BEFORE THE PUBLIC UTILITIES COMMISSION

OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider Long-Term Procurement Plans.	Rulemaking 10-05-006 Filed May 6, 2010

REPLY COMMENTS OF THE CALIFORNIA ENERGY STORAGE ALLIANCE ON RENEWABLE INTEGRATION MODELING METHODOLOGY

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October 8, 2010

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Pursuant to the California Public Utilities Commission's ("Commission's") Rules of Practice and Procedure and the *Administrative Law Judge's Ruling Requesting Comments on Renewables Integration Models* issued by Administrative Law Judge Victoria S. Kolakowski on September 8, 2010, as supplemented by a September 17, 2010, notice of ruling granting an extension of time for filing reply comments, and a second notice of ruling posing specific questions for response by parties, and further extending the due date for filing Reply Comments until October 8, 2010 ("ALJ's Ruling"), the California Energy Storage Alliance ("CESA")[1] provides the following reply comments.

I. INTRODUCTION.

In its Opening Comments,[2] CESA stated that it plans to work collaboratively with the Commission and parties to this proceeding to expeditiously advance implementation of the energy storage policy recommendations in the "White Paper" published by the Commission on July 9, 2010.[3] With the signing into law by Governor Schwarzenegger of AB 2514 (Skinner) [4],

[1] The California Energy Storage Alliance consists of A123 Systems, Altairnano, Applied Intellectual Capital, Beacon Power Corporation, Chevron Energy Solutions, Debenham Energy, Deeya Energy, East Penn Manufacturing Co., Inc., Enersys, Enervault, Fluidic Energy, Ice Energy, International Battery, Inc., Primus Power, Powergetic, Prudent Energy, PVT Solar, ReStore Energy Systems, SAFT, Samsung SDI, SEEO, Suntech, Sunverge, SustainX, and Xtreme Power. The views expressed in these Comments are those of CESA, and do not necessarily reflect the views of all of the individual CESA member companies. http://www.storagealliance.org.

[2] *Post-Workshop Comments of the California Energy Storage Alliance on Renewable Integration Modeling,* filed September 21, 2010.

[3] *Electric Energy Storage: An Assessment of Potential Barriers and Opportunities*, *Commission Policy and Planning Division White Paper,* July 9, 2010

[4] California Statutes, Chapter 469, September 29, 2010.

directing the Commission to open a new proceeding dedicated exclusively to energy storage, CESA will redouble its efforts to assure that energy storage is also appropriately addressed early and often in this proceeding.

Unfortunately, the fact that two different models are being developed concurrently with and based on the 20%[5] and 33%[6] Renewables Portfolio Standard ("RPS") studies (that are themselves works in progress) and the system plans of each of the utilities is causing a "leap frog" effect that is difficult for all stakeholders to deal with. For example, the California Independent System Operator ("CAISO") is still seeking comments on its 20% RPS study that are due on October 14, 2010 and the Commission has scheduled a workshop to discuss the 33% RPS study on October 22, 2010. CESA will continue to strike a consistent chord in this proceeding that any modeling that is not capable of taking energy storage into account has little or no value to the Commission or the parties. Further, the capability to model the benefits and costs of energy storage will be critical requirement for the implementation of AB 2514.

II. CESA SUPPORTS THE OPENING COMMENTS OF PARTIES THAT QUESTION THE VALUE OF THE MODELING APPROACHES PRESENTLY PROPOSED BY PG&E AND THE CAISO.

CESA certainly agrees with the statement in SCE's Opening Comments that: ". . . energy storage facilities, such as pumped hydro or combined solar thermal/molten salt, should have an opportunity to compete in the market for flexible resources." (SCE Opening Comments, p. 6). CESA also agrees with: "SCE's opinion, based on comparison to the CAISO Plexos renewable integration production model, is that the PG&E Model's overly simple input assumptions and methodology limit the value of the Model." (SCE Opening Comments, p. 19). In addition, CESA agrees that ". . . . there is major concern that the model lacks the flexibility to independently evaluate the benefits of using different technologies to integrate renewable resources. . . The Model should be refined to determine specific resource need based on each technology's ability to provide the needed services. (SCE Opening Comments, p. 26).

