VOLUME 8:

TRANSMISSION SUBMISSION

KCP&L

INTEGRATED RESOURCE PLAN

4 CSR 240-22.080

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TABLE OF CONTENTS

TABLE OF TABLES

TABLE OF RULES COMPLIANCE

VOLUME 8: TRANSMISSION SUBMISSION

This volume of the IRP report satisfies the requirements of Deficiency # 13 contained in the Non-Unanimous Stipulation and Agreement for Case No. EO-2007-2008 dated February 13, 2007.

SECTION 1: KCPL NON-PUBLIC UPGRADE INFORMATION

The discussions below cover the requirements for disclosure of non-public transmission upgrades and improvements under consideration by KCPL.

1.1 PUBLICALLY AVAILABLE INFORMATION

Generally all major KCPL transmission upgrade projects are currently made available as public information, either through KCPL's public OASIS site, or as part of the Southwest Power Pool's (SPP) Transmission Expansion Plan (STEP). Information posted on the OASIS site identifies major transmission projects in KCPL's 5 year construction budget, including; new and upgraded transmission lines, new and upgraded transmission transformers, and new substations. The STEP information includes the OASIS projects plus additional transmission projects that KCPL needs for load serving or reliability for up to 10 years in the future. STEP information includes expected in-service dates, construction lead times, and estimated costs for transmission projects. STEP reports are posted on SPP website.

1.2 NON PUBLIC INFORMATION

Some information included in KCPL's 5 year construction budget, judged to have limited public use, has not been made available for public viewing. This non-public information represents generally less expensive transmission projects for betterment and improvements to existing facilities that do not result in increases in transmission capacity or transfer capability. This includes projects for replacement of damaged, worn-out, or obsolete equipment. Unplanned upgrade projects, which may occur in an operational (real-time) time frame, only become public information as "after-the-fact" events. These are generally projects of minimal cost and construction time,

such as the upgrade of the Stilwell – Peculiar 345kV line in early 2007 by replacement of a wavetrap at the Peculiar substation.

1.3 OBJECTIVES

The objective of this volume of KCPL's 2008 IRP is to supply those requirements of Missouri Public Service Commission (MPSC) rules for Electric Utility Resource Planning, 4 CSR 240-22 (commonly referred to as the "IRP rules" in this report) which relate to electric transmission. Specifically, this volume will address those parts of 240-22.040 and 240-22.050 which deal with the analysis of electric transmission resources as they relate to the overall integrated resource planning process. For KCPL, electric transmission is defined as those facilities and related equipment operating at 60 kV and higher.

SECTION 2: SPP PUBLIC TRANSMISSION PLANNING

Discussions below cover requirements for referencing and summarizing portions of the SPP regional transmission planning efforts that are in the public record.

2.1 TRANSMISSION PLANNING PROCESS

In the mid 1990's KCPL functionally separated its generation and transmission operations (including planning) to meet the requirements of federally mandated open access to the electric transmission grid. The Federal Energy Regulatory Commission's (FERC) Standards of Conduct for Transmission Providers (Order No. 2004) ("Standards of Conduct") imposes significant restrictions on the transmission-related data that KCPL's transmission group can share with KCPL's generation group. KCPL's transmission group cannot, for example, share with the energy resource management group transmission system upgrades or improvements under consideration that are not a matter of public record on KCPL's OASIS.

KCPL no longer offers transmission service under its Open Access Transmission Tariff (OATT). As a member of the Southwest Power Pool (SPP), KCPL participates in the SPP OATT. All transmission service requests, including generation interconnection requests, must be submitted to the SPP and studied in a non-discriminatory process.

As a Regional Transmission Organization (RTO), SPP is responsible for collaborative intra-regional, cooperative inter-regional planning and arranging for coordinated transmission system expansion planning. This coordinated transmission expansion is performed in three processes; the SPP Transmission Expansion Plan (STEP), the Aggregate Facilities Studies (AFS), and Generation Interconnection Studies (GI). These processes enable SPP to provide efficient, reliable, and competitive generation market Transmission Services on a non-discriminatory basis taking into account the requirements of all Stakeholders while coordinating with applicable Federal, State and Local Regulatory Authorities.

