ASSESSING THE RELIABILITY CONTRIBUTIONS OF ENERGY STORAGE AS A TRANSMISSION ASSET

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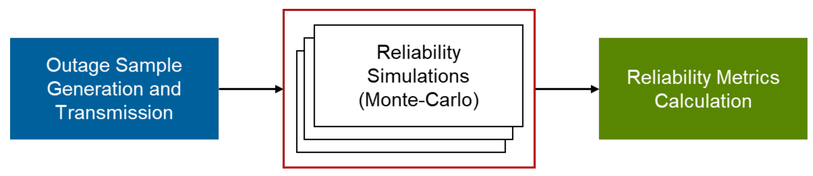
Project profiles
Topic: Next Generation, Large Scale Energy Storage
Vertical: Grid Integration and Field Validation
Strategic Pathway: Grow grid capacity, Improve grid reliability
Project start and finish: FY25-FY26

PROBLEM

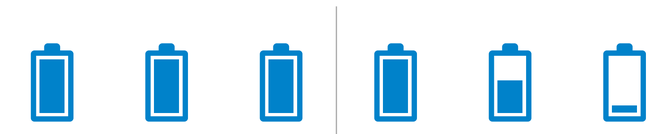
- Energy storage has seen significant growth in power systems in the last decade. However, its deployment for transmission application remains relatively limited.
- FERC policy statement, Jan. 2017, 18 CFR Part 35, Docket No. PL 17-2-000 provides guidance for storage resources recovering cost through cost-based and market-based rules, considering double recovery of costs, potential for adverse competitive impacts, and need for independence of grid operators. FERC orders allowing Storage as Transmission Only Asset (SATOA) selection in transmission planning process (TPP) for MISO (2020), SPP (2022), and ISONE (2023).
- **Storage as transmission asset**
  - Storage is part of transmission planning process, can only serve transmission services primarily at specific operational conditions
- **Research question**
  - As a transmission asset, how to quantify the reliability contribution of an energy storage project, to make it comparable with a conventional line-based transmission solution to address the same transmission upgrade need?

APPROACH

- A-LEAF Probabilistic Reliability Assessment (RA) Model



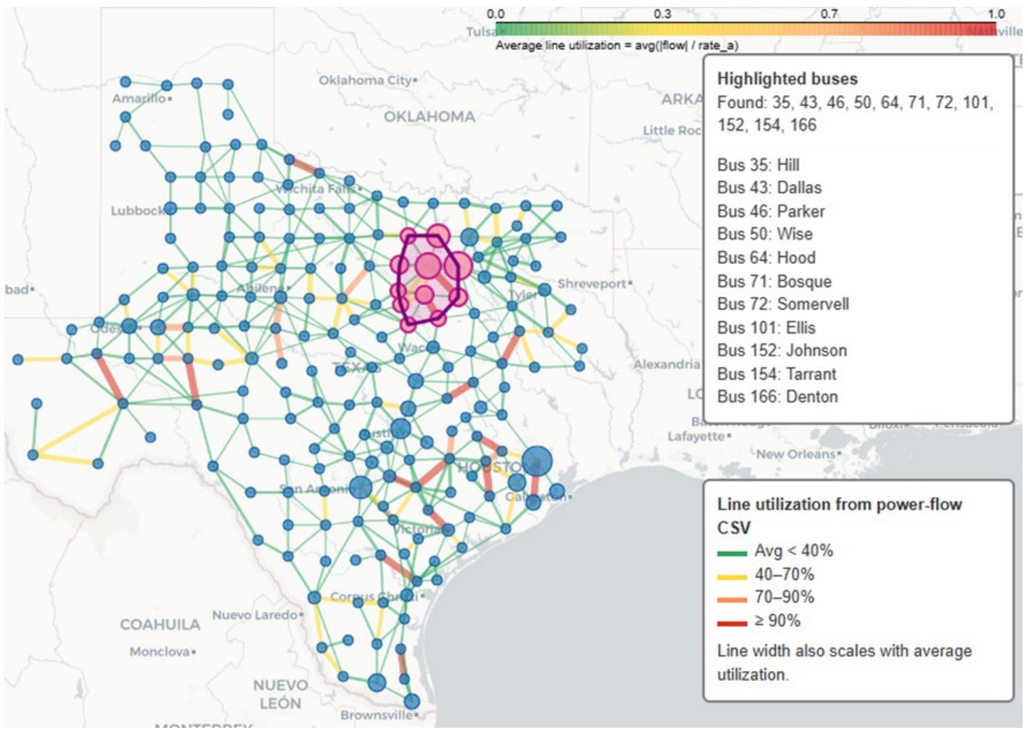
- SATA operation model



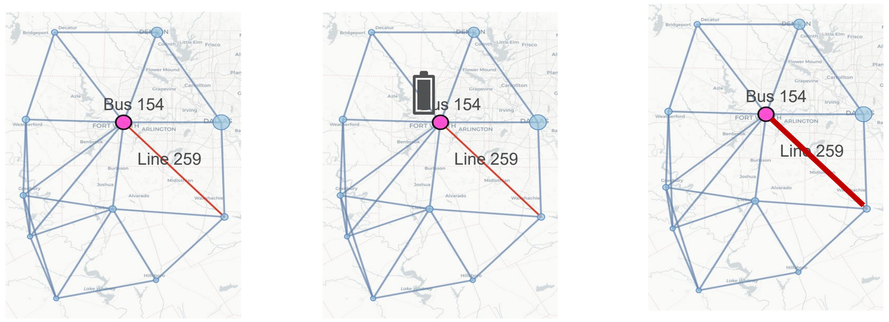
- **Normal conditions**
  - Standby with high SOC
- **Contingency operations**
  - Discharge