In the same vein, CESA agrees with the statement in SDG&E' Opening Comments that: "Both the CAISO and PG&E models attempt to identify future needs, however many questions

[5] *Integration of Renewable Resources: Operational Requirements and Fleet Capability at 20% RPS*, August 31, 2010.
[6] ISO Study of Operational Requirements and Market Impacts at 33% RPS, August 24, 2010.

regarding the proposed methodologies remain unanswered and more analysis is required to determine whether either model produces results that can be relied upon in making resources commitments." (SDG&E Opening Comments, p. 2). "It appears from the descriptions set forth in the models, for example, that their focus is strictly on identifying the renewable integration needs that can be supplied by existing conventional dispatchable resources and the addition of new gas-fired combustion turbines. This approach is too narrow; instead, all possible tools, including changes in dispatch, improvement in forecasting tools and scheduling should be considered." (SDG&E Opening Comments, p. 3). SDG&E also states that ". . . a study of 33% renewable cases set forth in a recent KEMA report "Research Evaluation of Wind Generation, Solar Generation, and Storage Impact on the California Grid" sponsored by the California Energy Commission ("CEC"), seems to indicate that modifying certain operating protocols, and/or incorporating fast response resources such as electric storage, may greatly help with the integration of variable resources." (SDG&E Opening Comments, p. 4).

It is also of interest to note that, in comments submitted to the CAISO on October, 4, 2010 in relation to a CAISO "Catalogue of Initiatives,"[7] PG&E itself supports modeling of many different energy storage technologies when it criticized the CAISO's proposed pumped storage generation modeling as follows:

> "[Pumped Storage Generation Modeling] Should Be Expanded to Include Basic Modeling of Any Energy Storage Technology: The current description of this initiative simply states that pumped Hydro units should be modeled more appropriately. However, there are also other energy storage technologies that are currently not modeled well in the CAISO markets. Rather than creating an entire initiative for one technology, we suggest that this initiative be expanded to facilitate the basic buying and selling of energy from all storage devices and their integration into other CAISO markets." (PG&E Comments, p. 4).

III. CESA PROVIDES THE FOLLOWING RESPONSES TO THE QUESTIONS POSED IN THE ADMINISTRATIVE LAW JUDGE'S RULING ISSUED ON OCTOBER 1, 2010.

CESA responds to the questions posed in the Administrative Law Judge's Ruling as follows:

(1) With regard to the data used to develop wind and solar generation profiles:

(a) Is the data used by CAISO and PG&E adequate and appropriate?

[7] Draft Catalogue of Market Design Initiatives, September 13, 2010.

(b) If the data inadequate or inappropriate, what alternative data is currently publicly available?

(c) Would using any alternative data have a material impact on the model's results? Please explain.

(d) What impact would changing the data have on the timing of the release of updated model results with the updated assumptions that will be employed in the 2010 LTPP cycle?

Response: The impact of the renewable generation will be felt in several ways – for distributed photovoltaic resources installed on commercial buildings the effect will be local power quality issues such as voltage flicker and can be mitigated with distributed energy storage. The modeling capabilities would require sub-minute based data to forecast power and voltage swings on local circuit lines. For remote larger scale renewables the effects will be felt on the transmission lines, and the CAISO will respond those issues via more "real time dispatch" of regulation services.

The best modeling data would be the 4 second automatic gain control ('AGC") signal for regulation services and the generator response to the signal. The concern is that these "at ready" resources will have sub-optimal operating efficiencies in both heat rate and post-combustion controls. This will lead to more criteria and GHG emissions than would normally be realized, which would reduce the desired effect of deploying renewable assets. The technical basis for this sub-optimal performance is explained in an often-cited Carnegie Mellon Report[8] and a paper recently released the Massachusetts Institute of Technology that provides a method for analyzing the data that is attached to these comments for ease of reference as Attachment A.[9]

(2) With regard to adjusting forecast errors associated with renewable generation to reflect the geographic diversity of generation:

(a) What inputs and methodologies for development of wind and solar forecast errors should be used?

