Exhibit No.:	
Issue(s):	*Variable Fuel*
Witness:	*Shawn E. Lange*
Sponsoring Party:	*MoPSC Staff*
Type of Exhibit:	*Direct Testimony*
Case No.:	*ER-2024-0319*
Date Testimony Prepared:	*December 3, 2024*

MISSOURI PUBLIC SERVICE COMMISSION

INDUSTRY ANALYSIS DIVISION

ENGINEERING ANALYSIS DEPARTMENT

DIRECT TESTIMONY

OF

SHAWN E. LANGE, P.E.

UNION ELECTRIC COMPANY,
d/b/a Ameren Missouri

CASE NO. ER-2024-0319

Jefferson City, Missouri
December 2024

** Denotes Confidential Information **

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Q. Please state your name and business address.

A. My name is Shawn E. Lange and my business address is Missouri Public Service Commission, P.O. Box 360, Jefferson City, MO 65102.

Q. What is your present position with the Missouri Public Service Commission ("Commission")?

A. I am a Senior Professional Engineer in the Engineering Analysis Department, Industry Analysis Division.

Q. Would you please review your educational background and work experience?

A. A list of the cases in which I have filed testimony and my credentials can be found in Schedule SEL-d1.

EXECUTIVE SUMMARY

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to address Staff's calculation of variable fuel and purchased power expense.

Q. In this testimony, do you provide any recommendations for expense levels to be reflected in the revenue requirement ordered in this case?

A. Yes. It is my recommendation that the revenue requirement determined by the Commission in this case should reflect Staff's calculation of variable fuel and purchased power expense, equal to $429,302,299.

Q. In this testimony, do you describe the development of a work product which you provided to another Staff witness for the development of an issue?

A. Yes. I provided the production cost model results to Staff witness Teresa Denny for use in determining the appropriate percentage of transmission expense for Ameren Missouri to recover, and to develop the Staff's recommended Fuel Adjustment Clause Base Factor. I also provided the production cost model results to Staff witness Lisa M. Ferguson to include in the calculation of Staff's revenue requirement.

VARIABLE FUEL AND PURCHASED POWER EXPENSE

Q. What is the purpose of your direct testimony regarding variable fuel and purchased power expense?

A. The purpose of this section of my direct testimony is to describe how Staff calculated its recommended variable fuel and purchased power expense for Ameren Missouri through the use of a production cost model. Staff recommends that the revenue requirement determined by the Commission include a variable fuel and purchased power expense of $429,302,299.

Q. Explain what variable fuel and purchased power expense is and how it affects the Staff calculation of the recommended revenue requirement for Ameren Missouri.

A. Variable fuel and purchased power expense is the net sum of fuel expense, market energy sales revenue, and market energy purchase expenses, as normalized and

annualized amounts. These are the amounts that are reasonably expected to be incurred given the assumptions associated with the fuel model run.

Q. What does Staff recommend concerning the variable fuel and purchased power expense for Ameren Missouri?

A. Staff recommends that the revenue requirement determined by the Commission include the variable fuel and purchased power expense calculated by Staff. Staff's variable fuel and purchased power expense is consistent with Staff's level of load and rate revenues.

Q. What is the purpose of a production cost model?

A. Staff uses a production cost model to perform a simulation of a utility's energy generation, energy sales, and energy purchases. The simulation results are used to calculate the indicated revenues and expenses.

The revenues and expenses calculated from the results of Staff's production cost modeling are:

- The purchase of the fuel necessary to support the generation of electricity at power plants;
- The costs and revenues from the purchases and sales of energy within integrated marketplace; and
- The purchases of energy through purchased power agreements.

Fixed expenses such as those related to the recovery of capital are not included in the results of Staff's production cost model.

Q. What production cost modeling software does Staff use?

A. Staff uses the PLEXOS® software for production cost modeling. This is the fourth time Staff has used the PLEXOS® software for an Ameren Missouri rate case.

Q. What modeling software is Ameren Missouri using?

A. Ameren Missouri uses PowerSimm® software.

Q. What inputs are necessary for Staff's production cost model?

A. Staff's production cost model includes input data developed by multiple Staff witnesses. These include: market prices from Staff witness Justin Tevie, fuel prices from Staff witness Lisa M. Ferguson, and system load from Staff witness Michael L. Stahlman. I developed the remaining inputs: generation from wind farms, planned and forced outages, and power plant characteristics.

