NP

VOLUME 4.5

TRANSMISSION AND DISTRIBUTION ANALYSIS

THE EMPIRE DISTRICT
ELECTRIC COMPANY D/B/A LIBERTY ("LIBERTY-EMPIRE")

20 CSR 4240-22.045

FILE NO. EO-2021-0331

April 2022

20 CSR 4240-2.135(2)(A)7

****Denotes Confidential****

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TRANSMISSION AND DISTRIBUTION ANALYSIS

Commission Rule 20 CSR 4240-22.0.060, Integrated Resource Plan and Risk Analysis, provides in part as follows:

PURPOSE: This rule specifies the minimum standards for the scope and level of detail required for transmission and distribution network analysis and reporting.

SECTION 1 ADEQUACY OF THE TRANSMISSION AND DISTRIBUTION NETWORKS

(1) The electric utility shall describe and document its consideration of the adequacy of the transmission and distribution networks in fulfilling the fundamental planning objective set out in 4 CSR 240-22.010. Each utility shall consider, at a minimum, improvements to the transmission and distribution networks that—

1.1 Opportunities to Reduce Transmission Power and Energy Losses

(A) Reduce transmission power and energy losses. Opportunities to reduce transmission network losses are among the supply-side resources evaluated pursuant to 4 CSR 240-22.040(3). The utility shall assess the age, condition, and efficiency level of existing transmission and distribution facilities and shall analyze the feasibility and cost-effectiveness of transmission and distribution network loss-reduction measures. This provision shall not be construed to require a detailed line-by-line analysis of the transmission and distribution systems, 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 directly dependent on the amount of current flowing on the line as well as the specific characteristics of the line (conductor type, line length, etc.). Liberty-Empire uses a combination of 161-kilovolt (“kV”), 69-kV, and 34.5-kV transmission lines for serving its respective substations. The majority of Liberty-Empire’s 161-kV transmission utilizes H-frame structures with a 795 Aluminum Conductor Steel Reinforced (“ACSR”) type conductor. The associated summer A and B ratings are 290 and 341 Mega Volt Amps (“MVA”), respectively. When a particular line segment studied is found to have become overloaded, Liberty-Empire evaluates the possibility of bundling conductors on the structures. This has the effect of halving the losses and doubling the capacity of the chosen conductor. The resultant summer A and B ratings for 795 ACSR are 579 and 682 MVA, respectively.

In evaluating Liberty-Empire's transmission system losses, approximately 11.07 MW of a total of 27.9 MW is accounted for on the 161-kV system. This is primarily due to the fact that Liberty-Empire's service territory mainly consists of rural loads, which do not necessitate the need to serve dense load pockets with much larger conductor types than 795 ACSR, such as 1192 ACSR used in urban load environments; however, Liberty-Empire's topography necessitates longer distances to be reconductored/bundled once a line segment is identified as a required upgrade. An example of such would be Liberty-Empire's 161-kV line connecting Tipton Ford #292 to Monett #383 Substations. This specific line is approximately 29 miles in length. A general cost comparative analysis of reconductoring the line requiring a rebuild versus bundling the conductor for minimal structural change-outs of the line yields is shown in Table 4.5-1.

Table 4.5-1 – Comparative Costs of Reconductoring versus Conductor Bundling of 161-kV Line

Configuration	R	X	B	Losses in 2021 SP Model (in MW)	Difference (in MW)
795 ACSR	0.0131	0.0856	0.0422	0.71	
2-795 ACSR	0.0065	0.0428	0.0211	0.68	0.03
2-566 ACSR	0.0093	0.0617	0.0585	0.67	0.04
Estimated cost to reconductor/bundle entire circuit:				$21,750,000	
Average cost per kW of loss reduction:				2-795 ACSR	$725,000
				2-556 ACSR	$543,750
Ratio of Avoided Transmission Costs (@ $86.24 / kW):				2-795 ACSR	8,407 : 1
				2-556 ACSR	6,305 : 1

If dual bundled 795 ACSR or dual bundled 556 ACSR were chosen as a loss reduction option, the cost for this specific line were $725,000/kW and $543,750/kW, respectively. As related to the avoided transmission costs, the ratios were 8,407:1 and 6,305:1, respectively. These ratios exhibit the cost-ineffectiveness of transmission loss reduction.

Liberty-Empire's system losses (in MWs) represent approximately 0.02 percent of the losses evident in the modeled 2021 summer peak model of the entire Southwest Power Pool ("SPP") footprint. When compared to like-configured systems (i.e. comparable size and topography), Liberty-Empire's system losses are of negligible difference to that of the comparative averages, as shown in Table 4.5-2.

Table 4.5-2 – Liberty-Empire's System Losses

Area	Load (MW)	Losses (MW)	% Loss
523	1373	18.11	1.3%
525	1,670	37.99	2.3%
534	1,197	31.81*	2.7%
546	763	8.6	1.1%
Liberty-Empire	1072	27.9	2.6%
Averages	1,215	24.88	2.1%

*124.47 Losses reported within models, 92.66MW of which were associated with wind farm collector systems which are not directly attributable to the SUNC area but rather owners of wind resources; therefore, collector system losses are excused from table above.

Additional analysis was done to measure the potential benefits of a case where the entire Liberty-Empire owned/operated 161kV system were to utilize a bundled conductor configuration, thereby reducing the impedance of all 161kV lines by half (doubling conductor equates to halving the impedance). The flows present on the 2021 Summer Peak Model Development Working Group ("MDWG") model set yield the results are as follows, as shown in Table 4.5-3.

Table 4.5-3 – Liberty-Empire's Avoided Transmission Costs

	Original System Losses by Zone (MW)	New System Losses with bundled (MW)	Difference in losses by Zone (MW)	Miles of line rebuilt (mi)	Assumed Cost of rebuild for entire Zone/system (in $ millions @ $1.2MM/mi)	Cost / MW of reduced losses ($ millions/MW)	Avoid Trans. Costs @ $86.24 /kW ($'s)
Aurora	3.79	3.46	-0.33	198.1	117.720	356.73	28,459
Baxter	2.85	3.08	+0.23	55.73	66.876	No benefit	0.00
Bolivar	1.00	0.77	-0.23	47.54	57.048	248.03	19,835
Joplin	6.77	5.65	-1.12	94.29	113.148	101.03	96,589
Webb City	1.87	1.77	-0.1	101.28	121.536	1,215.36	8,624
Neosho	1.08	1.18	+0.1	61.01	73.212	No benefit	0.00
Ozark	0.22	0.22	0.00	6.5	7.8	No benefit	0.00
Branson	0.81	0.65	-0.16	88.79	106.548	665.93	13,798
Totals	18.39	16.78	-1.61	653.24	663.88	2,587.08	167,305

The results show that only one area exhibited a reduction in losses of more than 1 MW (i.e., Joplin, at 1.12 MW). This reduction was at an anticipated cost of $113.15 million for a respective avoided transmission cost savings of $96,589. All other areas were below 1 MW of reduced system losses. The findings are a direct result of the positioning of generation on the Liberty-Empire Transmission system. Most generation assets are either within the Joplin area bounds (as defined by the planning model zones) or adjacent to the Joplin zones, and as stated above, the resulting system losses are directly proportional to the current flows. A total of $167,305 of avoided transmission costs would be realized at the expense of $663.88 million in transmission rebuild costs (a ratio of 3,968:1). These results differ from other areas within SPP due to the topography of the Liberty-Empire system. The low density of load coupled with the high cost of longer line builds results in a higher cost per MW of reduced losses. More densely concentrated loads would result in short lines with higher flows during peak conditions, as is evident in a typical Investor-Owned Utility ("IOU") topology.

With respect to the distribution level, Liberty-Empire has taken measures to standardize their construction efforts in stocking commonly used conductors within the industry. One example is the evaluation and subsequent restricted use of redundant conductor types. 4/0 ACSR was a commonly used conductor in past installations alongside 336 ACSR. The structural requirements are similar for either conductor type, however; the ampacity of 336 ACSR as compared to 4/0 was 519 and 366 amps, respectively (per Southwire's Overhead Conductor Manual, 2nd Edition). Table 4.5-4 provides a comparison of these conductors.

Table 4.5-4 – Comparison of Conductors of Interest

	Ohm / mi at 75 C	Ampacity (amps)
4/0 ACSR	0.5999	366
336 ACSR	0.3298	519

Standardizing to a 336 ACSR conductor versus the previously-used 4/0 ACSR reduces line losses while increasing the capacity of the wires. In doing so, capital projects on the distribution level are delayed, more readily available switching paths are gained, and system flexibility is increased.

1.1.1 Distribution System Overview

Liberty-Empire has a single planning group tasked with transmission and distribution planning efforts. This planning group analyzes data, develops electrical models representative of the Liberty-Empire distribution system, and performs associated power flow studies to assess and prioritize system improvement needs as system dynamics dictate. Liberty-Empire maintains distribution voltages of 25-kV, 12.47-kV, and 4.16-kV three-phase as well as a mixture of open wye (dual-phase) and single-phase feeders. These feeders are composed of an assortment of conductor types and configurations.

The majority of the Liberty-Empire distribution system mirrors that of a rural area co-op. Many of Liberty-Empire's distribution feeders are long in length and have a distributed load profile. The average total distribution feeder exposure length within the Missouri portion of the Liberty-Empire footprint is approximately 17.83 miles. This distance encompasses the total circuitry length (i.e. all trunk lines, taps, radials, etc.). The average length of overhead three phase of Missouri Liberty-Empire distribution circuits is 6.02 miles. The highest density loads are located in the Joplin and Branson areas. The rural areas have the most widespread infrastructure components and have the fewest or most limited emergency ties, where minute load manipulation can cause large disturbances to customers' voltage. The limited availability of switching paths is the largest factor in restoration efforts as well as feeder relief. The Liberty-Empire distribution system is configured as a radial fed system under normal operating conditions. Liberty-Empire maintains three auto throw schemes in different parts of the system (Joplin and Branson in Missouri, and Welch, Oklahoma) where alternate switching paths with available capacity are readily available. These type systems have limited applicability due to the typical Liberty-Empire distribution circuit being rural in character.

Expansion of the distribution network occurs in load pockets of expansive development (i.e. subdivision expansion, large industrial customer development on greenfield sites, etc.). System expansion typically occurs on a smaller scale in magnitude; however, with the addition of these types of incremental load additions, the existing infrastructure is impacted more heavily due to the voltage profile drastically changing from the application of spot loads applied to the circuit. Liberty-Empire continually evaluates possible economic development projects and their associative impacts on the available distribution feeders, power transformers, and existing customer voltage profiles to determine which specific large-scale upgrades are needed for a specific project of interest.

Liberty-Empire's planning department also maintains distribution feeder models. Liberty-Empire has continued to migrate the existing distribution system model/map to its distribution evaluation software, CYME Distribution System Analysis, and is currently integrating the available mapping resources to better model the distribution systems. The model will allow for detailed evaluations as data becomes available so that as expansion occurs and load reconfigures, projects may be identified and prioritized accordingly.

1.1.2 Annual Scope of Work

Throughout each year, Liberty-Empire's planning department prepares a number of system studies to determine weaknesses or risks and to assess the overall adequacy of their distribution system. The majority of the work focuses on increasing reliability and prioritizing work based upon cost, scope, impact, and effectiveness. This work encompasses four specific areas, which include capacity, contingency, voltage, and condition. Liberty-Empire uses a variety of tools to conduct these types of evaluations, including software such as Google Earth Pro, CYME International's Power Engineering Solutions, and GTI geospatial analysis and viewing.

Figure 4.5-1 provides a screenshot from Google Earth Pro. Liberty-Empire merged the mapping system topology with Google Earth which allows for detailed mapping of associated feeders to be studied as well as allows for ready review of proximity to alternate switching paths. Allowing for a view of the topography and attempting to head off any construction hindrances has proven effective on past projects. Projects imposed over the Google Earth snapshots allow those with a vested interest in the job to gain further knowledge of the scope of work to be done.