The STEP process is annual and begins in September with the development of loadflow models extending 10 years into the future. KCPL participates in the loadflow model development process by providing its forecast load requirements at the transmission substation level and the forecast generation dispatch necessary to meet those load requirements. This will include any new transmission substations and the transmission lines necessary to serve those substations. The model also includes any firm transmission reservations that KCPL may use to serve its load requirements. SPP combines the data provided by KCPL with similar data from other SPP members and the NERC ERAG models for the Eastern Interconnection to produce a loadflow model simulating the performance of the interconnected transmission system. SPP analyzes these models for compliance with NERC Reliability Standards and SPP Criteria. Where standard or criteria violations are identified, SPP and Transmission Owners (i.e. KCPL) work together to develop mitigation plans to eliminate the problem. These mitigation plans may include new or upgraded transmission facilities. The STEP also performs a screening analysis of potential economic transmission projects. These assessments do not study individual control area transfer capability but rather projects that may reduce or eliminate transmission congestion across the SPP footprint. These projects are ranked based on a cost/benefit analysis of generation dispatch cost savings compared to the cost of the potential project. These projects are typically bulk transmission projects (345kV and above) not required by standards or criteria that cross multiple control areas and/or states and would require project sponsors to actually agree to fund and construct.

The AFS process is performed three times per year by collectively analyzing specific transmission service requests, including those associated with generation interconnection requests, across the entire SPP footprint. These service reservations are modeled based on control area to control area transfers. The transmission system is assessed with these potential service requests and, where needed, transmission improvements are identified that would enable the service to occur without standard or criteria violations. Once the customer that has made the service request agrees to the conditions of the system improvement the project is included in the next STEP process.

The GI study process is initiated by generation customers making a request to SPP to interconnect new generation facilities to the SPP transmission system or increase the output of existing generation facilities. This process involves three levels of system analysis; Feasibility Study, System Impact Study, and Facility Study. The Feasibility Study assesses the practicality and costs involved to incorporate the generating unit or units into the SPP Transmission System. The analysis is limited to load flow analysis of the more probable contingencies within the Transmission Owner's control area and key adjacent areas. The feasibility study does not include short circuit or stability studies. The load flow analysis is conducted with and without the new generation so that the proposed generator's impact on the local area can be identified. The results of load flow analysis include power flow magnitudes and voltage levels under probable contingency conditions. The results of the load flow study will be used to identify equipment overloads and excessive voltage deviations that may be encountered due to the addition of new generation. The System Impact Study is primarily a Transient Stability Study of the GI Request. The transient stability analysis will be performed to determine generator unit response due to a fault on the system and unit outages. The Facility Study consists of two parts, a Facility Analysis and a Short Circuit Analysis. The Facility Analysis consists of SPP or Transmission Owner specifying and estimating the cost of equipment, engineering, procurement and construction cost needed to implement the Interconnection to the Transmission system. Facilities will be looked at that were identified in the Feasibility and System Impact Studies. These facilities will have detailed cost estimates. A short circuit (i.e., fault current) analysis will be performed to determine the effect that the new generation will have on the system fault currents. The new fault current levels will be used to evaluate the impact of the new generation on the fault duty (i.e., fault current interrupting capability or rating) of existing equipment, such as circuit breakers and switches. The results of this analysis may identify which equipment would have to be replaced as a result of the new generation. The GI study process only provides for interconnection of the new or increased generation to the transmission system and delivery of full output at the point of interconnection. It does

not provide for delivery of the generation output to a specific transmission customer. That requires a transmission service request and study in the AFS process.

SPP has recently completed an Extra High Voltage (EHV) transmission overlay study that provides a 20 year strategic assessment of how to meet SPP's future reliability and capacity needs through the use of a 500kV and 765kV transmission system overlaying the existing SPP footprint. This study focused on providing a foundation for long range planning and detailed economic assessments that can help SPP work with neighbors to create an interstate transmission superhighway. These study reports are very large in size and are available from the SPP website at www.spp.org.

