APPENDIX 4G
TRANSMISSION SUBMISSION

** PUBLIC **

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SECTION 1: GMO NON-PUBLIC UPGRADE INFORMATION

The discussions below cover the requirements for disclosure of non-public transmission upgrades and improvements under consideration by KCP&L Greater Missouri Operations Company (GMO). For GMO, electric transmission is defined as those facilities and related equipment operating at 60 kV and higher.

1.1 PUBLICALLY AVAILABLE INFORMATION

Generally all major GMO transmission upgrade projects are currently made available as public information, either through GMO'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 GMO'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 GMO 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.

1.2 NON PUBLIC INFORMATION

Some information included in GMO'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.

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 GMO 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 GMO's transmission group can share with GMO's generation group. GMO'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 GMO's OASIS.

GMO no longer offers point-to-point transmission service under its open access transmission tariff (OATT). As a member of the Southwest Power Pool (SPP), GMO 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 and arranging for coordinated transmission expansions. 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. GMO 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 GMO may use to serve its load requirements. SPP combines the data provided by GMO 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. GMO) 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 EHV Overlay Study that provides a 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

GMO 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 2009 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 in Table 1 below:

Table 1: 2009 SPP Loadflow Models

	Year	Season	Load
1	2009	Spring	Peak
2	2009	Summer	Peak
3	2009	Summer	shoulder
4	2009	Fall	Peak
5	2009	Winter	Peak
6	2010	April	minimum
7	2010	Spring	Peak
8	2010	Summer	Peak
9	2010	Summer	shoulder
10	2010	Fall	Peak
11	2010	Winter	Peak
12	2011	Summer	Peak
13	2011	Winter	Peak
14	2014	Summer	Peak
15	2014	Winter	Peak
16	2019	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 GMO transmission system is planned to meet the performance requirements of the NERC Reliability Standards (TPL-001 through TPL-004), SPP Criteria (Section 3), GMO 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. GMO planning criteria requires transmission voltages to be maintained within +5/- 5% of nominal voltage for system intact and within +5/-10% of nominal voltage for single contingency conditions.

SECTION 3: IRP REQUIREMENTS FOR TRANSMISSION

3.1 <u>4 CSR 240.22.040 (1)</u>

(1) The analysis of supply-side resources shall begin with the identification of a variety of potential supply-side resource options which the utility can reasonably expect to develop and implement solely through its own resources or for which it will be a major participant. These options include new plants using existing generation technologies; new plants using new generation technologies; life extension and refurbishment at existing generating plants; enhancement of the emission controls at existing or new generating plants; purchased power from utility sources, cogenerators or independent power producers; efficiency improvements which reduce the utility's own use of energy; <u>and upgrading of the transmission and distribution systems to reduce power and energy losses.</u> The utility shall collect generic cost and performance information for each of these potential resource options which shall include at least the following attributes where applicable:

In preparation for this IRP filing, GMO Transmission Planning received from GMO Resource Planning a list of possible new generation resource alternatives to analyze for associated transmission requirements. ** [redacted].** 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 GMO

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decides to pursue in the future will have to be evaluated though the SPP Generation Interconnection process.

** [redacted] ** It was assumed this new generation resource would be interconnected to the existing ** [redacted] **. The loadflow analysis involved studying the 2014 summer and winter peak and 2019 summer peak loadflow models with existing system conditions and with the new ** [redacted] **. ACCC (contingency) analysis was performed on all six models and results compared to determine if the increased wind farm generation resource created any new criteria violations (equipment overloads, voltage violations). The ACCC analysis did not identify any new criteria violations associated with this resource addition. Total estimated transmission upgrades for this resource option is approximately ** [redacted] **. Due to the use of existing transmission capacity with this option, there was no opportunity to upgrade equipment to reduce power and energy losses at the transmission level.

** [redacted] **. Due to the use of existing transmission capacity with this option, there was no opportunity to upgrade equipment to reduce power and energy losses at the transmission level.

** [redacted] **. Due to

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the use of existing transmission capacity with this option, there was no opportunity to upgrade equipment to reduce power and energy losses at the transmission level.

