UNITED STATES OF AMERICA
BEFORE THE FEDERAL ENERGY REGULATORY COMMISSION

Essential Reliability Services and the Evolving Bulk-Power System – Primary Frequency Response	Docket No. RM16-6-000

MOTION TO INTERVENE AND COMMENTS OF THE CALIFORNIA ENERGY STORAGE ALLIANCE

Donald C. Liddell
DOUGLASS & LIDDELL
2928 2nd Avenue
San Diego, California 92103
Telephone: (619) 993-9096
Facsimile: (619) 296-4662
Email: liddell@energyattorney.com

Counsel for the
CALIFORNIA ENERGY STORAGE ALLIANCE

October 10, 2017

TABLE OF CONTENTS

UNITED STATES OF AMERICA
BEFORE THE FEDERAL ENERGY REGULATORY COMMISSION

Essential Reliability Services and the Evolving Bulk-Power System – Primary Frequency Response	Docket No. RM16-6-000

MOTION TO INTERVENE AND COMMENTS OF THE CALIFORNIA ENERGY STORAGE ALLIANCE

The California Energy Storage Alliance ("CESA") appreciates the opportunity to submit these comments in response to the request from the Federal Energy Regulatory Commission ("FERC") for supplemental comments in the Notice of Proposed Rulemaking ("NOPR") issued on November 17, 2016. CESA appreciates FERC's intent to ensure reliability by considering rules for providing and delivery of Primary Frequency Response ("PFR"). The supplemental request focuses in large part on the roles and potential unique circumstances of electric storage.

CESA focuses primarily on energy storage markets and policies in California, and has played substantive roles in numerous energy storage-related procurements, legislation, and market reforms. CESA is an active stakeholder at the California Independent System Operator ("CAISO") in many initiatives, including the Frequency Response Initiative, where progress has been suspended due to the potential for a FERC ruling on the matter.

While CESA understands that FERC intends well, CESA is extremely concerned that FERC's approach could inadvertently sow market inefficiencies, raise costs, and reduce or impede electric storage resource participation in the providing or delivery of PFR. To date, FERC's actions have caused the CAISO to pause its market design initiative to consider the

development of a frequency response product.[1] Further, the NOPR's approach, which focuses on an interconnection-based requirement to have PFR capability, may yield a somewhat perverse outcome where the interconnection-based approach operates in a manner poorly suited to the characteristics of electric storage – *e.g.*, to deliver PFR without any time limit, so electric storage, rather than being a fast-start, fast response provider of PFR, is instead obliged to exempt itself from PFR providing capability and delivery.

FERC should instead promote competitive solutions to meet PFR needs, or should allow for regional solutions, rather than ensuring provision of PFR through interconnection-based requirements conveyed via the Small-Generator Interconnection Agreements ("SGIAs") and Large Generator Interconnection Agreements ("LGIAs"). This is extremely critical to California where two forms of competitive solutions are being considered, neither of which rely on interconnection-based approaches.

CESA responds to the FERC's request for supplemental comments below, but consistently emphasizes that many electric storage solutions are *ideally suited* to provide PFR in a regionally-designed market product structure. Only in cases where an interconnection-based requirement is used do some unique limitations of energy storage crop up, which in turn suggest some such requirements should not apply to electric storage.

Overall, CESA strongly recommends FERC alter its course to allow for regional solutions or market products. While CESA acknowledges that extensive and detailed work has been undertaken by FERC, the NOPR directs a pathway that may not fully resolve the PFR need yet (because it does not stipulate how PFR headroom is preserved, if at all), which allows for a fundamentally inefficient pathway that contravenes market principles that have largely held sway

[1] CAISO Frequency Response Phase 2 Initiative.
http://www.caiso.com/informed/Pages/StakeholderProcesses/FrequencyResponsePhase2.aspx

since FERC Order No. 888 and the shift to deregulated markets. A potentially inefficient outcome would occur if PFR is treated like voltage support in that headroom is required to be offered from resources, regardless of the marginal cost, and without any compensation or selection for the 'best' providers of PFR.