Q. How did you adapt the output from wind farms for use in Staff's production cost model?

A. For all wind farms except for High Prairie, historic hourly generation data for each of the wind farms that Ameren Missouri owns or purchases energy from was used to create representative average output profiles unique to each site.

Staff found that a 5 m/s cut-in speed[1] generating shape with no overnight generation during the bat season of April through October, to be most reflective of the 8,760-hour generation shapes available to Staff for the High Prairie Wind Farm. For additional information, please see Staff witness Claire M. Eubanks' direct testimony. This mimics Ameren Missouri's actual operation of High Prairie. Ameren Missouri voluntarily ceased all nighttime operations during the bat season on June 21, 2021.[2]

Q. Is this the same shape Staff used in the prior Ameren Missouri Rate Case (ER-2022-0337)?

[1] Cut-in speed represents the wind speed at which turbine blades begin to rotate and produce electricity.
[2] ER-2022-0337 Claire M. Eubanks Direct Pg. 3 lines 13-14.

A. Yes, Staff used this same method to determine the generation shape used in ER-2022-0337 as well as ER-2024-0319. It should be noted that Ameren Missouri used the same 5 m/s cut in speed generation shape[3] in its determination of the amount of generation modeled in ER-2022-0337.

Q. How were planned and forced outages accounted for in Staff's production cost model?

A. Planned and forced outages are infrequent in occurrence and variable in duration. In order to capture that variability, the outages experienced at each power plant were normalized by averaging seven years of historic data.

Q. How were power plant characteristics for Staff's production cost model derived?

A. Staff relied on Ameren Missouri's responses to data requests and data supplied to comply with 20 CSR 4240-3.190 for inputs relating to each generating unit such as:

- Unit capacity;
- Unit heat rate curve;
- Primary and startup fuels;
- Ramp rates;
- Startup costs; and,
- Variable operating and maintenance expense.

Definitions of the bulleted terms above are included in Schedule SEL-d2.

Q. Do the power plant characteristics change over time?

[3] ER-2022-0337 Surrebuttal and True-Up Direct Testimony of Shawn E. Lange, PE, Pg. 4. Lines 1-12.

A. Yes, there are many reasons why plant characteristics change. Operating hours may cause degradation of equipment; new equipment added may improve performance or perhaps increase auxiliary load; there may be legislation or legal rulings that impact operating characteristics and units retire.

Q. Has legislation impacted the operating characteristics of any Ameren Missouri generating facility?

A. Yes, in September 2021, the Governor of the State of Illinois signed into law the Climate and Equitable Jobs Act ("CEJA"). Provisions of this Act limit the level of emissions that a specific generating unit can produce over any rolling 12-month period of time to no more than the annual average for that same emission, produced by that same unit, over calendar years 2018-2020.

Q. What facilities are impacted by this legislation?

A. The Ameren Missouri facilities physically located in Illinois are the Venice Energy Center (489 MW), the Raccoon Creek Energy Center (308 MW), Pinckneyville Energy Center (316 MW), Goose Creek Energy Center (444 MW), and the Kinmudy Energy Center (210 MW).

Q. How are these units modeled?

A. The emissions are directly correlated with unit output; therefore, Staff imposed generation limits based on the annual average for the 2018-2020 time period that was used to establish the CEJA limits.

Q. Does Ameren Missouri have units that have retired or are not expected to be operational when new rates go into effect from this case?

A. Yes. The Rush Island Energy Center is no longer in operation as of October 15, 2024. Ameren Missouri was ordered by the U.S. District Court of Eastern Missouri to terminate operation of the Rush Island units no later than October 15, 2024.[4] The Rush Island Energy Center was previously designated by MISO as a System Support Resource ("SSR") through October 15, 2024. Staff, in its variable fuel and purchase power expense calculation, removed Rush Island 1 and Rush Island 2 from the production cost model.

Q. Was any other generating unit removed or not included in Staff's production cost model that was included in Ameren Missouri's last rate case (ER-2022-0337)?

A. Yes, even though it is a contracted unit, the contract with the owners of Pioneer Prairie wind farm expired on or around June 2024. Staff did not include that generation facility in its production cost model in this case.

Q. What are the industry best practices related to the calculation of variable fuel and purchased power expenses?

A. Production cost modeling software is widely used throughout the electric power industry in the United States and throughout the world for the calculation of variable fuel and purchased power expenses. Similar software is used by electric utilities, regional transmission operators, regulatory agencies, universities, and research laboratories for evaluating the costs related to the generation, transmission, and consumption of electricity. The use of modeling software allows for the calculation of the lowest cost method by which customer needs can be satisfied while considering a given utility's generating resources, load requirements, and other constraints.