(b) Would using this data have a material impact on the model's results? Please explain.

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[8] *Air Emissions Due to Wind and Solar Power*, Carnegie Mellon Electricity Center, October 23, 2008.

[9] *Energy Storage for Use in Load Frequency Control,* Massachusetts Institute of Technology, Paper presented at 2010 IEEE Conference on Innovative Technologies for an Efficient and Reliable Electricity Supply, September 27, 2010.

(c) What impact would changing the data have on the timing of the release of updated model results with the updated assumptions that will be employed in the 2010 LTPP cycle?

Response: CESA reserves comment on this topic and defers to other parties at this time.

(3) With regard to the number of standard deviations used to select values from distributions of operational flexibility requirements (i.e. regulation up, load-following up etc.):

(a) Should the selected number of standard deviations be changed in the CAISO and PG&E analysis, or is this a policy question that the Commission should address in the LTPP once the scenarios, portfolios, and renewable integration results are available?

(b) What impact would this change have for system reliability, if it differs from WECC or other requirements?

Response: CESA reserves comment on this topic, but would observe that granularity in the data and the analysis is key to driving better performance.

(4) Should day-ahead commitment be included as an operational flexibility requirement? Please explain.

Response: Yes, as that is how current ancillary services markets are structured.

(5) Is it appropriate to treat separate operational flexibility requirements as additive?

Response: Several important new energy storage technologies, notably flywheels and advanced batteries are designed specifically to provide fast response regulation. The Pacific Northwest National Laboratory, in "Assessing the Value of Regulation Resources Based on Their Time Response Characteristics"[10] *concluded that if the CAISO dispatched fast-responding regulation resources, it could reduce its regulation procurement by as much as 40 percent. More recently KEMA did a study in June 2010 for the California Energy Commission which concluded that "a 30 - to - 50 MW storage device is as effective or more effective as a 100 MW combustion turbine used for regulation purposes."*[11] *Because of the benefits to operational flexibility provided by fast response storage technologies, utilities should be allowed, if not*

[10] Makarov, Y.V., Ma, J., Lu, S., Nguyen, T.B. *Assessing the value of Regulation Resources Based on Their Time Response Characteristics. Pacific Northwest National Laboratory, PNNL – 17632, June 2008.*

[11] *"Research Evaluation of Wind Generation, Solar Generation, and Storage Impact on the California Grid*, Study by KEMA, Inc., done for California Energy Commission, page 6, June, 2010.

encouraged, to procure regulation separately from these resources. As noted earlier, peak-shifting storage also provides necessary operational flexibility for utilities and the CAISO in several regards beyond regulation services, including smoothing intermittent performance of weather-related renewables, time-shifting overnight surplus power generation so that it is available when needed on peak (or needed off peak for that matter is there is an unanticipated shortfall in generation), and in reducing power quality issues associated with the cycling of air conditioning induction motors.

Existing fossil fuel-powered plants displaced by energy storage can be shifted to provide a corresponding amount of spinning and non-spinning reserve, thus providing significant additional operational flexibility. If a utility's long-term procurement plan does not sufficiently utilize energy storage, including these new technologies, it would miss a major opportunity to improve the flexibility and cost-effectiveness of integrating renewable resources.

(6) Regarding the use of hourly instead of sub-hourly time intervals for determining operational flexibility requirements:

(a) What material impact does the use of hourly instead of sub-hourly time intervals for determining operational flexibility requirements have upon the analysis provided by CAISO and PG&E?

Response: The use of hourly time intervals will likely underestimate the quantity of regulation-up and –down required. Since WECC and NERC standards measure Area Control Error on 10-minute intervals, the use of an hourly interval could mask intra-hour violations of applicable standards.

(b) What impact would the use of sub-hourly time intervals have on the timeliness of producing model results?

Response: Sub-hourly time intervals are critical to determining operational flexibility requirements. Sub-hourly intervals may increase the time required to produce model results. However, the additional study duration must be balanced with the need for much more realistic results.