The fourth resource option to be analyzed involved ** [redacted]**. Due to the use of existing transmission capacity with this option, there was no opportunity to upgrade equipment to reduce power and energy losses at the transmission level.

** [redacted] **. Long range transmission planning has become significantly more complicated in the era of "open access" transmission. Requests for transmission service (TS) and generation interconnection (GI) have increased greatly, with some of these being purely speculative or exploratory. Some of the GI requests cannot identify the delivery point for their power output. GI requests can also go into a "suspended" mode of up to 3 years. This uncertainty, added to the need to maintain "roll over" rights for TS requests significantly increases the complexity of the analysis to determine future transmission needs. ** [redacted]

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[redacted]**. This range of transmission costs was developed by analyzing a regional transmission expansion plan and a local transmission expansion plan.

** [redacted]

[redacted]

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[redacted]**.

Table 2: [redacted] **

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[redacted]

Under this transmission expansion option, GMO would only pay for its ownership share of the total investment cost. For example, if GMO's ownership ** [redacted]**. Again it may be necessary to invest additional capital in local GMO 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 ** [redacted]**.

3.2 <u>4 CSR 240.22.040 (3)</u>

(3) The analysis of supply-side resource options shall include a thorough analysis of existing and planned interconnected generation resources. The analysis can be performed by the individual utility or in the context of a joint planning study with other area utilities. The purpose of this analysis shall be to

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ensure that the transmission network is capable of reliably supporting the supply resource options under consideration, that the costs of transmission system investments associated with supply-side resources are properly considered and to provide an adequate foundation of basic information for decisions about the following types of supply-side resource alternatives:

The 2010 Summer Peak Scenario 4 (North to South) STEP model simulates all GMO generation resources, including an 18% share of the planned Iatan 2 generator addition, (except slack generator & IPP) at full output. No GMO transmission facilities, except generator step-up transformers, were loaded above 95% of normal rating in this case. No system intact (N-0) criteria violations were identified in this case for GMO transmission facilities. Under contingent (N-1) conditions, ** [redacted]**. Design and Engineering have not been completed for this project at this time. It is ** [redacted]**. The ** [redacted] ** are listed in Table 3 below:

[redacted]

The 2014 Summer Peak Scenario 4 (North to South) STEP model simulates all GMO generation resources (except slack generator & IPP) at near full output. ** [redacted]

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[redacted] ** are listed in Table 4 below:

[redacted]

** [redacted] **

The 2019 Summer Peak Scenario 4 (North to South) STEP model simulates all GMO generation resources (except slack generator & IPP) at near full output. ** [redacted] ** are listed in Table 5 below:

[redacted]

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** [redacted] **.

New transmission facilities associated with the planned addition of the Iatan 2 generator were studied as part of the SPP generator interconnection process. This included the analysis of 345kV and 161kV interconnection options. The preferred plan, a 161kV option, involved joint planning with Aquila (now GMO) to utilize one of their existing transmission lines which is geographically close to Iatan. This reduced the need for new transmission line construction from 32 miles to 4 miles. The original plan was for addition of a 600 Mva, 345/161kV transformer at Iatan. When additional SPP studies identified the potential for a contingent overload on this transformer, the size was increased to 650 Mva. Total estimated project cost is ** [redacted] **.

3.3 4 CSR 240.22.040 (5)(F)

(F) Required improvements to the utility's generating system, transmission system, or both, and the associated costs; and

(G) Constraints on the utility system caused by wheeling arrangements, whether on the utility's own system, or on an interconnected system, or by the terms and conditions of other contracts or interconnection agreements.

The 2010 Summer Peak Scenario 3 (South to North) STEP model simulates a GMO import of ** [redacted] **. No GMO transmission facilities, except generator step-up transformers, were loaded above 97% of normal rating in this case. ** [redacted]

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[redacted] **. Design and Engineering have not been completed for this project at this time. It is ** [redacted] Table 6 below:

[redacted]

One of the voltage criteria violation mitigations requires ** [redacted] **.