2.2 TRANSMISSION SYSTEM ANALYSIS METHODOLOGY

KCPL uses the PTI Power System Simulator (PSS/E) as its' primary tool for transmission system analysis. PSS/E is a package of programs for studies of power system transmission network and generation performance in both steady-state and dynamic conditions. PSS/E handles power flow, fault analysis (balanced and unbalanced), network equivalent construction, and dynamic simulation. SPP also uses this software package to perform the STEP and AFS study processes.

Transmission analysis for this IRP process was based on the SPP 2007 series of loadflow models. This is a series of 16 seasonal loadflow models developed by SPP with input from SPP members and neighboring RTO's. These models are listed below in Table 1.

Table 1: SPP Seasonal Loadflow Models

	Year	Season	Load
1	2007	Spring	Peak
2	2007	Summer	Peak
3	2007	Summer	shoulder
4	2007	Fall	Peak
5	2007	Winter	Peak
6	2008	April	minimum
7	2008	Spring	Peak
8	2008	Summer	Peak
9	2008	Summer	shoulder
10	2008	Fall	Peak
11	2008	Winter	Peak
12	2009	Summer	Peak
13	2009	Winter	Peak
14	2012	Summer	Peak
15	2012	Winter	Peak
16	2017	Summer	Peak

For each of these base cases, SPP further develops transfer scenario cases to study the transmission system under more stressed conditions. These transfer scenarios are defined as the following conditions.

East to West

West to East

South to North

North to South

All requested transfers simultaneously

2.2.1 TRANSMISSION PLANNING CRITERIA

The KCPL transmission system is planned to meet the performance requirements of the NERC Reliability Standards (TPL-001 through TPL-004), SPP Criteria (Section 3), KCPL Bulk Electric System Planning Criteria and SPP OATT Attachment O. In

summary these requirements specify that for system intact (no contingencies) conditions, all line flows and transformer loads must be within "normal" limits. For single contingency (loss of any single line, transformer, or generator) conditions, all line flows and transformer loads must be within "emergency" limits. For more severe contingencies (loss of multiple transmission elements) the transmission system must perform without cascading outages or voltage collapse. KCPL planning criteria requires transmission voltages to be maintained within +/- 5% of nominal voltage for system intact and single contingency conditions. It should be noted that beginning in 2008, KCPL will relax its' planning criteria to accept transmission voltages within +5/-10% of nominal voltage for single contingency conditions. This change will bring the KCPL transmission planning criteria more in line with the SPP planning criteria.

SECTION 3: IRP REQUIREMENTS FOR TRANSMISSION

3.1 OVERVIEW

This section will identify each requirement of the IRP rules pertaining to transmission and provide KCPL's response to the requirements. Due to FERC Standards of Conduct rules, the detailed information in this section cannot be shared directly with KCPL's Energy Resource Management group.