[4] September 30, 2023 Order in Case No. 4:11 CV 77 RWS.

Q. What is the recommended variable fuel and purchased power expense that resulted from Staff's production cost modeling?

A. Staff calculated that the variable fuel and purchased power expense for Ameren Missouri for test year as updated, the 12-month period ending June 30, 2024, to be $429,302,299. The revenue requirement determined by the Commission should reflect Staff's calculation of variable fuel and purchased power expense.

VIRTUAL TRANSACTIONS AND REAL TIME DEVIATION ADJUSTMENTS

Q. Are you sponsoring any other adjustments associated with fuel expense?

A. Yes, I am sponsoring a normalized adjustment amount for Virtual Transactions and Real-time Deviations.

Q. What are Virtual Transactions?

A. Virtual transactions may be used by Market Participants to hedge energy settlement exposure between the MISO Day-Ahead energy market settlement and the MISO Real-time energy market settlement. Ameren Missouri uses this almost exclusively for Taum Sauk operation, to align the Real-time market exposure associated with pumping with the Day-Ahead market settlement.

Q. What are real-time deviation adjustments?

A. The real-time load and generation deviation adjustment is intended to capture the difference in dollars between the production cost model (which looks at day-ahead) and the operation of the MISO market, which has both a day ahead and real-time component.

Q. How did Staff determine the level of adjustment?

A. Typically to determine the normal level of for Virtual Transactions and real time deviation, Staff uses a three-year monthly average. In February 2021, Winter Storm Uri

affected the region with cold weather, causing increased electricity demand and natural gas demand, which increased the prices of electricity and natural gas. For further explanation of the effects of Winter Storm Uri please see Staff's report in AO-2021-0264. A large portion of 2022 was impacted by the war in the Ukraine as well as railroad issues. Staff made adjustments to normalize the market effects caused by Winter Storm Uri as well as the issues impacting 2022 to the bilateral transactions, financial swaps, and real-time deviation adjustments following the same method as outlined in Staff witness Justin Tevie's direct testimony section on Market Prices. Staff will update these recommendations with the True-up data Ameren Missouri provides to Staff.

Q. What are the recommended adjustments for Virtual Transactions and Real-time Deviations?

A. Staff made three adjustments outside the production cost model to account for revenues earned from Virtual Transactions and real time load and generation deviation adjustment. Virtual transactions and real time deviation of ** [redacted] ** should be utilized for these adjustments.

Q. Will Staff reevaluate these adjustments at true-up?

A. Yes, for true-up Staff will take into consideration all known and measurable changes in its true-up filing.

Q. Have you prepared an estimate of the revenue and generation associated with a normalized test year of production for the Huck Finn, Cass County, and Boomtown solar facilities?

A. Yes. For the limited purposes of estimating the net impact of these facilities in Staff's allowance for known and measurable changes, I have relied upon the Ameren Missouri

generation shape and Staff's energy prices. Consistent with the testimony of Brodrick Niemeier, Staff will include in its true-up testimony in this matter a review of whether these facilities have satisfied applicable criteria for determination that they are useful for service.

Q. Does this conclude your direct testimony?

A. Yes, it does.

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 Its Revenues for Electric Service	)))	Case No. ER-2024-0319

AFFIDAVIT OF SHAWN E. LANGE, PE

STATE OF MISSOURI	)	
	)	ss.
COUNTY OF COLE	)	

COMES NOW SHAWN E. LANGE, PE and on his oath declares that he is of sound mind and lawful age; that he contributed to the foregoing *Direct Testimony of Shawn E. Lange, PE*; and that the same is true and correct according to his best knowledge and belief.

Further the Affiant sayeth not.

Shawn E. Lange

SHAWN E. LANGE, PE

JURAT

Subscribed and sworn before me, a duly constituted and authorized Notary Public, in and for the County of Cole, State of Missouri, at my office in Jefferson City, on this 25th day of November 2024.

D. SUZIE MANKIN
Notary Public - Notary Seal
State of Missouri
Commissioned for Cole County
My Commission Expires: April 04, 2025
Commission Number: 12412070

D Suzie Mankin

Notary Public

CREDENTIALS AND CASE PARTICIPATION OF SHAWN E. LANGE, PE

PRESENT POSITION:

I am a Professional Engineer in the Engineering Analysis Department, Industry Analysis Division, of the Missouri Public Service Commission.

