Southwest Station 138 kV, Carnegie-Fort Cobb 138 kV.

Project ID: 229
Project Name: Multi - Flint Creek - E Centerton 161 kV
Required In-Service Date: 6/1/2013
Estimated Project Cost: $15,200,000

Upgrade ID: 10292
Upgrade Description: Reconductor 1.09 MILES of 2-397 ACSR with 1590 ACSR from Flint Creek to Gentry 161 kV
Upgrade Justification: To address overloads on Flint Creek - Gentry 161 kV line for the outages of Lowell - Tontitown 161 kV, Lowell - Rogers 161 kV or East Rogers - Dyess 161 kV.
Required In-Service Date: 6/1/2011

Upgrade ID: 10293
Upgrade Description: Reconductor Gentry - Bentonville 279th St. 161 kV with 1590 conductor
Upgrade Justification: To address overloads on Flint Creek - Gentry 161 kV line for the outages of Lowell - Tontitown 161 kV, Lowell - Rogers 161 kV or East Rogers - Dyess 161 kV.
Required In-Service Date: 6/1/2013

Upgrade ID: 10294
Upgrade Description: Reconductor Bentonville 279th St. 161 kV - East Centerton with 1590 conductor 161 kV
Upgrade Justification: To address overloads on Flint Creek - Gentry 161 kV line for the outages of Lowell - Tontitown 161 kV, Lowell - Rogers 161 kV or East Rogers - Dyess 161 kV.
Required In-Service Date: 6/1/2013

Project ID: 450
Project Name: Multi - Flint Creek – Centerton 345 kV and Centerton- East Centerton 161 kV
Required In-Service Date: 6/1/2014
Estimated Project Cost: $35,185,000

Upgrade ID: 10582
Upgrade Description: Install 2 miles of 161 kV from new Centerton Substation to East Centerton Substation.
Upgrade Justification: To address the overload East Rogers - Rogers West REC 161 kV for the outage of Flint Creek to Gentry 161 kV. This assumes Inductor East Rogers to AVOCA and the switchable Reactor is on the East Rogers to Dyess 161 kV line.
Required In-Service Date: 6/1/2014
Estimated Upgrade Cost: $2,000,000

Upgrade ID: 10584
Upgrade Description: Install 345/161 kV transformer at Centerton.
Upgrade Justification: To address the over load East Rogers - Rogers West REC 161 kV for the outage of Flint Creek to Gentry 161 kV. This assumes East Rogers to Avoca 161 kV inductor and the switchable reactor is on the East Rogers to Dyess line.
Required In-Service Date: 6/1/2014
Estimated Upgrade Cost: $9,500,000

Upgrade ID: 10585
Upgrade Description: Install 22 miles of new 345 kV, 2-954 ACSR line.
Upgrade Justification: To address the overload East Rogers - Rogers West REC 161 kV for the outage of Flint Creek to Gentry 161 kV. This assumes East Rogers to Avoca 161 kV inductor and the switchable reactor is on the East Rogers to Dyess 161 kV line
Required In-Service Date: 6/1/2014
Estimated Upgrade Cost: $23,685,000

Project ID: 511
Project Name: Multi - Centerton - Osage Creek 345 kV
Required In-Service Date: 6/1/2016
Estimated Project Cost: $57,500,000

Upgrade ID: 10656
Upgrade Description: Install new 345/161 kV transformer at Osage Creek
Upgrade Justification: To relieve overload on Lines - Beaver-Eureka 161 kV and East Rogers-Avoca 161 kV for outage of Flint Creek to Brookline 345 kV
Required In-Service Date: 6/1/2016
Estimated Upgrade Cost: $12,000,000

Upgrade ID: 10659
Upgrade Description: Install 9 miles of 345 kV line from Centerton to East Rogers
Upgrade Justification: To relieve overload on Lines - Beaver-Eureka 161 kV and East Rogers-Avoca 161 kV for outage of Flint Creek to Brookline 345 kV
Required In-Service Date: 6/1/2016
Estimated Upgrade Cost: $13,500,000

Upgrade ID: 10660
Upgrade Description: Install 32 miles of 345 kV line from East Rogers to Osage Creek
Upgrade Justification: To relieve overload on Lines - Beaver-Eureka 161 kV and East Rogers-Avoca 161 kV for outage of Flint Creek to Brookline 345 kV
Required In-Service Date: 6/1/2016
Estimated Upgrade Cost: $32,000,000

The Required In-Service Date represents the timing required for the upgrade to address the identified need. We would appreciate your prompt attention to the formulation and approval of any necessary mitigation plans if this date is not feasible.

American Electric Power shall submit certification of commercial operation for each listed upgrade to SPP as soon as the upgrade is complete and in-service. Please provide SPP with the actual costs of these upgrades as soon as possible after completion of construction. This will facilitate the timely billing by SPP based on actual costs.

Please keep SPP advised of any inability on American Electric Power's part to complete the approved upgrades. In addition, SPP requests that a construction schedule supporting the required upgrade(s) noted above be provided within 30 days of receipt of this Notice to Construct. For project tracking, SPP will request on a quarterly basis, in conjunction

with the SPP Board of Directors meetings, that American Electric Power submit updates to the schedule status to SPPprojecttracking@spp.org. If it is anticipated that the completion of any approved project will be delayed past the required in-service date, SPP requires a mitigation plan be filed within 30 days of the determination of expected delay in the project schedule.

Sincerely,

P. Jay Caspary
Director, Engineering

cc: Paul Johnson, Richard Ross, Terri Gallup, Brent Wilson, Scott Rainbolt, Les Dillahunty, Carl Monroe, Pat Bourne, SPPprojecttracking@spp.org.