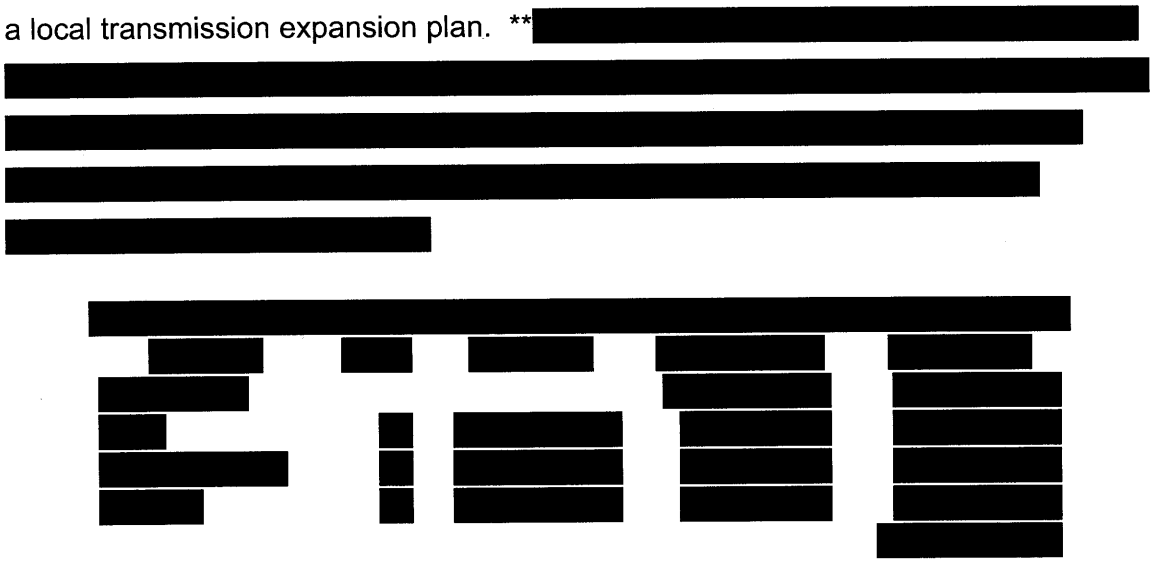
3.2 4 CSR 240.040 (1)

This part of the IRP rules states, "Analysis of supply side resource alternatives shall include upgrading of the transmission & distribution systems to reduce power and energy losses".

In preparation for this IRP filing, KCPL Transmission Planning received from KCPL Resource Planning a list of possible new generation resource alternatives to analyze for associated transmission requirements. These alternatives included new generation resources at Montrose (2 options) and Wolf Creek (unit 2). The only information Transmission Planning communicated back to Resource Planning from this analysis was an estimate of the total cost of the transmission additions and upgrades necessary to provide adequate transmission for the new generation resources. No details about the specific transmission upgrades or additions were communicated to Resource Planning. Ultimately, any generation resource KCPL decides to pursue in the future will have to be evaluated though the SPP Generation Interconnection process.

The two Montrose options involved replacing the existing three generating units there with, (1) a new 750 Mw Selective Catalytic Pulverized Coal (SCPC) unit, or (2) a new 650 Mw Integrated Gasification Combined Cycle (IGCC) unit. The existing Montrose plant has a total generation capacity of 510 Mw, with adequate transmission to deliver this resource to KCPL. The loadflow analysis involved studying the 2012 summer and winter peak and 2017 summer peak loadflow models with the existing Montrose generation and with the new Montrose generator. ACCC (contingency)

a local transmission expansion plan. **[redacted]



**Under this transmission expansion option, KCPL would only pay for its ownership share of the total investment cost. For example, if KCPL's ownership in the new Wolf Creek unit was 50%, its share of the transmission expansion costs would be $87.5 million. Again it may be necessary to invest additional capital in local KCPL facilities to deliver the power to load. This can happen when local generation resources are replaced by remote generation resources.

The estimated range of capital investment for transmission outlet capacity for a second generating unit at Wolf Creek is $87.5 million to $176 million. If the decision is made to pursue a second generator at Wolf Creek, a generation interconnection request would have to be made to SPP for the full amount of generation to be added there. Delivery points for the generation would also have to be identified. With this information SPP could study the request in the Aggregate Study Process and provide a more accurate estimate of transmission costs needed to connect this generation.

3.3 4 CSR 240.040 (3)

This part of the IRP rules states, "...a thorough analysis of existing and planned interconnected resources for the purpose of ensuring; (1) adequate transmission is

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available, (2) the cost of transmission investments is captured, and (3) joint participation in generating projects is considered".

The 2007 Summer Peak Scenario 4 (North to South) SPP loadflow transfer model simulates all KCPL generation resources (except slack generator) at full output. No KCPL transmission facilities, except generator step-up transformers, were loaded above 75% of normal rating in this case. No criteria violations were identified in this case for KCPL transmission facilities, demonstrating adequate transmission within KCPL for existing generation resources.