EDUCATIONAL BACKGROUND AND WORK EXPERIENCE:

In December 2002, I received a Bachelor of Science Degree in Mechanical Engineering from the University of Missouri, at Rolla now known as the Missouri University of Science and Technology. I joined the Commission Staff in January 2005. I am a registered Professional Engineer in the State of Missouri and my license number is 2018000230.

TESTIMONY FILED:

Case Number	Utility	Testimony	Issue
ER-2005-0436	Aquila Inc.	Direct	Weather Normalization
		Rebuttal	Weather Normalization
		Surrebuttal	Weather Normalization
ER-2006-0314	Kansas City Power & Light Company	Direct	Weather Normalization
		Rebuttal	Weather Normalization
ER-2006-0315	Empire District Electric Company	Direct	Weather Normalization
		Surrebuttal	Weather Normalization
ER-2007-0002	Union Electric Company d/b/a AmerenUE	Direct	Weather Normalization
ER-2007-0004	Aquila Inc.	Direct	Weather Normalization
ER-2007-0291	Kansas City Power & Light Company	Staff Report	Weather Normalization
		Rebuttal	Weather Normalization
ER-2008-0093	Empire District Electric Company	Staff Report	Weather Normalization
ER-2008-0318	Union Electric Company d/b/a AmerenUE	Staff Report	Weather Normalization

Case Number	Utility	Testimony	Issue
ER-2009-0089	Kansas City Power & Light Company	Staff Report	Net System Input
ER-2009-0090	KCP&L Greater Missouri Operations Company	Staff Report	Net System Input
ER-2010-0036	Union Electric Company d/b/a AmerenUE	Staff Report	Net System Input
ER-2010-0130	Empire District Electric Company	Staff Report	Variable Fuel Costs
		Surrebuttal	Variable Fuel Costs
ER-2010-0355	Kansas City Power & Light Company	Staff Report	Variable Fuel Costs
ER-2010-0356	KCP&L Greater Missouri Operations Company	Staff Report	Engineering Review-Sibley 3 SCR
ER-2011-0004	Empire District Electric Company	Staff Report	Variable Fuel Costs
ER-2011-0028	Union Electric Company d/b/a Ameren Missouri	Staff Report	Net System Input
ER-2012-0166	Union Electric Company d/b/a Ameren Missouri	Staff Report	Weather Normalization
		Surrebuttal	Weather Normalization Maryland Heights In-Service
ER-2012-0174	Kansas City Power & Light Company	Staff Report	Weather Normalization Net System Input Variable Fuel Costs
		Surrebuttal	Weather Normalization
ER-2012-0175	KCP&L Greater Missouri Operations Company	Staff Report	Weather Normalization Net System Input
		Surrebuttal	Weather Normalization
ER-2012-0345	Empire District Electric Company	Rebuttal	Interim Rates
		Staff Report	Weather Normalization
EC-2014-0223	Noranda Aluminum v. Ameren Missouri	Rebuttal	Weather Normalization
EA-2014-0207	Grain Belt Express CCN	Rebuttal	Certificates of Convenience/Feasibility Analysis
		Surrebuttal	

Case Number	Utility	Testimony	Issue
ER-2014-0258	Union Electric Company d/b/a Ameren Missouri	Staff Report	Net System Input Variable Fuel Costs
ER-2014-0351	Empire District Electric Company	Staff Report	Net System Input Variable Fuel Costs
ER-2014-0370	Kansas City Power & Light Company	Staff Report	Net System Input Variable Fuel Costs
		True-up Direct	Variable Fuel Costs La Cygne In-service
EA-2015-0146	ATXI CCN	Rebuttal	Certificates of Convenience/Feasibility Analysis
		Surrebuttal	
ER-2016-0023	Empire District Electric Company	Staff Report	Net System Input Variable Fuel Costs
		Surrebuttal	Variable Fuel Costs
ER-2016-0179	Union Electric Company d/b/a Ameren Missouri	Staff Report	Variable Fuel Costs
EA-2016-0385	Grain Belt Express CCN	Rebuttal	Certificates of Convenience/Feasibility Analysis
		Surrebuttal	
ER-2018-0145	Kansas City Power & Light Company	Staff Report	Variable Fuel Costs Market Prices
		Rebuttal	Variable Fuel Costs Market Prices
		True-up Direct	Variable Fuel Costs Market Prices
EA-2018-0327	ATXI CCN	Rebuttal	Certificates of Convenience/Feasibility Analysis
EA-2019-0021	Ameren CCN	Staff Report	Certificates of Convenience/Feasibility Analysis
EA-2019-0010	Empire District Electric Company CCN	Staff Report	Certificates of Convenience/Feasibility Analysis
EC-2020-0408	MLA v. Grain Belt Complaint	Staff Recommendation	Formal Complaint
EA-2021-0167	ATXI CCN	Staff Recommendation	Certificates of Convenience/Feasibility Analysis

