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File No.: ER-2022-0337
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MISSOURI PUBLIC SERVICE COMMISSION

FILE NO. ER-2022-0337

REBUTTAL TESTIMONY

OF

JAMES HUSS

ON

BEHALF OF

UNION ELECTRIC COMPANY

D/B/A AMEREN MISSOURI

St. Louis, Missouri
February 15, 2023

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REBUTTAL TESTIMONY

OF

JAMES HUSS

FILE NO. ER-2022-0337

I. INTRODUCTION

Q. Please state your name and business address.

A. James Huss, Union Electric Company d/b/a Ameren Missouri ("Ameren Missouri" or "Company"), One Ameren Plaza, 1901 Chouteau Avenue, St. Louis, Missouri 63103.

Q. What is your position with Ameren Missouri?

A. I am Senior Director of Operations Excellence.

Q. Please describe your educational background and employment experience.

A. I am a registered professional engineer with the state of Missouri. I have Bachelor's and Master's degrees in Electrical Engineering from the University of Missouri – Columbia. I joined Union Electric Company in 1991 and worked at the Callaway Nuclear Plant in electrical design engineering and was responsible for various plant systems and modifications until 1995. Beginning in 1995, I worked as a Distribution Operating Engineer with responsibilities for substation operations, supervisory control and data acquisition ("SCADA"), metering, and power quality and reliability. In 2008, I was promoted to a Supervising Engineer in the Distribution Operating organization. In that role, I was responsible for the formation and oversight of a Distribution Systems Technology team that designed, installed, and maintained a variety of smart grid equipment including

switching devices and sensors. In 2014, I was promoted to Senior Manager, Distribution Operating with responsibility for operation and oversight of the St. Louis and Jefferson City Distribution Control offices and the SCADA engineering team. I was promoted to Director, Distribution Operating with responsibilities including the two Distribution Control offices, Metro St. Louis first responders, SCADA Engineering, and Distribution System Technology in 2015. In 2019, I transferred to the Director, Operations Excellence and I was assigned oversight of Distribution System Planning, Distribution Construction Standards, Joint Use, Damage Prevention, SCADA/ Advanced Distribution Management System ("ADMS") engineering, and oversight of capital allocations and project selection and execution for Ameren Missouri. In 2021 I was promoted to Senior Director Operations Excellence where I retained existing responsibilities with addition of Distribution Operations.

Q. What are your responsibilities in your current position?

A. My primary responsibilities are System Planning, Engineering Standards, Distribution Operations and oversight of the five-year capital budgeting and forecasting process for Ameren Missouri's Energy Delivery function.

II. PURPOSE OF TESTIMONY

Q. What is the purpose of your rebuttal testimony in this proceeding?

A. The purpose of my rebuttal testimony is to address the Office of Public Counsel ("OPC") witness Dr. Geoff Marke's comments regarding Ameren Missouri's deployment of a Private LTE communications system and questions about the installation of Tripsavers on Ameren Missouri's distribution system. I also address the

recommendations on Utility Coordination on Excavation of Distribution Projects presented in the direct testimony of OPC witness Jordan Seaver.

Q. Are you sponsoring any schedules in connection with your testimony?

A. Yes, I am sponsoring Schedule JH-R1 and the schedule is attached to my rebuttal testimony.

II. REASONABLENESS OF PRIVATE LTE COMMUNICATION AND TRIPSAVER INVESTMENTS

A. Benefits of Private LTE Communication Investment

Q. Does Dr. Marke accurately describe the benefits of a Private LTE communications system?

A. No, he did not review all the benefits. While Dr. Marke accurately describes a number of considerations that led Ameren Missouri to conclude that a Private LTE ("PLTE") system is in the best interest of our customers, including enhanced security, reliability, and reduced complexity, Dr. Marke acknowledges that he reviewed limited information on the benefits of the PLTE system. I explain below that by investing in the network today, we create a number of additional benefits. Some of the benefits relate to network lifecycle concerns, Cyber Security concerns, and the proliferation of devices that is often referred to as the Internet of Things ("IoT"). Further, PLTE can also help us to make sure we are prepared for the potential proliferation of Distributed Energy Resource ("DER") technologies being encouraged by federal legislation and regulation such as FERC Order 2222. A primary concern that I will address first is the network lifecycle contrast between public versus private wireless communications systems.

Q. Describe why network lifecycle is important.

A. There are three drivers that make network lifecycle an important consideration: (i) the number of communicating devices deployed for grid operations, (ii) the costs of upgrading those devices for each network lifecycle upgrade when required by public cellular providers, and (iii) the frequency of network lifecycle updates required by public cellular providers.

(1) Ameren Missouri currently has thousands of devices on a variety of wireless communications platforms. For example, distribution substations, distribution automation reclosers, capacitor controls, voltage regulators, smart meter takeout points, and a variety of other line sensor and asset monitoring devices require communication devices connected to a communications platform. Communications platforms utilized to reach these devices include:

a. Licensed low data bandwidth 900MHZ radio systems in place since the 1980s;

b. Unlicensed low data bandwidth spread spectrum radios used since the early 2000s to alleviate extreme congestion on the licensed radio system, in the public spread spectrum range subject to greater and greater interference;

c. Proprietary spread spectrum radio system; and

d. Public Cellular.

In the Company's more populated areas of its service territory, which also have more communicating smart grid devices, Ameren Missouri reached the capabilities limits of the licensed radio system in terms of number of devices that could be deployed. As a result,

this led us to utilizing public cellular. At the time of our analysis of the benefits of a PLTE network in the first half of 2021, Ameren Missouri had approximately 3,800 communicating devices on public cellular communication in the St. Louis Metro Area.

