CPUC Energy Storage Use Case Analysis

Application Scenario: Bulk Generation

Use Case: Ancillary Services Only

Version 0.1

Contents

1. Overview Section

Bulk Generation storage is large-scale energy storage that is interconnected to the grid at transmission-level voltage and is used to supply wholesale services of energy, capacity, and/or ancillary services. Ancillary Services are the services needed to maintain electrical system reliability and meet WECC/NERC operating criteria. As renewable integration studies show, as the level of Variable Energy Resources (VERs) increases, the need for Ancillary Services increases. Energy Storage resources, with their fast response and accurate dispatch characteristics, are well-suited to provide Ancillary Services.

2. Use Case Description

This Use Case describes a large-scale (MW-level capacity), limited-duration Energy Storage system that is transmission-grid-connected and providing Ancillary Services at the wholesale level. Because of wholesale market rules, this Energy Storage resource only provides Ancillary Services and not Energy (other than Energy associated with providing Ancillary Services) or Capacity.[1]

One example of this case is the California Independent System Operator (CAISO) Regulation Energy Management (REM) program, which is designed to enable greater participation by non-generator resources in the ISO's ancillary services market by allowing these resources to bid their capacity more effectively into the ISO's regulation markets.[2]

2.1 Objectives

The main objective in this Use Case is to provide Ancillary Services. These services can be sold into the wholesale market or sold on a bilateral basis with a utility or other buyer. The CAISO procures four types of ancillary services products in the day-ahead and real-time markets: Regulation Up, Regulation Down, Spinning Reserve, and Non-Spinning Reserve. Other Ancillary Services in CAISO include Voltage Support, and Black Start capability. Providing Ancillary Services contributes to maintaining system reliability and improved renewable integration.

Another objective of the Energy Storage resource is to provide other benefits to the grid. These benefits include increased generating fleet efficiency, reduced fleet fuel consumption and emissions, and lower system costs.

2.2 Actors

The Energy Storage system may be owned by a utility or an independent power producer (IPP). The storage system may be operated and maintained by the owner or a third party. The buyer of the services may be an Independent System Operator (ISO) (initially), power marketer (secondly), or a load-serving entity (i.e. utility) (ultimately). The plant dispatcher and grid

[1] It is important to note that some Energy Storage systems can provide Energy and Capacity, in addition to Ancillary Services, depending on technology and market rules.

[2] Section 8.4.1.2 of the CAISO REM Tariff states: A resource using Regulation Energy Management may not provide Energy other than Energy associated with Regulation.

operator would be the ISO (e.g. CAISO) in an organized market. The storage equipment manufacturer and systems integrator could also be the plant owner or operator or a third party.

Name	*Role description*
Storage Provider	Storage equipment manufacturer and systems integrator; may be plant owner and/or operator
ISO	Grid operator and wholesale market administrator
Utility	Ancillary Services buyer and load-serving entity; may be plant owner and/or operator

2.3 Proceedings and Rules that Govern Procurement Policies and Markets for This Use

Agency	*Description*	*Applies to*
CPUC	Long-Term Procurement Plan (LTPP)	Utility / Owner
CPUC	Resource Adequacy (RA)	Utility / Owner
CPUC	Renewable Portfolio Standard (RPS)	Utility / Owner
FERC	Order No. 890	Utility / ISO / Owner
FERC	Order No. 755	ISO / Owner
CAISO	Order No. 755 Implementation	Owner
CAISO	Renewable Integration Studies	Utility / Owner
CAISO	Ancillary Service Market Administrator	Owner / Utility
CAISO	Regulation Energy Management (REM)	Owner

In addition to the Energy Storage Proceeding (R.10-12-007), the CPUC has several proceedings that govern procurement policies and directly impact markets for this Use Case. The LTPP proceeding and the RA proceeding will consider how the rules governing the procurement process should change to appropriately include and value Energy Storage resources. RPS program implementation will affect the need for renewable integration and Ancillary Service requirements, and should address how Energy Storage resources can contribute to the state meetings its renewable procurement targets.

FERC, in Order No. 890 (Preventing Undue Discrimination and Preference in Transmission Service) issued February 16, 2007, modified Schedules 2, 3, 4, 5, 6, and 9 of the pro forma open access transmission tariff (OATT) to make clear that Ancillary Services – reactive supply and voltage control, regulation and frequency response, energy imbalance, spinning reserves, supplemental reserves and generator imbalance services, respectively – may be provided by non-generation resources, such as energy storage resources and demand resources, where appropriate. In Order No. 755 (Frequency Regulation Compensation in Organized Wholesale Power Markets) issued October 20, 2011, FERC required that ISOs compensate frequency regulation resources based on the actual amount of frequency regulation service provided in responding to the dispatch signal and discussed the superior speed and accuracy of energy storage resources.