FERC may benefit strongly from more closely considering inputs to the record from California stakeholders, where Balancing Authority Areas ("BAAs") have advanced far on the path of fleet turnover towards inverter-based resources. California, in its Frequency Response deliberations (which are currently paused due to expectations of FERC action), has focused heavily on market solutions or intra-BAA transfers of PFR obligations over interconnection-based approaches to address its North American Electric Reliability Corporation ("NERC") BAL-003 Standard and other related requirements. The NOPR's approach may disrupt this innovative and efficient enhancement to grid reliability. Any rule that restricts more efficient solutions seems counterproductive and unnecessary. While an interconnection-requirement may not in fact impede California's progress, this approach risks authorizing a 'voltage support' type of approach that is likely very inefficient in providing and selecting PFR.

Again, CESA strongly requests considerations of these remarks with an outcome where FERC either: (a) declares it will not proceed with an interconnection-based national rule on PFR at this time; (b) decides it will allow regional solutions and will not establish an interconnection-based rule; or (c) decides it will require market-based solutions, such as fungible 'in-market' products or constraints, and will not establish an interconnection-based rule.

Finally, CESA appends remarks[2] and slides[3] provided on February 9, 2017 in the CAISO's Frequency Response Phase 2 Initiative. These slides in particular highlight how market-based solutions are possible and can yield strong and effective yet efficient reliability solutions, and how energy storage can be a great provider of PFR.

I. BACKGROUND.

Founded in 2009, CESA is a non-profit membership-based advocacy group committed to advancing the role of energy storage in the electric power sector through policy, education, outreach, and research. CESA's mission is to make energy storage a mainstream energy resource which accelerates the adoption of renewable energy and promotes a more efficient, reliable, affordable, and secure electric power system. As a technology-neutral group that supports all business models for deployment of energy storage resources, CESA membership includes technology manufacturers, project developers, systems integrators, consulting firms, and other clean-tech industry leaders.

II. COMMUNICATIONS AND CORRESPONDENCE.

Address all communications and correspondence concerning this proceeding to:

Donald C. Liddell
DOUGLASS & LIDDELL
2928 2nd Avenue
San Diego, California 92103
Telephone: (619) 993-9096
Facsimile: (619) 296-4662
Email: liddell@energyattorney.com

[2] *CESA's Frequency Response Phase 2 Initiative Working* Group Comments on, submitted on March 17, 2017.
https://www.caiso.com/Documents/CESAComments_FrequencyResponsePhase2WorkingGroup_Feb92017.pdf

[3] *Primary Frequency Response – Energy Storage*. Presentation by CESA at the CAISO's February 9, 2017 Working Group Meeting in the Frequency Response Phase 2 Initiative.
https://www.caiso.com/Documents/CESAPresentation-FrequencyResponseWorkingGroupMeeting.pdf