Case Number	Utility	Testimony	Issue
EA-2021-0087	ATXI CCN	Staff Report	Certificates of Convenience/Feasibility Analysis
ER-2021-0240	Union Electric Company d/b/a Ameren Missouri	Staff Report	Variable Fuel Costs Atchison wind farm Construction Audit and in-service review
		Rebuttal	Atchison in-service and Variable Fuel Costs
		True-up Direct	Variable Fuel Costs
ER-2021-0312	Empire District Electric Company	Staff Report	Transmission and Distribution Investment
EA-2022-0043	Evergy Metro and Evergy West Hawthorn Solar CCN	Staff Report	Certificates of Convenience/Feasibility Analysis
EA-2022-0099	ATXI CCN	Staff Direct Testimony	Certificates of Convenience/Feasibility Analysis
EA-2022-0244	Union Electric Company d/b/a Ameren Missouri	Staff Report	Certificates of Convenience/Feasibility Analysis
EA-2022-0245	Union Electric Company d/b/a Ameren Missouri	Staff Rebuttal Testimony	Certificates of Convenience/Feasibility Analysis
ER-2022-0337	Union Electric Company d/b/a Ameren Missouri	Direct Testimony	Variable fuel Costs
		Rebuttal Testimony	Variable fuel Costs
		Surrebuttal/True-up Direct	Variable fuel Costs
		True-up Rebuttal	Variable fuel Costs
EA-2022-0328	Evergy West	Staff Rebuttal Testimony	Certificates of Convenience/Feasibility Analysis
EA-2023-0017	GrainBelt Express	Staff Rebuttal Testimony	Certificates of Convenience/Feasibility Analysis

Case Number	Utility	Testimony	Issue
EA-2023-0226	Ameren Missouri	Staff Memo	Certificates of Convenience/Feasibility Analysis
ET-2023-0249	Ameren Missouri	Staff Memo	Cogeneration and Net Metering rate
EA-2024-0286	Ameren Missouri	Rebuttal Testimony	Certificates of Convenience/Feasibility Analysis
EF-2024-0021	Ameren Missouri	Rebuttal	Financing Order Authorizing the Issue of Securitized Utility Tariff Bonds
ER-2024-0189	Evergy Missouri West	Rebuttal	Variable Fuel Cost
EA-2024-0237	Ameren Missouri	Staff Memo/Report	Certificates of Convenience/Feasibility Analysis

Definitions

Unit capacity:

The maximum capacity of a power plant is equal to its maximum level of energy output in megawatts (MW).

Unit heat rate curve:

The heat rate of a power plant, typically measured in BTU/kWh, is a measure of efficiency. It shows how much energy from the fuel consumed by the power plant is required to generate one kWh of electricity. The larger the magnitude of the heat rate, the less efficient a power plant is.

Primary and startup fuels:

A power plant's primary fuel is the main source of energy that it uses to generate electricity. For example, a coal-fired power plant will have coal as its primary fuel. This is distinct from startup fuel which may be used sparingly during limited periods of time while the power plant is being started. Fuel oil might be used as a startup fuel while a coal plant is being started. Once a certain power level is achieved, the startup fuel will stop being used, and the power plant will operate solely on it primary fuel.

Ramp rates:

Ramp rates describe how quickly a power plant can change its output power level and are typically given in units of megawatts per hour or megawatts per minute. Large coal or nuclear power plants have lower ramp rates than smaller natural gas-fired combustion turbines.

Startup costs:

Startup costs are the operations and maintenance costs associated with the startup of a power plant. The magnitude of startup costs can influence how a power plant is dispatched within a market. All other factors being equal, high startup costs would tend to make a power plant less likely to be dispatched in a given situation.

Variable operating and maintenance expense:

Variable operations and maintenance expenses ("VOM") are a part of the incremental cost of running a power plant. They represent the costs related to the equipment replacement and servicing that are necessarily incurred by the wear and tear that occurs when a power plant operates. These costs are measured in dollars per megawatt-hour ($/MWh) and will affect the price at which energy from a power plant is offered into the market. All other factors being equal, high VOM costs would tend to make a power plant less likely to be dispatched in a given situation.