Sandia National Laboratories

ARES GRAVITY ENERGY STORAGE OVERVIEW AND LESSONS LEARNED

Executive Summary: The ARES (Advanced Rail Energy Storage) system utilizes large mass cars (up to 750,000 lbs per pair) transported along a unique track and rail configuration. With two sites (Nevada and California), this gravity storage system aims to provide long-term energy storage, integrating seamlessly with varied utility-scale generation sources. Key advantages include modularity and a target cost of $200-$350/kWh. However, challenges remain, including safety considerations, design limitations, and the need for further efficiency improvements.

Key Features:

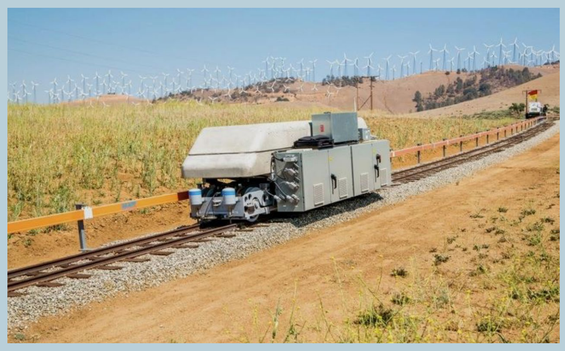
- Modular Design**:** Scalable for utility integration.
- Cost Efficiency**:** Targeting $200-$350/kWh.
- Environmental Impact**:** Minimal compared to chemical batteries.

Challenges:

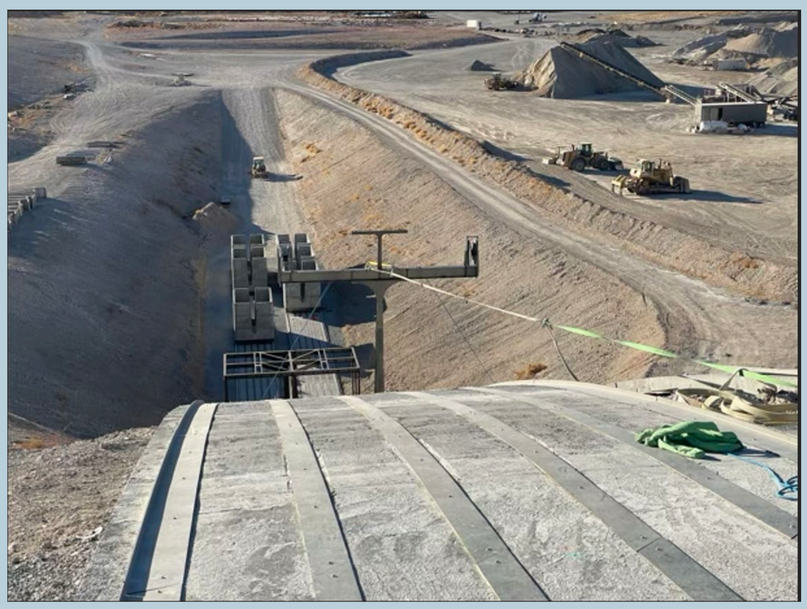
- Safety and failure mode analysis.
- Limitations in simultaneous mass car operations.
- Design refinements needed for optimal performance.

Intellectual Property: ARES holds multiple patents focusing on gravity-based energy storage systems, with innovations in rail technology and energy transfer mechanisms. Recent patents include the use of chain drives and non-standard rails..