The 2012 Summer Peak Scenario 4 (North to South) SPP loadflow transfer model simulates all KCPL generation resources (except slack generator) at near full output, including the planned Iatan 2 generator addition. **[redacted]

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[redacted]

[redacted]** Total estimated project cost is $19.1 million.

3.4 4 CSR 240.040 (5)

This part of the IRP rules states, "...evaluate opportunities for long-term power purchases including (F) associated requirements for improvements to the utility's transmission system and (G) constraints on the [transmission] system caused by wheeling agreements".

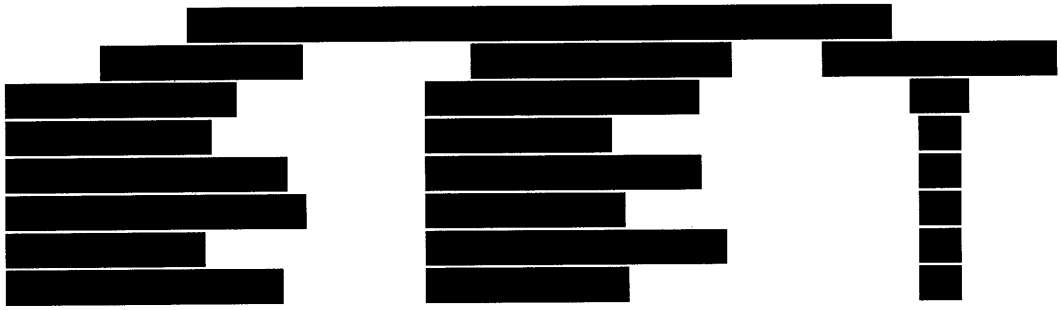
The 2007 Summer Peak Scenario 3 (South to North) SPP loadflow transfer model simulates a reduction of KCPL generation resources by 130 Mw with a corresponding import of 130 Mw to replace the generation reduction. No KCPL transmission facilities, except generator step-up transformers, were loaded above 75% of normal rating in this case. **[redacted]

[redacted]

[redacted]** Estimated cost for HC

this project is approximately $5 million. There were also a number of contingent voltage violations (10) identified in this case. Most of these can be mitigated by changing generator voltage schedules or manual switching of capacitor banks. The 2007 SPP STEP process identified the need for additional capacitor banks at Riley and Craig. The estimated cost for 50 Mvar capacitor banks at these substations is approximately $850,000 each. It should be noted that KCPL transmission losses for this case were approximately 6 Mw higher than for the 2007 summer peak base case.

The 2012 Summer Peak Scenario 3 (South to North) SPP loadflow transfer model simulates a reduction of KCPL generation resources by 301 Mw with a corresponding import of 301 Mw to replace the generation reduction. No KCPL transmission facilities were loaded above normal rating in this case. **[redacted]



[redacted]** There were significantly more voltage violations (76) in this case compared to the 2007 case and the levels of violations were more severe. This is mainly due to replacement of local generation resources with remote supply resources. The problem with this is that local generation resources provide voltage support that remote supply resources cannot. Var losses

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are approximately 200 Mvar greater in this import case than in the 2012 base case. The cost to provide 200 Mvar of capacitor banks to mitigate these violations is estimated at $3.5 million. It should be noted that KCPL transmission losses for this case were approximately 14 Mw higher than for the 2012 summer peak base case.

The 2017 Summer Peak Scenario 3 (South to North) SPP loadflow transfer model simulates a reduction of KCPL generation resources by 301 Mw with a corresponding import of 301 Mw to replace the generation reduction. No KCPL transmission facilities were loaded above normal rating in this case. **[redacted]

[redacted]

** There were significantly more voltage violations (87) in this case compared to the 2007 case and the levels of violations were more severe. Var losses are approximately 225 Mvar greater in this import case than in the 2017 base case. KCPL transmission losses for this case were approximately 15 Mw higher than for the 2017 summer peak base case.

