Chapter 10 - Appendix D

Other Implementation Analysis

10D.1 Gas Price Volatility Analysis

Introduction

To assess potential impacts of gas price volatility during extreme weather events, Ameren Missouri has analyzed the potential costs to customers that may result from an extreme winter weather event similar to those seen in the past couple of years.[1] The evaluation includes two key aspects:

- An evaluation of the feasibility and cost of fully firm gas supply contracts for existing and planned gas plants.
- An evaluation of rate and bill impacts to customers, taking into account any reduction in the risk of gas price volatility due to existing futures contracts.

The Company assessed these two key aspects separately for existing and planned simple cycle natural gas combustion turbine generators (CTG) and planned combined cycle natural gas combustion turbine generators (NGCC or CC)

Feasibility and Cost of Firm Gas Supply Contracts - CTG

For CTGs, Ameren Missouri concludes that 'fully firm gas supply contracts' is not a feasible option. Assuming that each pipeline has, or could develop, enough Firm Transportation (FT) capacity to supply our CTG fleet, there are other pipeline tariff restrictions that conflict with Midcontinent Independent System Operator (MISO) utilization of our CTG fleet during extreme winter weather events. During extreme winter weather events, we typically see the pipelines take the following actions:

1. Curtail all schedules utilizing Interruptible Transport (IT).
2. Require all shippers to adhere to tariff provisions requiring ratable flows.

The ratability provision generally requires Ameren Missouri's CTGs to be made unavailable. Even on critical winter days, MISO does not commit our CTG fleet for a full 24-hour operation. Generally, MISO would prefer to commit the CTG fleet for winter morning and evening peaks. Since this gas flow would conflict with the pipeline's ratability requirements, the CTGs become unavailable. As a result, they are immune to natural gas price volatility because they simply would not operate.

[1] Winter Storm Uri in February 2021 and Winter Storm Elliott in December 2022.

One exception is for any existing or planned CTGs that are capable of firing on dual fuels. During critical winter weather events, any CTGs capable of firing on fuel-oil will remain available to MISO. Since the fuel-oil will have been previously bought and stored in tanks onsite, the units should not be exposed to any fuel-oil price volatility during the weather event in this case, either. However, such units could benefit from any related increase in the market price arising from volatile natural gas prices. This value has not been included in the customer rate impact calculations.

Feasibility and Cost of Firm Gas Supply Contracts - NGCC

The NGCC project differs from the CTG fleet, in that it would have 'fully firm gas supply contracts'. The fuel arrangements for the CC would be to have pipeline FT contracts back to a major supply basin. Assuming Ameren Missouri's preferred location for a new NGCC project is at Sioux Energy Center, this means Ameren Missouri would contract for FT on Spire STL, and for FT on Rockies Express (REX) back to a supply basin.

With this firm pipeline transport investment, Ameren Missouri would also seek to source firm natural gas supply. A logical approach would be to buy monthly baseload gas for an amount equivalent to the expected capacity factor for the NGCC units. In a winter month, it is prudent to assume that the CC would have a modeled 70% capacity factor. With the CC assumed to be a 1,200 MW unit, the site could potentially consume 185,000 MMBtu/day – based on reasonable heat rate expectations.

If baseload gas purchases match expected capacity factors, then Ameren Missouri would have bought 70% of the 185,000 daily max requirements at the stable monthly gas price, thus avoiding the daily price volatility of the extreme weather event. However, Ameren Missouri would be exposed to the volatile daily gas price for 30% of that daily 185,000 volume, or 55,500 MMBtu per day. Looking to Winter storms Uri and Elliott, each storm had an approximate 5-day impact. 55,500 MMBtu/day times 5 days equals, 277,500 MMBtu with volatile price exposure.

Volatility of gas prices: During Winter storm Uri and Elliott, the highest reported daily gas price for REX zone 4 was $65/MMBtu. This was escalated from what was normally a $3 gas price pre-storm.

Customer Rate Impact - NGCC

For purposes of calculating potential rate impact, Ameren Missouri has assumed that any differences in net fuel cost are recovered through the Company's fuel adjustment clause (FAC), including application of the existing 95/5 sharing mechanism by which customers incur 95% of any changes in net fuel cost. For purposes of determining market revenue for generation, Ameren Missouri has assumed normal operation of the NGCC unit in the MISO market, including application of the make-whole provisions of the MISO Energy and Ancillary market. It was also assumed that the Company has the opportunity to buy gas

on a daily basis. This means that the Company would not buy daily gas for first two days of the weather event. Note that if the NGCC unit does not clear on Day 1 and 2, then the Company would have the opportunity to arbitrage the $3 baseload gas that was bought in advance by selling it into the $65 daily gas market. This potential sales revenue has not been included.

Based on the assumptions described above, the analysis shows that incremental fuel costs borne by customers would be approximately $9.4 million, and incremental market revenues of $18.9 million would be credited to customers. The net impact to customers would thus be a net benefit of $9.5 million.