(7) Are <u>historical</u> case runs (as opposed to 'all-gas' or 20% renewables case runs simulating 2020 scenarios) necessary for the validation of models? Please be specific about the number of runs, which specific runs or combination thereof are necessary.

Response: AGC time granularity based computer simulations that are based on key operating times such as morning and evening ramp rates during seasonal changes such as fall/ spring and summer and winter peaks would be appropriate.

IV. CONCLUSION.

CESA thanks the Commission for this opportunity to submit these reply comments and looks forward to continuing a constructive dialogue with parties and the Commission.

Respectfully submitted,

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ATTACHMENT A

Energy Storage for Use in Load Frequency Control

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***Abstract*—*Certain energy storage technologies are well-suited to the high-frequency, high-cycling operation which is required in provision of load frequency control (LFC). To limit the total stored energy capacity required while reducing the cycling burden on traditional thermal generators, the LFC signal may be split between thermal generators and energy storage units. To evaluate the dispatch of energy storage units in concert with thermal generators, this paper presents energy-duration curves and ramp-rate-duration curves as graphical tools. The energy storage requirement and thermal ramping requirement may also be graphically compared to provide insight for cost evaluations.*

I. INTRODUCTION

Traditional thermal generators are limited in their ability to provide load frequency control (LFC) because of restrictions on power ramp rate. [1]–[3]. By contrast, certain energy storage devices are well suited to such high-frequency, high-power cycling operation [4]–[6].

The approach described in this work is to split the LFC signal between two dissimilar sets of assets: nimble but lower-capacity energy storage units, and slower traditional thermal generators. The goal is to decrease the fuel and maintenance requirements of the thermal generators and to enable the integration of variable generation resources that can increase LFC requirements [7]. Further, this approach may enable better provision of LFC through the use of storage to track fast fluctuations without increased cost. This paper proposes graphical tools for use in evaluating the suitability and dispatching of an energy storage unit for LFC duty. Also proposed is a broad strategy for incorporating the storage in dispatch.

The use of energy storage units for LFC has been limited by the concern that they will unexpectedly be completely filled or emptied and hence be made unavailable. The graphical tools suggested here, called energy-duration curves and ramp-rate-duration curves, seek to manage and inform the dispatch of energy storage for LFC. Using these tools on a representative data set, it is easy to see the net energy storage and ramp rates that LFC requires. Unit outage rates due to insufficient energy capacity may be predicted based on historical data and the system may be designed to avoid or mitigate any such outages. Different methods for dividing the power signal between energy storage and thermal assets may then be easily compared using the curves.

II. BACKGROUND

Load frequency control, or the minute-to-minute adjustment of generated power on the grid to follow fluctuations in load, is traditionally provided by baseload, mid-merit, or peaking thermal plants running at part load [1]. This is an expensive mode of operation, because in addition to the efficiency penalty imposed by part-load operation, the plants also suffer an additional efficiency penalty when throttling [8], [9]. The varying output power can also increase maintenance costs and increase wear and tear on the plants [3]. Even so, the LFC performance of these plants may not be sufficient for good grid control, as response times and ramp rates are limited [2].

By contrast, energy storage plants can be very well suited to the provision of LFC. Some energy storage technologies (such as flywheels and some battery chemistries) are very nimble and can rapidly change power settings with virtually unlimited ramp rates [4]. Unlike in arbitrage applications like load-shifting, in this application a small energy capacity is not a major difficulty. Some energy storage plants have successfully been incorporated into the electric grid for frequency control [5], [6], [10]. Still, the use of energy storage for this application is not widespread.

The use of energy storage units for LFC requires some different analytical tools from those associated with traditional thermal generating units. Because of the mixture of time scales in this problem, time-series graphics of LFC power requirements offer little insight. For thermal units, the load-duration curve is a useful tool for examining use patterns [11]. However, load-duration curves provide no information on ramp rates or required net energy delivery. Fourier decompositions also fail to provide insight into net energy and ramp rate because the magnitude and phase decompositions are not easily interpreted. When using an energy storage unit in concert with thermal units, two related metrics become more important. The first we shall call the ramp-rate-duration curve, and the second the energy-duration curve.