(2) The costs associated with such network lifecycle replacement of communications equipment average about $2,000 per communicating device including materials and the truck rolls and back-office engineering associated with the upgrade, all resulting in additional customer costs.

(3) Our experience with public cellular over the past 10 to 15 years has seen much more frequent network lifecycle upgrades, about every five years on average, of the wireless communications equipment compared to a ten-year lifecycle for a network that Ameren Missouri would own and control. Currently, the third-party communications carriers' decisions about when to implement upgrades dictates the Company's requirements to replace or otherwise upgrade its existing equipment that uses the network, resulting in significant costs.

Q. Are there any benefits to a Private LTE network in terms of software and technology lifecycles and upgrades?

A. Yes. A private network, where Ameren Missouri controls both the network endpoints and the network itself, allows the Company to control the technology lifecycles as well as software upgrade lifecycles. This means from a technology standpoint Ameren Missouri can control and plan for when we will no longer support devices or technology in a manner that will be more fiscally responsible to our customers. The PLTE system is expected to double the lifecycle of the wireless communications system when compared to public cellular, from five years to ten years.

Q. What is the impact of expected future growth of IoT on the decision to utilize PLTE with regards to lifecycle?

A. There are two elements to the growth of IoT. First, in terms of sheer numbers, we anticipate wireless communicating devices to grow by many thousands, resulting from increased smart grid devices for customer reliability. Examples are smart switches, wireless communicating Faulted Circuit Indicators ("FCIs") that reduce time required for fault isolation and restoration, and smart capacitor controls for reliability. Additionally, thousands of Smart Meter System collector sites are currently on public cellular and would, absent existence of the PLTE system, require a lifecycle replacement with public cellular upgrades.

Second, Dr. Marke describes many of the IoT devices that Ameren Missouri would install for increased situational awareness and will have communications fully embedded in the device. This makes the lifecycle of the wireless infrastructure more important because it would lead to more costly complete equipment replacements versus just replacing the communications component in the device. Wireless communicating FCIs are completely self-contained and hang directly on the conductors near key switching points on the distribution system. If we rely on public cellular and those carriers modify their systems, the entire FCI would require replacement. This would make public cellular a disincentive to volume deployment of sensors such as these FCIs that will improve situational awareness and reliability metrics such as SAIDI through reduced patrol time and restoration switching since the FCIs provide field personnel with a more precise segment of the grid that experienced the fault. This means instead of patrolling the entire

feeder to find the location of the fault, the field personnel will be able to go straight to the section the FCIs indicated is experiencing an issue to begin taking restoration actions.

Q. Other than lifecycle, are there operational concerns with public cellular?

A. Yes, Ameren Missouri has had and continues to have concerns about public cellular availability during public emergencies. Numerous examples exist of public cellular unavailability during emergencies due to congestion and infrastructure issues such as backup power availability. Specifically, Ameren Missouri has experienced communication outages of the public cellular network on various occasions during weather events. Additionally, an example was in Texas during the extreme cold snap in 2021. During the cold snap, the communication outages hampered utility restoration efforts resulting in extended customer outages. However, during recent hurricanes impacting Alabama and Georgia, utility PLTE systems (Southern Linc) proved more resilient than public carriers. Reliable voice communication and SCADA allows for faster and safer restoration of power. These two examples highlight the available capacity on the communications network during emergencies is a significant concern because our communications networks are critical during emergencies that don't just affect the grid, but also impact the community in general, e.g., in extreme weather conditions. Further, Ameren Missouri has incurred outages due to vendor software changes on the public carrier network, which have impacted our operations because those software changes were imposed on us without an ability to test them.

Q. How does a PLTE network address these operational concerns?

A. Operation and maintenance of a PLTE network will include sufficient emergency battery backup or backup generation at tower sites to allow us to mitigate operational risk by prioritizing operations of our system in cases of emergencies, including severe weather. Additionally, since we control the software, the Company can ensure testing is completed for compatibility prior to upgrades to mitigate operational impacts from such upgrades.

Q. Is there a Cyber Security benefit to a Private LTE network.

A. Yes, PLTE gives us an enhanced Cyber Security posture since it is a completely private and separate network. Since energy delivery in the United States is considered critical infrastructure and is at potential risk of attack from outside entities desiring to disrupt society, it is important for Ameren Missouri to have complete control of the network in terms of what devices are allowed on the network and what those devices can access. This complete control increases the Cyber Security of the communications network that in turn controls the distribution grid. Additionally, not having our network open to the Internet (like a public carrier network is) reduces the cyber-attack vector footprint. Isolating devices from the public network makes it harder for bad actors to disrupt the Company's system and thus interrupt electric service to our customers.

Q. Were revenue streams through ancillary opportunities to lease the PLTE system a consideration in the decision to implement private LTE?

A. No. Ancillary opportunities were not considered in the business case. As the project developed and we applied for tower permits, we had feedback from permitters in some cases to allow co-location of other wireless providers on towers that we construct.

Those revenues are not expected to be significant and like pole attachment revenue, flow back to customers as an offset to revenue requirement.

Q. Is Ameren Missouri a "first-mover" in Private LTE?

A. Ameren Missouri is not a first-mover and is not the only utility looking into or in the process of deploying a Private LTE network. Southern Linc, a subsidiary of Southern Company, has been operating a Private LTE network for several years (more than twenty years) in Georgia, Alabama, and parts of Mississippi. Other utilities which are deploying PLTE networks include Evergy, Duquesne Power, Xcel Energy, San Diego Gas and Electric and Southern California Edison. The following utilities are in the process of conducting Private LTE trials: New York Power Authority, Avangrid, as well as several co-ops and municipalities across the country.