Figure 4.5-1 – Google Earth Pro Screenshot

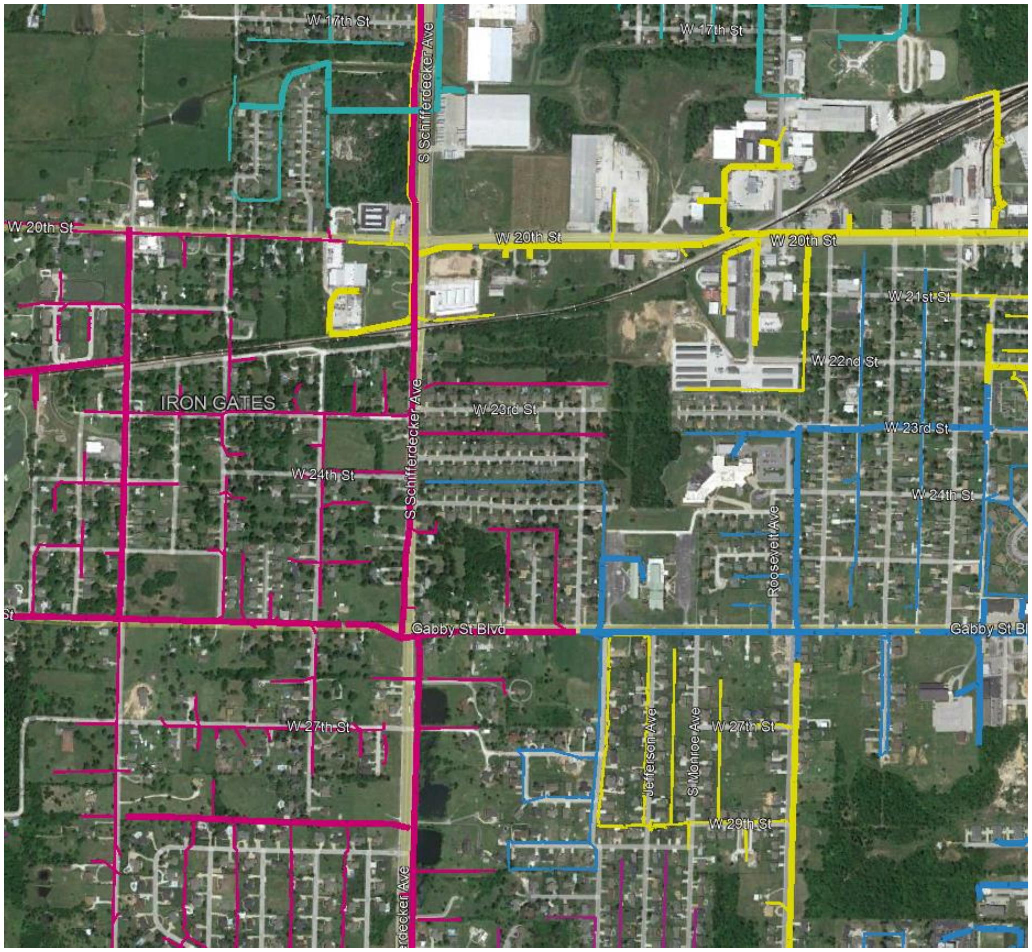


Figure 4.5-2 provides a screenshot from GTI's GTViewer. This software allows engineers to acquire model data for use in distribution analysis software, CYME Distribution System Analysis. GTI's software device characteristics and connectivity drive load-flow models in use by Liberty-Empire's planning department. In the near horizon, Liberty-Empire will attempt to merge all planning software platforms so that real time data and analysis will be available to users. In doing so, real-time models will allow for an exhaustive review should the need arise.

Figure 4.5-2 – GTViewer Screenshot

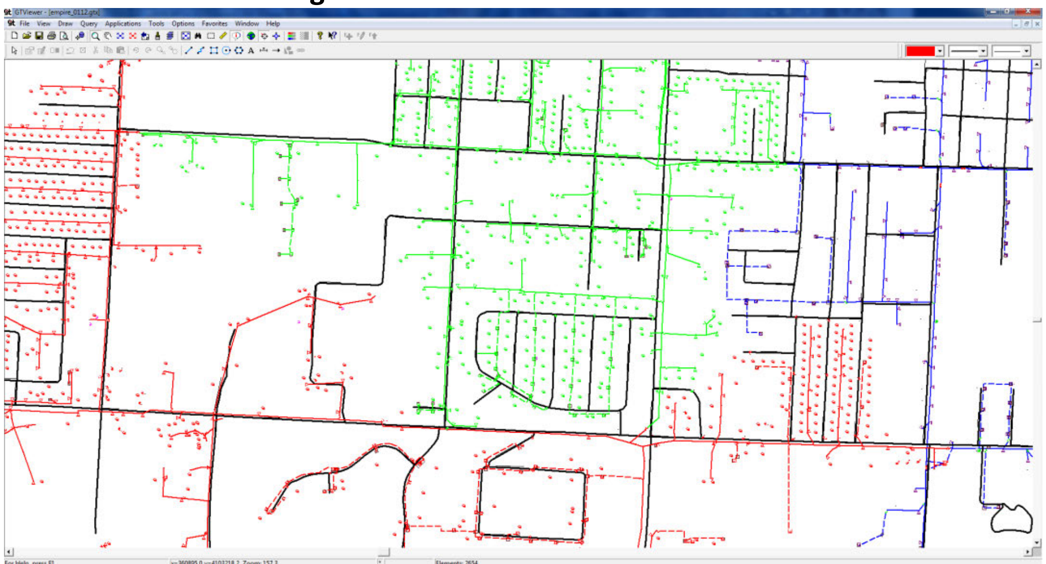
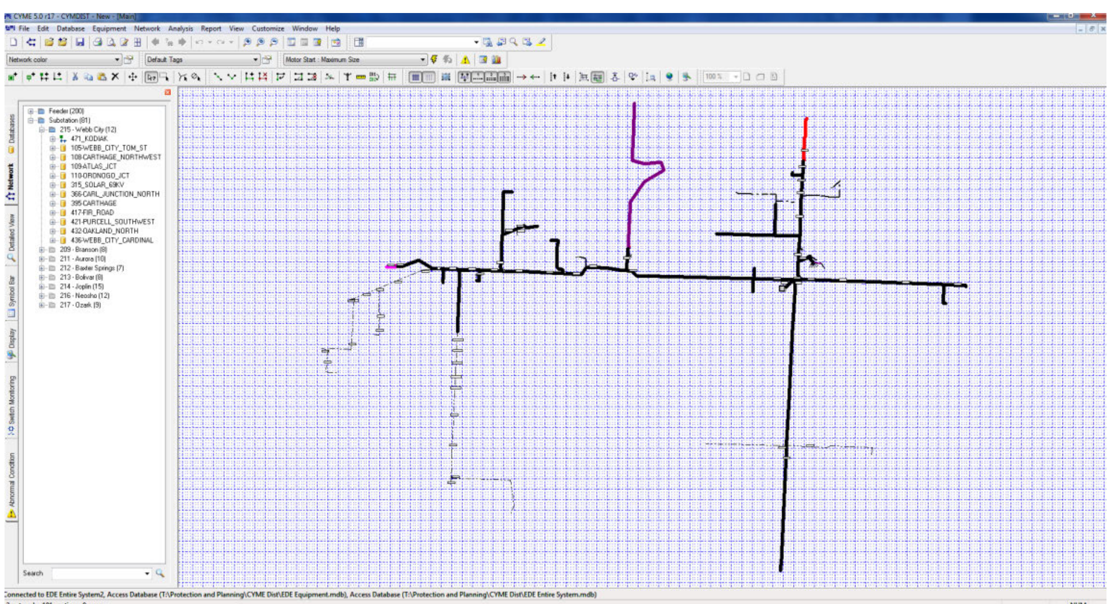


Figure 4.5-3 provides a screenshot from CYME Distribution System Analysis. CYMDIST is a multipurpose tool primarily used by engineers to analyze load-flow characteristics of distribution feeders. Liberty-Empire's planning department also provides fault current information to its customers' electrical contractors when performing arc-flash studies, a process which requires the use of CYMDIST.

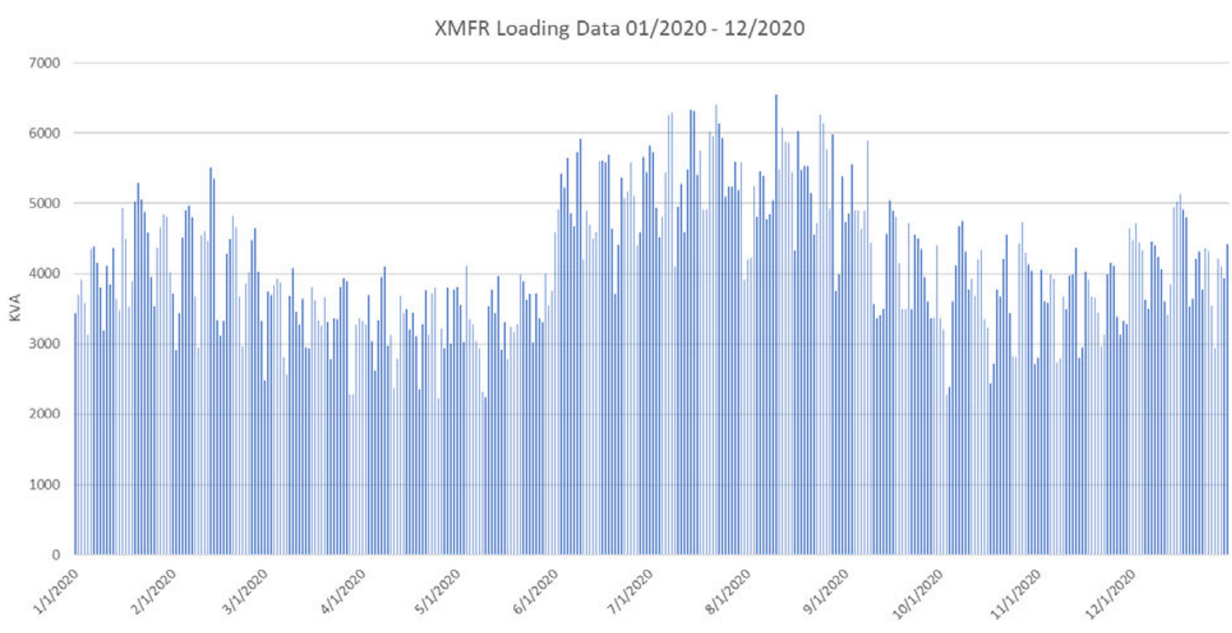
Figure 4.5-3 – CYMDIST Screenshot



1.1.2.1 Capacity Planning

Substation transformer and distribution circuit loads are collected annually, with the primary sources being monthly metering data and seasonal station checks. This load data is compiled into a database that can be parsed into different seasons, definite dates, specific months, or years' worth of data for analysis. The data is also compared to the maximum capacity available at the service transformer to determine overloads evident in past scenarios or present system configurations. These types of overloads are higher in priority due to the severity and long lead time mitigations available.

Figure 4.5-4 – Substation Trending Over Multiple Years during Peak Load Switching



1.1.2.2 Contingency Planning

Transmission and distribution system planning includes consideration of contingencies and their impact on the systems as they may change under varying conditions. As the graph in Figure 4.5-4 shows, switching arrangements are reflected in Liberty-Empire's system load database. Inclusion of this type contingency event allows for evaluation in subsequent capital improvement project weighting. Projects are then scoped appropriately to allow for contingency switching events and redundancy of adequate capacity.

1.1.2.2.1 Distribution Contingency Evaluation

From distribution studies performed throughout a given year, Liberty-Empire's planning department determines what switching paths are available during a contingency event. Examples of these types of studies include evaluation of substation transformer loading (as in the graph above) to determine available capacity present on a substation of interest, splitting trunk lines and their effects on voltage profiles on a given feeder, and phase loading imbalance due to the topography changes made during switching adjustments. These studies allow the engineering department to make informed decisions on available transfer capabilities on specific feeders. Once weaknesses are identified and analyzed, the resulting system impacts can be ranked against other to determine capital budget project priority. Ultimately, this ranking, energy efficiency impacts, reliability and customer impact risks, and the project cost are used to determine whether or not a system improvement should be implemented. The Liberty-Empire planning department identifies the weaknesses and provides budgetary estimation and project description in conjunction with Liberty-Empire's Line Design department. The planning department also communicates the justifications for projects to the vested departments internal to Liberty-Empire.

1.1.2.2.2 Transmission Contingency Evaluation

Liberty-Empire conducts transmission system performance studies as required by the North American Electric Reliability Corporation ("NERC") TPL-001-4 and associated prescribed planning events (P0, P1, etc.). These studies are provided as supplements to the SPP TPL Compliance Report. Studies include Planning Events as prescribed within Table 1 of the TPL-001-4 Standard.

Table 1 is attached as Appendix 4.5-A for reference as to the specified planning events: P0-P7. Upon written request, the latest iteration of the TPL assessment can be provided. This study is an annual assessment of the Liberty Transmission system(s). In addition, Liberty participates in the annual RTO coordinated TPL study as required by TPL-001-4. The results of this study can be found on the SPP website (spp.org). The loading profiles and generation dispatch vary according to the available model set(s) and the coordination of members and SPP staff to meet TPL-001-4 criterion.

1.1.2.2.3 Worst Performing Circuit Analysis

To improve the performance of its worst performing circuits (“WPCs”), Liberty-Empire adopted a corrective action plan approach that includes the following activities:

1. Liberty-Empire employees perform a “walk-through” of the WPC, collecting engineering data to support the following coordination study and sectionalizing program. Items are noted and corrected as part of the corrective action plan.
2. Upon walk-through completion, a coordination study of the circuit occurs. The coordination study evaluates protective equipment settings and application to ensure each protective device properly operates with other upstream and downstream protective equipment.
3. Additional sectionalizing is then added to the circuit to reduce the number of customers experiencing an outage, in the event that an outage occurs, thus increasing reliability to other customers on the circuit.
4. Faulted circuit indicators are also added to the circuit to reduce restoration time and shorten customer outage duration.
5. In addition to the coordination study and sectionalizing program, any vegetation-related issues identified are scheduled to be cleared for each circuit.

Each of the activities listed above is performed as a process of implementing the WPC remediation. The engineering portion of the process includes the coordination study, and the construction portion follows. Typically, engineering is performed in the year prior to construction.

1.1.2.2.4 Cable replacement Initiative

Liberty-Empire has committed approximately $7 million annually to remediation/replacement of underground cabling. This commitment is related to long restoration efforts required when cables fail. The impacts to customers are long lasting and intensive. Proactive treatment and replacement should yield a more robust system and improve reliability to customers impacted by aged cabling.

1.1.2.2.5 Pole Replacements

Over the next three years, $42 million is planned to invest in the existing distribution infrastructure, specifically for Bad Order pole replacements. Poles are regularly identified as being in a compromised state, which directly impacts reliability indices to customers. Initiatives such as these allow the company to identify, design, and construct replacements so that failures are addressed proactively vs. reactively.