III. MOTION TO INTERVENE IN THIS PROCEEDING.

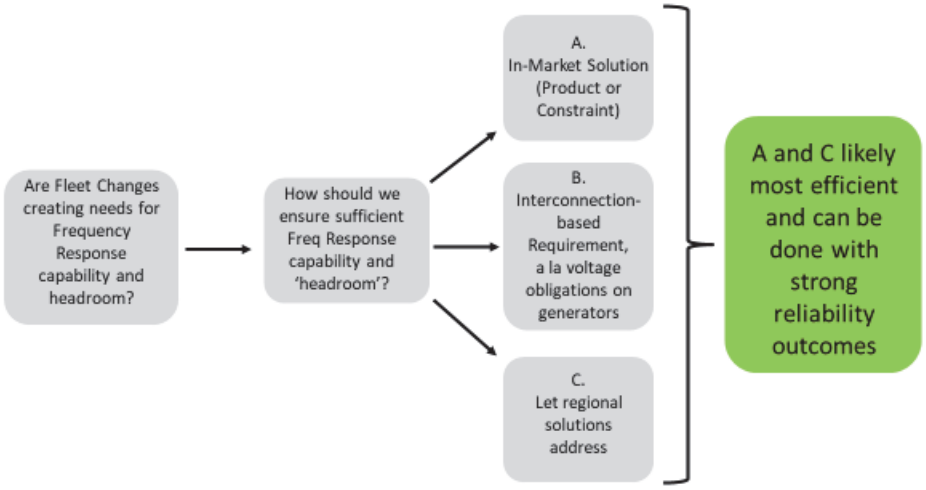
CESA's current membership consists of 8minutenergy Renewables, Able Grid Energy Solutions, Adara Power, Advanced Microgrid Solutions, AES Energy Storage, AltaGas Services, Amber Kinetics, American Honda Motor Company, Inc., Bright Energy Storage Technologies, BrightSource Energy, Brookfield, California Environmental Associates, Consolidated Edison Development, Inc., Customized Energy Solutions, Demand Energy, Doosan GridTech, Eagle Crest Energy Company, East Penn Manufacturing Company, Ecoult, EDF Renewable Energy, ElectrIQ Power, eMotorWerks, Inc., Energport, Energy Storage Systems Inc., GAF, Geli, Green Charge Networks, Greensmith Energy, Gridscape Solutions, Gridtential Energy, Inc., Hitachi Chemical Co., IE Softworks, Innovation Core SEI, Inc. (A Sumitomo Electric Company), Johnson Controls, LG Chem Power, Inc., Lockheed Martin Advanced Energy Storage LLC, LS Power Development, LLC, Magnum CAES, Mercedes-Benz Energy, National Grid, NEC Energy Solutions, Inc., NextEra Energy Resources, NEXTracker, NGK Insulators, Ltd., NICE America Research, NRG Energy, Inc., Ormat Technologies, OutBack Power Technologies, Parker Hannifin Corporation, Qnovo, Recurrent Energy, RES Americas Inc., Sempra Renewables, Sharp Electronics Corporation, SolarCity, Southwest Generation, Sovereign Energy, Stem, STOREME, Inc., Sunrun, Swell Energy, Viridity Energy, Wellhead Electric, and Younicos. CESA's intervention in this proceeding is in the public interest, and CESA's interests will not be adequately reflected by any other party, particularly given CESA's leadership role in this matter in the CAISO and California market place, and in the fact that the CAISO's PFR initiative is currently suspended due to FERC's rule-making activities. CESA therefore respectfully requests that this motion to intervene be granted.

IV. COMMENTS.

A. A properly designed market product will enable high-performing and competitive providing of PFR by electric storage resources, avoiding limitations of an interconnection-based approach for electric storage resources.

An efficient national rule for ensuring PFR would likely allow for providing and delivery by resources expected to be high-performing and competitive providers of PFR, such as electric storage solutions. Any rule that instead may prompt some exemptions of energy storage solutions from any providing and delivery of PFR seems likely to yield a less efficient outcome and may strand or restrict capacity in sub-optimal ways. Yet the Notice for Supplemental comments explicitly inquires where, how, and why electric storage solutions may be poorly-suited to deliver PFR under an interconnection-based approach, highlighting that the design could be sub-optimal. To CESA, this is a red flag to pursuing this approach.

Figure 1: Frequency Response Solutions Decision Tree



Source: CESA's Presentation at the Public Audiences regarding the Frequency Response Phase 2 Initiative.

While an interconnection-based approach is inherently inefficient in that it raises costs when it requires PFR capabilities of all providers, even those which never plan to provide PFR, CESA understands that many resources may need to interconnect with PFR capabilities in the future. A key distinction, however, is that an interconnection-based approach also follows the structure of voltage support rules, where providing of voltage support is directed regardless of cost and based on locational needs. Since PFR is not location specific and quantities can be determined on a system-wide basis, FERC should be clear that any interconnection-based approach should not be structured to be provided based on operator discretion and interconnection settings and regardless of operational costs or efficiency, as is the case with voltage support. CESA does not criticize existing voltage support rules, which address a problem that is fundamentally different from PFR providing and delivery.

B. An interconnection-based approach may perversely shift the role of electric storage from being a highly capable PFR provider to providing little or no PFR.

Electric storage resources, in a properly designed market product structure, are extremely well-positioned to provide fast and responsive PFR. Their inverters can be programmed to provide nearly instantaneous PFR and can deliver it in large megawatt amounts, when headroom is preserved. Through an inverter, electric storage resources can provide PFR more efficiently than spinning resources, which rely on governors (when enabled) and which cannot respond as quickly and provide sustained output.[4] CESA believes PFR should be an 'opt-in', competitively procured service provided by capable resources obliged to hold a scheduled amount of

[4] *See*, CESA slide 4 in the Appendix, where CESA explains how energy storage is an efficient provider of PFR.

headroom. PFR service should be limited to a short duration – *e.g.*, less than 5 minutes – likely determined by the Balancing Authority and the Independent System Operator ("ISO").