The 2014 Summer Peak Scenario 3 (South to North) STEP model simulates a GMO import of ** [redacted] **. No GMO transmission facilities were loaded above normal rating in this case. ** [redacted] **.

The 2019 Summer Peak Scenario 3 (South to North) STEP model simulates a GMO import of ** [redacted] **. No GMO transmission facilities were loaded above normal rating in this case. ** [redacted]
** Table 7 below:.

[redacted]

** [redacted] **.

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 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.

GMO currently has primary responsibility for eight defined flowgates as determined by SPP or the Midwest Independent System Operator (MISO). These are listed in Table 8 below:

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Table 8: SPP/MISO Flowgates For GMO

SPP/MISO FLOWGATES Defined for GMO

Flowgate #	Flowgate Name	Monitored element	Contingent element(s)
5275	TURMARSTIRED	Turner Road-Martin City	Stilwell-Redel
6102	STJOE_MIDWAY	St. Joseph-Midway	none
6104	IATAN_STJOE	Iatan-St. Joseph	none
6152	STMDSJFASJCO	St. Joseph-Midway	St. Joseph-Fairport Fairport-Cooper
6191	STJCOOSTJWOO	St. Joseph-Cook	St. Joseph-Woodbine
6281	PLELAKGRELEE	Plsnt Hil-Lake Winnebag	Greenwood-Lee's Sum
90751	DUNBLSSIBORR	Duncan Rd-Blue Sprg E	Sibley-Orrick
90995	STJMIDFAIXFR	St. Joseph-Midway	Fairport 345/161kV Tx

Flowgates 5275 will be mitigated by addition of a new interconnection between GMO and KCPL at KC South. The St. Joseph – Midway flowgates (6102, 6152, 90995) can be mitigated by an operating guide that splits the Maryville 161kV bus. Flowgate 6104 will be mitigated by addition of the Iatan – Nashua 345kV line. Flowgate 6191 involves transmission facilities supplying the city of St. Joseph, Missouri. A transmission planning study is being conducted to determine the most cost effective way to provide more transmission capacity for St. Joseph. Flowgate 6281 will be mitigated by terminal upgrades at Pleasant Hill and Lake Winnebago. Flowgate 90751 can be mitigated by reducing generation at Sibley power plant.

There are eight additional flowgates adjacent to or near the GMO service territory that are not the primary responsibility of GMO. These are listed in Table 9 below:

Table 9: Flowgates Adjacent To GMO

Flowgate #	Flowgate Name	Monitored element	Contingent element(s)
	FLOWGATES Adjacent to GMO		
1035	NODMARSTJMID	Nodaway-Maryville	St. Joseph-Midway
3108	OVERT_SIBLEY	Overton-Sibley	none
6205	SIECSJFAFACO	Sibley-Eckles Road	St. Joseph-Fairport Fairport-Cooper
6244	SIBECKHAWBIR	Sibley-Eckles Road	Hawthorn-Birmingham
6258	SIBECKSIBHAW	Sibley-Eckles Road	Sibley-Hawthorn
6300	SIBECKMOCLIB	Sibley-Eckles Road	Mo City-Liberty South
6309	MAMASTFAFACO	Maryville-Maryville	St. Joseph-Fairport Fairport-Cooper
90994	MARCLRMARCRE	Maryville-Clarinda	Maryville-Creston

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

3.4 4 CSR 240.22.040 (6)

(6) For the utility's preferred resource plan selected pursuant to 4 CSR 240-22.070(7), the utility shall determine if additional future transmission facilities will be required to remedy any new generation-related transmission system inadequacies over the planning horizon. If any such facilities are determined to be required and, in the judgment of utility decision-makers, there is a risk of significant delays or cost increases due to problems in the siting or permitting of any required transmission facilities, this risk shall be analyzed pursuant to the requirements of 4 CSR 240-22.070(2).