III. DIVIDE REGULATION BURDEN

The main approach taken in this paper is to divide the burden of LFC between fast energy storage units and slower traditional thermal generators [12]. In this way, the energy storage can assume the fastest-cycling portion of the required

[1]Paper No. 631

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LFC and allow thermal generators to be operated at steadier conditions. This approach is illustrated in Fig. 1.

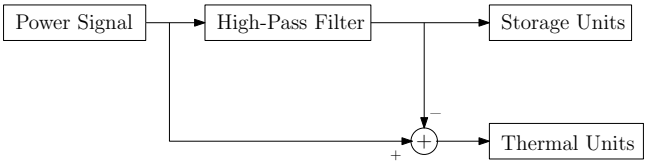

Fig. 1. Block diagram of scheme to partition load frequency control signal between thermal generators and energy storage units.

To demonstrate this concept, this paper uses a data set from a United States balancing area which includes 10-second total control area load. The data set runs for 9 non-consecutive days representing different load conditions and times of year. All data processing is done on each day individually to avoid artifacts due to the discontinuity between days. The raw load data is initially processed through a 5-point median filter to remove anomalous data spikes. This minimally processed load data is included as Fig. 2. This data is used in the following sections to illustrate the techniques which are described.

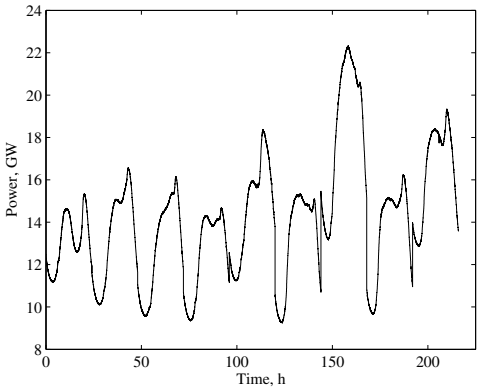

Fig. 2. Total load power in a balancing area on 9 non-consecutive days. Data points are sampled every 10 seconds. Note that discontinuities between days do not represent actual step changes in load and each day is processed individually in figures that follow.

IV. Ramp-Rate-Duration Curve

The ramp-rate-duration curve displays the use of ramping capability in much the same way as a load-duration curve displays the use of (thermal) power capacity. It is a visual representation of the fraction of time that a certain total ramp rate is required of a generating system. A ramp-rate-duration curve can be constructed by first determining the ramp rate by taking the derivative (or finite differences) of the dispatched power curve. The ramp-rate-duration curve is then created by tallying the fraction of time the ramp rate is at or below a certain level, for example by sorting the ramp rate curve data [13].

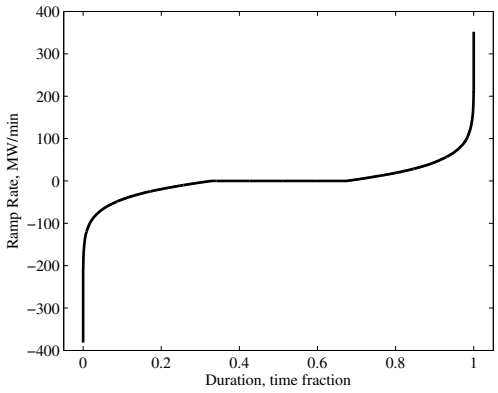

Fig. 3. Ramp-rate-duration curve for total area load power (corresponding to Fig. 2). The large ramp rates are difficult and expensive for thermal generators to produce.

The ramp-rate-duration curve corresponding to Fig. 2 is in Fig. 3, where a small number of outlying points have been removed.[2] The flat portion in the center of the curve is due to the use of the median filter. This figure clearly indicates the potentially large ramp rate requirement of the regulation signal, compared to the capabilities of thermal units. Although some of the larger ramp rates indicated by this plot may be due to data collection errors, the data indicate an average absolute ramp rate of about 24 MW/min, out of a total generating capacity of 10-20 GW [1].

