Integration of Pumped Heat Energy Storage with a Fossil-Fired Power Plant

Award No. DE-FE0032031
AOI 1B, Phase 1 Feasibility Study

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<td>$ 199,875</td>
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Benefiting government, industry and the public through innovative science and technology

Meet the Future of Energy Storage

Powered by people generating safe, reliable, and cleaner electricity for today.

~39,000 MW of generation across 12 states, powered by a diverse portfolio of natural gas, nuclear, coal, and solar facilities
Pumped Heat Energy Storage (MPHES)

**Cycle:**
Simple recuperated
Air as the working fluid

**Hardware:**
Two separate drivetrains
Heat exchangers shared between modes
Storage systems shared

**System:**
Stand-alone system
Integrates electrically with fossil-energy
Thermal integration with waste heat possible

**Performance:**
High round trip efficiency (60-65%)
Long lifespan (30+ years)
100 MW system
Long-duration (10+ hours)
Scalable to integrate with assets across a portfolio

**Charge Mode**
1. Molten Salt Heat Exchanger
2. Charge Compressor
3. Molten Salt at 565°C
4. Recuperator
5. Charge Turbine
6. Antifreeze Heat Exchanger

**Discharge Mode**
1. Molten Salt Heat Exchanger
2. Discharge Compressor
3. Molten Salt at 565°C
4. Recuperator
5. Discharge Turbine
6. Antifreeze at -60°C

Molten Salt at 565°C
Antifreeze at -60°C
Synergy with Fossil:
Uses hardware components, workforce personnel, and skillsets similar to those used by fossil EGUs

TRL & Development:
System leverages commercially available hardware
Laboratory-scale demonstration of a PHES system investigating control strategies and first implementation challenges of the technology (DE-AR0001018)

Nearly prototype technology readiness level (TRL-5), with near-term pilot demonstration
Integration with Fossil EGU in ERCOT

ERCOT
- Beginning to see a significant shift in the generation mix, as of August 2020,
  - VRE makes up 26% of the ERCOT generation mix
  - Wind energy has seen continued growth
  - Solar energy has grown to a non-zero contribution
- Market with high wind penetration
  - In 2019, ramps due to wind were experienced at 12% total generation in one hour

Luminant Site Selection
Three potential gas-fired power plants were identified during the proposal phase
- Two combined cycle natural gas plants with negative pricing at night
- A simple cycle peaker located near a variety of other assets

All based in North or West Texas where wind energy contributes to grid disturbances throughout the year

Site selection on-going as first major project task
Demonstrate the potential benefits of integrating MPHES with a gas-fired plant

**Improved operational performance:** Enable gas plants to run with reduced cycling

**Increased economic performance:** Enable gas plants to better respond to grid disturbances

**Improved environmental performance:** Allow asset owners to better monitor emissions usage

Site Selection

XX.XX %
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