

AES Energy Storage ERCOT Storage Workshop April 2010



AES develops, owns, and operates fast response grid stability projects, such as this 12 MW installation in Chile.





Largest Lithium-ion battery in service on the power grid. © 2010 The AES Corporation, All rights reserved. The AES portfolio of assets and broad market footprint provide the market insight and capability to deliver grid services.





Batteries on the grid? Yes. (example from A123 Systems)





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Frequency Regulation



Regulation is a <u>near zero-energy</u> service compensating for minute-to-minute fluctuations in total system load and uncontrolled generation.



2004 Oak Ridge National Labs:

"Regulation is a zero-energy service, making it an ideal candidate for supply by storage....Once regulation markets mature, the almost perfect control exhibited by storage devices should command higher prices than the poor control exhibited by large thermal power plants."

AES Energy Storage: Operational Projects

Operational Projects:

- 12 MW in Chile
 - Spinning reserve and frequency regulation on island grid

- 2 MW California
 - Frequency regulation

- 1 MW Pennsylvannia (PJM)
 - In PJM's frequency regulation market









Technical Validation: AES built and interconnected a ٩F٢ 2 MW grid-scale battery energy storage system in the Spring of 2008 power of being alobal

- Validated with KEMA Consulting for Ancillary Services applications.
- Less than 1-sec response time to any dispatch level
- Over 90% round-trip efficient in regulation test operating on ACE signal

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ALTAIR

Market Integration: 1 MW in PJM Market





- 1 MW / 250 kWh unit online Nov 2008
- Passed PJM regulation certification test to become qualified market participant
- Following PJM regulation signal
- Revenue-earning market participant

Field experience: 2 MW in California





AES Huntington Beach



- 2 MW / 500 kWh unit online Nov 2008
- Participating in pilot program with California ISO

Commercial Project: 12 MW in Chile (16 MW nominal)



Remote island grid

Transmission substation





Arlington, Virginia and Watertown, Massachusetts, November 18, 2009. AES Energy Storage and A123 Systems announced the commercial operation of a 12 MW frequency regulation and spinning reserve project at AES Gener's Los Andes substation in the Atacama Desert, Chile. The commissioning ceremony took place November 16 and included Marcelo Tokman, Chilean Minister of Energy. The project will help improve



the power of being global

8 x 2 MW building blocks

Chile Project: Spinning Reserve replacement in operation to provide much needed capacity and flexibility.



- •12MW system (16MW nominal) installed in northern Chile – commissioned Nov 2009
- •Releases generation capability previously held back for contingency reserve (typically <20 min calls)
- •Received local system operator approval based on transient system study performed by DigSILENT
- •Frequency responsive, automated operation



October 10th, 2009 - Live SCADA screenshot:



Site: Los Andes substation, Atacama Desert

Digital Response

Frequency @ 50 Hz

A simple framework of grid energy storage operational characteristics: Speed, Accuracy, Duration



Attribute	Description	Implication to grid/market integration
Voltage	AC (Grid Voltage)	None
Inverter	Known interconnection standards	None
Positive and negative real power dispatch from same resource	High (>90%) round-trip efficiency (recycles excess energy)	Offline gen site = net load Customer DG = net gen
Speed	< 1s response up to maximum 2x nameplate change in real power	"ACE eraser": Solves ACE faster than conventional fleet can begin to respond <i>if signal takes advantage</i> <i>of this capability</i>
Accuracy	Power level requested = Power level delivered	Programmed ideal response
Duration	15min duration capability	Energy management (by ISO or by resource)

Additional questions to consider in market integration



- Registration: Should a storage plant register as generation or load (or other)?
- Testing/qualification: What duration is embedded in the test signal?
- Net energy:
 - How is net energy consumption of a storage plant settled?
 - TDSP charges?
- IT:
 - Can the system handle negative numbers?*
 - Can a resource offer regulation only?

AES Energy Storage: Grid Stability & Efficiency Services



Key Value:

Improve the Grid Today

- Reduce system operating costs
- Improve efficiency and reliability
- Reduce environmental footprint

Enable the Future

- Provide fast response capabilities to support renewables
- Deploy granular smart grid control capabilities

Benefits to Rate Payers (via wholesale service model)

- Improved reliability
- Lower emissions
- Protects ratepayers from technology performance risks.

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