The reason for using a ramp-rate-duration curve stems from a performance difference between traditional thermal assets and energy storage units. While in general energy storage units are able to ramp from one power level to another very quickly, ramping with thermal units is slow and is more expensive than steady state operation [2]–[4]. From the ramp-rate-duration curve of an LFC signal sent to a thermal unit, both the maximum ramp rate to be required of the unit and the fraction of time the unit is ramping at any given rate are clear.

V. Energy Duration Curve

The energy-duration curve is similar to the ramp-rate-duration curve, but tallies net energy required at each instant. It is primarily of interest for resources that cannot deliver nonzero average power. Because a nonzero average power value will lead to a ramp in energy upon integration, the low frequency components of a power signal must be removed before an energy-duration curve is created. As an illustration, a Chebyshev type I high-pass filter of order 3 is used to

[2]Ramp rate points outside of 5 standard deviations were removed if their absolute values exceeded 4 times the absolute value of neighboring points on both sides. This intentionally conservative method for detecting telemetry errors resulted in the removal of less than 0.1% of data points. Some remaining points may also be the result of telemetry errors. Balancing Area engineers indicated that sustained load ramps do not generally exceed about 40 MW/min, although ramp rates for shorter changes may be higher.

separate high-frequency and low-frequency components. The break frequency of this filter is approximately 1/60 minutes. The high-frequency and low-frequency components of the signal are illustrated in Fig. 4.

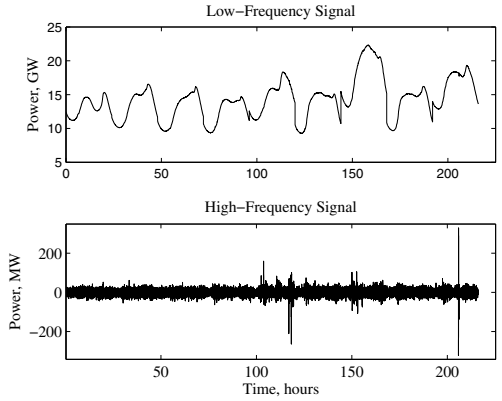

Fig. 4. High- and low-frequency portions of the total power signal of Fig. 2 using a Chebyshev type I filter of order 3, with a cutoff frequency of approximately 1/60 min, in a scheme like that illustrated in Fig. 1. The sum of the upper and lower graphs is equal to the total signal.

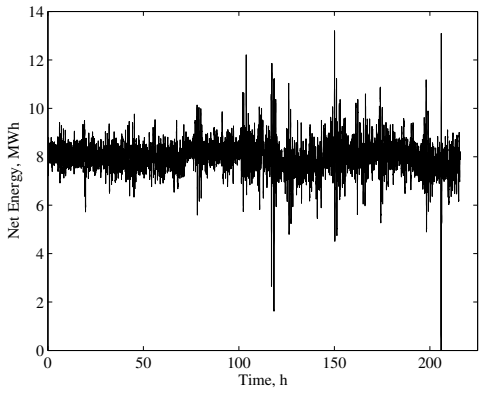

Fig. 5. Integral of high-frequency (bottom) portion of Fig. 4, the total power signal of Fig. 2 processed using a Chebyshev type I high-pass filter of order 3 with a cutoff frequency of approximately 1/60 min, in a scheme like that illustrated in Fig. 1. The majority of low-frequency content has been removed.

Once a power signal with only high-frequency content has been generated, the net energy as a function of time is obtained by taking the integral of the power curve. This is pictured in Fig. 5. However, if low frequency components of the power signal have been effectively removed, it is difficult to draw further conclusions about energy storage requirement from this graph.

The energy-duration curve is created by tallying the percent of time that the net energy requirement is at or below a certain level. (For example, this can be done by sorting the data points.) Figure 6 shows the energy-duration curve corresponding to the high-frequency portion of the control signal of Fig. 4. Note that the absolute energy values in the energy-duration curve are of less interest than the total change, so the data has been shifted vertically to set the low energy point to zero.