Q. Dr. Marke expressed concern Ameren Missouri is enabling a 4G platform and not a 5G platform.[1] Do you agree with his concerns?

A. No. The utility use-cases we are planning to implement or have implemented do not require 5G capability.

Q. Do any of the utility use-cases Ameren Missouri is planning to implement require 5G LTE in order to be successful? If so, which ones?

A. No. Utility use-cases require low bandwidth and moderate latency. 5G capabilities go beyond this utility requirement and are not needed at this time, and we do not anticipate needing this technology for utility operations for the foreseeable future.

[1] File No. ER-2022-0337, Direct Testimony of Geoff Marke at p. 23.

Q. Can you discuss the 4G vs 5G device ecosystem as it relates to utility use-cases?

A. A vast 5G LTE device ecosystem does not exist for IoT and Machine to Machine ("M2M") devices that are required in the utility industry. Moreover, 5G devices will need to be environmentally hardened to withstand the harsh environments in which they are installed. In contrast, the 4G device ecosystem for utility use-cases has dramatically expanded in the last few years as more utilities are looking to deploy PLTE networks and utility consortiums are being formed with manufacturer/vendor participation to develop 4G products for utilities.

Q. In terms of technology stability, is 4G an established technology? Is 5G?

A. 4G LTE is an established technology while 5G LTE is still being developed and refined from the perspective of utility use-cases.

Q. Is 4G technology being obsoleted or retired in the next couple of years for utility applications?

A. No. 4G LTE technology has a long lifespan. At this time, 5G LTE is being deployed to highly populated metropolitan areas on public carrier networks. It is seeing limited deployment in less dense areas. There is no discussion to retire 4G LTE technology in the foreseeable future.

Q. Why does Ameren Missouri have a lifecycle concern with public cellular if 4G is going to be around for many more years?

A. Use-cases for public cellular providers do not align with those of utility infrastructure. Public cell providers may choose to declare end of life of 4G in some

coverage areas for several reasons. Those reasons typically include a need to replace 4G with 5G to reclaim tower space, capacity concerns of various frequency bands and needing to free up more spectrum for 5G users, and incentivizing customers to replace their phones etc. However, 4G equipment will be available to Ameren Missouri for many years, and as described above, will be sufficient to meet the use-cases for utility operations for the foreseeable future.

Q. Did Ameren Missouri consider an upgrade path to 5G if, and when, it becomes required for utility use-cases?

A. Yes. Ameren Missouri installed dual, geo-redundant evolved packet cores ("EPCs") that are dual mode and can be upgraded to support 5G LTE in the future. At that time, Ameren Missouri would then install 5G NR (new radio) technology at the cell sites to fully support 5G LTE, if that need arises. As noted, that need is not expected to arise for many years.

Q. What qualitative factors were considered when deciding on a PLTE strategy?

A. As described above, a higher volume of sensor technologies is expected to be driven both by the proliferation of IoT, as well as the need to meet customers' increasing expectations and need for higher levels of reliability of service. Ameren Missouri reviewed the use cases and considered the following factors for its PLTE strategy:

- Cybersecurity risk and communications system reliability, as previously described.
- Customer reliability from wireless communicating fault indicators, described above.

- Setpoint control of DERs may be a requirement in the next five to ten years if sufficient penetration occurs, and may be encouraged or required by FERC Order 2222.
- Sensors to monitor oil temperature of a three-phase transformer serving a large critical customer-facility.
- Placing wireless sensors on select pole assets on remote off-road rights of way, to assist in locating and isolating a downed wire and/or pole in rugged remote locations where patrol by truck, on foot or with drone is difficult and time-consuming.

For perspective, our original wireless systems installed in the late 1980s were sized to support 1200 baud (bits per second) communications to 32 substations from each tower site. As distribution system technologies evolved in the 1990s and more rapidly in the early 2000s, the number of communicating end points grew rapidly due to the customer benefits and situational awareness provided by those technologies. Building a scalable PLTE system allows Ameren Missouri to scale to the needs in an area and not suffer a strong economic disincentive to deployment of IoT with embedded communications, primarily due to the lifecycle considerations, described above.

Q. Dr. Marke suggests that Ameren Missouri did not provide workpapers to support the cost assumptions related to the inputs in the Company's response to OPC Data Request ("DR") 2011. In addition to the benefits described above, what other information can you provide regarding the Company's analysis of the PLTE network?

A. In response to OPC DR 2011, Ameren Missouri provided a summary of expected costs between a PLTE network and a public cellular network, both covering Ameren Missouri devices across the entire Ameren Missouri service territory, which covers all or part of 63 of Missouri's 114 counties. Currently, Ameren Missouri is strategically investing in and deploying the PLTE network only in the Metro region, primarily because a majority of the customer base is located in the Metro region and consequently, a majority of our communicating grid devices are in the region that serves these customers. While the analyses discussed in the response to OPC DR 2011 did address a service-territory-wide deployment, a final decision on whether to expand PLTE to the rest of our service territory has not yet been made. Given that the only deployment that has been made, and that is currently planned is solely in the Metro region, we have prepared an analysis quantifying benefits Ameren Missouri and its customers will receive from deployment of PLTE Metro network. This analysis demonstrates that customer benefits from just extending modem lifecycles and avoiding monthly device fees paid to public carrier's produce benefits of nearly 80% of the costs, on a net present value basis. Using nominal values and taking a simple payback approach to evaluating the Metro PLTE network, these benefits are over 1.5 times the cost of the investment. The results of these analyses are attached to my testimony as Schedule JH-R1. It is important to note that the

quantified benefits do not account for the significant benefits customers will see in reliability from communicating FCIs, reductions in Cyber Security risk, and mitigated operational risk of lost network communications, as previously described. These analyses also do not include additional qualitative and quantitative benefits related to the anticipated growth in the number of IoT devices that may be deployed on the Metro system in the future to incorporate DERs and electrification.

