Response to the Concerns of The Missouri Office of the Public Counsel from the 2022 Integrated Resource Plan (File No. EO-2021-0331)

Filed in the 2023 IRP Annual Update

File No. EO-2023-0294

The Empire District Electric Company

d/b/a Liberty

March 2023

Liberty – The Empire District Electric Company
("Liberty-Empire" or the "Company")

This is the response to the concerns of the Missouri Office of the Public Counsel ("OPC") from the Liberty-Empire 2022 Integrated Resource Plan ("IRP") (File No. EO-2021-0331), based on the Joint Agreement filed by the parties on November 3, 2022.

1. OPC Hourly Reliability Concern Modeling

OPC staff identified three concerns related to how reliability was addressed in the modeling of the 2022 IRP:

- OPC Concern #1: Liberty-Empire did not properly evaluate its ability to provide reliable service.
- OPC Concern #2: Liberty-Empire did not evaluate the risk of Southwest Power Pool ("SPP") market volatility.
- OPC Concern #3: Algonquin's goal of net-zero by 2050 has improperly guided Liberty-Empire's Resource Planning Process.

OPC and Liberty-Empire agreed that the joint resolution set forth below will remedy these three concerns. Liberty-Empire will include a full analysis of unserved hours (number of hours and cost) for each plan modeled with a restriction of Southwest Power Pool ("SPP") energy available to 10% or less of Liberty-Empire's annual peak in its next triennial IRP filing.

As a near-term remedy, Liberty-Empire developed an estimate of the number of hours that might have been unserved by Liberty-Empire's resources *under potential assumptions where purchases from the SPP market were limited or completely unavailable* through a review of hourly reports from the model runs completed as part of its 2022 IRP:

- For plans 1, 3, 7, 8, 11, and 12;
- for years 1, 3, 5, and 15; and
- under the following conditions for all of the uncertain factors that Liberty-Empire determined were critical (load, cost of new builds, natural gas prices, and emission price/carbon pressure):
    - base for all factors;
    - high for all factors; and
    - low for all factors.

The following outputs were produced:

- Number of hours where market purchases exceed 110 MW; and
- Number of hours when Liberty-Empire load exceeded available Liberty-Empire resources in that hour taking into account the modeled forced and planned outages and availability of wind and solar generation. In other words, the available resources were not assumed to be the same for every hour, but were varied according to expected resource availability on an hourly basis

CRA performed the analysis per the OPC request with years 2022, 2024, 2026 and 2036 representative of years 1, 3, 5, and 15.

The results are summarized below:

Table 1.1- Number of Hours with Liberty-Empire Market Purchases Exceeding 110 MW by Plan

Case:	**Base Conditions**					
	1	**3**	**7**	**8**	**11**	**12**
2022	905	910	913	913	913	913
2024	908	913	918	918	918	918
2026	1,052	1,064	1,065	1,065	1,065	1,065
2036	1,461	1,536	1,079	1,166	1,166	1,166

Case:	High Conditions					
	1	3	7	8	11	12
2022	801	801	803	803	803	803
2024	1,016	1,023	1,028	1,028	1,028	1,028
2026	1,377	1,401	1,415	1,415	1,415	1,415
2036	3,506	3,660	2,907	3,158	3,158	3,158

Case:	Low Conditions					
	1	3	7	8	11	12
2022	906	907	911	911	911	911
2024	905	908	909	909	909	909
2026	907	929	935	935	935	935
2036	1,405	1,470	1,001	1,082	1,082	1,082

Table 1.2- Number of Hours Portfolio with Liberty-Empire Demand Exceeding Portfolio Resource Capability by Plan

Case:	Base Conditions					
	1	3	7	8	11	12
2022	28	28	28	28	28	28
2024	25	25	25	25	25	25
2026	40	40	40	40	40	40
2036	18	21	19	21	21	21