1.1.2.2.6 Aging/Aged Equipment

$35 million has been identified over the next 3 years to address the existing aging infrastructure present on the full spectrum of plant in-service. The majority of spend will be allocated to distribution assets. Examples of reviews are station transformers older than 50 years, electromechanical relaying, breakers >40 years of age, and various distribution sectionalization devices unable to be maintained due to age/vintage.

Evaluation and proactive address of the above categories will increase the ability of DERs and DSM initiatives to deliver positive impacts to Liberty-Empire's collective systems as well as magnify the associated results.

1.2 Assessment of Interconnecting New Facilities

(B) Interconnect new generation facilities. The utility shall assess the need to construct transmission facilities to interconnect any new generation pursuant to 20 CSR 4240-22.040(3) and shall reflect those transmission facilities in the cost benefit analyses of the resource options;

Liberty-Empire is required to meet the interconnection needs of transmission customers for connection to, and use of, the Liberty-Empire transmission system. The Federal Energy Regulatory Commission ("FERC")-approved transmission tariffs provide procedures for detailed transmission studies and interconnection estimates for connecting to and using Liberty-Empire's transmission system. Liberty-Empire's planning department provides a range of transmission costs for various sites of interest on defined projects and identifies potential transmission limitations with the inclusion of projects of interest. Any Liberty-Empire generation resource addition that would impact transmission level flows is required to proceed through the SPP Generation Interconnection ("GI") process before it can be interconnected to the transmission system. Every resource addition would also have to be included in the SPP Aggregate Facility Study ("AFS") process to obtain firm transmission service for delivery of generation to load. The most recently completed Interconnection Study that directly involved Liberty-Empire petitioning for new interconnection was the SPP Definitive Interconnection System Impact Study ("DISIS") for Generation Interconnection Requests (DISIS-2017-001). Liberty-Empire has two requests: GEN-2017-060 and GEN-2017-082, which are presently being studied within the DISIS-2017-001 groupings. Results have been posted and are attached as supporting documentation as Appendix 4.5-B1. The costs associated with interconnection request GEN-2017-060 are $3.2 million (anticipated terminal additions at existing generation site, LaRussel) and an additional $80k was identified under the affected system studies (e.g. Associated Electric owned Transformers 1 & 2 at Sportsman substation; 0.62% impact). Results have been posted and are attached as supporting documentation as Appendix 4.5-B2. The costs associated with interconnection request GEN-2017-082 are $4.2 million (anticipated terminal additions at existing generation site, Asbury) and an additional $301k was identified under the affected system studies (e.g. Associated Electric owned Transformers 1 & 2 at Sportsman substation; 2.32% impact). There is no appreciable way in which to estimate the system impacts and associated estimated costs for the necessary upgrades needed to facilitate future interconnection requests submitted by Liberty-Empire; however, Liberty-Empire developed a generic estimate for generator interconnection for purposes of evaluating new generation resources, as further described in Technical Volume 040 Section 4.3. The most recent study results are not necessarily indicative of future projects.

1.3 Assessment of Transmission Upgrades for Power Purchases

(C) Facilitate power purchases or sales. The utility shall assess the transmission upgrades needed to purchase or sell pursuant to 4 CSR 240-22.040(3). An estimate of the portion of costs of these upgrades that are allocated to the utility shall be reflected in the analysis of preliminary supply-side candidate resource options; and

All Liberty-Empire transmission planning is performed in conjunction with SPP, the Regional Transmission Organization ("RTO") to which Liberty-Empire belongs. Liberty-Empire's affiliation with SPP began during World War II, when SPP was initially formed. FERC empowers RTOs to ensure power supply reliability, transmission infrastructure adequacy, and competitive wholesale electricity prices through the NERC. In turn, SPP oversees enforcement and development of NERC reliability standards within its footprint, which spans across 14 states. Liberty-Empire fully participates in SPP's regional transmission expansion planning processes. Regardless of whether or not Liberty-Empire adds supply resources or contracts for sales, the unique and specific costs of the portfolio of projects determined in the various SPP coordinated studies are allocated throughout SPP. Thus, no costs for Liberty-Empire's allocation of the costs have been included in the analyses of preliminary supply-side resource options in this plan.

Liberty-Empire participates with non-SPP members such as Associated Electric Cooperative, Incorporated ("AECI") to examine potential mutually beneficial projects. One recent example is Liberty-Empire's participation in the AECI-SPP Joint Study. The AECI-SPP Joint Study is a recurring study that involves impacted SPP members in the southeastern portion of SPP's footprint, along with neighboring seams companies. The scope of the studies involves identifying forecasted issues on seams parties' footprints and studying proposed projects to acquire mutually beneficial results. This type of study allows for conversation to flow between SPP members and non-members so that interconnections, mitigation techniques, and cost sharing projects can be vetted by both sides of ownership. Collaboration shares the burden and pairs common goals with collective and impactful results. Liberty-Empire not only provides possible projects for study, but also internally studies presented projects. Liberty-Empire does this to determine whether a proposed project could mutually benefit Liberty-Empire and AECI exclusive of other southeastern SPP members' lack of interest or benefit. Liberty-Empire also participates in AECI's Long Range Plan meetings, to assess proposed projects within the AECI system in upcoming years.

1.4 Assessment of Transmission or Distribution Improvements with Respect to Cost-Effectiveness of Demand-Side Management or Supply-Side Resources

(D) Incorporate advanced transmission and distribution network technologies affecting supply-side resources or demand-side resources. The utility shall assess transmission and distribution improvements that may become available during the planning horizon that facilitate or expand the availability and cost effectiveness of demand-side resources or supply-side resources. The costs and capabilities of these advanced transmission and distribution technologies shall be reflected in the analyses of each resource option.

Technologies previously and currently evaluated by Liberty-Empire can be reviewed both individually and holistically in their respective impacts to facilitating DSM or supply-side resources. Although merits on individual initiatives may be somewhat muted, the platforms on which future implementation could utilize for fruition should not go unnoticed. For example, at the onset of the Liberty-Empire's evaluation of various ATDNT, FERC Order 2222 had not existed nor materialized at various public engagements with FERC. Liberty-Empire could not foresee Order 2222's potential impacts to their respective system. However, preemptive evaluations/implementations of ATDNT will act as supplementation to Order 2222, whereby varying technologies will enable the facilitation of energy aggregation which could potentially alter the trajectory of a resource strategy but will aide in bringing to market potential renewable energy resources. As the prescriptive requirements are delineated by the RTO, Liberty-Empire will gain a better understanding as to the positive traction gained by their presently evaluated ATDNT technologies.

An immediate benefit brought by the ATDNT under consideration and practice on the Liberty-Empire system point to the facilitation of newly installed AMI. Meters were installed on the system and the data collection efforts will hinge on the communications platforms associated with (3) technologies listed below: OPGW/ADSS, Fiber Optic Substation Network, and Substation Data Archive, Server and Database. Rollout of these technologies over the past few years will allow for bidirectional communications between the utility and the customers, once fully implemented across the system. AMI paired with the communications platforms allow for higher penetration of DSM due to real-time awareness for either entity, and will encourage focused investment efforts for needed infrastructure improvements/postponements accordingly. Liberty-Empire looks forward to the near-term horizon for utilizing both the technologies of present interest and the yet to be vetted technologies to further enhance AMI applications.

1.4.1 Baseline of Activity: Continuity with the Liberty-Empire 2019 IRP

Liberty-Empire places section 22.045 compliance into a context of long-term ATDNT aspirations while also determining any specific nexus of ATDNT to supply and/or demand-side resource choices (involving the identification of associated costs, benefits and other assumptions). Part of this context setting involves explaining its progress on several areas of ATDNT piloting and implementation described in its 2019 IRP.

In these recent IRPs, Liberty-Empire described the role of advanced technologies on its system, including but not limited to microprocessor relaying, fiber optic relaying and communications, transformer oil dissolved gas monitoring ("DGM"), transformer bushing monitoring, transformer bushing monitoring with partial discharge, transformer fiber optic winding temperature sensors, transformer monitoring, comprehensive transformer health monitoring, fiber optic substation data network, substation data archive, server, and database, 69-kV vacuum circuit breakers. Also discussed were automatic throw-over switching schemes, dynamic voltage control, conservation voltage reduction, energy storage, communications, Liberty-Empire's *Operation Toughen Up* ("OTU"), a feeder automation demonstration, expanded recloser utilization, an advanced fusing study, event analysis activities, and inspection of load profile data.

In the context of the 2022 IRP, many of these efforts form an activity baseline that continues indefinitely, reflects sound engineering practice, comports with current and emerging standards, stays aligned with vendor innovation, applies advanced asset management techniques, stays true to fundamental functional and technology dependencies (such as Supervisory Control and Data Acquisition ("SCADA") communications), and proceeds prudently in recognition of core grid functions (i.e. safety, security, reliability, resiliency, capacity, and contingency). For example, Liberty-Empire expects that it will continue to apply advanced network technology (Optical Ground Wire ("OPGW"), All Dielectric Self-supporting ("ADSS"), microprocessor relaying for protection, automatic throw-over switching schemes on the 69-kV system, use of smart fuses and reclosers), OTU will continue to harden the system, and SCADA communications will continue to enable more grid functions. Increase of communication platforms allow for future implementation of real-time system awareness and auto-healing networks, which will increase the penetration efforts of DSM as well as DER potentiality.

1.4.2 Status of ATDNT Pursuits as Described in the 2019 IRP

For continuity purposes, it is useful to provide updates on Liberty-Empire's pursuit of various ATDNT as described in its 2019 IRP. Table 4.5-5 provides this update.

Table 4.5-5 – Advanced Network Technology as Described in the 2019 IRP

2019 IRP Plan Element	Pursuit Scope
System Protection and Communications: OPGW and ADSS Cable	Liberty-Empire continues to employ use of ADSS cable and OPGW for system protection and communication needs on transmission circuits. Presently, Liberty-Empire incorporates OPGW in all transmission rebuild efforts. In locations where transmission upgrades have yet to be identified within the capital construction budget, ADSS is employed to further expand the optical network(s).
Microprocessor Relay Controls	Liberty-Empire continues to utilize microprocessor relaying for all new relaying substations (for system protection requirements). These controls provide high levels of reliability as well as diagnostics for root cause analysis. All new line panels are standardized to consist of microprocessor relaying as well as any coupled line terminals. 23 of 24 Transmission Addition projects are driven by the expanded use of microprocessor relays.
Automatic Throw-over switching schemes	Liberty-Empire continues to deploy this scheme on 69 kV transmission circuits to reduce the extent of outages due to the nature and location of 69 kV load taps. Auto Transfer schemes are presently planned to continue in the foreseeable future as needed to increase resiliency.
OTU	"Operation Toughen Up" ("OTU") is progressing and is scheduled to be completed by 2021; however, sectionalization and resiliency efforts of the transmission systems will continue in capital project scoping. It has been grounded on the use of advanced transmission and distribution technologies throughout. Furthermore, OTU has made important improvements throughout the Liberty-Empire transmission and distribution system by reinforcing system resiliency and improving reliability. Auto-throw transfer schemes (including new micro-processer controls and switches) have been implemented, breakers replaced, circuits reconductored across all voltage levels. The success of OTU has made the Liberty-Empire system more reliable and resilient, supporting Liberty-Empire's ability to serve load confidently.

2019 IRP Plan Element	Pursuit Scope
	Moreover, the ATDNT aspirations identified in this IRP are only possible because Liberty-Empire has made the essential OTU investments.
Transformer Monitoring Initiatives: Dissolved Gas (Full Suite)	Liberty-Empire continues to install DGM capabilities on all new large (50 MVA and larger) transformers. Liberty-Empire specifies any large power transformers with the capabilities to incorporate communications and monitoring interfaces for future deployment/utilization as communications and data gathering/repository mature.
Transformer Monitoring Initiatives: Dissolved Gas (Lite Suite)	Liberty-Empire continues to order new transformers with extra sample ports that allow future installation of equipment to monitor hydrogen gas build up. Same as above. Allows for future data gathering and alarming of transformer conditions as communications and data gathering/repository matures.
Transformer Bushing Monitoring	For new 22.4 MVA or larger transformers Liberty-Empire is installing monitoring devices. For 10.5 MVA Liberty-Empire will upgrade the purchase requirement. These will come with a capacitance tap, enabling monitoring. Evaluation ongoing. The inability to alarm in real time limits benefits to be realized. Units have been installed and due to low age of units, results are undeterminable at this time.
Transformer Bushing Monitoring and Partial Discharge Monitoring	This is similar as above, except it additionally includes monitoring equipment and capabilities on neutral bushings. Also, the partial discharge monitor provides a supplement to dissolved gas analysis monitoring. Presently shelved for future consideration. The additional costs paired with inconclusive results from bushing monitoring installs do not justify further implementation.
Transformer Monitor	Liberty-Empire continues to specify new transformers equipped with Schweitzer SEL-2414 monitor. Further deployment of SCADA and alarming for transformer health will allow for the prolonging asset life as well as proactively addressing alarms received in real time. Will directly support aging infrastructure initiatives over the near-term horizon.
Fiber Optic Substation Data Network	Schweitzer ICON system, has been installed as pilot during 2016, connecting 20 substations in Joplin area and in subsequent iterations. Presently 8 rings have been deployed. Planned additional rings for upcoming years include the Neosho/AR service area, partial Baxter Springs,

2019 IRP Plan Element	Pursuit Scope
	KS service territory, and the Greenfield to Bolivar areas. Further deployment will be at a higher cost/site due to the additional fiber build out necessary, however hardware and install costs should maintain. This pilot project was completed, and the results are supporting Liberty-Empire's plan for expanded communications.
Substation Data Archive, Server and Database	This element is paired to the ICON system pilot. Ongoing and currently in conceptual stage as platforms for ADMS and AMI are solidified and communications are presently being deployed.
69-kV Vacuum Circuit Breaker	Liberty-Empire recently installed multiple gas-less vacuum breakers and subsequent evaluation points to pausing further deployments. Due to the unrealized benefits on the above evaluation, Liberty-Empire does not plan to continue to use 69kV vacuum breakers at this time but will continue to review as new inputs become available.
Feeder Automation System Study	Liberty-Empire deployed radios, remote terminal units ("RTUs"), antennae, advanced micro-processor based reclosers, a SCADA-mate switch, substation breakers, and other control elements to pilot a self-healing schema on a section of 40-mile section of transmission and distribution circuitry. This project has shown to be beneficial to the customers on a particular feeder in question. Although presently a unique install, Liberty-Empire will look to use the Welch feeder automation project as a baseline for future projects which are more conducive to automation and have a higher customer per dollar impact.
Advanced Recloser Controls	Liberty-Empire noted in its 2016 IRP that its Pilot project was completed on the installation of an electronic, single phase recloser with microprocessor controls. This has helped influence Liberty-Empires plan for ATDNT as described throughout this section.
Fusing Pilot Studies	Liberty-Empire has monitored the performance of several smart fuses located on its distribution system. Liberty-Empire has learned more about how the fusing might work on its system, and this knowledge has helped influence Liberty-Empires plan for ATDNT as described throughout this section.