C. PFR is well-situated to be procured as a competitive market product that ensures efficient solutions and guarantees headroom and performance.

In line with past efforts to focus on competitive markets to ensure efficient grid management and reliability, such as with Order No. 888, Order No. 1000, and Order No. 784, FERC has an opportunity to direct more efficient and competitive markets for PFR. Alternatively, FERC may choose to authorize regional solutions. FERC has precedents for allowing regional solutions, such as in FERC's Final Rule on the coordination of scheduling processes of interstate natural gas day and energy market timing.[5]

Importantly, PFR is not location specific and can be provided across a BAA. This aspect of PFR allows for broad competition and greatly diminishes market power concerns (and subsequent market power mitigation needs). Compensation for PFR and headroom will also select for the most efficient PFR providers, rather than requiring PFR of all providers or allowing operator discretion in 'set-points' for PFR, which may be inefficient and may not be reflected as opportunity costs. This in turn incents only competitive PFR resources that will elect to compete in this service, and resources that do not choose to compete may elect to forego installing and programming PFR capabilities, or may adjust governor settings accordingly.

The providing of headroom may be costly, and requiring headroom 'as a cost of doing business', similar to how some resources forego revenues when directed to provide voltage support, can be inefficient. CESA is particularly concerned that an interconnection-based approach could lead to cases where headroom is directed upon many resources uneconomically

[5] Order No. 809, Docket No. RM14-2-000. *Coordination of the Scheduling Processes of Interstate Natural Gas Pipelines and Public Utilities, Notice of Proposed Rulemaking*, 18 CFR Part 284 (April 16, 2015), 151 FERC ¶ 61,049 (2015) (NOPR).

and without regard to opportunity cost or performance efficiency. Whereas voltage support is very locational in nature and less suited to a competitive product, PFR is very well suited to a product-style procurement and service. FERC should avoid using any interconnection-response based voltage providing rule as a template for PFR.

D. FERC has time to reconsider and redirect any Final Rule away from an interconnection-based approach and could augment its record for a revised NOPR focused on market-based solutions.

Action is not needed right away and there is no near-term grid reliability threat forecast due to any lack of a PFR rule. Even in California, where fleet transformation away from spinning generators and towards inverter-based generation is well underway via an aggressive Renewable Portfolio Standard ("RPS") policy and relatively significant electric storage procurement actions and market developments, the CAISO has an existing PFR solution in place to achieve near-term compliance with NERC BAL-003. Ironically, progress on any enhancements to the CAISO's PFR solutions have been slowed by the potential for a Final Rule from FERC on PFR. While CESA salutes FERC for its diligence, the fact remains that further time is available to change course from the NOPR. CESA greatly appreciates consideration of its views and of any further work involved by FERC in determining the ideal nationwide PFR policy approach, if any. Of course, this important work should focus on ensuring reliability in reasonable and cost-effective or competitive manners.

CESA appreciates that FERC focuses on and relies on a record built over time. In some cases, particularly with new tools and expanding capabilities and thinking on grid-related roles for electric storage, it may be helpful to ensure the record is as robust as can be for a final determination. In this manner, FERC can rely on a solid and clear public process while also ensuring policy outcomes reflect the latest or most critical findings.

FERC has precedent for allowing regional solutions and thus should consider whether regional solutions or competitive market products are more efficient and better suited to address PFR needs over a national interconnection-based approach.

E. If FERC chooses to take an interconnection-based approach for PFR providing, it should ensure that opportunity costs and variable operating and maintenance costs such as 'fuel costs' are recoverable.

When some electric storage solutions provide PFR, they do so in large bursts. This is different from traditional generators which, through a governor, provide PFR while still delivering on presumably large energy schedules. This means that electric storage can have proportionally large 'fuel costs' for the delivery of PFR. Other variable operations and maintenance ("O&M") costs, such as a warranty violation, can also be costly. These costs should all be recoverable. Allowing recovery of these costs may be difficult through an interconnection-based approach, and market-product type of solutions or regional solutions should be used instead.