B. Reliability Benefits of the Tripsaver Investment

Q. Is Dr. Marke's description of a Tripsaver accurate?

A. I agree that Dr. Marke's technical description of a Tripsaver device is accurate. A Tripsaver is a reclosing device that can be installed to isolate a branch circuit when a problem occurs on that tap. However, unlike a fuse, it will attempt to reenergize the circuit one time. If the problem persists, then power remains out.

Q. How often will the ability of the Tripsaver to reclose successfully restore power to customers?

A. In 2018, Ameren Missouri studied all outages involving fuses, including causes and repair actions. That information showed that 40% of the time power was restored to customers, regardless of the cause of the outage, no repairs were required other than replacing the fuse.

Q. What types of outage causes were noted in those outages?

A. The five most common were:

- Lightning
- High winds/storms in the area
- No cause determined

- Tree contact
- Animal contact

Q. Why is a fuse or recloser needed at all for even a temporary issue?

A. With electricity, once a path between an energized circuit and earth is established, an arc can continue in open air between the energized circuit and earth, until something interrupts the electricity and extinguishes the arc. If a fuse or other isolating device is not present, the impact of even the temporary issue will affect far more customers.

Q. What benefits do customers see from being served by a Tripsaver instead of a fuse?

A. The benefits are as follows:

(1) The primary benefit is immediate power restoration when a temporary issue causes an interruption. On average, 40% of the time this is expected to occur.

(2) Temporary faults occur most frequently during high winds and storm events, when many outage orders are coming in and strain our people resources. This can make an outage very long for these customers, even if the solution is as simple as replacing the fuse. As noted below, the locations where we have installed Tripsavers average about 30 customers downstream of the devices. As we prioritize work, we initially focus on larger outages, to restore as many customers as possible, as quickly as possible, and work our way down to outages impacting smaller customer counts. So, there is tremendous reliability benefit during storms as these customers avoid multiple hour- or days-long outages that have a simple fix, but which might not be worked immediately due

to the large number of issues that may be impacting even more customers at that point in time.

(3) In areas of our territory where we don't have 24-hour coverage, when an off-hours outage occurs, we have to call a serviceman to respond. The time to complete what may be an otherwise simple repair can be unnecessarily lengthy in these off-hours circumstances, depending on who is able to respond, how long it takes them to prepare for the work and arrive at the job location. This can easily be two hours or more for restoration even if no patrol needs to be performed. As described above, 40% of the time on average, the problem may be temporary and a Tripsaver would have allowed the customer to experience a seconds-long outage with no need to roll a truck to restore service.

Q. Is Ameren Missouri installing Tripsavers with the primary objective of saving O&M?

A No. While installing Tripsavers might have small secondary benefit of reducing operation and maintenance costs in some parts of our territory,[2] the primary reason to install Tripsavers is to reduce extended customer outages.

Q Do you intend to install Tripsavers everywhere?

A. No. We are strategically installing Tripsavers where it makes sense to do so. We have more than 30,000 fuses that are installed to isolate overhead branch circuits away from the rest of the distribution backbone circuits when problems occur. Many of the customers served from those fused branch circuits would not be likely to see a reliability

[2] Assuming the elimination of the 40% of overtime incurred by off-shift callouts to replace the blown fuse, a small reduction in O&M can be anticipated, all other costs being equal.

benefit from a Tripsaver because they do not have a history of fuses blowing that could have been avoided with a Tripsaver.

Q. What criteria do you use to decide when to install a Tripsaver?

A. We will evaluate the installation of a Tripsaver on single phase or three phase overhead circuits, rated at 140 Amps or less, where any of the following conditions also exist:

(1) The fuse location is on our Multiple Device Interruption ("MDI") list, indicating a history of problems occurring on the circuit downstream of the fuse, causing the fuse to blow multiple times in a year.

(2) The distribution feeder is on our Worst Performing Circuit ("WPC") List, indicating that the feeder is experiencing poor reliability, often several years in a row.

(3) Customers served by the circuit are on our CERT list ("Customers Exceeding Reliability Above Threshold"). To be on this list, these customers have experienced either multiple interruptions or multiple hours of interruption three years in a row. Tripsavers are considered when looking at remedies to the repeat issues these customers are seeing.

(4) On newly designed circuits, designers are evaluating whether the circuit will be in close vicinity to vegetation, where we have limited easements to adequately manage, that could be future causes of poor reliability performance.

Q. Will you install Tripsavers on all MDI locations, and every fuse that's part of a WPC or CERT?

A. No. Generally, we limit the circumstances by applying additional criteria as follows:

(1) Multiple spans of overhead conductor downstream of the isolating device where there are at least five or more spans of conductor.

(2) Vegetation present (trees, vines etc.). Where trees and other heavy vegetation is present, animals are also present such as squirrels, raccoons, or black snakes.

(3) Number of customers served from the branch circuit. This number can be a small number in special situations, but the criteria is 10 customers or more. Our average customers served downstream of Tripsavers is 30.