SECTION 2 AVOIDED TRANSMISSION AND DISTRIBUTION COST

(2) Avoided Transmission and Distribution Cost. The utility shall develop, describe, and document an avoided transmission capacity cost and an avoided distribution capacity cost. The avoided transmission and distribution capacity costs are components of the avoided demand cost pursuant to 4 CSR 240-22.050(5)(A).

2.1 Avoided Transmission Capacity Cost

Liberty-Empire's transmission projects included in the SPP regional planning processes for economic or reliability benefits would not be impacted by the implementation of specific demand-side programs or individual DSM initiatives. Therefore, Liberty-Empire conservatively assumed a zero avoided cost of transmission capacity for DSM analysis purposes.

2.2 Avoided Distribution Capacity Cost

Positioning a distributed energy resource in an area with historically high congestion or delivery costs could yield benefits to Liberty-Empire's system and customers by way of injection at the load site as opposed to the transmission of energy across various delivery systems. While determining the exact value of such benefits is complex, it can be estimated by quantifying the ability of distributed energy resources to defer certain distribution system upgrade costs.

Currently, Liberty-Empire has not identified any specific distribution investment projects located within any established areas that can be specifically targeted for *DSM* programs, and therefore for DSM analysis purposes, conservatively assumed a zero avoided cost of distribution capacity. However, to assess the value of distributed energy resources, such as distributed solar and distributed storage (paired or unpaired), Liberty-Empire identified a set of planned and/or representative distribution upgrade projects that could be deferred if transformer current was reduced. Assuming that distributed solar and storage resources can be placed at specific sites on the distribution grid to avoid system upgrades, Liberty-Empire incorporated the value of these representative upgrade projects as offsets to the capital and fixed costs of distributed solar and

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storage resources. Based on the identified representative distribution upgrade projects, Liberty-Empire could avoid approximately **[redacted]** in project capital costs and [redacted]** per year in fixed O&M costs by installing at least **[redacted]** of firm distributed capacity at one representative site, and avoid approximately **[redacted]** in project capital costs and **[redacted]** per year in fixed O&M costs by installing at least **[redacted]** of firm distributed capacity at another representative site.

Future intersections of resource cost paired with increases in infrastructure/labor costs may merit further investigations. Additionally, a multiplying effect may become evident if DER aggregation facilitated by FERC Order 2222 materializes to a level which could become impactful to load centers.

SECTION 3 ANALYSIS OF TRANSMISSION NETWORK PERTINENT TO A RESOURCE ACQUISITION STRATEGY

(3) Transmission Analysis. The utility shall compile information and perform analyses of the transmission networks pertinent to the selection of a resource acquisition strategy. The utility and the Regional Transmission Organization (RTO) to which it belongs both participate in the process for planning transmission upgrades.

3.1 Transmission Assessments

(A) The utility shall provide, and describe and document, its—

3.1.1 Transmission Assessment for Congestion Upgrades

1. Assessment of the cost and timing of transmission upgrades to reduce congestion and/or losses, to interconnect generation, to facilitate power purchases and sales, and to otherwise maintain a viable transmission network;

Liberty-Empire's participation in SPP was previously addressed in Section 1.3. Liberty-Empire also utilizes SPP's integrated transmission planning ("ITP") process to assess the need for, cost of, and timing of transmission upgrades to reduce congestion and/or losses, to interconnect generation, to facilitate power purchases and sales, and to otherwise maintain a viable transmission network along with other SPP members and affiliates.

The ITP is an annual planning cycle that assesses near- and long-term economic and reliability transmission needs. The SPP ITP process is used to determine transmission requirements for maintaining electric reliability and for providing both near- and long-term economic benefits to SPP members and affiliates. The result of SPP's ITP process is the development of lowest-cost transmission solutions to anticipate and respond to constantly changing loads, environmental and regulatory requirements, and grid anatomy, all while meeting evolving reliability criteria. The SPP ITP process identifies transmission expansion projects and prioritizes their schedules in order to maintain a reliable and cost-effective transmission network with improved access to SPP's diverse resources, including renewables. Wind energy development generally dominated new generating capacity additions in SPP for much of the last decade, but has recently been surpassed by applications for solar generation, with growing applications for battery storage. Figure 4.5-5 summarizes SPP's active Generator Interconnection Queue as of September 2021.

Figure 4.5-5 – SPP Ops Portal, Active Generation Interconnection Requests As of 9/29/2021

Year	Coal	Natural Gas	Wind	Solar	Storage / Battery	Hybrid	Other	Grand Total
2001		1,027	735					**1,762**
2002		80	936					**1,016**
2003	700		1,003				50	**1,753**
2004	925	400	200				75	**1,600**
2005		358	599					**957**
2006	895	2,288	1,282					**4,465**
2007		150	1,985					**2,135**
2008	65	102	2,771				58	**2,996**
2009			379					**379**
2010		210	1,954				5	**2,168**
2011	50	403	2,488				12	**2,952**
2012		472	1,232					**1,704**
2013	30	916	875	25				**1,846**
2014		50	1,988	170				**2,208**
2015		5	6,708	180	20			**6,913**
2016		61	13,438	324	20		29	**13,871**
2017			14,230	11,162	1,245	1,790		**28,426**
2018			7,652	8,487	3,410			**19,548**
2019		247	1,047	3,692	2,583			**7,568**
2020		4,786	2,908	10,143	1,813			**19,649**
2021		1,002	6,912	11,218	4,504	1,300		**24,937**
Grand Total	**2,665**	**12,556**	**71,320**	**45,400**	**13,594**	**3,090**	**228**	**148,854**

The ITP leads to a 10-year transmission expansion plan each year, combining near-term, 10-year, and NERC transmission planning (TPL-001-4) assessments into one study. The process seeks to target a reasonable balance between long-term transmission investments and congestion costs to customers. The 20-year assessment was originally performed once every five years unless otherwise directed by the SPP board of directors. However, the present status of multiple delayed studies necessitated the postponement of more recent iterations of the 20-year study process until after the Generation Interconnection queue congestion is alleviated.[1] The

1 Revisions to federal tax credit eligibility, renewable mandates and goals, and the implementation of SPP's day-ahead market led to a flood of interconnection requests in the 2013-2017 period that SPP was not able to accommodate. In addition, customers often withdraw speculative projects from the interconnection queue late in the process, causing multi-year study delays. As a result, as of the time of development of this report, interconnection requests submitted since November 2016 still have not been studied due to the backlog of projects in the GI queue. To help alleviate the queue congestion, SPP is currently moving to a three-stage process with increased financial milestones and points in the study process for customers to withdraw interconnection requests.

Generation Interconnection queue for SPP has grown significantly in recent years due to a large amount of new generation interconnection requests from renewable energy developers. The ITP works in concert with SPP's existing subregional planning stakeholder process and continues in parallel with the NERC TPL-001-4 compliance process.

The current ITP process includes the 20-year ITP assessment ("ITP20") and the latest iteration of the ITP study process ("2020 ITP" or "ITP").[2,3] The goal of these two studies is to assess the transmission requirements to meet load growth and other potential developments. The 2013 ITP20 process, which is the most recent ITP20 assessment currently available, examined high-voltage transmission needs at voltages above 300-kV, and included state-by-state requirements for renewable energy over time. ITP20 evaluated potential impacts of a 20-percent federal Renewable Electricity Standard ("RES"), a $36/ton carbon constraint, an additional 10 GW of exported wind, investment in demand side management ("DSM") and smart grid technology, and a joint SPP/MISO future. ITP20 projected renewable energy generation of 10 GW without a federal RES, and 16.5 GW with a federal RES. The ITP20 Consolidated Portfolio included 436 miles of transmission lines and installation of six 345-kV step-down transformers. In 2013, the implementation of ITP20 results was estimated to have a total cost of $560 million (present value revenue requirement of $845 million) and was expected to provide net benefits of approximately $1.5 billion over the life of the projects. SPP has not performed an ITP20 study since 2013, but monitors the 2013 and 2010 ITP20 approved projects and provides an updated cost estimate in the annual SPP Transmission Expansion Report. Table 4.5-6 provides the cost estimates for the 2010 and 2013 ITP20 projects.

Table 4.5-6 – Project Cost Estimates for 2010 and 2013 ITP20

Assessment	Updated Cost
2010 ITP20	$1,119,587,300
2013 ITP20	$514,277,650

[2] The 10-year ITP assessment ("ITP10") and near-term ITP assessment ("ITPNT") were combined for gain of efficiencies to both study participants and to SPP.
[3] The 2020 ITP was the most recent finalized ITP study process available at the time of development of this analysis.

The 2020 ITP was the latest iteration of the ITP study process. A value-based planning approach was used for the ITP assessment to analyze the transmission system over a 10-year horizon. Using economic and reliability analyses, the ITP process develops solutions for issues identified on the system for voltages of 100-kV and above. Unless specifically identified, 60-kV+ assets were included within the applicable planning events as prescribed by Table 1 within the NERC TPL-001-4 standard. The 2020 ITP encompassed a 10-year planning horizon to ensure the deliverability of energy within the SPP footprint on the bases of reliability, economically, public policy facilitation, and interconnected entities/regions to maximize benefits to the end-users of energy transported across the SPP footprint. Three scenarios were considered for the various system configurations within the 10-year planning horizon: Base Reliability (ensures deliverability of firm service, pointed to reliability), Future 1: Reference Case (continuation of present industry trends paired with environmental regulations), and Future 2: Emerging Technologies Case (widespread adoption/deployments of EVs, DERs, and energy efficiency). Taken directly from the 2020 ITP report,[4] Table 4.5-7 exhibits the aforementioned scenarios and their associated inflection drivers.

[4] 2020 ITP, Table 2.1 Future Drivers

Table 4.5-7 – Future Drivers (Source: 2020 ITP)

Key Assumptions	Drivers				
	Year 2	Reference Case Year 5	Reference Case Year 10	Emerging Technologies Year 5	Emerging Technologies Year 10
Peak Demand Growth Rates	As submitted in load forecast	As submitted in load forecast		As submitted in load forecast	
Energy Demand Growth Rates	As submitted in load forecast	As submitted in load forecast		Increase due to electric vehicle growth	
Natural Gas Prices	Current industry forecast	Current industry forecast		Current industry forecast	
Coal Prices	Current industry forecast	Current industry forecast		Current industry forecast	
Emissions Prices	Current industry forecast	Current industry forecast		Current industry forecast	
Fossil Fuel Retirements	Current forecast	Coal age-based 56+, Gas/Oil age-based 50+, subject to generator owner review		Coal age-based 56+, Gas/Oil age-based 50+, subject to repowering or emissions upgrades	
Environmental Regulations	Current regulations	Current regulations		Current regulations	
Demand Response[9]	As submitted in load forecast	As submitted in load forecast		As submitted in load forecast	
Distributed Generation (Solar)	As submitted in load forecast	As submitted in load forecast		+300MW	+500MW
Energy Efficiency	As submitted in load forecast	As submitted in load forecast		As submitted in load forecast	
Storage	None	20% of projected solar		35% of projected solar	
Total Renewable Capacity					
Solar (GW)	Existing + RARs	4	7	5	9
Wind (GW)	Existing + RARs	26	28	30	33

SPP and participating member organizations worked to compile forecasts, given the above drivers along with benchmarking of model sets. Analysis of economic, reliability, operational and public policy needs were conducted with inputs by both stakeholders, member organizations, and various working groups in structuring the study. Finally, an additional assessment incorporated the GridLiance – High Plains local planning process assessment so as to satisfy SPP tariff requirements, which were not included in the approved model sets.

The study results were provided to participants and associated stakeholders, from which recommended solutions for the identified needs were developed by SPP staff and study participants during planning summits and stakeholder review. The final portfolio identified 54 projects encapsulating 233 miles of new/rebuilt transmission, with an estimated cost of $532M in Engineering and Construction ("E&C") costs. The final portfolio solved 163 system needs identified while achieving an assumed Benefit to Cost ratio range of 4.0-5.2 to 1.