Case:	High Conditions					
	1	3	7	8	11	12
2022	32	32	32	32	32	32
2024	26	26	26	26	26	26
2026	53	53	53	53	53	53
2036	42	56	35	42	42	42

Case:	Low Conditions					
	1	3	7	8	11	12
2022	27	27	27	27	27	27
2024	21	21	21	21	21	21
2026	31	31	31	31	31	31
2036	15	15	10	12	12	12

Across the range of conditions evaluated, hours where purchases exceeded 110 MW ranged from 801 to 3,660 during a given year, or 9% to 42% of the time. These occurrences increase with time, beginning with 801-913 hours per year, or 9-10% of the time, in 2022, and reaching 1,001-3,660 hours per year, or 11% to 42% of the time in 2036. Significant

levels of market purchases do not imply that Liberty-Empire faces significant reliability risk. Instead, it is an indicator that purchasing from the SPP market is expected to offer lower costs for customers than operating some of Liberty-Empire's peaking resources during certain times of the year and for certain hours of the day.

Occurrences of purchases above 110 MW are expected to increase over time more so in Plans 1 and 3 which have a higher reliance on gas and less renewable generation. This observation can be explained in large part by the substantial energy output associated with accredited solar capacity additions under Plans 7, 8, 11, and 12, whereas Plans 1 and 3 produce lower levels of energy from gas generators per unit of accredited capacity, resulting in higher purchases. In other words, the capacity factors of the gas additions are expected to be lower than those of the renewable additions on an accredited capacity basis as a result of their expected economic dispatch within the wider SPP market.

The higher and lower load conditions generally resulted in higher and lower hours of market purchases that exceeded 110 MW, respectively, although there is less variance across the Plans within the same market condition. The exception being the 2036 period where the gas-based Plans (1 and 3) relied more on market purchases to meet load than the renewable focused cases. This suggests that in the long-term, market prices will often be below the marginal cost of generation for the fossil resources in the portfolio, resulting in more instances of market purchases above 110 MW.

Hours where portfolio demand exceeded portfolio resource capability ranged from 10 to 56 hours during a given year, or 0.1% to 0.6% of the time. The trend over time is not as clear for capability shortfall as it is with purchases. Although hours with capability shortfall increase by 2026, this trend reverses with lower levels of capability shortfall by 2036. The replacement of the Energy Center 1 and 2 units in 2035 improves the portfolio's expected capability position over the long-term as a result of modeled maintenance assumptions (as described in more detail below).

CRA examined the results for the resource capability to determine the underlying cause of the hours where portfolio capability was short of demand and observed that the majority of these occurred during April:

Table 1.3- Number of Hours of Output Capability Shortage by Month and by Plan - Base Case 2036