GMO Resource Planning has determined that the preferred resource plan for the GMO IRP filing includes wind generated energy, small amounts of solar generated energy, and combustion turbine resources several years in the future. The preferred resource plan is shown in detail in Table 10 below:

Table 10: Preferred Resource Plan

Date	Plan 22: Install Prop C Wind and Solar, CT's, Additional 500 MW Wind Above Prop C beginning in 2012, All DSM, and Sibley 1&2 converted to 10% biomass usage				
	Install CT's	Install Solar	Install Prop C Wind	Install Other Wind	All DSM
2009	0				5.9
2010	0				31.8
2011	0	1.79			64.1
2012	0	0.03		100	89.4
2013	0	0.02			109.4
2014	0	2.80			122.9
2015	0	0.05			127.3
2016	0	0.11	100	100	131.7
2017	0	0.08		200	134.9
2018	0	5.02	100		138.6
2019	0	0.15			142.0
2020	0	0.20			143.4
2021	0	5.33	100		144.3
2022	0	0.24			144.4
2023	0	0.24	100		144.2
2024	0	0.32		100	143.8
2025	154	0.26			141.1
2026	0	0.32			138.3
2027	0	0.32			135.3
2028	154	0.35			131.2
2029	0	0.25			126.7

Because specific locations have not been identified for this new generation, it is not possible to develop an accurate estimate of the transmission investment necessary to deliver this capacity and energy to GMO customers. Any generation resource GMO 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.

It should be noted that GMO was granted "Waiver Request 10" by the Commission under "Order Granting KCP&L-GMO'S Request For Waivers", Case No. EE-2009-0237, dated March 11, 2009.

3.5 <u>4 CSR 240.22.040 (7)</u>

(7) The utility shall assess the age, condition and efficiency level of existing transmission and distribution facilities, <u>and shall analyze the feasibility and cost-effectiveness of transmission</u> and distribution system loss-reduction measures as a supply-side resource. This provision shall not be construed to require a detailed line-by-line analysis of the transmission and distribution

system, but is intended to require the utility to identify and analyze opportunities for efficiency improvements in a manner that is consistent with the analysis of other supply-side resource options.

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 (I2R) on the transmission line. GMO uses 161kV transmission lines (approximately 545 miles) for the majority of its' load serving substations. The standard line design for GMO's 161kV transmission lines use a single 795 ACSR conductor per phase on H-frame wood structures. This design provides a normal summer power flow capability of 233 Mva and an emergency capability of 265 Mva. For increased power flow capability (and lower losses), GMO uses a line design with two, 795 ACSR conductors per phase on H-frame wood or steel structures. This design provides a summer normal power flow capability of 466 Mva and an emergency capability of 530 Mva.

In order to "Analyze the cost effectiveness of transmission loss reduction measures as a supply-side resource", GMO Transmission Planning staff analyzed the costs and loss reductions associated with rebuilding four of GMO's most heavily loaded 161kV transmission lines. This analysis involved calculating new impedances values for the five transmission lines converted from 795 conductor to bundled 795 conductors and performing a loadflow analysis to determine the level of loss reduction with the rebuilt lines. For 2011 summer peak conditions, results of this analysis are shown in Table 11 below:

Table 11: Cost Analysis For 161 kV Transmission Line Loss Reduction **

[redacted]

The average cost of loss reduction for these five transmission lines is ** [redacted] **. This is approximately five times the average $/kW construction cost of Iatan 2. Clearly transmission loss reduction is not cost effective for GMO when compared to the cost of construction for new supply side resources. This is mainly due to the fact that GMO already has a relatively low loss transmission system.

The GMO 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. As shown in Table 3.6 B, GMO's projected

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transmission loss as a percent of peak load served for 2010 summer peak load conditions is ** [redacted] **. The comparative value for the rest of the SPP is 2.7%.

Table 12: 2010 Summer Peak Load Projected Transmission Loss ** Highly Confidential **

[redacted]

SPP - GMO	42,950.9	1,158.2	2.7%

Table 13 shows similar data for the 2019 summer peak conditions. In this case GMO projected transmission losses are ** [redacted] ** of peak load compared to 3.1% for the rest of SPP.

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Table 13: 2019 Summer Peak Load Projected Transmission Loss ** Highly Confidential **

[redacted]

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