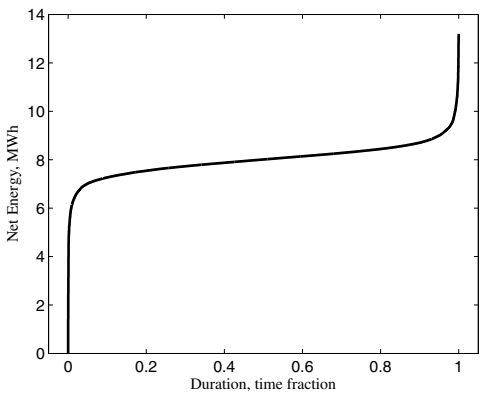

Fig. 6. Energy-duration curve for Fig. 5, output of a high-pass filter on total area load power. It can be seen that for the high frequency portion of the signal, a limited amount of stored net energy is required.

The advantage of the energy-duration curve is that it simplifies the evaluation of whether a given energy storage unit is well-suited to following a given power signal. First, the maximum required energy storage capacity is readily available from the two ends of the graph. Furthermore, it is easy to determine how often the storage capacity is being used. As can be seen from Fig 6, an energy storage unit of only 14 MWh would be sufficient to follow the high-frequency regulation signal of Fig. 4.

VI. Example Filter Evaluation

To illustrate the utility of the energy- and ramp-rate-duration curves, consider again the task of partitioning the load power signal of Fig. 2 between fast-acting, limited-energy storage units and slower, limited-power thermal generators. The goal of the partition is to limit the total required energy storage and the maximum and average ramp rate of the thermal units while adequately responding to the entire signal. The ultimate aim is to produce a method to partition the power requirement in real-time. Hence, only causal candidate filters are investigated.

To demonstrate the use of this technique, the effects of a class of simple filters will be explored. All filters seek to partition the signal between the thermal and energy storage assets to more effectively take advantage of the strengths of each unit type. The Chebyshev type I high-pass filter used in Section V was selected for its good attenuation of low frequencies and its fast transition band. A filter of order 3 was found to offer a good compromise between fast rolloff and the increased delay produced by additional poles.

A range of cutoff frequencies was selected with periods from 20 minutes to 90 minutes. Because filters with these cutoff frequencies lead to moderate energy storage requirements, higher frequencies are not included in these plots. Figure 7 illustrates the energy-duration curves which result

from these filters. The energy capacity requirement for these filters ranges from about 12 to about 130 MWh. The power requirement for the high frequency component of these filters is included as Fig. 8. Each filter requires about ± 400 MW and thus the 20 minute cutoff filter requires about 2 minutes of energy storage, while the filter with a 90 minute period cutoff requires about 20 minutes of energy storage. The substantial improvement in thermal unit ramp rate which these filters provide may be seen in Fig. 9. It is notable that both the energy-duration curves and the ramp-rate-duration curves have long "tails," indicating a requirement for high energy storage capacity and high ramping capability which are used only infrequently.

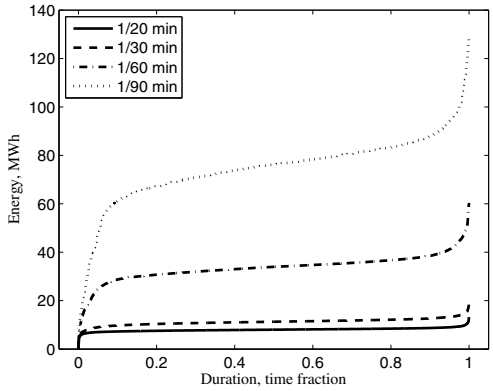

Fig. 7. Energy-duration curve of high frequency portion of load power signal using Chebyshev type I high-pass filters of order 3 with several different cutoff frequencies.