Q. What about the cost? A Tripsaver device is $2900 versus $75 for a fuse.

A. The Company recognizes the difference in cost as part of its decision of when to install a Tripsaver device. Tripsavers are one remedy for customers experiencing repeated long duration outages or at high risk of repeat extended outages, where the cause may be temporary in nature. If a decision is made to do something more than maintain the status quo, this can be the most cost-effective option. Alternatives to status quo typically applied other than Tripsaver are:

- More frequent tree trimming, or tree trimming outside of our easements. However, these solutions are often rejected by the property owner.

- Undergrounding the tap or relocating the tap on to a new easement away from vegetation issues is another alternative. However, any physical relocation of a tap (overhead or underground) is very expensive compared to installation of a reclosing device.

C. OPC Recommendation To Enhance Coordination for Distribution Projects

Q. What is your response to OPC's recommendation to explore cost savings between other utilities and public entities to coordinate and plan distribution projects?

A. OPC witness Seaver acknowledges that Ameren Missouri consults and coordinates with other utilities to prevent duplicative excavation.[3] Mr. Seaver believes more can be done to ensure "all possible costs savings for ratepayers are considered and that disruptions to the public are limited." Ameren Missouri agrees with this goal.

Q. Do you agree with OPC's recommendation to meet with representatives from Staff and OPC at least twice to discuss what actions Ameren Missouri will document and what Ameren Missouri will include in Reports?

A. Yes. Ameren Missouri agrees with the recommendation. In the meetings we can discuss how to align on what Ameren Missouri would be benchmarking. Ameren Missouri will develop and recommend proposals for discussion and alignment. OPC also recommends certain reporting and an annual workshop. The Company believes it is best to defer that decision until after the meetings with Staff and OPC, so that we can determine if such reporting or workshop would be beneficial.

[3] File No. ER-2022-0337, Direct Testimony of Jordan Seaver at p. 3, lines 3-6.

III. CONCLUSION

Q. Does this conclude your rebuttal testimony?

A. Yes, it does.

Public Cellular

Maintenance Costs		
Replace Cell Modem	$	2,000.00
Number of years to replace a cell modem		5
Monthly Service Fee per Modem (O&M)	$	15.50

Private LTE

Maintenance Costs		
Replace Cell Modem	$	2,000.00
Number of years to replace a cell modem		10
Monthly Service Fee per Modem on PLTE	$	-

Category	Variables
Return on Equity	9.53%
Equity % (Capital Structure)	51.80%
Taxes (Federal and State Combined)	23.84%
Short Term Debt	2.38%
Debt % (Capital Structure)	48.20%
Start Year	2020
Escalation/Inflation	2.00%
Discount Rate (=After tax WACC)	5.81%
Communicating FCI's in 2024 through 2032	1,665.00
Additional AMI Takeoff Points in Metro from 2023 to 2030	2250
Capacitor Controls to be added from 2023 to 2030	1600
LMR Replacements per year in 2031 and 2032	500
Total Devices on Public Cellular as of 12/31/20	3800
% of planned DA devices in metro	66%
Average Cost per DA Install	$ 80,000.00
Percent Rate of Current Public Cell Devices cut to PLTE in 2023	8%
Percent Rate of Current Public Cell Devices cut to PLTE in 2024	20%
Percent Rate of Current Public Cell Devices cut to PLTE in 2025	25%
Percent Rate of Current Public Cell Devices cut to PLTE in 2026	25%
Percent Rate of Current Public Cell Devices cut to PLTE in 2027	22%
Cost of MO Urban PLTE Spectrum	$ 7,900,805.00
Cost of MO Rural PLTE Spectrum	$ 11,516,781.00

NOTE: The CPOC Gate 3 Approved costs included approval to purchase LTE Spectrum for Metro, Urban, and Rural parts of the territory. As described in the testimony of Jim Huss, Ameren Missouri has not yet determined if the expansion of PLTE will take place in the Urban or Rural parts of the territory and therefore those forecasted costs have been removed from this analysis so as to include only costs associated with the Metro deployment.

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New DA based on: 1. Actuals for 2020 2. AF154 for 2021-2025 3. AF181 for 26-27 4. 28-30 the same as 2027 *All in $M's*		$ 19	$ 11	$ 7	$ 6	$ 39	$ 28	$ 15			
Communicating DA Devices	201	237.50	137.50	87.50	75.00	487.50	350.00	187.50			

SCHEDULE JH-R1

Private LTE

Total

Year Count		1	2
Device Projections	**Current**	**2020**	**2021**
	Existing Metro Original @12.31.20 (Cell)		
	Planned Metro DA (Cell)	133	157
	Planned Capacitor Controls		
	Planned AMI Takeoff Points		
	Future Metro Communicating FCIs and LMR Radios (Cell)		
	Cell Sub-Total	133	157
	Existing (Other)		
	Total Deployment	133	157
	RUNNING TOTALS		
	Existing (Cell)	-	-
	Planned (Cell)	133	289
	Future (Cell)	-	-
	Cell Sub-Total	133	289
	Existing (Other)		
	TOTAL NUMBER OF DEVICES	133	289

COSTS

Cap Ex Costs	**INITIAL CAPEX COST**	2020	2021
	CPOC Gate 3 Corp Model with Urban and Rural Spectrum Removed	$ 2,620,000	$ 31,110,000
	Total Initial CapEx Based on Corp Model @ PV	$ 2,476,131	$ 27,787,201
	Escalation/Inflation	100%	102%

3	4	5	6	7	8
2022	**2023**	**2024**	**2025**	**2026**	**2027**
	304	760	950	950	836
91	58	50	322	231	124
	128	320	400	400	352
	180	450	563	563	495
		1,665	1,665	1,665	1,665
91	670	3,245	3,899	3,809	3,472
91	670	3,245	3,899	3,809	3,472