SPP utilizes a "constrained element" approach in determining Available Transfer Capability (ATC) as described in Section 4 of the SPP Criteria. This approach is referred to as a Flowgate ATC methodology. Constrained facilities, termed "Flowgates", used in this approach are identified primarily from a non-simultaneous transfer study using standard incremental transfer capability techniques that recognize thermal, voltage and contractual limitations. Stability limitations are

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studied as needed. Flowgates serve as proxies for the transmission network and are used to study system response to transfers and contingencies. Using Flowgates with pre-determined ratings, this process is able to evaluate the ATC of specific paths on a constrained element basis (Flowgate basis) while considering the simultaneous impact of existing transactions.

KCPL currently has primary responsibility for three defined flowgates as determined by SPP. These are listed in Table 7;

Table 7: SPP FLOWGATES Defined for KCPL

Flowgate #	Flowgate Name	Monitored element	Contingent element(s)
5050	SJHALKNAIASC	St. Joe-Hawthorn	Lake Road-Nashua Iatan-Stranger Creek
5228	IASCLKNASJHA	Iatan-Stranger Crk	Lake Road-Nashua St. Joe-Hawthorn
5219	STIREDSTIPEC	Stilwell-Redel	Stilwell-Peculiar

Flowgates 5050 and 5228 are on the north side of the KCPL service territory. They can become transmission constraints for heavy north to south power transfers. Historically this has usually only occurred during off-peak periods and generally only impacted non-firm transmission service. KCPL Transmission Operations has recently decided to remove the Lake Road-Nashua line from these flowgate definitions and manage overloads on this line with an operating guide. KCPL has installed tension line monitoring (TLM) equipment on the St. Joseph-Hawthorn and Iatan-Stranger Creek lines which provides dynamic rating capability. This would allow these lines to operate at levels above their normal flowgate limit under favorable conditions. There are a number of wind generation facilities proposed for northwest Missouri. If these additional generation resources are developed, flowgates 5050 and 5228 will become more constrained and will probably require long term mitigation plans. These plans could include upgrading the constrained facilities or building new transmission facilities.

Flowgate 5219 is on the south side of the KCPL service territory. It can become a transmission constraint for heavy south to north power transfers. Historically this

flowgate has had very limited impact on transmission service and there are no plans to upgrade these facilities at this time.

There are eight additional flowgates adjacent to or near the KCPL service territory that are not the primary responsibility of KCPL. These are listed in Table 8;

Table 8: SPP FLOWGATES Adjacent to KCPL

Flowgate #	Flowgate Name	Monitored element	Contingent element(s)
1003	THMMOBTHMSAL	Thom Hil-Moberly	Thom Hil-Salisbury
3108	OVERT_SIBLEY	Overton-Sibley	none
5022	LACNEOLANWIC	LaCygne-Neosho	Lang-Wichita
5035	MONTROCLINTN	Montrose-Clinton	none
5052	STOMORLACNEO	Stockton-Morgan	LaCygne-Neosho
5275	TURMARSTIRED	Turner-Martin City	Stilwell-Redel
5283	THMSALTHMMOB	Thom Hil-Salisbury	Thom Hil-Moberly
6104	IATAN_STJOE	Iatan-St. Joseph	None

These flowgates require actions by other utilities to mitigate the potential overloads which constrain transmission service.

3.5 4 CSR 240.040 (6)

This part of the rules states, "...for the utilities preferred resource plan, determine if additional future transmission facilities will be required to remedy any new generation-related transmission system inadequacies over the planning horizon".