3.1.2 Transmission Assessment for Advance Technologies

2. Assessment of transmission upgrades to incorporate advanced technologies;

Liberty-Empire incorporates three main advanced technologies in its transmission system: All-dielectric self-supporting ("ADSS") cable and/or Optical Ground Wire ("OPGW"), microprocessor relaying, and automatic throw-over switching schemes on the 69-kV transmission system(s).

Liberty-Empire currently uses ADSS cable and has previously used OPGW for most or all of new shield wire installations. This enables not only superior lightning performance due to the lower resistance of the OPGW compared to conventional galvanized steel strand shield wires, but also provides a high-capacity path for internal communications and system protection functions. The standard OPGW options provide either 48 or 144 single-mode fibers per shield wire, whereas ADSS incorporates 144 single-mode fibers, allowing for not only presently needed communication paths for protection schemes but also for future implementation of further SCADA installation(s) and communication paths for backup/redundant relaying.

Liberty-Empire utilizes microprocessor relaying for all new relaying installations. The implementation of microprocessor relaying is useful for conducting root cause analysis of fault events and in the protective coordination of transmission elements. With the use of microprocessor relaying, event recordings are able to be reviewed for possible mis-operation as well as duplication of fault events to determine possible common fault locations. In conjunction with the aforementioned ADSS or OPGW, differential relaying on transmission elements can be implemented, resulting in a much more robust and increased speed of relay operation.

Liberty-Empire has also implemented automatic throw-over switching schemes on the 69-kV transmission system to help reduce the system average interruption duration index ("SAIDI") and the system average interruption frequency index ("SAIFI"). Due to their location on the transmission system, load taps on the 69-kV transmission system are dependent on remote relaying operations. When the remote relaying opens a transmission line segment, the load tap is de-energized. A solution is an automated throw-over scheme in which either side of the load tap of transmission is opened during a fault condition and tested to determine the faulted section. Once the faulted section is determined, the alternate section is then restored, thereby restoring power to the load tap. Liberty-Empire incorporates microprocessor relaying in these schemes as well as ADSS cable (when applicable) so as to ensure fast response and robust protection.

In addition to the above technologies evaluated by Liberty-Empire, a list of emerging technologies that Liberty-Empire is currently evaluating for possible future implementation is provided below.

Fiber Optic Substation Data Network

Characteristic	Description
Application	Provide a network for substation engineering data
Benefit	A dedicated data network will allow large amounts of engineering data to be collected. Currently the only data connection to the substations is through the EMS system which needs to remain focused on its core function of operations and control. Trying to collect engineering data through the EMS system would have security implications as well as loading down the system with data that is not relevant to its core function

Substation Data Archive, Server, Database

Characteristic	Description
Application	Assumed to be a stand-alone system from that of AMI data repository, a data archive, database, and server hosting the collected substation data would be needed as more data is acquired throughout the system with the increase in deployed technologies across the system. With the collection and analysis of the data gathered, equipment health and real time system impacts can be accumulated for better optics into system conditions. Data processing and analytics can be applied in an effort the make the most appropriate use of capital

Characteristic	Description
Benefit	This is the second component of critical data infrastructure required to allow substation monitoring (the first being the data network itself). When various types of substation monitors begin to be connected, they will quickly create an unusably high number of different databases for all types of information and from different makes and models. A centralized system will make data analysis easier and facilitate analysis which requires data from more than one source

69kV Vacuum Circuit Breaker

Characteristic	Description
Application	A 69-Kv class substation circuit breaker which does not require SF6 as an insulating gas
Benefit	The use of SF6 gas requires careful handling and reporting. Eliminating equipment which requires SF6 gas is a benefit to environmental reporting as well as operations and maintenance. Longer life of asset, lower maintenance costs, reduced gas handling requirements, as well as increased fault current interrupt capabilities.

These technologies exhibit a focused effort on substation equipment. This focus is of particular importance due to the significant and wide-ranging impacts of potential outages resulting from possible equipment failures. Such equipment failures involve long lead times and impact a large number of customers. Thus, Liberty-Empire chose to focus on substation equipment to ensure cost-effective and reliable service to its customers.

Alongside the listed benefits, additional platforms can and will be evaluated to yield additional potential benefits based on the future evolution of the grid. One such evolution is the recent issuance of FERC Order 2222, which sets the groundwork for implementation of DER aggregation. In anticipation of FERC Order 2222 and compliance structures implemented at the RTO level, establishing fiber-optic networks could also be used in the real-time system awareness and aggregation efforts for DERs. In doing so, Liberty would be poised for implementation to comply with plans set forth by the RTO. Further investigation as to the utilization of these systems as well as other future technologies should yield a more robust electrical network to serve Liberty-Empire's customers and a more fluid implementation of near-term regulatory requirements.

While it is currently unknown exactly how the transmission and distribution system will evolve to accommodate changing customer needs, Liberty-Empire has invested in and is currently piloting various advanced technology applications in anticipation of major potential benefits. Liberty-Empire will continue to strike a healthy balance of vetting newly emerging technologies in parallel with proven technologies. This constant evaluation process is designed to implement new technology that will benefit customers. Liberty-Empire will continue to vet advanced technologies to best balance costs and benefits to customers.

3.1.3 Avoided Transmission Cost Estimate

3. Estimate of avoided transmission costs;

Avoided transmission costs are discussed in Section 2.

3.1.4 Regional Transmission Upgrade Estimate

4. Estimate of the portion and amount of costs of proposed regional transmission upgrades that would be allocated to the utility, and if such costs may differ due to plans for the construction of facilities by an affiliate of the utility instead of the utility itself, then an estimate, by upgrade, of this cost difference;

The SPP OATT requires that a "Rate Impact Analysis" be performed for each ITP. Per Attachment O: Transmission Planning Process – Section III: Integrated Transmission Planning Process, Sub-Section 7):

7) Process to Analyze Transmission Solutions and Alternatives for the Integrated Transmission Planning Assessment":

The following shall be performed, at the appropriate time in the respective planning cycle, for the 20-Year Assessment, 10-Year Assessment and Near Term Assessment studies:

d) The analysis described above shall take into consideration the following:

"vi) The analysis shall assess the net impact of the transmission plan, developed in accordance with this Attachment O, on a typical residential customer within the SPP Region and on a $/kWh basis."

The Rate Impact Analysis process includes the determination of benefits evidenced from the final portfolio of projects as compared to the overarching costs assigned to each SPP member under the cost allocation approach for both zonal and regional allocations according to the metric of benefits realized by reliability projects. Allocations hold true to previous study processes:

Table 4.5-8 – Highway Byway Cost Allocation

Highway Byway Cost Allocation		
Voltage	Regional	Zonal
300-kV and above	100%	0%
100-kV - 299-kV	33%	67%
Below 100-kV	0%	100%

Benefits were calculated to determine the value and economic impacts of the finalized portfolio of projects and subsequently, benefit-cost ratios were calculated for Future 1 and Future 2, as prescribed by the Economic Studies Working Group ("ESWG"). All projects included within the final portfolio had a benefit calculation, regardless of whether or not a Notification to Construct ("NTC") was issued for the recommended portfolio of projects. The metrics calculated in compiling the project portfolio are shown in the following table.[5]

Table 4.5-9 – 2020 ITP Project Portfolio Evaluation Metrics

Metric Description
APC Savings
Savings Due to Lower Ancillary Service Needs and Production Costs
Avoided or Delayed Reliability Projects
Marginal Energy Losses
Capacity Cost Savings Due to Reduced On-Peak Transmission Losses
Reduction of Emissions Rates and Values
Public Policy Benefits
Assumed Benefit of Mandated Reliability Projects
Mitigation of Transmission Outage Costs
Increased Wheeling Through and Out Revenues

[5] Table 8.1: Benefit Metrics; extracted from the 2020 ITP report

Once each of the above metrics were calculated and determined, the summary of the 40-year NPV of the estimated benefit metrics and costs and the resultant B/C ratios for each SPP zone were summarized for Future 1 and Future 2 respectively. These tables are shown in Table 4.5-10 and Table 4.5-11.[6]

6 Table 8.10: Estimated 40-year NPV of Benefit Metrics and Costs-Zonal and Table 8.11: Estimated 40-year NPV of Benefit Metrics and Costs-Zonal; extracted directly from 2020ITP report

Table 4.5-10 – 2020 ITP Evaluation Metrics by Zone – Future 1

Reference Case (Future 1)											
Present Value of 40-yr Benefits for the 2025-2065 Period (in 2020$M)										Present Value of 40-yr ATRRs (in 2020$M)	Est. Benefit/ Cost Ratio
Zone	APC Savings	Avoided or Delayed Reliability Projects	Capacity Savings from Reduced On-peak Losses	Assumed Benefit of Mandated Reliability Projects	Benefit from Meeting Public Policy Goals	Mitigation of Trans-mission Outage Costs	Increased Wheeling Through and Out Revenues	Marginal Energy Losses Benefits	Total Benefits		
AEPW	$350	$0	$1	$28	$0	$43	$23	($23)	$423	$93	4.6
EMDE	$39	$0	($0)	$4	$0	$5	$2	($4)	$46	$8	5.5
GMO	$20	$0	$0	$15	$0	$8	$4	$6	$53	$13	4.0
GRDA	$186	$0	$0	$2	$0	$4	$2	($7)	$187	$7	27.1
KCBPU	$12	$0	($0)	$3	$0	$2	$0	$5	$22	$3	6.6
KCPL	$57	$0	$0	$18	$0	$16	$8	$7	$106	$32	3.3
LES	$4	$0	$0	$5	$0	$3	$1	$3	$16	$5	3.2
MIDW	($21)	$0	$0	$4	$0	$2	$1	($1)	($15)	$3	(5.8)
NPPD	$12	$0	$0	$12	$0	$13	$6	$8	$51	$25	2.0
OKGE	$854	$0	$6	$27	$0	$28	$12	($20)	$907	$61	14.9
OPPD	($8)	$0	($0)	$7	$0	$10	$4	$23	$36	$16	2.2
SPRM	$6	$0	($0)	$6	$0	$3	$2	$2	$18	$5	3.9
SPS	$1	$0	$1	$4	$0	$24	$18	$26	$73	$92	0.8
SUNC	($67)	$0	$0	$4	$0	$5	$2	$2	($55)	$11	(4.9)
SWPA	$12	$0	$18	$45	$0	$2	$1	($0)	$77	$3	27.9
UMZ	$134	$0	$7	$11	$0	$20	$16	$1	$190	$65	2.9
WERE	$83	$0	$1	$14	$0	$21	$30	($4)	$145	$159	0.9
WFEC	$165	$0	$3	$7	$0	$7	$5	($12)	$175	$31	5.6
Total:	**$1,840**	**$0**	**$38**	**$217**	**$0**	**$213**	**$137**	**$11**	**$2,456**	**$634**	**3.9**

Table 8.10: Estimated 40-year NPV of Benefit Metrics and Costs-Zonal

Table 4.5-11 – 2020 ITP Evaluation Metrics by Zone – Future 2

Emerging Technologies (Future 2)											
Present Value of 40-yr Benefits for the 2025-2065 Period (in 2020$M)										Present	Est.
Zone	APC Savings	Avoided or Delayed Reliability Projects	Capacity Savings from Reduced On-peak Losses	Assumed Benefit of Mandated Reliability Projects	Benefit from Meeting Public Policy Goals	Mitigation of Trans-mission Outage Costs	Increased Wheeling Through and Out Revenues	Marginal Energy Losses Benefits	Total Benefits	Value of 40-yr ATRRs (in 2020$M)	Benefit/ Cost Ratio
AEPW	$588	$0	$1	$28	$0	$60	$23	($15)	$685	$93	7.4
EMDE	$50	$0	($0)	$4	$0	$7	$2	$2	$65	$8	7.8
GMO	$57	$0	$0	$15	$0	$11	$4	$0	$87	$13	6.5
GRDA	$152	$0	$0	$2	$0	$5	$2	($3)	$158	$7	22.9
KCBPU	$38	$0	($0)	$3	$0	$3	$0	$4	$47	$3	14.4
KCPL	$30	$0	$0	$18	$0	$22	$8	$0	$78	$32	2.4
LES	$26	$0	$0	$5	$0	$4	$1	$1	$38	$5	7.4
MIDW	($17)	$0	$0	$4	$0	$2	$1	($0)	($10)	$3	(3.8)
NPPD	$17	$0	$0	$12	$0	$18	$6	$3	$55	$25	2.2
OKGE	$980	$0	$6	$27	$0	$38	$12	$0	$1,063	$61	17.4
OPPD	$21	$0	($0)	$7	$0	$13	$4	$2	$47	$16	2.9
SPRM	$2	$0	($0)	$6	$0	$4	$2	$3	$17	$5	3.5
SPS	($12)	$0	$1	$4	$0	$34	$18	$29	$73	$92	0.8
SUNC	($52)	$0	$0	$4	$0	$6	$2	($1)	($41)	$11	(3.7)
SWPA	$34	$0	$18	$45	$0	$2	$1	$1	$102	$3	36.9
UMZ	$361	$0	$7	$11	$0	$28	$16	($14)	$410	$65	6.3
WERE	$58	$0	$1	$14	$0	$29	$30	($4)	$129	$159	0.8
WFEC	$248	$0	$3	$7	$0	$10	$5	$7	$280	$31	8.9
Total:	**$2,581**	**$0**	**$38**	**$217**	**$0**	**$295**	**$137**	**$15**	**$3,283**	**$634**	**5.2**

Table 8.11: Estimated 40-year NPV of Benefit Metrics and Costs-Zonal

Based on the benefit-cost ratio and the projected zonal energy usage over the study horizon, the rate impact is calculated for each zone. Rate impacts (both costs and benefits) are allocated along the industry standard of a flat-line usage of 1,000 kWh/month. The values are shown in Table 4.5-12 and Table 4.5-13 in real 2020 dollars for Future 1 and for Future 2. The regional net benefit for Future 1 and for Future 2 was shown as 16 and 30 cents, respectively.