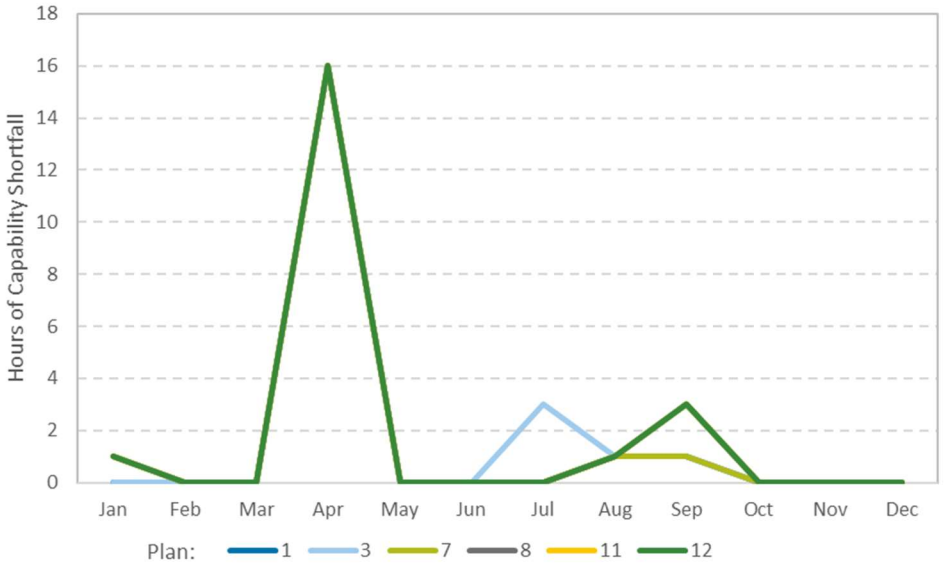


Table 1.4- Number of Hours of Output Capability Shortage by Month and by Plan - High Case 2036

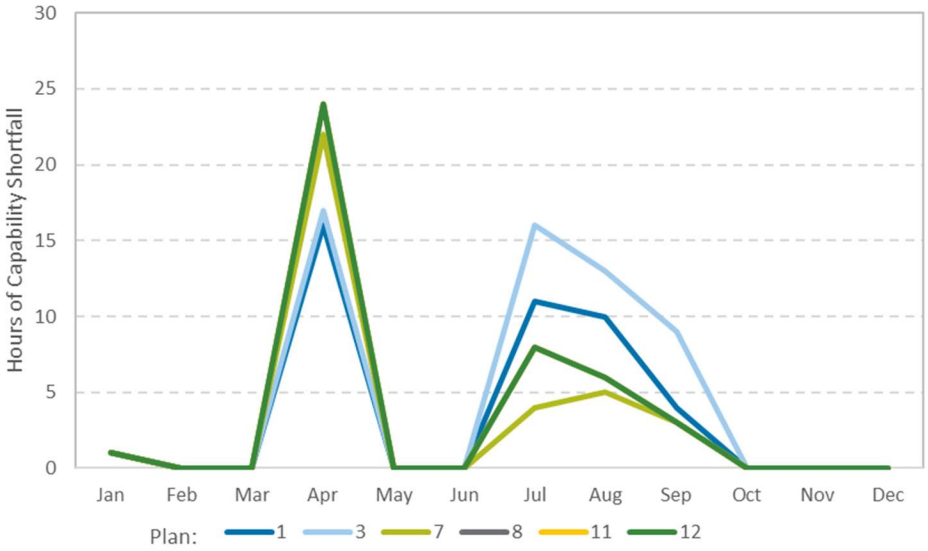
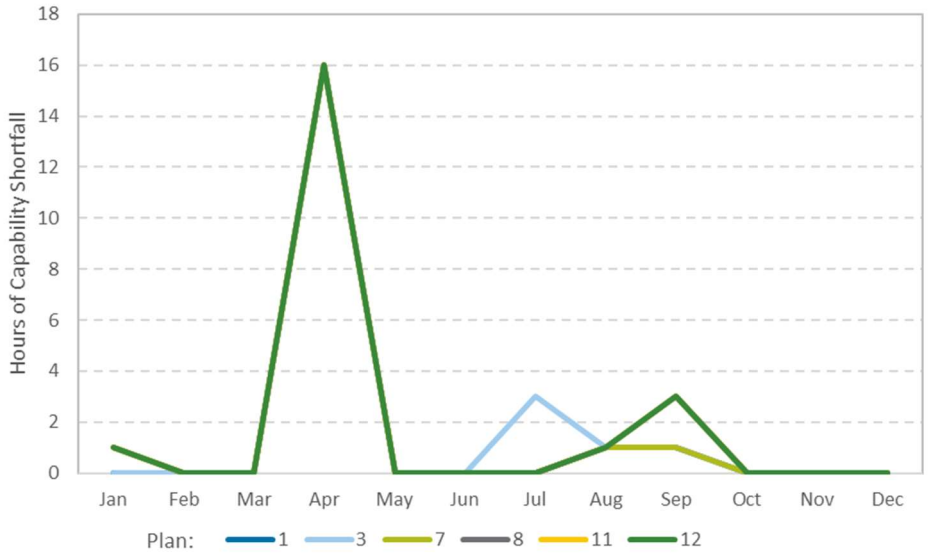


