Sandia National Laboratories

RESOURCE EVALUATION FOR STORAGE ENERGY AND RELIABILITY VALUE ENHANCEMENT (RESERVE)

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PROJECT PROFILE

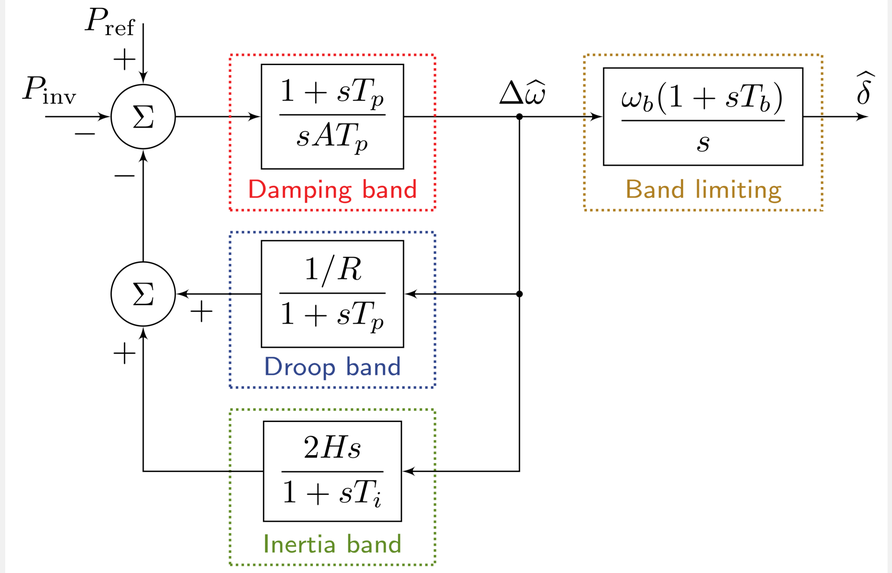
Topic: Analytics & Tools | Vertical: Analytics
Strategic Pathway: Optimize
Project start and finish: FY26–FY27

PROBLEM

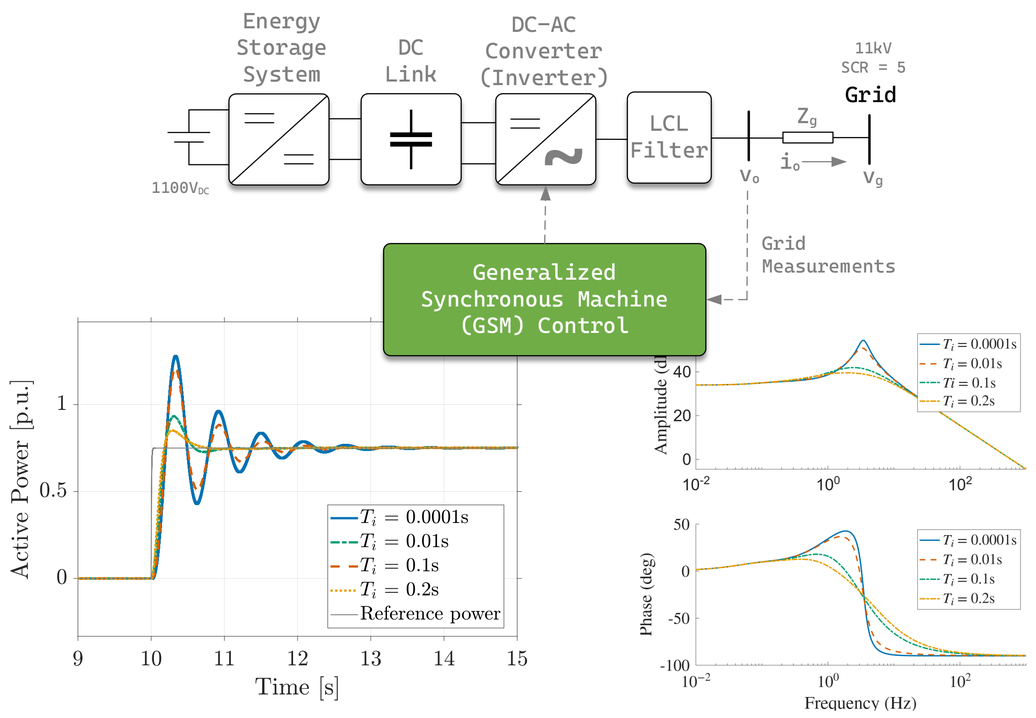
- **Opportunity:** BESS can theoretically provide reliability-critical grid services such as synthetic inertia, primary frequency response, and voltage/frequency control.
- **Gap:** Existing control strategies don't fully incorporate real operational constraints, i.e., power/energy headroom, ramp-rate limits, state-of-charge bounds.
- **Why it matters:** These constraints directly affect deployability and key reliability concerns for grid operators, storage developers, and policymakers.

APPROACH

- **Objective:** Quantify how operational constraints limit or enable BESS delivery of grid services, and identify practical operating/control requirements.
- **Approach:** Evaluate the impacts of BESS operational constraints using advanced modeling and simulation, including EMT analysis and phasor-domain simulations.
- **Case studies:** Quantify power and energy headroom requirements for grid services by performing scenario-based evaluations to measure performance and tradeoffs.
- **Control innovation:** We developed a new grid-forming control architecture that enables more flexible, constraint-aware tuning while maintaining fast, robust dynamics.



RESULTS

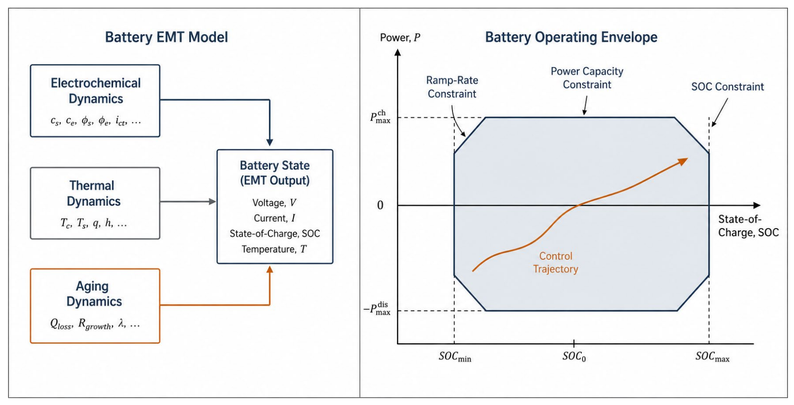


CONCLUSIONS & IMPACT

- **Stakeholders:** Grid operators, storage developers, and policymakers need credible answers on when BESS can reliably provide inertia and voltage/frequency support under real limits (headroom, ramp-rate, SOC).
- **Impact:** Reduced deployment and operational risk, clearer interconnection/market requirements, and faster adoption of BESS for resilience and reliability.
- **Near-term wins:** Reusable EMT/phasor simulation test cases and grid-forming control implementations released via PSTess for immediate stakeholder use.

FUTURE DIRECTIONS

- Increase fidelity of BESS within simulation framework
- Develop case studies to quantify performance under various scenarios and provide data-driven insights.



This material is based upon work supported by the U.S. Department of Energy, Office of Electricity (OE), Energy Storage Division.

SAND2026-23832C