Chapter 5 - Appendix A

Fatal Flaw Analysis – Energy Storage Technologies

Description	Fatal Flaw
Pumped Hydro Energy Storage	✓
Compressed Air Energy Storage (CAES)	✓
Hydrogen Storage/Fuel Cell Generation	✗
Thermal or Pumped Heat Energy Storage	✗
Zinc – Bromine Flow Battery (ZnBr)	✗
Sodium Sulfur Battery (NaS)	✗
Lithium – Ion Battery (Li-Ion)	✗
Advanced Lead Acid Battery	✗
Metal – Air Battery	✗
Vanadium Redox Flow Battery	✗
Lead – Carbon Battery (PbC)	✗
Nickel – Cadmium Battery (NiCad)	✗
Flywheels	✗

A high-level fatal flaw analysis was conducted as part of the first stage of the supply-side selection analysis. Options that did not pass the high-level fatal flaw analysis consist of those that could not be reasonably developed or implemented by Ameren Missouri for one or more of the following reasons:

- The storage technology is cost prohibitive to install and equally cost prohibitive and/or burdensome to maintain.
- The storage technology, while perhaps advancing, is still in the development or demonstration phase and hence is not field-proven. (In fact, very few storage technologies above have utility scale applications that are operational in the United States, and some are still not commercially available even in community or household scale applications.)
- The storage application is overly limited by a short cycle life, especially if deeply discharged.
- The storage application is limited for various reasons in its scalability to either utility-grade or community-grade installations. The application may, in fact, not be intended for anything other than consumer end-use behind-the-meter.
- The storage application is hampered by low cycle efficiencies or energy densities.
- The storage application is hampered by environmental risk (e.g. batteries whose chemical elements are considered hazardous materials or have combustible tendencies under different operating conditions).

- Responses by potential vendors to an energy storage survey sent by Ameren for purposes of getting additional information and determining storage technology applicability and cost were very sparse – this was perceived as indicative of the overall state of the energy storage industry.

Additionally, there are a number of reasons in general why Ameren Missouri may not be able to develop as strong a business case for energy storage as other utilities:

- Ameren Missouri is not currently operating in a capacity-constrained environment from either a generation or energy delivery standpoint.
- Ameren Missouri is not currently operating in a real estate-constrained environment. When line or substation capacity additions are necessary, Ameren Missouri is not typically hampered by physical constraints associated with the expansion and upgrade of facilities.
- Ameren Missouri is not currently subject to the type of power market volatility that warrants the strategic use of energy storage from an arbitrage standpoint.
- Ameren Missouri is not currently hampered by the types of service reliability problems that would make energy storage a strategic option. In fact, as a direct a result of a number of reliability-based initiatives undertaken over the past several years, Ameren Missouri customers are experiencing measurably improved levels of electric service reliability.
- Ameren Missouri does not currently have a substantive amount of non-dispatchable intermittent resources in its generation portfolio to warrant a serious consideration of widespread energy storage.