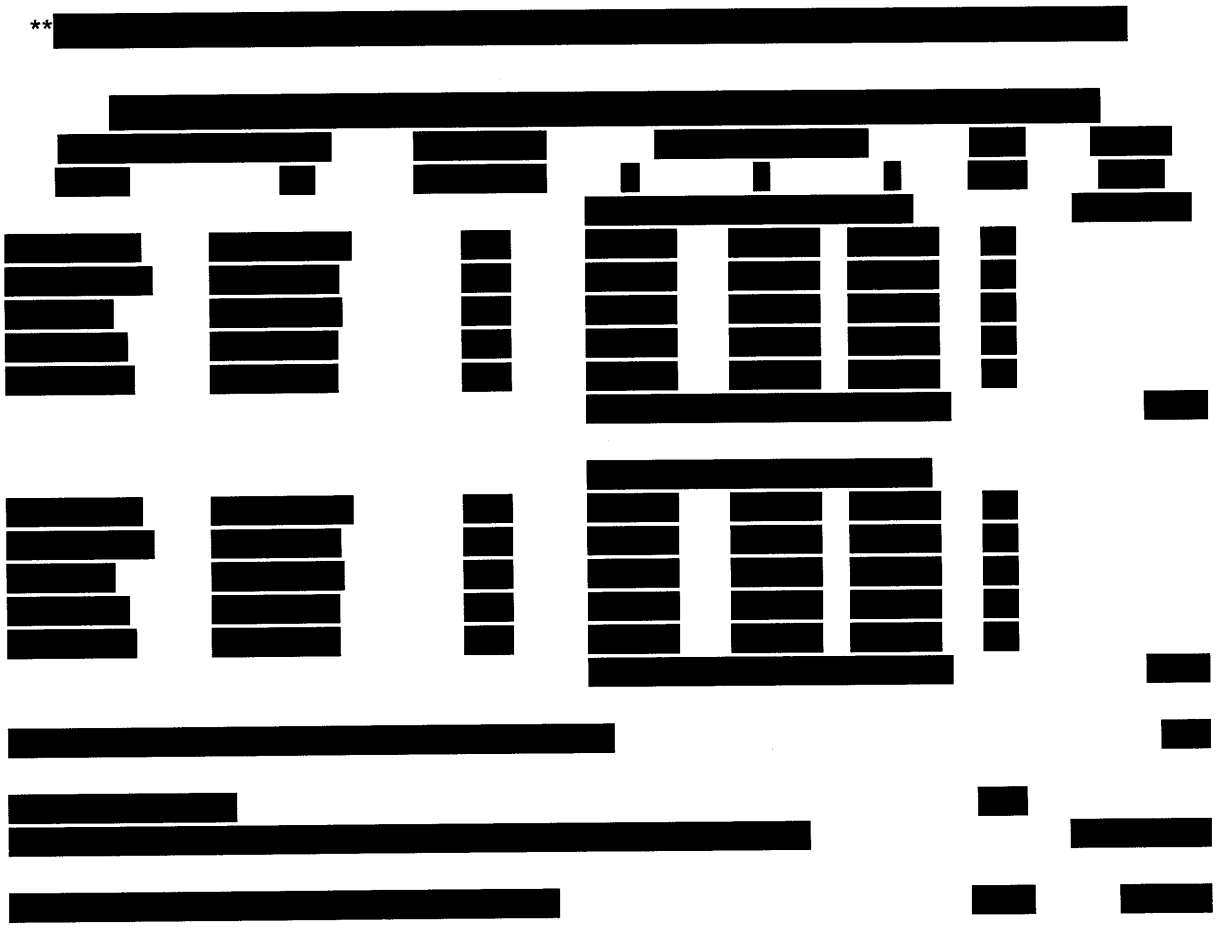
KCPL Resource Planning has determined that its preferred resource plan for this IRP filing will include addition of 100 Mw of wind generated energy for each of the next four years; 2009, 2010, 2011, and 2012, a total of 400 Mw of additional generation resources. Because specific locations have not been identified for this generation, it is not possible to develop an accurate estimate of the transmission investment necessary to deliver this capacity and energy to KCPL customers. Any generation resource KCPL intends to add would have to studied through the SPP GI and AFS processes to accurately determine the need for additional or upgraded transmission facilities.

3.6 4 CSR 240.040 (7)

This part of the IRP rules states, "Analyze the cost effectiveness of transmission and distribution loss reduction measures as a supply-side resource".