The CAISO, as electric system operator and market administrator, has a central role in maximizing the use of, benefits of, and value of energy storage resources. As an ISO, CAISO is responsible for implementing the Regulation market rule changes necessary to comply with FERC Order No. 755. CAISO also has a lead role in conducting and coordinating renewable

integration studies, which include recommendations on Ancillary Service requirements. CAISO is also the Ancillary Service market administrator, in addition to the Energy market administrator. In that role, CAISO is responsible for implementing new market products and enhancements to existing markets like REM, which enables greater participation by non-generator resources (i.e. energy storage and demand response) in the ISO's ancillary services market by allowing non-generator resources to bid their capacity more effectively into the ISO's regulation markets. As the CAISO stated in its REM filing to FERC, "these resources can help balance supply and demand on the ISO system as increasing numbers of intermittent resources such as wind and solar interconnect to the ISO grid."[3]

2.4 Location

A Bulk Generation Energy Storage device providing Ancillary Services is interconnected to the grid at transmission-level voltage and is an independent resource and may be separately located and operated from other grid resources.

2.5 Operational Requirements

Grid-connected resources must meet interconnection requirements. Ancillary Service providers must meet grid operation requirements for communication and data telemetry, plant availability, ramp rate, dispatch accuracy, and duration.

2.6 Applicable Storage Technologies

The most applicable Energy Storage technologies for Ancillary Service-only use are non-generator resources including flywheel systems and battery systems.

Storage Type	*Storage capacity*	*Discharge Characteristics*
Flywheel system	1-100 MW	Fast response, medium duration
Battery system	1-100 MW	Fast response, medium duration

2.7 Non-Storage Alternatives for Addressing this Objective

Non-Storage options to provide Ancillary Services include conventional (hydro, fossil, nuclear) resources and dispatchable Demand Response resources.

[3] See CAISO August 2, 2011 filing in Docket No. ER11-4353, transmittal letter at p. 1.

3. Cost/Benefit Analysis

3.1 Direct Benefits

End Use	*Primary/ Secondary*	*Benefits/Comments*
1. Frequency regulation	P	Fast, accurate response provides optimal regulation
2. Spin	P	Fast, accurate response
3. Ramp	P	Fast, accurate response
4. Black start	P	
5. Real-time energy balancing	S	
6. Energy arbitrage		
7. Resource Adequacy		
8. VER[4] / wind ramp/volt support,	S	
9. VER/ PV shifting, Voltage sag, rapid demand support	S	
10. Supply firming		
11. Peak shaving: load shift		
12. Transmission peak capacity support (deferral)		
13. Transmission operation (short duration performance, inertia, system reliability)		
14. Transmission congestion relief		
15. Distribution peak capacity support (deferral)		
16. Distribution operation (volt/VAR support)		
17. Outage mitigation: microgrid		
18. TOU energy mgt		
19. Power quality		
20. Back-up power		

[4] VER = Variable Energy Resource

3.2 Other Beneficial Attributes

Benefit Stream	*Y/N*	*Assumptions*
Operational flexibility		Fast, accurate response
Reduced fossil fuel use		
Reduced emissions		
Reduced system cost		
Faster and easier plant development		

3.3 Costs

Cost Type	*Description*
Installation	
O&M	

3.4 Cost-effectiveness Considerations

Bulk Energy Storage is a cost effective resource for providing Ancillary Services. Because Energy Storage systems have low operating costs, due in part to not consuming fossil fuel, they are low cost providers. Because Energy Storage resources are significantly more effective at responding to system imbalances due to their superior speed and accuracy than slower-ramping generation resources, their use on the grid can lower the overall amount of Regulation that needs to be procured. A study by KEMA for the California Energy Commission found that a 30-50 MW fast-response storage device could provide as much or more Regulation capability than a 100 MW combustion turbine.[5] Energy Storage can reduce costs to California's ratepayers by displacing relatively high cost Ancillary Service providers and lowering Ancillary Service procurement.

Fossil fuel-powered plants displaced from providing Ancillary Services by Energy Storage can be shifted to provide a corresponding amount of additional Energy. In doing so, these plants can run at higher load, improving their energy efficiency and reducing emissions. Unlike generators that consume fossil fuel, Energy Storage resources like flywheels and batteries recycle existing power, thereby lowering operating costs and benefiting the environment by producing zero direct CO2 or other greenhouse gases, particulates or other air emissions. A study by KEMA concluded that a 20 MW Flywheel Energy Storage System emits 56% less CO2 than a natural gas power plant providing regulation and 26% less emissions than a pumped hydro power plant.[6]

[5] "Research Evaluation of Wind Generation, Solar Generation, and Storage Impact on the California Grid," Study by KEMA, Inc., done for California Energy Commission funded via Public Interest Energy Research Program (PIER) page 6, June, 2010.

[6] KEMA, Emissions Comparison for a 20MW Flywheel-based Frequency Regulation Power Plant, May 18, 2007.