-	304	1,064	2,014	2,964	3,800
380	438	487	809	1,040	1,164
-	-	1,665	3,330	4,995	6,660
380	742	3,216	6,153	8,999	11,624
380	742	3,216	6,153	8,999	11,624

2022	2023	2024	2025	2026	2027
$ 49,390,000	$ 43,170,000	$ 47,029,195		$ -	
$ 41,692,334	$ 34,440,673	$ 35,459,248	-	-	

104%	106%	108%	110%	113%	115%

SCHEDULE JH-R1

9	10	11	12	13	14
2028	**2029**	**2030**	**2031**	**2032**	**2033**
0	0	0	0	0	0
1,665	1,665	1,665	1,665	2,165	1,333
1,665	1,665	1,665	1,665	2,165	1,333
1,665	1,665	1,665	1,665	2,165	1,333

3,800	3,800	3,800	3,800	3,800	3,800
1,164	1,164	1,164	1,164	1,164	1,164
8,325	9,990	11,655	13,320	15,485	16,818
13,289	14,954	16,619	18,284	20,449	21,781
13,289	14,954	16,619	18,284	20,449	21,781

2028	2029	2030	2031	2032	2033

117%	120%	122%	124%	127%	129%

SCHEDULE JH-R1

15	16	17	18	19	20
2034	**2035**	**2036**	**2037**	**2038**	**2039**
-	-	-	-	-	-
-	-	-	-	-	-

3,800	3,800	3,800	3,800	3,800	3,800
1,164	1,164	1,164	1,164	1,164	1,164
16,818	16,818	16,818	16,818	16,818	16,818
21,781	21,781	21,781	21,781	21,781	21,781
21,781	21,781	21,781	21,781	21,781	21,781

2034	2035	2036	2037	2038	2039

132%	135%	137%	140%	143%	146%

SCHEDULE JH-R1

21	22	23	24	25
2040	**2041**	**2042**	**2043**	**2044**
-	-	-	-	-
-	-	-	-	-

3,800	3,800	3,800	3,800	3,800
1,164	1,164	1,164	1,164	1,164
16,818	16,818	16,818	16,818	16,818
21,781	21,781	21,781	21,781	21,781
21,781	21,781	21,781	21,781	21,781

2040	2041	2042	2043	2044

149%	152%	155%	158%	161%

SCHEDULE JH-R1

26	27	28	29	30
2045	**2046**	**2047**	**2048**	**2049**
-	-	-	-	-
-	-	-	-	-

3,800	3,800	3,800	3,800	3,800
1,164	1,164	1,164	1,164	1,164
16,818	16,818	16,818	16,818	16,818
21,781	21,781	21,781	21,781	21,781
21,781	21,781	21,781	21,781	21,781

2045	2046	2047	2048	2049

164%	167%	171%	174%	178%

SCHEDULE JH-R1

PUBLIC CELLULAR

	Year Count	1	2	3	4
Device Projections	**Current**	**2020**	**2021**	**2022**	**2023**
	Existing Metro Original @12.31.20 (Cell)	3,800			
	Planned Metro DA, Cap Controls, and AMI Take Off Points	133	157	91	366
	Future Metro Communicating FCIs and LMR Radios (Cell)	0	0	0	0
	Cell Sub-Total	3,933	157	91	366
	Existing (Other)	0	0	0	0
	Total Deployment	3,933	157	91	366
	RUNNING TOTALS				
	Existing (Cell)	3,800	3,800	3,800	3,800
	Planned (Cell)	133	289	380	746
	Future (Cell)	-	-	-	-
	Cell Sub-Total	3,933	4,089	4,180	4,546
	Existing (Other)	-	-	-	-
	TOTAL NUMBER OF DEVICES	3,933	4,089	4,180	4,546

COSTS

	ONGOING CAPEX COST	2020	2021	2022	2023
Cap Ex Costs	Modem Replacement (Existing)	$ -	$ -	$ -	$ -
	Modem Replacement (Planned)	$ -	$ -	$ -	$ -
	Modem Replacement (Future)	$ -	$ -	$ -	$ -
	Sub-Total	$ -	$ -	$ -	$ -
	Total CAPEX	$ -	$ -	$ -	$ -
	Present Value ongoing Cap Ex				
	O&M COST	2020	2021	2022	2023

O&M Costs	Existing Wireless Networks				
	Public Cell Payments (Existing)	$ 706,800	$ 706,800	$ 706,800	$ 706,800
	Public Cell Payments (Planned) (avoided O&M)	$ 24,675	$ 53,830	$ 70,710	$ 138,739
	Public Cell Payments (Future) (avoided O&M)	$ -	$ -	$ -	$ -
	Total O&M	$ 731,475	$ 760,630	$ 777,510	$ 845,539
	Total O&M (with escalation)	$ 731,475	$ 775,843	$ 808,921	$ 897,293
	Total O&M (with escalation at PV)	$ 691,308	$ 692,977	$ 682,847	$ 715,853
	Existing + Planned (with escelation)	$ 731,475	$ 775,843	$ 808,921	$ 897,293
	Escalation	100%	102%	104%	106%

5	6	7	8	9	10	11
2024	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
820	1,284	1,194	971	0	0	0
1,665	1,665	1,665	1,665	1,665	1,665	1,665
2,485	2,949	2,859	2,636	1,665	1,665	1,665
0	0	0	0	0	0	0
2,485	2,949	2,859	2,636	1,665	1,665	1,665