Similar with other generators, any headroom reserved for PFR may create an opportunity cost for a resource. Such opportunity costs can be accounted for via market mechanisms, such as in-market products, but less so via interconnection agreements. CESA recommends any interconnection-based approach, if used, fully authorize cost-recovery for these real and material electric storage expenses as well.

F. CESA's responses to FERC's Supplemental Request for Comments respectfully indicate that FERC should redirect any Final Rule to support regional solutions or to require in-market product-style solutions.

CESA offers the following responses to selected questions raised in the Notice of Supplemental Request for Comments. Not all questions (which are bolded and italicized below)

are answered, although CESA may still have views on all matters discussed in the NOPR and Supplemental Request.

1. **Some commenters state that certain proposed requirements are not appropriate for electric storage resources, in particular, certain of the proposed settings related to droop (e.g., basing the droop parameter on nameplate capacity) and the requirement for timely and sustained response to frequency deviations.**

    a. **Are there challenges or operational implications (e.g., unusual or excessive wear and tear) of requiring electric storage resources to implement the proposed operating settings for droop (including basing the droop parameter on nameplate capacity), deadband, and timely and sustained response? If so, please provide an explanation, and explain how these challenges are different than those faced by other synchronous and non-synchronous generating facilities.**

For electric storage resources, the providing of potentially large bursts of PFR for longer periods of time can affect the finite cycle life or finite energy throughput of electric energy storage solutions. This in turn means that there are likely more variable O&M effects on electric storage resources than on traditional large spinning generators, which can deal with providing PFR without major O&M costs and can provide PFR only as a small percentage of total energy delivered.

    b. **Also, please explain whether and how possible impacts of the proposed requirements on electric storage resources vary by their state of charge, and whether those possible impacts are the same or different for all electric storage technologies. If these impacts vary by the type of electric storage technology, please elaborate.**

Each electric storage technology will likely have its own unique variable O&M costs and needs that could vary widely depending on the depth and duration of provided PFR. Standardizing this is likely to be difficult and perhaps inaccurate, creating inefficiencies in cost recovery.

c. If the proposed operating settings for droop, deadband, and sustained response would cause any operational or other concerns unique to electric storage resources that would justify different operating settings than those proposed in the NOPR, what minimum requirements for droop, deadband, and timely and sustained response might be more appropriate for the effective provision of primary frequency response from electric storage resources? Or are there parameters other than those discussed in the NOPR (e.g., droop, deadband) that are more applicable to electric storage resources that could be used to accomplish effective timely and sustained primary frequency response? If so, what would those parameters be?

CESA recommends an opt-in, product-style solution, where resources choose to provide PFR pursuant to a product design effort and competitive procurement. This approach allows for more regional and merchant determination on the proper droop, deadband, and sustained response settings. BAL-003 and other rules direct the systems performance requirements and products can be designed to meet these requirements.

2. Please describe the relationship between electric storage resources being online and the providing of primary frequency response.

a. Are electric storage resources that are always online available on a more frequent basis to provide primary frequency response than generating facilities that start-up and shut-down (i.e., go offline)? If so, please elaborate on possible operational or other impacts, if any, that the proposed requirements may have on generating facilities that are always online, as compared to generating facilities that go offline.

It is possible to have inverters that prevent providing of PFR in 'non-committed' periods. Any interconnection-standard should authorize 'gating' or the restriction from providing PFR when not committed. Behind-the-meter electric storage or electric storage resources as non-wires transmission assets (even if in an authorized multiple-use application) will also need this capability. Importantly, electric storage in a multiple use application that is providing generation at times and transmission at times may interconnect under an LGIA or SGIA, and so rules should

explicitly accommodate gating at the correct times – *e.g.*, when not committed for market services.

3. Please explain what is meant by "minimum set point" and elaborate on how and by whom it would be defined and determined.

This question highlights the complexities and challenges of an interconnection-based approach in terms of how to gate or 'control' the amount of PFR from a resource. Instead, products directed to be developed regionally with in-market compensation can readily factor in key information for PFR services, including any minimum set-points. Many products in the wholesale markets are based on capacity availability, which can be determined via market participation interfaces (*e.g.*, the 'master file') or the bids, granting market solutions a superior ability to manage state of charge or the clear use of available capacity ranges from a resource.