Electrical losses in a transmission line are primarily dependent on the specific characteristics of the line (conductor type, line length, etc.) and the amount of power flowing (I^2R) on the transmission line. KCPL uses 161kV transmission lines (approximately 1000 miles) for the majority of its' load serving substations. The standard line design for KCPL's 161kV transmission lines use a single 1192 ACSR conductor per phase on H-frame wood structures. This design provides a normal power flow capability of 293 Mva and an emergency capability of 335 Mva. For increased power flow capability (and lower losses), KCPL uses a line design with two, 954 ACSR conductors per phase on H-frame wood or steel structures. This design provides a normal power flow capability of 513 Mva and an emergency capability of 584 Mva.

In order to "Analyze the cost effectiveness of transmission loss reduction measures as a supply-side resource", KCPL Transmission Planning staff analyzed the costs and loss reductions associated with rebuilding five of KCPL's most heavily loaded 161kV transmission lines. This analysis involved calculating new impedances values for the five transmission lines converted from 1192 conductor to bundled 954 conductors and performing a loadflow analysis to determine the level of loss reduction with the rebuilt lines.



**The average cost of loss reduction for these five transmission lines is $11,289/kw. This is approximately four times the average $/kw construction cost of Iatan 2. Clearly transmission loss reduction is not cost effective for KCPL when compared to the cost of construction for new supply side resources. This is mainly due to the fact that KCPL already has a relatively low loss transmission system.

The KCPL transmission system is a relatively low loss network due to good line design, concentration of load, and the distribution of its generation resources throughout its service territory.

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As shown in Table 10, KCPL's projected transmission loss as a percent of peak load served for 2007 summer peak load conditions is only 1.4%. The comparative value for the rest of the SPP is 2.6%.

Table 10: 2007 Summer Peak Loadflow Model

Area	Load Mw	Loss Mw	Loss/Load
502	2,176.5	41.8	1.9%
503	460.0	7.0	1.5%
504	218.0	0.0	0.0%
515	828.5	20.5	2.5%
520	9,783.2	286.6	2.9%
523	902.3	21.8	2.4%
524	5,928.5	132.3	2.2%
525	1,246.1	46.5	3.7%
526	4,859.9	178.9	3.7%
527	595.6	1.0	0.2%
531	340.8	8.8	2.6%
534	431.5	15.3	3.5%
535	0.0	1.2	0.0%
536	5,531.0	137.9	2.5%
539	480.6	19.7	4.1%
540	1,857.6	39.1	2.1%
KCPL	**3,596.9**	**50.3**	**1.4%**
542	543.5	3.5	0.6%
544	1,116.4	35.5	3.2%
545	324.6	2.3	0.7%
546	769.2	10.8	1.4%
SPP Total	41,990.7	1,060.8	2.5%
SPP - KCPL	38,393.8	1,010.5	2.6%

Table 11 shows similar data for the 2017 summer peak conditions. In this case KCPL projected transmission losses are 1.5% of peak load compared to 2.9% for the rest of SPP.

Table 11: 2017 Summer Peak Loadflow Model

Area	Load Mw	Loss Mw	Loss/Load
502	2,373.2	61.7	2.6%
503	553.0	5.2	0.9%
504	240.0	0.0	0.0%
515	1,077.5	26.0	2.4%
520	11,700.4	362.7	3.1%
523	1,096.0	29.5	2.7%
524	6,799.2	196.6	2.9%
525	1,557.9	61.6	4.0%
526	5,943.7	253.5	4.3%
527	700.9	1.8	0.3%
531	374.8	9.9	2.6%
534	497.3	11.6	2.3%
535	0.0	1.3	0.0%
536	6,927.8	151.7	2.2%
539	522.0	18.3	3.5%
540	2,288.8	58.1	2.5%
KCPL	**4,143.9**	**63.3**	**1.5%**
542	558.5	3.7	0.7%
544	1,360.2	46.3	3.4%
545	374.5	2.6	0.7%
546	943.0	15.4	1.6%
SPP Total	50,032.6	1,380.8	2.8%
SPP - KCPL	45,888.7	1,317.5	2.9%