3,800	3,800	3,800	3,800	3,800	3,800	3,800
1,565	2,850	4,043	5,014	5,014	5,014	5,014
1,665	3,330	4,995	6,660	8,325	9,990	11,655
7,030	9,980	12,838	15,474	17,139	18,804	20,469
-	-	-	-	-	-	-
7,030	9,980	12,838	15,474	17,139	18,804	20,469

2024	2025	2026	2027	2028	2029	2030
$ -	$ 7,600,000	$ -	$ -	$ -	$ -	$ 7,600,000
$ -	$ 265,320	$ 313,500	$ 181,500	$ 731,500	$ 1,639,000	$ 2,833,820
$ -	$ -	$ -	$ -	$ -	$ 3,330,000	$ 3,330,000
$ -	$ 7,865,320	$ 313,500	$ 181,500	$ 731,500	$ 4,969,000	$ 13,763,820
$ -	$ 8,683,949	$ 353,052	$ 208,486	$ 857,069	$ 5,938,415	$ 16,778,020
	$ 6,188,019	$ 237,764	$ 132,696	$ 515,546	$ 3,375,938	$ 9,014,405
2024	2025	2026	2027	2028	2029	2030

$ 706,800	$ 706,800	$ 706,800	$ 706,800	$ 706,800	$ 706,800	$ 706,800	
$ 291,166	$ 530,037	$ 752,028	$ 932,587	$ 932,587	$ 932,587	$ 932,587	
$ 309,690	$ 619,380	$ 929,070	$ 1,238,760	$ 1,548,450	$ 1,858,140	$ 2,167,830	
$ 1,307,656	$ 1,856,217	$ 2,387,898	$ 2,878,147	$ 3,187,837	$ 3,497,527	$ 3,807,217	
$ 1,415,449	$ 2,049,413	$ 2,689,161	$ 3,306,087	$ 3,735,059	$ 4,179,869	$ 4,640,977	
$ 1,067,226	$ 1,460,373	$ 1,811,021	$ 2,104,231	$ 2,246,721	$ 2,376,220	$ 2,493,479	
$ 1,080,231	$ 1,365,568	$ 1,642,877	$ 1,883,141	$ 1,920,803	$ 1,959,220	$ 1,998,404	
108%	110%	113%	115%	117%	120%	122%	

12	13	14	15	16	17
2031	**2032**	**2033**	**2034**	**2035**	**2036**
0	0	0	0	0	0
1,665	2,165	1,333	0	0	0
1,665	2,165	1,333	-	-	-
0	0	0	0	0	0
1,665	2,165	1,333	-	-	-

3,800	3,800	3,800	3,800	3,800	3,800
5,014	5,014	5,014	5,014	5,014	5,014
13,320	15,485	16,818	16,818	16,818	16,818
22,134	24,299	25,631	25,631	25,631	25,631
-	-	-	-	-	-
22,134	24,299	25,631	25,631	25,631	25,631

2031	2032	2033	2034	2035	2036
$ -	$ -	$ -	$ -	$ 7,600,000	$ -
$ 2,700,500	$ 2,123,000	$ 731,500	$ 1,639,000	$ 2,833,820	$ 2,700,500
$ 3,330,000	$ 3,330,000	$ 3,330,000	$ 6,660,000	$ 6,660,000	$ 6,660,000
$ 6,030,500	$ 5,453,000	$ 4,061,500	$ 8,299,000	$ 17,093,820	$ 9,360,500
$ 7,498,169	$ 6,915,723	$ 5,253,983	$ 10,950,354	$ 23,006,031	$ 12,849,961
$ 3,807,360	$ 3,318,782	$ 2,382,880	$ 4,693,687	$ 9,319,659	$ 4,919,631
2031	2032	2033	2034	2035	2036

SCHEDULE JH-R1

$	706,800	$	706,800	$	706,800	$	706,800	$	706,800	$	706,800
$	932,587	$	932,587	$	932,587	$	932,587	$	932,587	$	932,587
$	2,477,520	$	2,880,210	$	3,128,055	$	3,128,055	$	3,128,055	$	3,128,055
$	4,116,907	$	4,519,597	$	4,767,442	$	4,767,442	$	4,767,442	$	4,767,442
$	5,118,857	$	5,731,942	$	6,167,195	$	6,290,539	$	6,416,350	$	6,544,677
$	2,599,212	$	2,750,698	$	2,797,056	$	2,696,334	$	2,599,240	$	2,505,641
$	2,038,372	$	2,079,139	$	2,120,722	$	2,163,137	$	2,206,399	$	2,250,527
124%		127%		129%		132%		135%		137%	

SCHEDULE JH-R1

18	19	20	21	22	23
2037	**2038**	**2039**	**2040**	**2041**	**2042**
0	0	0	0	0	0
0	0	0	0	0	0
-	-	-	-	-	-
0	0	0	0	0	0
-	-	-	-	-	-

3,800	3,800	3,800	3,800	3,800	3,800
5,014	5,014	5,014	5,014	5,014	5,014
16,818	16,818	16,818	16,818	16,818	16,818
25,631	25,631	25,631	25,631	25,631	25,631
-	-	-	-	-	-
25,631	25,631	25,631	25,631	25,631	25,631