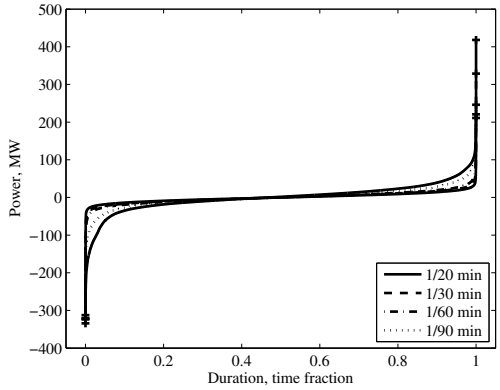

Fig. 8. Power-duration curve of high frequency portion of load power signal using Chebyshev type I high-pass filters of order 3 with several different cutoff frequencies. Displays the power requirement corresponding to the energy requirement of Fig. 8.

VII. Ramp Rate versus Energy Storage

Another way to visualize the interaction of fast energy storage with traditional thermal units is with of a plot of

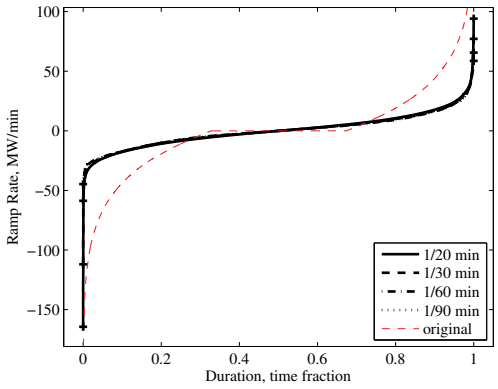

Fig. 9. Ramp-rate-duration curve of low frequency portion of load power signal, obtained by subtracting from the original signal the output of Chebyshev type I high-pass filters of order 3 with several different cutoff frequencies. Compared to Fig. 3, both the maximum and the mean ramp rates required of the thermal units have been substantially reduced.

average ramp rate versus maximum energy storage requirement. Instead of plotting the percent of time spent at each ramp rate or at at each stored energy level, the average of the absolute ramp rate is used as a ramping cost metric and plotted against the maximum energy storage required. In this way several filters or dispatch methods can be compared, and an economically and operationally appropriate solution may be selected by comparing the cost of energy storage with the cost of ramping. An example of this plot including the Chebyshev filters is shown as Fig. 10.

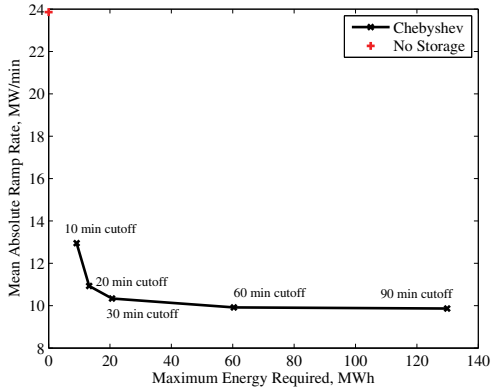

Fig. 10. Comparison of different filters in terms of average absolute ramp rate versus maximum energy storage requirement. The filters of Figs. 7–9 are included.

VIII. Conclusions

This paper has demonstrated some of the advantages of dividing the burden of LFC between fast energy storage units and slower traditional thermal generators. The use of fast energy storage can lead to substantial reductions in the ramp rate requirement of the thermal units and thus to reduced costs.

Energy-duration curves and ramp-rate-duration curves are useful tools for evaluating the performance of dispatch methods. Slope-duration curves in particular may also prove useful in other applications which focus on ramping at different time scales, such as for economic dispatch.

The authors wish to acknowledge the generous support of the MIT-Portugal Program and the Masdar Institute of Science and Technology in funding this work. In addition, the accomodating staff of the balancing area which provided the data deserve many thanks for their help. Thanks also to Ignacio Perez-Arriaga for helpful comments.

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CERTIFICATE OF SERVICE

I hereby certify that I have this day served a copy of ***Reply Comments of the California Energy Storage Alliance on Renewable Integration Modeling Methodology*** on all parties of record in proceeding ***R.10-05-006*** 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 8, 2010, at Woodland Hills, California.

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