10D.2 Battery Storage at Retired Coal Generation Sites

Introduction

Ameren Missouri completed a preliminary review of the Meramec and Rush Island Energy Centers to determine the amount of battery storage each site could support based on available acreage, and to estimate the potential costs associated with said installation. Separately, the Company also completed preliminary modeling for a 200 MW lithium-ion storage facility, which reflects the likely size of a battery energy storage system (BESS) that could be placed at either Meramec or Rush Island prior to 2030 based on system resource and reliability needs. The modeling estimates expected rate base, revenue requirement, tax credit value, and levelized cost of storage for two lithium-ion battery chemistries under four different Inflation Reduction Act tax incentive scenarios:

1. No Investment Tax Credit
2. Investment Tax Credit
3. Investment Tax Credit with Energy Community Adder
4. Investment Tax Credit with Energy Community Adder and Loan Program Office Loan Benefit

At this time, Ameren Missouri expects that a BESS located at either Meramec or Rush Island would qualify for the investment tax credit with the energy community adder (scenario 3). Please note that current modeling does not include expected market revenues for the BESS installations and is not reflective of the full costs to complete a BESS installation (such as demolition costs for existing structures, interconnection upgrades, and internal and external project development costs). Such revenues and more complete cost estimates will be incorporated into future modeling iterations.

The opportunity to utilize retired coal power plant sites for battery energy storage systems (BESS) was examined. The goal of this preliminary analysis was to determine the amount of battery storage each site can support based on available acreage, and estimate the potential costs associated with said installation. This assessment was a very preliminary

review, and therefore, the data and conclusions included in this discussion should not be used for decision-making purposes. Further detailed studies are required before proceeding with specific BESS projects. This document serves as a brief overview of our findings.

Assumptions

In the assessment, several foundational assumptions were made. It was presumed that all existing buildings, water treatment facilities, storage spaces, and generators currently existing at the sites would be demolished. New power lines and step-up transformers would be needed in addition to the new battery systems. With respect to the physical layout at each site, we made use of satellite maps to avoid existing ash ponds and other obstacles. Although a formal civil review has not been performed to determine the precise boundaries of these ash ponds and other potential obstructions, we stayed within the white boundaries indicated by the satellite maps.

As this is a high-level evaluation of these sites, there are many aspects that were not considered and would need further investigation prior to project approval and initiation. These items include, but are not limited to permitting, flood plain mitigation, internal costs, market data, interconnection upgrades, MISO filings, detailed engineering studies, raw material pricing, supply chain impacts, and other risks associated with BESS projects. Therefore, the layouts and pricing are only for preliminary evaluation purposes as Ameren continues to explore locations for BESS projects.

Pricing

Pricing information was developed in a 2023 Roland Berger study performed in collaboration with Ameren, which evaluated industry-wide BESS project costs covering several battery technologies. In addition, pricing information was provided by Florida Power & Light (FPL) for their Manatee battery storage site, which went online in 2021. It is worth noting that FPL utilized nickel manganese cobalt (NMC) batteries, but lithium iron phosphate (LFP) batteries are the most likely candidate for future battery storage projects. The FPL Manatee project data offered insights into real-world pricing, inverter size, battery capacity, and other relevant details. Leveraging this, we crafted our own battery layout blocks to create a standardized footprint and pricing based on our own substation design standards. The data from FPL aligned closely with figures from a budgetary quote by an equipment supplier, NREL data, and the Roland Berger data in terms of $/kWh and MWh/acre. We settled on the most recent LFP cost estimate developed by Roland Berger of $279/kWh, as illustrated below in Table 10D.1.

Site Layout

For the layout configuration, we adopted the same container size as employed by FPL. However, our assumed container spacing adheres to the standards set by Ameren

Missouri Substation Design. We aimed for a 4-hour battery system and consequently designed 81.6MW/326.4MWh blocks to be mapped onto satellite imagery at each specific location. This configuration results in a density of 61.8MWh/acre (calculated from 326.4MWh divided by 5.28 acres per block). This density surpasses FPL's specification of 48MWh/acre. This increase is attributed to advances in equipment sizing and enhancements in battery containerization but may not be achievable in a real-world project due to other siting considerations as mentioned above. While assumed placement avoided ash ponds, we did assume placement of equipment over the locations of existing structures, as these would be slated for demolition.

Site-Specific Considerations

At the Meramec and Rush Island sites, there would be required interconnection upgrades. Actual interconnection requirements would be determined upon completion of a MISO interconnection study. For Rush Island, we limited the addition of battery systems during the layout phase even though there is still usable acreage, as the available land is of such great size that it would not be reasonable to fill the available land with additional batteries. Neither site was evaluated for flood exposure, which could greatly impact the design or available space.

Results and Conclusion

Table 10.D1 below summarizes the results of the assessment, including detailing the maximum sizing and associated costs developed. This assessment provides an overview of the possibilities of repurposing the Meramec and Rush Island Energy Centers for battery energy storage. The data and conclusions included below should not be used for decision-making purposes, and further detailed studies are required before proceeding with specific BESS projects.

Table 10D.1 Forecasted Potential Solar Resources (2025$)

Point of Interconnection	**Meramec**	**Rush Island**
Interconnection Voltage	138 kV	345 kV
Acreage Available (avoiding coal ash)	86 acres	127 acres
Design MWh	979 MW - 3,917 MWh	1,142 MW - 4,570 MWh
Design Cost (Million $) ($279/kWh)	$1,093	$1,275