4. Please explain what is meant by "inadequate state of charge" and elaborate on how and by whom it would be defined and determined.

An inadequate state of charge is likely to be very resource specific and linked to the duration of PFR services expected (if any), contracts, and circumstances. In theory, this question focuses on a situation where a storage resource has too little energy left to provide a sustained PFR burst of indeterminate duration. This is a reasonable concern for a resource potentially obliged to provide PFR even if off-line or where the PFR burst is large compared to any energy schedule. Moreover, this question also highlights the complexities and challenges of an interconnection-based approach in terms of how to gate or 'schedule' the amount of PFR from a resource. Instead, products directed to be developed regionally with in-market compensation can readily factor in key information for PFR services.

5. What impacts, if any, would owners/operators of electric storage resources experience if their resources are not allowed to maintain a specified range of state of charge?

Electric storage resources have many capabilities for PFR, but are also energy limited and have lifetime throughput and cycling limitations. The management of a state of charge is important for managing wear and tear and for meeting other or subsequent obligations or schedules, and are fundamental to electric storage resources operations, warranties, and contracts. While the state of charge is not explicitly linked to PFR capabilities, the prospect of an unspecified duration and amount of PFR capability creates concerns that state of charge could not be reasonably managed and that costly damage or missed schedules or obligations could occur. These negative outcomes can be extremely material and would constitute an unreasonable burden on electric storage resources without appropriate exemptions or protections.

6. In lieu of (1) establishing a minimum set point for electric storage resources and (2) including an inadequate state of charge as an operational constraint, could owners/operators of all or certain types of electric storage resources or another entity specify an operating range 16 outside of which electric storage resources would not be required to provide and/or sustain primary frequency response to prevent adverse impacts on the electric storage resources?

a. Would it be possible to base such an operating range on manufacturer specifications and, if so, would establishing such an operating range potentially address concerns about the harm to the resource, degradation of its useful life, or other potential adverse impacts?

No. Inverter settings are generally more important than PFR settings and many electric storage technologies likely will need different standards and programming for providing and delivery of PFR. Furthermore, inverters are not often designed for a specific electric storage technology at the time of manufacture. Inverter settings are often customized when placed with already manufactured electric storage solutions. One option for standardizing PFR for electric

storage is to explore and use IEEE 1547, as this forum may be appropriately technical to consider the many permutations and barriers to standardizing at the manufacturing stage. CESA recommends that FERC allow for in-market solutions and regional solutions so that difficult-to-come-by standards will not be needed at this time.

7. Are there other mechanisms or ways to address the concerns raised by ESA and others on the proposed primary frequency response requirements instead of: (1) establishing a minimum set point and including an inadequate state of charge as an operational constraint; or (2) establishing an operating range as described above.

Yes. CESA strongly recommends a competitive market product approach where headroom is compensated, services are only provided through 'on-line' and committed resources, and resources choose to be eligible to compete in a regionally directed and specified product where they can bid for services.

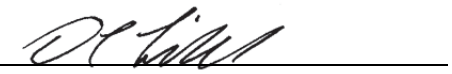
V. CONCLUSION

CESA supports FERC's deliberations on if and what rules are appropriate for ensuring sufficient PFR exists in the grid. While the NOPR focused on an interconnection-based approach, this Supplemental Request highlights that an interconnection approach is complicated and may work poorly for electric storage without more specificity. Even then, the interconnection approach could miss an opportunity to develop a new and competitive 'in-market' product-style solution, which works helpfully and more efficiently for reliability.

CESA appreciates FERC's consideration and hopes the record can be expanded to allow for a Final Rule that directs either regional solutions and no interconnection-based approaches stylized after voltage support rules, or that directs the development of a market product. With the benefit of this kind of clear and new direction from FERC, CESA looks forward to continuing collaboration with the CAISO and other stakeholders to develop the detailed

implementation frameworks needed to effectively respond to reliability requirements like BAL-003.