Table 4.5-12 – 2020 ITP Rate Impacts by Zone – Future 1

Zone	One-Year ATRR Costs 2030 ($thousands)	One-Year Benefit 2030 ($thousands)	Rate Impact-Cost	Rate Impact Benefit	Net Impact (2020$)
AEPW	$7,896	$17,468	$0.15	$0.34	($0.19)
EMDE	$719	$2,859	$0.14	$0.56	($0.42)
GMO	$1,156	$950	$0.12	$0.10	$0.02
GRDA	$581	$10,114	$0.06	$1.05	($0.99)
KCBPU	$283	$496	$0.10	$0.18	($0.08)
KCPL	$2,688	$2,940	$0.18	$0.20	($0.02)
LES	$443	$230	$0.13	$0.07	$0.06
MIDW	$227	($1,145)	$0.10	($0.50)	$0.60
NPPD	$1,854	$577	$0.11	$0.03	$0.07
OKGE	$5,184	$44,561	$0.16	$1.33	($1.18)
OPPD	$1,417	($281)	$0.10	($0.02)	$0.12
SPRM	$408	$509	$0.14	$0.18	($0.04)
SPS	$7,336	($63)	$0.25	$0.00	$0.25
SUNC	$910	($3,729)	$0.14	($0.56)	$0.70
SWPA	$235	$583	$0.43	$1.07	($0.64)
UMZ	$5,297	$7,186	$0.17	$0.23	($0.06)
WERE	$13,179	$4,675	$0.49	$0.17	$0.31
WFEC	$2,521	$8,817	$0.16	$0.56	$0.40
Total:	**$52,334**	**$96,748**	**$0.19**	**$0.35**	**($0.16)**

Table 8.14: Future 1 2030 Retail Residential Rate Impacts by Zone (2020$)

Table 4.5-13 – 2020 ITP Rate Impacts by Zone – Future 2

Zone	One-Year ATRR Costs 2030 ($thousands)	One-Year Benefit 2030 ($thousands)	Rate Impact-Cost	Rate Impact Benefit	Net Impact (2020$)
AEPW	$7,896	$29,423	$0.15	$0.57	($0.42)
EMDE	$719	$4,016	$0.14	$0.79	($0.65)
GMO	$1,156	$2,901	$0.12	$0.31	($0.19)
GRDA	$581	$8,221	$0.06	$0.86	($0.80)
KCBPU	$283	$1,665	$0.10	$0.60	($0.50)
KCPL	$2,688	$1,269	$0.18	$0.09	$0.10
LES	$443	$1,230	$0.12	$0.35	($0.22)
MIDW	$227	($1,009)	$0.10	($0.44)	$0.54
NPPD	$1,854	$732	$0.11	$0.04	$0.06
OKGE	$5,184	$50,551	$0.15	$1.51	($1.35)
OPPD	$1,417	$1,110	$0.10	$0.08	$0.02
SPRM	$408	$327	$0.14	$0.11	$0.03
SPS	$7,336	$1,530	$0.25	$0.05	$0.20
SUNC	$910	($3,052)	$0.14	($0.46)	$0.60
SWPA	$235	$1,853	$0.43	$3.41	($2.98)
UMZ	$5,297	$18,039	$0.17	$0.08	($0.40)
WERE	$13,179	$3,594	$0.49	$0.13	$0.35
WFEC	$2,521	$12,985	$0.16	$0.82	$0.60
Total:	**$52,334**	**$135,386**	**$0.19**	**$0.49**	**($0.30)**

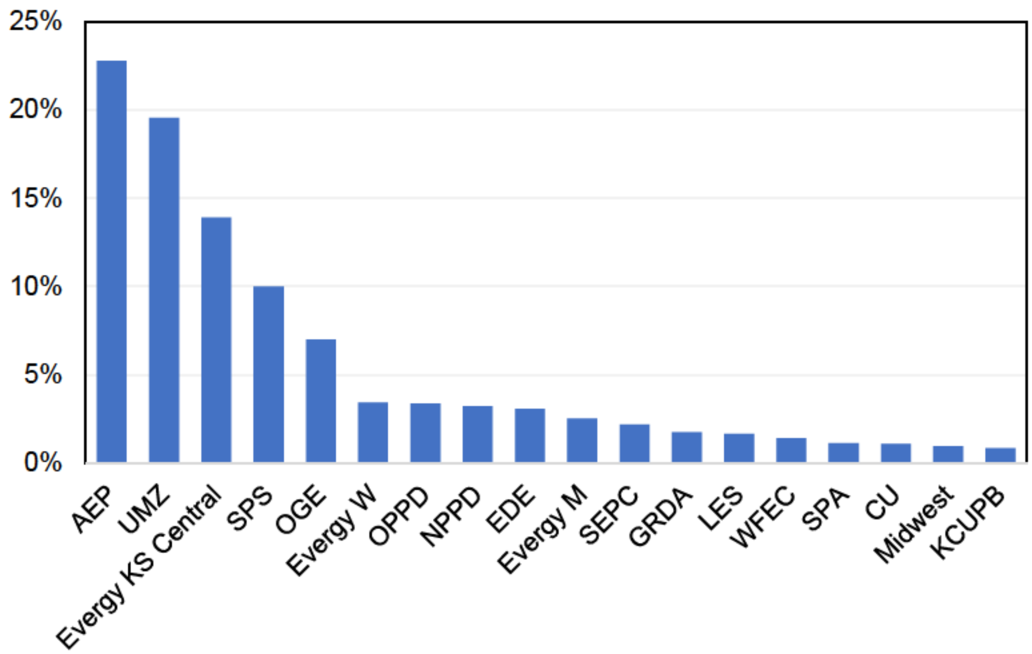
Table 8.15: Future 2 2030 Retail Residential Rate Impacts by Zone (2020$)

3.1.5 Revenue Credits Estimate

5. Estimate of any revenue credits the utility will receive in the future for previously built or planned regional transmission upgrades; and

The process for revenue credits for SPP is governed by the SPP Open Access Transmission Tariff ("OATT") and in particular Attachment L and Attachment Z2. Attachment L of the SPP OATT describes the treatment of revenues associated with Base Plan Zonal and Base Plan Regional Annual Transmission Revenue Requirement ("ATRR"). Attachment Z2 prescribes the form for which creditable upgrades may receive based on the date of an agreement authorizing construction. In particular, Attachment Z2 creates a bright line of July 1, 2020 for the agreement authorizing construction. Projects that pre-date July 1, 2020 are eligible to choose between revenue credits or Incremental Long-Term Congestion Rights ("ILTCR") both of which are described in the SPP OATT. Projects with an agreement authorizing construction after July 1, 2020 are only eligible for ILTCR credits. SPP's forecasted utility-specific ATRRs are shown in Figure 4.5-6 for each zone in order of magnitude.

Figure 4.5-6 – Zonal ATRR



Liberty-Empire is in the middle of the utilities shown, as well as representing approximately 3.1 percent of the collective ATRR.

3.1.6 Timing of Needed Resources Estimate

6. Estimate of the timing of needed transmission and distribution resources and any transmission resources being planned by the RTO primarily for economic reasons that may impact the alternative resource plans of the utility.

The 2020 ITP Assessment portfolio of projects did not include any projects in the Liberty-Empire service territory. Therefore, there will be no impact on Liberty-Empire alternative resource plans.

3.2 Use of RTO Transmission Expansion Plan

(B) The utility may use the RTO transmission expansion plan in its consideration of the factors set out in subsection (3)(A) if all of the following conditions are satisfied:

Please refer to the previous sections for descriptions of Balanced Portfolio studies and ITP studies.

3.2.1 Utility Participation in RTO Transmission Plan

1. The utility actively participates in the development of the RTO transmission plan;

Liberty-Empire actively participates in the development of SPP transmission expansion plans through a number of related activities. Liberty-Empire is an active annual participant within the MDWG which reviews and updates the transmission planning models used for regional transmission expansion analysis. Liberty-Empire adds transmission projects into the planning models and provides a substation level load forecast for the seasonal and future years planning models. These models include the generation dispatch Liberty-Empire expects to be required for meeting its native load requirements. The analysis of these models identifies future transmission projects necessary to maintain reliable service and reduce transmission congestion.

Liberty-Empire is also a monitoring member of the TWG which works on coordinated planning and NERC and SPP compliance with individual transmission owners. The TWG is responsible for the planning criteria for evaluating transmission additions, seasonal available transfer capability ("ATC") calculations, seasonal flowgate ratings, oversight of coordinated planning efforts, and oversight of transmission contingency evaluations. The TWG coordinates the calculation of the ATC for commerce maintaining regional reliability while ensuring study procedures and criteria are updated to meet the regional needs of SPP, in cooperation with governing regulatory entities. The TWG is responsible for publication of seasonal and future reliability assessment studies on the transmission system of the SPP region. The TWG works closely with the ESWG to develop the scope documents used to direct the analysis and studies performed for the ITP process.

In addition, SPP hosts multiple ITP workshops and Planning Summits each year seeking stakeholder input to the transmission planning process and providing analysis results for stakeholder review. The workshops allow SPP stakeholders to provide input on assumptions for economic analysis and propose transmission projects to reduce congestion and improve reliability. Liberty-Empire reviews transmission projects in its area and proposes alternatives that may provide better benefit or requests restudy of projects that it believes are not required.

3.2.2 Annual Review of RTO Expansion Plans

2. The utility reviews the RTO transmission overall expansion plans each year to assess whether the RTO transmission expansion plans, in the judgment of the utility decision-makers, are in the interests of the utility's Missouri customers;

Liberty-Empire reviews SPP overall expansion plans each year specifically for transmission projects in its area. Liberty-Empire proposes alternatives, where applicable, and/or requests restudy for projects that it believes are unmerited. In other instances, Liberty-Empire may suggest solutions to resolve a transmission problem in order to temporarily delay or potentially avoid new transmission construction. Liberty-Empire also submits alternative upgrade projects and their associated NTCs to be withdrawn if the requirements for the project changes or if the project is delayed beyond the scope of the study process.

3.2.3 Annual Review of Service Territory Expansion Plan

3. The utility reviews the portion of RTO transmission expansion plans each year within its service territory to assess whether the RTO transmission expansion plans pertaining to projects that are partially or fully-driven by economic considerations (i.e., projects that are not solely or primarily based on reliability considerations), in the judgment of the utility decision-makers, are in the interests of the utility's Missouri customers;

Liberty-Empire reviews SPP transmission expansion plans each year specifically for projects in its area. Some of these are zonal projects that may result in additional obligations to serve or for Liberty-Empire to comply with specific planning and bulk electric reliability criteria. Liberty-

Empire participates within the study processes throughout the year by way of the TWG or the Market and Operations Policy Committee ("MOPC"). Planned projects are presented to the associated groups for consideration and votes cast accordingly. Liberty-Empire maintains monitoring or voting membership on both of the above groups.

3.2.4 Documentation and Description of Annual Review of RTO Overall and Utility-Specific Expansion Plans

4. The utility documents and describes its review and assessment of the RTO overall and utility-specific transmission expansion plans; and

Liberty-Empire's participation in the SPP planning process is continuous throughout the year, and includes directly participating on SPP committees, working groups, various task forces, and projects, reviewing transmission plans, and providing recommendations. Liberty-Empire reviews SPP overall expansion plans each year specifically for transmission projects in its area. Liberty-Empire proposes improved alternatives, where applicable, and/or requests restudy for projects that it believes are not required. In other instances, Liberty-Empire may suggest solutions to resolve a transmission problem in order to temporarily delay or potentially avoid new transmission construction. Liberty-Empire representatives also participate in the overall approval of SPP transmission expansion plans in the Market and Operations Policy Committee ("MOPC") (full membership) and the Members Committee ("MC").

Liberty-Empire conducts an annual assessment of its transmission system as required within the reliability standards specified by NERC. The annual assessment includes contingency analysis of the Liberty-Empire owned and operated Bulk Electric System ("BES"), short circuit analysis of in-service/planned additions equipment, as well as a stability analysis prescribed within the NERC standards. These assessments are shared with the adjacent or possibly impacted Transmission Planners and Planning Coordinators. Liberty-Empire specific projects that are either planned and internally funded are included within the assessment as needed or prescribed.

3.2.5 Affiliate Build Transmission Project Discussion

5. If any affiliate of the utility intends to build transmission within the utility's service territory where the project(s) are partially or fully-driven by economic considerations, then the utility shall explain why such affiliate-built transmission is in the best interest of the utility's Missouri customers and describe and document the analysis performed by the utility to determine whether such affiliate-built transmission is in the interest of the utility's Missouri customers.

Liberty-Empire does not have any affiliate-built transmission at this time.

3.3 RTO Expansion Plan Information

(C) The utility shall provide copies of the RTO expansion plans, its assessment of the plans, and any supplemental information developed by the utility to fulfill the requirements in subsection (3)(B) of this rule.

The following SPP regional transmission planning reports are provided as attachments in the appendix to this report.