2037	2038	2039	2040	2041	2042
$ -	$ -	$ -	$ 7,600,000	$ -	$ -
$ 2,123,000	$ 731,500	$ 1,639,000	$ 2,833,820	$ 2,700,500	$ 2,123,000
$ 7,660,000	$ 5,995,000	$ 6,660,000	$ 6,660,000	$ 6,660,000	$ 7,660,000
$ 9,783,000	$ 6,726,500	$ 8,299,000	$ 17,093,820	$ 9,360,500	$ 9,783,000
$ 13,698,562	$ 9,607,098	$ 12,090,076	$ 25,400,517	$ 14,187,395	$ 15,124,319
$ 4,956,534	$ 3,285,245	$ 3,907,301	$ 7,758,234	$ 4,095,391	$ 4,126,111
2037	2038	2039	2040	2041	2042

SCHEDULE JH-R1

$	706,800	$	706,800	$	706,800	$	706,800	$	706,800	$	706,800
$	932,587	$	932,587	$	932,587	$	932,587	$	932,587	$	932,587
$	3,128,055	$	3,128,055	$	3,128,055	$	3,128,055	$	3,128,055	$	3,128,055
$	4,767,442	$	4,767,442	$	4,767,442	$	4,767,442	$	4,767,442	$	4,767,442
$	6,675,570	$	6,809,082	$	6,945,263	$	7,084,168	$	7,225,852	$	7,370,369
$	2,415,413	$	2,328,435	$	2,244,588	$	2,163,760	$	2,085,844	$	2,010,733
$	2,295,538	$	2,341,449	$	2,388,278	$	2,436,043	$	2,484,764	$	2,534,459
140%		143%		146%		149%		152%		155%	

SCHEDULE JH-R1

24	25	26	27	28	29
2043	**2044**	**2045**	**2046**	**2047**	**2048**
0	0	0	0	0	0
0	0	0	0	0	0
-	-	-	-	-	-
0	0	0	0	0	0
-	-	-	-	-	-

3,800	3,800	3,800	3,800	3,800	3,800
5,014	5,014	5,014	5,014	5,014	5,014
16,818	16,818	16,818	16,818	16,818	16,818
25,631	25,631	25,631	25,631	25,631	25,631
-	-	-	-	-	-
25,631	25,631	25,631	25,631	25,631	25,631

2043	2044	2045	2046	2047	2048
$ -	$ -	$ 7,600,000	$ -	$ -	$ -
$ 731,500	$ 1,639,000	$ 2,833,820	$ 2,700,500	$ 2,123,000	$ 731,500
$ 5,995,000	$ 6,660,000	$ 6,660,000	$ 6,660,000	$ 7,660,000	$ 5,995,000
$ 6,726,500	$ 8,299,000	$ 17,093,820	$ 9,360,500	$ 9,783,000	$ 6,726,500
$ 10,607,013	$ 13,348,421	$ 28,044,224	$ 15,664,030	$ 16,698,470	$ 11,710,999
$ 2,734,831	$ 3,252,668	$ 6,458,411	$ 3,409,245	$ 3,434,818	$ 2,276,635
2043	2044	2045	2046	2047	2048

SCHEDULE JH-R1

$	706,800	$	706,800	$	706,800	$	706,800	$	706,800	$	706,800
$	932,587	$	932,587	$	932,587	$	932,587	$	932,587	$	932,587
$	3,128,055	$	3,128,055	$	3,128,055	$	3,128,055	$	3,128,055	$	3,128,055
$	4,767,442	$	4,767,442	$	4,767,442	$	4,767,442	$	4,767,442	$	4,767,442
$	7,517,776	$	7,668,132	$	7,821,494	$	7,977,924	$	8,137,483	$	8,300,232
$	1,938,326	$	1,868,527	$	1,801,242	$	1,736,379	$	1,673,852	$	1,613,577
$	2,585,149	$	2,636,852	$	2,689,589	$	2,743,380	$	2,798,248	$	2,854,213
158%		161%		164%		167%		171%		174%	

SCHEDULE JH-R1

2049
0
0
-
0
-

3,800
5,014
16,818
25,631
-
25,631

2049
$ -
$ 1,639,000
$ 6,660,000
$ 8,299,000
$ 14,737,735
$ 2,707,713
2049

SCHEDULE JH-R1

$	706,800
$	932,587
$	3,128,055
$	4,767,442
$	8,466,237
$	1,555,472
$	2,911,297
178%	

Costs				
		Non NPV		NPV
Initial Cap EX Cost	$	173,319,195.00	$	141,855,587.10

Quantified Project Benefits				
Avoided Life Cycle Changeouts (Current+Planed+Future)		Non NPV		NPV
2025-2029	$	16,040,971.00	$	10,449,962.13
2030-2034 (10 year cycle on PLTE)		0		0
2035-2039	$	71,251,727.82	$	26,388,369.82
2040-2044 (10 year Cycle on PLTE)		0		0
2045-2049	$	86,855,458.63	$	18,286,821.54
Avoided Monthly Public Cell O&M Fees				
2025-2049	$	111,720,676.80	$	57,726,585.17
Total Benefits	**$**	**285,868,834.25**	**$**	**112,851,738.65**
Percent of Quantified Beneifts compared to Costs		165%		80%

BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MISSOURI

In the Matter of Union Electric Company	**)**	
d/b/a Ameren Missouri's Tariffs to Adjust	**)**	Case No. ER-2022-0337
Its Revenues for Electric Service.	**)**	

AFFIDAVIT OF JAMES HUSS

STATE OF MISSOURI)
) ss
CITY OF ST. LOUIS)

James Huss, being first duly sworn states:

My name is James Huss and on my oath declare that I am of sound mind and lawful age; that I have prepared the foregoing *Rebuttal Testimony*; and further, under the penalty of perjury, that the same is true and correct to the best of my knowledge and belief.

/s/ James Huss
James Huss

Sworn to me this 15th day of February, 2023.