Respectfully submitted,



Donald C. Liddell
DOUGLASS & LIDDELL

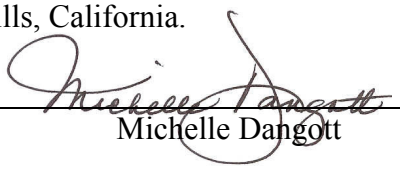
Counsel for the
CALIFORNIA ENERGY STORAGE ALLIANCE

October 10, 2017

CERTIFICATE OF SERVICE

I hereby certify that I have this day served a copy of ***Motion to Intervene and Comments of the California Energy Storage Alliance*** on all parties of record in proceeding ***RM16-6-000*** by serving an electronic copy on their email addresses of record and by mailing a properly addressed copy by first-class mail with postage prepaid to each party for whom an email address is not available.

Executed on October 10, 2017, at Woodland Hills, California.



Michelle Dangott

acchan@bpa.gov
aclair@thompsoncoburn.com
adrian.pye@ieso.ca
afishman@eei.org
allen.schriver@nexteraenergy.com
amckenna@caiso.com
andrew.wells@aes.com
atunnell@balch.com
aulmer@caiso.com
aweinst@entergy.com
bblair@thompsoncoburn.com
berman@wrightlaw.com
bewatson@tesla.com
blake.urban@bracewelllaw.com
candice.castaneda@nerc.net
capp@gridstorageconsulting.com
cara.lewis@pseg.com
casey.roberts@sierraclub.org
charlie.berardesco@nerc.net
cheri.m.yochelson@dominionenergy.com
christina.bigelow@pinnaclewest.com
cpatka@nyiso.com
craig.glazer@pjm.com
craig.silverstein@marchcounsel.com
cynthia.bogorad@spiegelmcd.com
deanna.king@bracewelllaw.com
dex@smxblaw.com
dhartman@rstreet.org
diane.watkins@xcelenergy.com
dpatterson@publicpower.org
dscott@peakrc.com
ebaran@westernenergyboard.org
eela@epri.com
erin.moore@sce.com
eservice@spiegelmcd.com
ferccaseadmin@sce.com
gbaker@semprautilities.com
gdj@dwgp.com
ggrace@awea.org
hjacob@nteenergy.com
howard.illian@energymark.com
j.moroz@jennifermoroz.com
james.burlew@pjm.com
jbixby@itctransco.com
jcy5@pge.com
jennifer.spina@pinnaclewest.com
jhilton@idahopower.com
jhorgan@iso-ne.com
jhughes@elcon.org
jmurphy@naruc.org
jodi.moskowitz@pseg.com
jonathan.schneider@stinsonleonard.com
jramsay@naruc.org
jshakespeare@provencompliance.com
jsweeney@nyiso.com
jtwitty@tapsgroup.org
kenneth.carretta@pseg.com
kts1@pge.com
latif.nurani@spiegelmcd.com
leslie.freiman@edpr.com
lin.franks@aes.com
lmaile-smith@iso-ne.com
lmorrison@iso-ne.com
lou.oberski@dom.com
lsg@dwgp.com
m.nielsen@ieee.org
maia.chase@ieso.ca
marisa.hecht@nerc.net
mark.lauby@nerc.net
mcalcara@sunflower.net
mcaley@iso-ne.com
mgalbraith@westernenergyboard.org
mharnish@misoenergy.org
mike.benn@powerex.com
misolegal@misoenergy.org
mjacobs@ucsusa.org
mkessler@misoenergy.org
mparke@firstenergycorp.com
mrc@dwgp.com
mrh2@pge.com
mscalvert@tva.gov
mwsmith@ci.tacoma.wa.us
nancyb@epsa.org
nsaracino@weawlaw.com
paul.breakman@nreca.coop
pennington5@verizon.net
pjs@dwgp.com
pmills@semprautilities.com
psuskie@spp.org
randall.griffin@aes.com
randolph.elliott@nreca.coop
raymond.depillo@pseg.com
rbergmeier@sunflower.net
rbidstrup@cgsh.com
reed@wrightlaw.com
rfernandez@nyiso.com
rmasiello@quanta-technology.com
robert.davis@chelanpud.org
robert.eckenrod@pjm.com
robert.kang@sce.com
rshelley@misoenergy.org
rshelton@thompsoncoburn.com
rsmit56@entergy.com
rstalter@nyiso.com
sburbure@firstenergycorp.com
shamai.elstein@nerc.net
skeegan@nyiso.com
skozal@weawlaw.com
sph@nei.org
stephen.hug@bracewell.com
steve.wright@chelanpud.org
stevekozey@misoenergy.org
steven.williams@aps.com
tparadise@iso-ne.com
tracey.bradley@bracewell.com
twoolley@tristategt.org

APPENDIX

Below are slides and remarks presented by CESA at a CAISO working group meeting on February 9, 2017 in the Frequency Response Phase 2 Initiative. These remarks highlight how energy storage is very well-suited to provide frequency response in a reasonably designed market product.