Appendix 4.5-C: 2013 Integrated Transmission Plan 20-Year Assessment Report (ITP20)
Appendix 4.5-D: 2020 Integrated Transmission Plan Report v1.0
Appendix 4.5-E: 2021 SPP Transmission Expansion Plan Report

3.4 Transmission Upgrades Report

(D) The utility shall provide a report for consideration in 4 CSR 240-22.040(3) that identifies the physical transmission upgrades needed to interconnect generation, facilitate power purchases and sales, and otherwise maintain a viable transmission network, including:

3.4.1 Transmission Upgrades Report – Physical Interconnection within RTO

1. A list of the transmission upgrades needed to physically interconnect a generation source within the RTO footprint;

Liberty-Empire cannot provide a generic list of the transmission upgrades needed to physically interconnect any given generation source within the SPP footprint because each interconnection is unique, and each evaluation is site-specific. Each generator is required to submit a generator interconnection ("GI") request according to the SPP GI process, as defined in the applicable SPP transmission tariff. This process examines the specific location proposed for generator interconnection and the proposed generator's unique technical characteristics, and determines the necessary transmission upgrades necessary for that unique interconnection as required by SPP. Presently, Liberty-Empire has applied to connect 300 MW of wind generation at two native locations (Asbury, MO and LaRussel, MO) (GEN-2017-060 and GEN-2017-082, respectively; DISIS-2017-001). The following table exhibits the allocated costs determined within the *DISIS-2017-001-1 Restudy #1 (Power Flow) Draft Results*, posted on 10/08/2021.

Gen Number	Group	Upgrade ID	Service Type	Upgrade Name	Upgrade Type	Upgrade Details	Allocated Cost ($M)	% Allocated	Total Upgrade Cost
GEN-2017-060	12 - Northwest Arkansas	133019	ERIS	LaRussell Energy Center 161 kV Substation GEN-2017-060 Interconnection (Non-Shared NU) (EDE)	Interconnection	Interconnection upgrades and cost estimates needed to interconnect the following Interconnection Customer facility, GEN-2017-060	$0.00	100.00%	$0.00
GEN-2017-060	12 - Northwest Arkansas	133018	ERIS	LaRussell Energy Center 161 kV Substation GEN-2017-060 Interconnection (TOIF) (EDE)	Interconnection	Interconnection upgrades and cost estimates needed to interconnect the following Interconnection Customer facility, GEN-2017-060	$0.00	100.00%	$0.00
GEN-2017-082	12 - Northwest Arkansas	133057	ERIS	Asbury Plant 161 kV Substation GEN-2017-082 Interconnection (Non-Shared NU) (EDE)	Interconnection	Interconnection upgrades and cost estimates needed to interconnect the following Interconnection Customer facility, GEN-2017-082	$0.00	100.00%	$0.00
GEN-2017-082	12 - Northwest Arkansas	143123	ERIS	Asbury Plant 161 kV Substation GEN-2017-082 Interconnection (Non-Shared NU) (WERE)	Interconnection	Potential interconnection impacts from the following generating facility, GEN-2017-082	$6,649.00	100.00%	$6,649.00

Gen Number	Group	Upgrade ID	Service Type	Upgrade Name	Upgrade Type	Upgrade Details	Allocated Cost ($M)	% Allocated	Total Upgrade Cost
GEN-2017-082	12 - Northwest Arkansas	133056	ERIS	Asbury Plant 161 kV Substation GEN-2017-082 Interconnection (TOIF) (EDE)	Interconnection	Interconnection upgrades and cost estimates needed to interconnect the following Interconnection Customer facility, GEN-2017-082	$0.00	100.00%	$0.00
Total							$6,649.00		$6,649.00

Two other generation interconnection requests (GEN-2017-148 and GEN-2017-188) are presently within the DISIS-2017-002 queue for study. Results are not available at this time due to the delay in higher queued studies (DISIS-2016-002 and DISIS-2017-001).

3.4.2 Transmission Upgrades Report - Deliverability Enhancement within RTO

2. A list of the transmission upgrades needed to enhance deliverability from a point of delivery within the RTO including requirements for firm transmission service from the point of delivery to the utility's load and requirements for financial transmission rights from a point of delivery within the RTO to the utility's load;

Requests for firm transmission service are processed through the AFS process in the SPP. Since the AFS is an iterative process, it is not possible to identify a list of the specific transmission upgrades needed to generally deliver energy from a resource in the SPP footprint into Liberty-Empire unless the process for a specific Transmission Service Request has been completed.

The AFS process occurs three times each year when specific Transmission Service Requests and GI requests are modeled collectively across the entire SPP footprint, based on control area to control area transfers. SPP analyzes the transmission system for the service requests including transmission improvements that would enable the service to occur without standard or criteria violations. Costs for the upgrades deemed necessary to deliver all of the Transmission Service Requests are allocated to all transmission customers within SPP. Transmission customers may decline the allocated costs and drop out of the study process, after which the analysis is repeated for the reduced set of Transmission Service Requests. This process iteration continues until a final set of Transmission Service Requests is reached for the remaining customers. The remaining transmission customers with service requests in the process agree to the projects needed to deliver the remaining transmission service and share the resulting upgrade cost allocations. These remaining upgrade projects are included in the next cycle of the SPP transmission expansion plan process.

3.4.3 Transmission Upgrades Report - Physical Interconnection outside RTO

3. A list of transmission upgrades needed to physically interconnect a generation source located outside the RTO footprint;

Liberty-Empire cannot provide a list of specific transmission upgrades needed to interconnect a generation resource located outside the SPP footprint without performing a project-specific study for SPP GI request for a particular project location.

3.4.4 Transmission Upgrades Report - Deliverability Enhancement outside RTO

4. A list of the transmission upgrades needed to enhance deliverability from a generator located outside the RTO including requirements for firm transmission service to a point of delivery within the RTO footprint and requirements for financial transmission rights to a point of delivery within the RTO footprint;

A list of the specific transmission upgrades needed to enhance deliverability of capacity and energy from a particular generation resource located outside the SPP footprint cannot be obtained without making a SPP GI request and an associated Transmission Service Request at a particular location.

3.4.5 Transmission Upgrades Report - Estimate of Total Cost

5. The estimated total cost of each transmission upgrade; and

Liberty-Empire has a single active NTC which was issued in November of 2020 by SPP (NTC# 210570) as a result from a request for transmission service studied within SPP-2019-AG1-AFS-2.

The work encompasses the rebuilding of approximately 29 miles of 161kV line and is scheduled for completion in October 2023. The original estimate for this NTC was $43.153MM. The present estimate for this NTC is $73.062MM.

3.4.6 Transmission Upgrades Report - Cost Estimates

6. The estimated fraction of the total cost and amount of each transmission upgrade allocated to the utility.

Liberty-Empire's estimated fraction of the total cost for transmission upgrades within the previous and ongoing ITP portfolios is unknown at this time. No projects in the finalized 2020 portfolio were identified within the Liberty footprint. As mentioned in Section 3.4.5, Liberty Empire has a single active NTC. Liberty Empire has a single active NTC which was issued in November of 2020 by SPP (NTC#210570) as a result from a request for transmission service studied within SPP-2019-AG1-AFS-2. The work encompasses the rebuilding of approximately 29 miles of 161kV line and is scheduled for completion in October 2023. The original estimate for this NTC was $43.153MM. The present estimate for this NTC is $73.062MM.

SECTION 4 ADVANCED TECHNOLOGY ANALYSIS

4.1 Transmission Upgrades for Advanced Technologies

(A) The utility shall develop, and describe and document, plans for transmission upgrades to incorporate advanced transmission technologies as necessary to optimize the investment in the advanced technologies for transmission facilities owned by the utility. The utility may use the RTO transmission expansion plan in its consideration of advanced transmission technologies if all of the conditions in paragraphs (3)(B)1. through (3)(B)3. are satisfied.

As discussed in Section 3.1.2, Liberty-Empire incorporates three main advanced technologies in its transmission system: ADSS and/or OPGW, microprocessor relaying, and automatic throw-over switching schemes on the 69-kV transmission system(s). In addition to these technologies evaluated by Liberty-Empire, the Company is currently reviewing additional technologies for potential future implementation on its transmission system, including transformer oil DGM, transformer bushing monitoring, transformer bushing monitoring with partial discharge, transformer fiber optic winding temperature sensors, transformer monitoring, comprehensive transformer health monitoring, fiber optic substation data network, substation data archive, server, and database, and 69-kV vacuum circuit breakers.

As discussed later in this section and in Section 1.4, Liberty-Empire is also pursuing changes across its organization through AMI, Distribution Automation, ADMS, OMS, voltage control, and reclosers. These changes will enhance Liberty-Empire's future grid capabilities and allow for expanded, safe, and secure communication at the transmission and distribution levels. These changes are also occurring against the backdrop of the issuance of FERC Order 2222. As mentioned in Section 3.1.2, these additional platforms and advanced technology could yield future benefits that are difficult to currently quantify.

Liberty-Empire has also made transmission upgrades through its Asset Replacement Program and the conclusion of Operation Toughen Up ("OTU"). These efforts form an activity baseline. This baseline reflects sound engineering practice, comports with current and emerging standards, and aligns with vendor innovation. This baseline also applies advanced asset management techniques and proceeds prudently in recognition of core grid functions (safety, security, reliability, resiliency, capacity, contingency, etc.).

In summary, these initiatives demonstrate Liberty-Empire's focus on meeting core grid functions by efficiently implementing advanced technology on the transmission system.

4.2 Distribution Upgrades for Advanced Distribution Technologies

(B) The utility shall develop, and describe and document, plans for distribution network upgrades as necessary to optimize its investment in advanced distribution technologies.

As discussed in Section 1.4, Liberty-Empire is pursuing several important programs that will bring advanced technology capabilities to its distribution system. These programs primarily include Advanced Metering Infrastructure ("AMI"), a new ADMS system with GIS and OMS upgrades, distribution automation, and several other programs.

AMI is currently being implemented across the Liberty-Empire territory. AMI is a comprehensive metering solution intended to create two-way communications between customer meters and the utility. AMI meters, often referred to as "smart meters," are digital meters with advanced features and capabilities beyond traditional electricity meters. AMI meters include more granular data, tamper detection, net metering capability, and an internal remotely operable connect/disconnect switch. AMI is a customer-focused technology that leads to greater convenience and transparency over a customer's energy consumption and will provide greater insights to Liberty-Empire regarding customer electricity usage. The AMI investment supports Empire's long-term efforts to upgrade its company technologies and capabilities in order to improve the efficiency, quality, and range of services it provides to its customers.

Liberty-Empire is also implementing a new ADMS platform which will include a new outage management system ("OMS") and an upgraded geographic information system ("GIS"). The new

ADMS platform will include a geographic-based outage management system with the ability to quickly identify outages. In the future, Liberty-Empire will be able to apply advanced analytics in the ADMS platform to better predict and respond to outages. In addition, the updated OMS will integrate with SCADA capabilities. Integrating will lead to more efficiencies in operating the grid and more automated control, as well as allow grid operators to work in a more complex grid environment with DERs, two-way power flow, and storage. It will provide more grid awareness and situational awareness in real time. The new platform will also have a customer portal, enabling the provision of quicker feedback and enhanced customer and outage information.

The new GIS system will have capabilities for better outage identification and fault location which will provide operators and customers with better outage information. The GIS system will also link with a corporate Liberty system. This is beneficial because Liberty-Empire analysts will have access to significant amounts of data which can be used to better predict risks to the grid and outages.

Liberty-Empire is also pursuing several opportunities to expand distribution automation across the grid. Efforts have included beginning to install viper reclosers and introducing automation onto interconnected circuits. These initial efforts are useful to develop a future scheme of automated overhead switches that would replace a largely manual system today. In addition, Liberty-Empire is working with third-party engineering firm, Burns and McDonnell, to conduct a study on the impacts of automated systems. This information, combined with recent efforts, will help Liberty-Empire to set a foundation that can be built on with emerging technology like a Distributed Energy Resource Management System ("DERMS") or advanced analytics in the future to achieve a more modern and advanced grid.

The OTU program has brought advanced technology-based improvements to system reliability challenges and issues at the distribution level. OTU has involved intensive reviews of issues related to SAIDI and SAIFI across the Liberty-Empire distribution system. A key aspect of OTU and the reliability improvement goals has been a focus on bringing advanced technology solutions to cost-effectively address reliability challenges. This has included a compilation of distribution circuit sectionalizing evaluations, fuse coordination optimization studies, advanced recloser control upgrades, and measures to increase Liberty-Empire's system hardening. Liberty-Empire will also continue to install OPGW and ADSS cables on the distribution system, improving these conductors and system protection schemas.

In support of further advanced distribution technologies on Liberty-Empire's system, Liberty-Empire continually evaluates avenues to improve reliability with minimal rate impact in order to better serve its customers. Liberty-Empire strives to strike a balance between vetting, evaluating, and implementing emerging technologies for the benefit of customers.

In sum, Liberty-Empire is implementing advanced technologies on its distribution system where it identifies benefits to customers. The advances in informational and operational technologies alongside high-speed communications platforms is leading Liberty-Empire to invest in a range of high-value customer investments including AMI, ADMS, and upgrades OMS and GIS systems. In the future, Liberty-Empire expects to build upon these platform investments to deliver an increasingly smarter, reliable, and efficient grid.