RESULTS: TESTING SYSTEM AND SETUP

- Texas ERCOT county system
- Reliability assessment on a regional area as highlighted below.



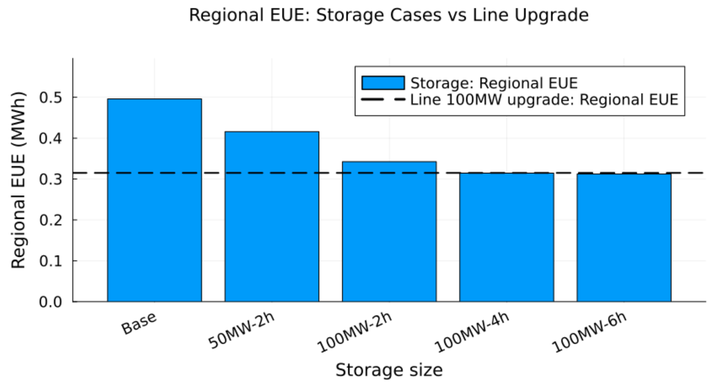
- Cases: One representative day and 100,000 samples



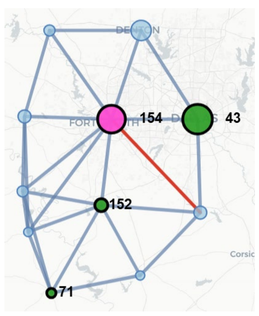
Base SATA Line upgrade

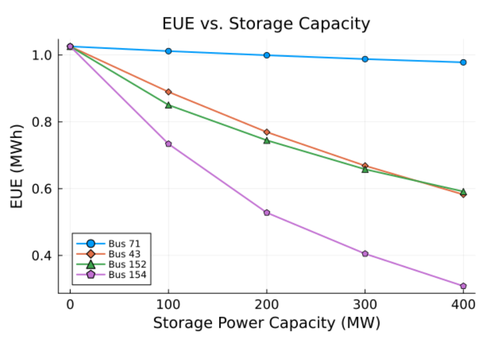
RESULTS: EQUIVALENT SATA SOLUTION AND LOCATION IMPACT

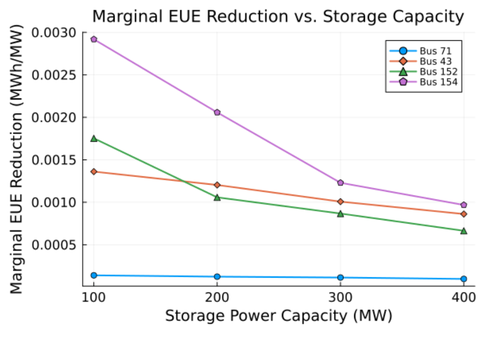
- **Equivalent SATA solution to line upgrade**
  - 100MW-4h storage can achieve equivalent EUE results to the 100MW line upgrade
  - 100MW-4h Li-ion battery sees a higher cost ($10.3 million/year) than the line solution ($2.4 million/year) if the storage serves as the transmission asset only.
  - Longer storage duration reduces EUE from 2h to 4h, but benefits beyond 4h are limited due to outage-duration constraints.



- **Locations of SATA**
  - The placement locations of SATA can significantly impact the reliability results.
  - Bus 71 is not directly connected to Bus 154, which sees little reliability contributions when SATA is located.







CONCLUSIONS AND FUTURE WORK

- The project reviews the role and operational constraints of SATOA and develops representation models of SATA, which can be integrated to existing grid reliability assessment and planning models.
- This work develops a reliability assessment framework to evaluate SATOA's contributions towards system reliability, and compare it with a transmission-line based solution regarding their reliability equivalence. Economic evaluation indicates that SATOA is currently more costly than line upgrades under reliability equivalence. However, potential dual use, declining storage costs, and greater siting flexibility are expected to enhance the competitiveness of SATOA.
- This framework evaluates the concept of a locational marginal reliability contribution. Simulation results reveal strong heterogeneity in reliability contributions across locations and highlight the importance of explicitly considering the siting of SATOA to enable proper cost savings and allocation.
- In future dual-use use case: SATA is allowed for market participation during a period when system reliability is sufficient without it. This use case may improve the revenue of SATA, but may be at the cost of reliability loss or additional cost/degradation associated with market participation.
- The project can be extended to develop an integrated end-to-end decision support tool for RTOs and SATA operators/investors.