CESA
CALIFORNIA ENERGY STORAGE ALLIANCE

Primary Frequency Response – Energy Storage

February 9, 2017

CESA Members

Board Members

8minutenergy · Advanced Microgrid Solutions · AES · AltaGas · EastPenn · ecoult · LG Chem · LS Power · NextEra Energy Resources · nrg · SolarCity · stem · Wellhead

General Members

Amber Kinetics	Energy Storage Systems	Mercedes Benz R&D NA	Sharp Labs
Bright Energy Storage	eMoterWerks	NEC Energy Solutions	Southwest Generation
Brookfield Renewables	Enphase Energy	NEXTracker	Sovereign Energy
Consolidated Edison Development	Geli	NGK Insulators	STOREME Inc.
Customized Energy Solutions	Green Charge Networks	NICE America Research	Sumitomo Electric
Demand Energy	Greensmith Energy	OutBack Power Technologies	Sunrun
Doosan GridTech	Gridscape Solutions	Parker Hannifin Corporation	Swell Energy
Eagle Crest Energy	Gridtential Energy	Qnovo	Tri-Technic
EDF Renewable Energy	Hitachi Chemical Company	Recurrent Energy	Younicos
ElectrIQ Power	IESoftworks	RES Americas	
	Johnson Controls		
	Lockheed Martin AES		

CESA

Where we are…

The Problem?

» Fleet and rules changes driving consideration Primary Frequency Response (PFR) provision.

- PFR is important
- No financial incentives to provide this critical service
- No longer workable to assume PFR will be provided 'for free'

Solution?

» An **in-market constraint or product can incent capability and performance** while compensating for opportunity costs
- CAISO Markets should reserve PFR capability and service

» Constraint/Product design should **include mechanisms for calculating how much PFR resources can provide**
- Not all resources provide PFR equally or linearly

PFR: *"In-Market"* Design

» How an in-market constraint or product would work:
- Day-Ahead and Real-Time Markets solve for constraints and products, including reserving capacity/capability for PFR provision
- When dispatched, resources also settles for energy (like Regulation)

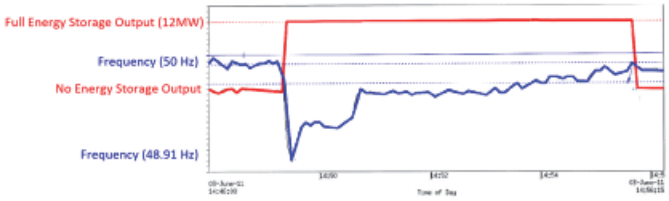
» How much PFR capability (in MW of PFR service) is procured
- ISO to determine based on BAL-003 need

» Procured from whom?
- From eligible resources if so equipped/capable and with deliverable and countable PFR capability

» How to determine capability of PFR from a resource
- Counting metric is: "MW capable and delivered/ MW reserved"
  - "1/1" is very efficient, but ".1/1" is less efficient
- Easy to determine/know PFR capability from some resources
- May need methodology for determining amount *of* PFR available from some resources.
- Duration of PFR 'burst' (in terms of energy backing a MW of PFR) may need definition.

PFR from Energy Storage

- Efficient provider of PFR, a.k.a. "1:1"
- Autonomous, instantaneous response & contribution
- Most storage has sufficient energy, e.g. ≥ 15 min., for PFR service.
- Fully configurable: rate of response, time-delay, deadband
- Bi-directional if required (under and over freq. support)



Source: https://www.neoen.com/assets/CIGRE-Frequency-Response-from-Autonomous-Storage-Units2.pdf

Appendix

- Storage can be programming for any desired PFR responses.
  - (MW/0.1Hz, time-delay, deadband etc.)