4. Barriers Analysis & Policy Options

4.1 Barrier Resolution

Barriers Identified	*Y/N*	Policy Options / Comments
System Need	Y	
Cohesive Regulatory Framework	Y	
Evolving Markets	Y	
Resource Adequacy Value	Y	
Cost Effectiveness Analysis	Y	
Cost Recovery Policies	Y	
Cost Transparency & Price Signals	Y	
Commercial Operating Experience	Y	
Interconnection Processes	Y	
Other issues		Other comments
Procurement process, RFO design, lack of long-term procurement commitments	Y	

4.2 Other Considerations

It is difficult to finance the construction of new advanced Energy Storage projects designed to provide Ancillary Services only in California without a regulatory change in how utilities procure Energy, Capacity, and Ancillary Services. Even with the new federal rules for Regulation compensation as required by FERC Order No. 755, currently there is no method for utilities to procure Regulation from advanced storage technologies designed to provide Regulation-only (i.e. not designed to provide Energy, and not credited for providing Capacity).

This means storage projects must be financed based on their expected revenue in the Regulation spot market, which makes it virtually impossible to obtain traditional private-capital project financing. Consequently, even though Energy Storage resources are successfully providing Regulation and other Ancillary Services on the grid today in other parts of the country, most of those projects were financed through government funding, and it will remain difficult for Energy Storage companies to obtain project financing for Ancillary Services-only Energy Storage projects in California because the private capital markets will not provide financing without some level of revenue certainty.

Procurement targets and associated long-term procurement contracts for Ancillary Services-only Energy Storage projects will help overcome these barriers.

5. Real World Example

5.1 Project Description

Beacon Power, LLC – Stephentown Project

The Stephentown Project is a 20 MW flywheel energy storage system located in Stephentown, NY that is currently operating and providing Ancillary Services in the New York Independent System Operator (NYISO) wholesale market. The Stephentown plant began operating in January 2011 and is qualified to provide Frequency Regulation service in NYISO. It is owned by Spindle Grid Regulation, LLC and operated by Beacon Power, LLC, which are both subsidiaries of Rockland Power Partners, LP. Beacon Power developed the project, manufactured the flywheels, and integrated the related electronics and other systems for the plant to connect to the grid and accurately follow the grid operator's dispatch signals. The Stephentown facility sits on 3.5 acres and is comprised of 200 flywheels each with a storage capacity of 100 kW / 25 kWh.[7]

As a Limited Energy Storage Resource (LESR) in NYISO, by Tariff requirement the Stephentown Project only bids Regulation service and not Energy in the wholesale market, but does inject and withdraw Energy as part of the provision of Regulation service. The fast and accurate Stephentown Project can ramp to its full capacity (20 MW) in one Frequency Regulation dispatch cycle (6 seconds) and provides continuous (24x7) Regulation service. On average, the Stephentown Project is 10% of the Regulation market capacity, yet provides 25% - 35% of NYISO's Area Control Error (ACE) Correction.

Location	Stephentown, NY
Operational Status	Online since January 2011
Ownership	Spindle Grid Regulation, LLC (subsidiary of Rockland Power Partners, LP) Operated by Beacon Power, LLC
Primary Benefit Streams	Frequency Regulation
Secondary Benefits	Renewable integration. Increased fleet efficiency, reduced fuel consumption and emissions. Lower system costs.
Available Cost Information	

5.2 Outstanding Issues

Description	*Source*
LESRs do not qualify for Capacity value in NYISO	NYISO Procedures

5.3 Contact/Reference Materials

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[7] This power-to-energy ratio allows the flywheel to charge or discharge for 15 minutes at full power level.

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6. Conclusion and Recommendations

Is ES commercially ready to meet this use?

Yes.

Is ES operationally viable for this use?

Yes.

What are the non-conventional benefits of storage in this use?

Provision of Ancillary Services aids in renewable integration. Storage resources help increase fleet efficiency and reduce fleet fuel consumption and emissions and lower system costs.

Can these benefits be monetized through existing mechanisms? If not, how should they be valued?

These non-conventional benefits cannot be monetized through existing market rules. They should be valued by market mechanisms where possible and by procurement targets where necessary.

Is ES cost-effective for this use?

Yes.

What are the most important barriers preventing or slowing deployment of ES in this use?

The lack of incentives for utilities to procure Energy Storage resources using long-term contracts is the most important barrier to Energy Storage in this use. The lack of Resource Adequacy value for Ancillary Service-only Energy Storage is also a barrier.

What policy options should be pursued to address the identified barriers?

The policy options that should be pursued to address the identified barriers include: (1) enable investor-owned utilities to utilize a "portfolio approach" that allows them to procure resources that provide one specific service to the grid, such as frequency regulation, if utilization of that resource in the utility's portfolio provides a benefit (i.e. lower cost set of resources) to ratepayers; (2) establish procurement targets for energy storage resources; (3) make energy storage a Preferred Resource; and (4) ensure that laws are in place for utilities and energy storage resources to execute long-term contracts.

Should procurement target or other policies to encourage ES deployment be considered for this use?

Yes.