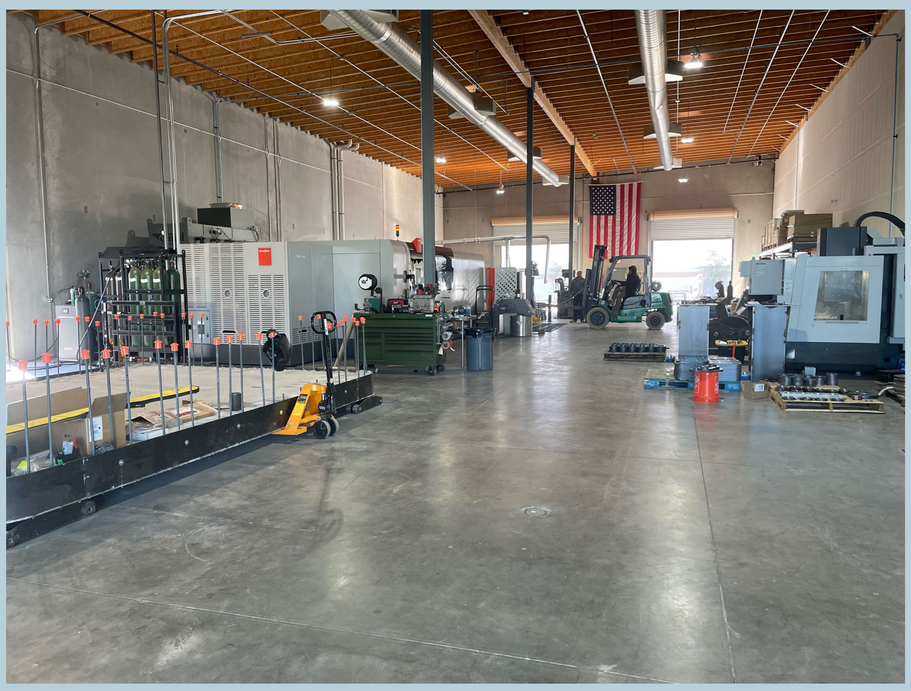
Current Status and Development



Tehachapi Site:
Completed in 2013, this demonstration project validated the feasibility of ARES technology, achieving 80-90% efficiency. It utilized a single track to showcase the system's ability to respond to grid demands and provide load balancing, informing the design of the larger Gamebird Pit project.



Gamebird Pit Site**:**
Located near Pahrump, this site features parallel tracks and rails for mass car pairs weighing up to 750,000 lbs, with an elevation change of 118 ft and a track inclination of 28.6 degrees. The system is designed for efficient energy storage and retrieval, with ongoing private funding aimed at optimizing performance and reducing costs.



Las Vegas Prototype Manufacturing Site**:**
ARES operates a 7,000 sqft manufacturing facility in Las Vegas, equipped with a $1.7M laser cutting machine for efficient component production. This vertical integration reduces costs and enhances design flexibility.

Insights:

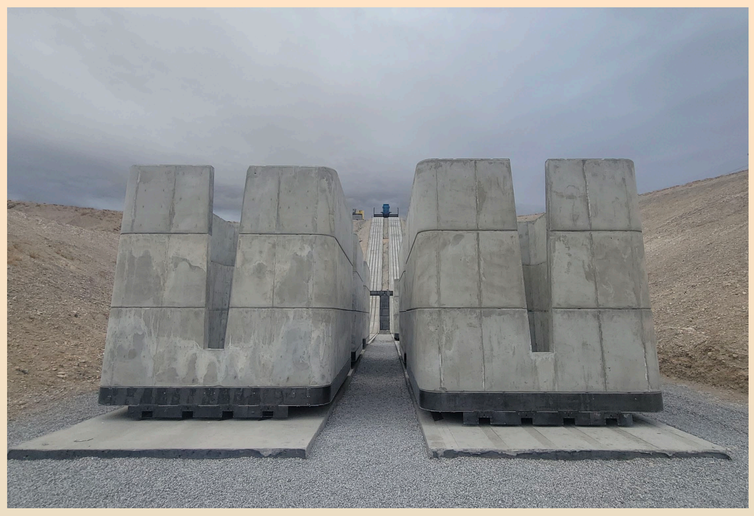
- In-House Manufacturing: Strategic decision to control costs and understand operations better.
- Application: Increasing demand from AI and data centers creates opportunities for ARES.
- Energy: Each mass car can store approximately 20 kWh.
- Power: The system can deliver up to 5.7 MW/car.
- Scalability: Emphasized through modular designs that enable expansion for greater energy storage capacity.

Comparative Analysis

Parameter	Tehachapi	Gamebird
Track Length	880 ft	246.5 ft
Track Design	Conventional rails	6 parallel flat plates
Mass Car Weight	12,500 lbs	750,000 lbs
Drive	Electric-powered	Chain-driven

Lessons Learned

- Supply Chain**:** Mechanical energy storage needs innovation beyond established ecosystems.
- Design**:** Simple track configurations avoid complexity, but lateral stability is a concern.
- Manufacturing**:** In-house production is vital for cost control and efficiency.
- Market Demand**:** AI and data centers increase the need for flexible storage solutions.
- Safety**:** Insufficient safety standards raise operational risk concerns.
- Environmental**:** Supportive land-use policies aid development, but wildlife may pose challenges.
- Financial Viability**:** ARES is privately funded, focusing on long-term system life and cost control.
- Design Testing**:** Some design elements require further validation.
- Overall Assessment**:** ARES's innovative system must prioritize safety, maintenance, and design refinement for long-term success.



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