4.3 Optimization of Investment in Advanced Transmission and Distribution Technologies

(C) The utility shall describe and document its optimization of investment in advanced transmission and distribution technologies based on an analysis of-

4.3.1 Costs of Advanced Grid Investments

1. Total costs and benefits, including:
A. Costs of the advanced grid investments;

Liberty-Empire has not identified any advanced grid investments that influence the supply- or demand-side resource options that were evaluated for inclusion in final screening evaluations. The interconnection of supply-side resources is highly location-specific and is largely unidentified in terms of requirements and locations (with the potential exception of Liberty-Empire's existing sites with available interconnection capacity, as further discussed in Technical Volume 040). However, there are currently no identified limitations introduced to the candidate resource options related to limits of the transmission or distribution grid capabilities that may be resolved or improved by Liberty-Empire's planned advanced technology upgrades. Liberty-Empire has also provided separate justification for these advanced technology upgrades in its 2021 Rate Case for investments in AMI and ADMS.

For each advanced technology, Liberty-Empire conducts an assessment on an as-needed basis of costs and benefits of the technology as compared to alternative investments. To reduce costs, many grid automation applications, intelligent grid assets, and newer technologies are initially tested through a pilot project before wide-scale deployment. Pilots are prudent in order to verify correct operation and maintain a flexible environment.

4.3.2 Costs of Non-Advanced Grid Investments

B. Costs of the non-advanced grid investments;

There are no costs associated with non-advanced grid investments that influence Liberty-Empire's consideration of the supply-side or demand-side resource choices.

Liberty-Empire has optimized distribution grid investments as opposed to expending efforts and resources in attempting to evaluate newly trended technologies. Liberty-Empire is able to promote a much more robust system for the customers served off the associated feeders to which the recently formatted methodology is applied. Liberty-Empire has developed fusing methodology alongside the use of advanced software modeling of the distribution systems. Fusing is considered non-advanced technology due to the longevity of implementation on the electric system. Liberty-Empire has re-evaluated the methodology used in previous iterations of protective coordination studies and has found improvements could be made in how the distribution system is sectionalized. Evaluation of the fusing methodology entails the use of industry standard fusing and standardization of coordination. The revamped fusing methodology has led to a more significant impact from distribution system sectionalization.

The advancement in fuse technology has allowed for more flexibility and configurability on the coordination of radially fed systems. In evaluating new technologies, Liberty-Empire has been able to provide and increase in service to distribution customers while lessening the cost to the customers. With the associated costs of newly specified fusing mainly residing in the engineering evaluation and specification, install costs are minimal due to the cooperative efforts in the worst performing circuit ("WPC") evaluations. Liberty-Empire foresees no appreciable cost impacts to customers due to new fuse deployment at this time. If the scope of deployment veers away from WPC cooperation and to total system implementation, the majority of the associated costs for such an initiative would be encompassed within the labor costs of install. This would be site deterministic and could not be estimated on a system wide basis.

4.3.3 Reduced Resource Costs through Demand Response and Demand Generation

C. Reduced resource costs through enhanced demand response resources and enhanced integration of customer-owned generation resources; and D. Reduced supply-side production costs;

Liberty-Empire has evaluated demand response measures and included several as candidate demand-side resources (described further in Technical Volume 5 – Demand-Side Analysis). These resources require time-variant pricing. Accordingly, they require the availability of detailed participant billing determinants at the hourly or sub-hourly level of granularity, which can be addressed through the use of two-way AMI. Liberty-Empire is implementing two-way AMI across its service territory through 2021.

Additionally, Liberty-Empire has not identified any customer-owned generation resource options that factor into the screening and final selection of resource options. These customer-owned generation resource options are also not constrained within the current resource modeling or impacted by the evaluation regarding the availability of advanced distribution network technologies that may be useful for their integration and monitoring to the extent they participate in serving load. As described elsewhere, Liberty-Empire's long-term plan to implement advanced distribution technologies will assist Liberty-Empire in integrating customer owned resources as they emerge over time.

4.3.4 Cost-Effectiveness of Advanced Technologies

2. Cost effectiveness, including:

4.3.5 Incremental Costs of Energy Resources (With and Without Advanced Technology)

A. The monetary values of all incremental costs of the energy resources and delivery system based on advanced grid technologies relative to the costs of the energy resources and delivery system based on non-advanced grid technologies

Liberty-Empire has not identified specific advanced technologies that influence the final candidates considered for supply- and demand-side resource selection. Moreover, it did not disqualify any resource due to the lack of availability of an advanced network technology. To the extent that certain resources were not selected for further review in the final resource analysis stages, the decision criteria was unrelated to the availability of advanced network technology. Therefore, Liberty-Empire is not able to define a difference in the resource costs of a delivery system based on advanced grid technologies versus non-advanced grid technologies.

4.3.6 Incremental Benefits of Advanced Grid Technologies vs. Non-Advanced Grid Technologies

B. The monetary values of all incremental benefits of the energy resources and delivery system based on advanced grid technologies relative to the costs and benefits of the energy resources and delivery system based on non-advanced grid technologies; and

Liberty-Empire has not identified specific advanced technologies that influence the final candidates considered for supply- and demand-side resource selection. Moreover, it did not disqualify any resource due to the lack of availability of an advanced network technology. To the extent that certain resources were not selected for further review in the final resource analysis stages, these factors were unrelated to the question of the availability of advanced network technology. Therefore, Liberty-Empire is not able to define a difference in the resource costs of a delivery system based on advanced grid technologies versus non-advanced grid technologies.

4.3.7 Optimization of Investment – Non-Monetary Factors

C. Additional non-monetary factors considered by the utility;

4.3.7.1 Optimization of Investment – Societal Benefit

3. Societal benefit, including:

4.3.7.1.1 Societal Benefit – Consumer Choice

A. More consumer power choices;

Liberty-Empire's advanced technology investment will support Liberty-Empire's ability to usher in the needed changes to the distribution system to support new market services. AMI in particular unlocks Liberty-Empire's ability to offer the cost-effective means to provide its customers with new rate programs, which in turn support emerging energy technologies and services. With two-way AMI-provisioned metering data, customers will become empowered to make independent choices concerning their energy usage. The new ADMS platform will also provide better situational awareness to Liberty-Empire which can lead to better siting information for consumer power options.

4.3.7.1.2 Societal Benefit – Existing Resource Improvement

B. Improved utilization of existing resources;

Liberty-Empire's planned integration of advanced resources will lead to improved utilization of existing distribution grid assets. ADMS and AMI provide more information and insight into how the grid is functioning at more granular levels and set the foundation for advanced analytics around congestion and reliability issues. These investments will help Liberty-Empire improve reliability, reduce energy losses, improve power quality, and increase load serving capacity in an efficient manner.

4.3.7.1.3 Societal Benefit – Price Signal Cost Reduction

C. Opportunity to reduce cost in response to price signals;

As described previously, AMI can provide information on interval usage data that will expand Liberty-Empire's ability to offer different rate designs such as time variant pricing. While this benefit will not be immediate, AMI can provide price signals to customers which can lead to reduced usage and cost. In the near future, Liberty-Empire plans to introduce a Residential Time-of-Use Pilot schedule and a Commercial Building Time-of-Use Pilot schedule for its residential and small commercial customers. Additionally, Liberty will be proposing a Large Power Time-of-Use rate schedule applicable for certain very large customers.

Time-of-use ("TOU") rates present different power prices associated with the corresponding costs to provide electricity during pre-determined times of the day. This type of rate structure usually includes on-peak and off-peak pricing. The on-peak period is broadly defined by the periods of the day in which system loads are highest and off-peak times are associated with the remaining periods in which loads are typically lower. The cost of providing electricity varies within these pre-defined time periods. A goal of a TOU rate is to provide a tool for customers to have more control of their electricity bill.

4.3.7.1.4 Societal Benefit – Environmental Signals

D. Opportunity to reduce environmental impact in response to environmental signals;

AMI can assist the utility in lower energy losses (such as theft and tamper). Over time, the grid control functionality envisioned by Liberty-Empire with the implementation of AMI, ADMS, and distribution automation, and other systems will permit the increased use of storage technology, which can influence the total operating efficiencies of wholesale generation resources. These should reduce the environmental impact of Liberty-Empire.

4.3.7.2 Optimization of Investment – Other Utility-Identified Factors

4. Any other factors identified by the utility; and

No other factors were identified by Liberty-Empire.

4.3.7.3 Optimization of Investment – Other Non-Utility-Identified Factors

5. Any other factors identified in the special contemporary issues process pursuant to 4 CSR 240-22.080(4) or the stakeholder group process pursuant to 4 CSR 240-22.080(5).

No other factors were identified.

4.4 Inclusion of Non-Advanced Transmission and Distribution

(D) Before the utility includes non-advanced transmission and distribution grid technologies in its triennial compliance filing or annual update filing, the utility shall-

4.4.1 Non-Advanced Transmission and Distribution Required Analysis

1. Conduct an analysis which demonstrates that investment in each non-advanced transmission and distribution upgrade is more beneficial to consumers than an investment in the equivalent upgrade incorporating advanced grid technologies. The utility may rely on a generic analysis as long as it verifies its applicability; and

2. Describe and document the analysis.

Liberty-Empire is not proposing installation of any new non-advanced distribution grid technologies or programs in this triennial IRP compliance filing. Liberty-Empire will conduct and document such an analysis which demonstrates such an investment to be more beneficial to consumers than an advanced grid technology if Liberty-Empire is to include such non-advanced technologies in future IRP filings.

4.5 Advanced Transmission and Distribution Required Cost-Benefit Analysis

(E) The utility shall develop, describe, and document the utility's cost benefit analysis and implementation of advanced grid technologies to include:

4.5.1 Advanced Grid Technologies

1. A description of the utility's efforts at incorporating advanced grid technologies into its transmission and distribution networks;

Liberty-Empire makes every effort to incorporate advanced technologies in presently budgeted or recently substantially completed projects. As demonstrated by its investments in AMI, ADMS, distribution automation, and other technologies, Liberty-Empire is taking significant action to incorporate advanced technologies into its distribution and transmission network and is modernizing its grid to better set the stage for future advanced grid technologies.

As described previously, Liberty-Empire has separately provided cost-benefit analysis for some of these investments such as AMI and ADMS. A full cost-benefit analysis at this stage is premature as the impacts of many of these investments are difficult to quantify.

4.5.2 Distribution Advanced Grid Technologies

2. A description of the impact of the implementation of distribution advanced grid technologies on the selection of a resource acquisition strategy; and

The implementation of advanced grid technologies did not influence the current selection of resource acquisition strategy. The aforementioned implementations – and the diverse set of specifically aspirational and long-term investment areas such as distribution automation are foundational elements of a more modern and advanced grid.

Organization-wide, Liberty is working to establish a platform of capabilities involving AMI, ADMS, and DA that are important for the safe, compliant, and cost-effective operation of the distribution grid. Over time, Liberty-Empire will better understand the extent of implementation of these programs, determining Liberty-Empire's specific requirements in relation to load and customer needs, and when said advanced technologies may become cost-effective. In summary, advanced grid technologies on resource acquisition have been shown to be of minimal impact. However, Liberty-Empire will continue to evaluate the possible influence these technologies may have within subsequent future filings.

4.5.3 Transmission Advanced Grid Technologies Impact

3. A description of the impact of the implementation of transmission advanced grid technologies on the selection of a resource acquisition strategy.

Notwithstanding the central and critical role of Liberty-Empire's application of technology to support the fundamental reliability and resiliency of the transmission system, thereby facilitating the interconnection of wholesale generators to the grid to serve intended market functions, the implementation of transmission advanced grid technologies did not influence the selection of resource acquisition strategy. Liberty-Empire anticipates that subsequent cost benefit analyses could possibly determine several advanced grid technologies to be cost-effective. At a minimum, Liberty-Empire will better understand the extent of implementation at which said advanced technologies become cost-effective.

SECTION 5 UTILITY AFFILIATION

(5). The electric utility shall identify and describe any affiliate or other relationship with transmission planning, designing, engineering, building, and/or construction management companies that impact or may be impacted by the electric utility. Any description and documentation requirements in sections (1) through (4) also apply to any affiliate transmission planning, designing, engineering, building, and/or construction management company or other transmission planning, designing, engineering, building, and/or construction management company currently participating in transmission works or transmission projects for and/or with the electric utility.

Liberty-Empire collaborates with SPP members and non-members in the annual RTO-hosted model building summits, planning summits, and various cooperative joint study meetings. Liberty-Empire actively participates on multiple committees, working groups, and task forces. Liberty-Empire participates in the development of and annually reviews the various RTO reports. Liberty-Empire annually confirms tie line ratings with interconnected utilities in an effort to maintain communication and congruency during the associated model building process.

SECTION 6 FUTURE TRANSMISSION PROJECTS

(6) The electric utility shall identify and describe any transmission projects under consideration by an RTO for the electric utility's service territory.

No economically viable Liberty-Empire transmission projects are merited at this time for review by the RTO. Liberty-Empire has previously submitted high-value projects for consideration as mitigation to various overloads and voltage issues around the Southwest Missouri areas. Due to muted load growth over the past years, paired with the position within the SPP footprint, subsequent evaluations by the RTO and Liberty-Empire have not exhibited the need for any future transmission projects at this time. Liberty-Empire has and will continually attempt to identify transmission projects that will have positive impacts for their customers.

SECTION 7 APPENDIX

Appendix 4.5-A: Table 1 of the TPL-001-4 Standard

Appendix 4.5-B1: GEN-2017-060

Appendix 4.5-B2: GEN-2017-082

Appendix 4.5-C: 2013 ITP20

Appendix 4.5-D: 2020 ITP v1.0

Appendix 4.5-E: 2021 SPP Transmission Expansion Plan Report