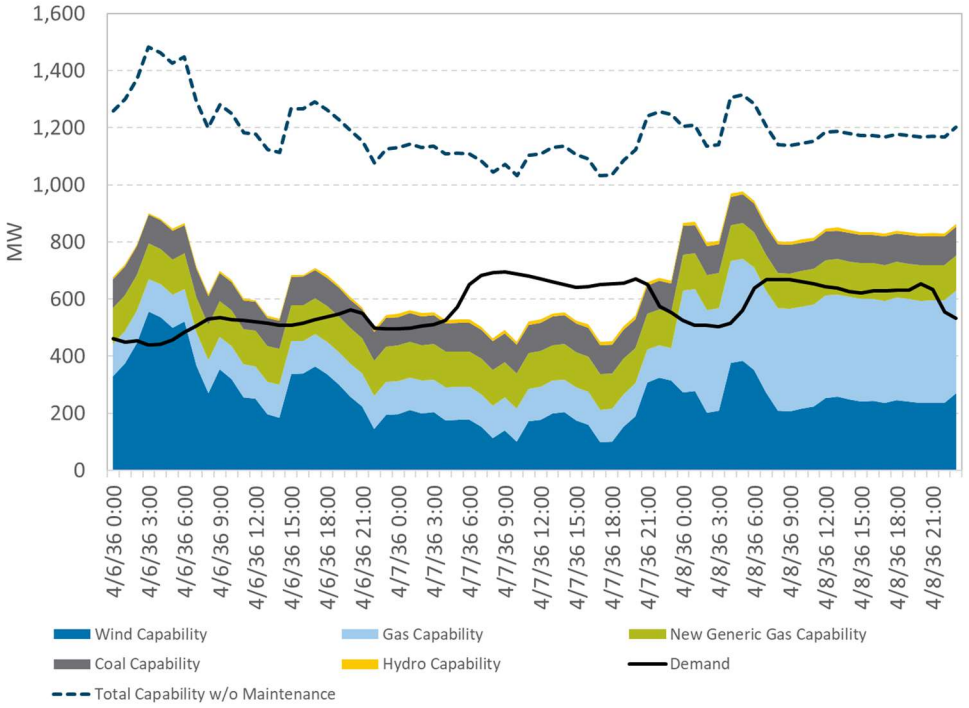
Table 1.5- Number of Hours of Output Capability Shortage by Month and by Plan - Low Case 2036



The shortfall concentration in April is driven by scheduled maintenance of the major Liberty-Empire fossil generators (Stateline, Plum Point, Riverton) during this time. April is a low demand month where the abundance of market energy allows the portfolio to still meet demand in spite of the resource capability shortfall due to maintenance events. The

figure below shows a sample of this dynamic for Plan 3 during a day in April of 2036, suggesting that if Liberty-Empire operated without access to the wider SPP market, maintenance schedules could be adjusted to ensure sufficient resource availability throughout this month.

Table 1.6- Plan 3 Capability Balance for April 2036



There are also instances with resource capability shortfalls during the summer months, particularly in the High load case. The gas-focused Plans (1 and 3) show the highest shortage hours during summer, while the renewable and storage-focused Plans perform relatively better. The substantial solar output of the renewable-focused Plans is well aligned to the natural peak hours during late afternoons, allowing the system to mitigate shortfalls during those times.

Overall, given the strong interconnection of the Liberty-Empire system with the rest of SPP and broader Eastern Interconnect, economic imports exceeding 10% of peak load during less than half of the time and demand exceeding internal capability during less

than 1% of the time (without further optimization of maintenance schedules) represent a fairly low reliability risk to the Liberty-Empire system.