29th June 2021

Shri Sanoj Kumar Jha
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Subject – Comments on **"**Draft Central Electricity Regulatory Commission (Ancillary Services) Regulations, 2021."

Dear CERC Team,

Fluence is a global energy storage technology solutions and services company, and a joint venture of the U.S.-headquartered AES Corporation and Germany-headquartered Siemens AG. Fluence leads the energy storage industry with over 2,700 MW of projects deployed or awarded in 24 countries and territories. Our solutions are built on the foundation of industry-leading technology platforms that are optimized for different application groupings.

Fluence also offers a comprehensive services suite to ensure customers are staying ahead of the market. From early-stage feasibility and cost-benefit analysis that stand up in the real world, to ensuring optimal performance of storage assets, Fluence provides expert advice and services to propel customers' projects forward.

In India, Fluence is the technology provider for South Asia's biggest grid connected Battery energy storage (BESS) project till date- Tata Power-DDL 10MW/10MWh BESS situated in Rohini- Delhi.

Fluence supports the Ministry of Power's and CERC's leadership and goal to achieve 450GW of Renewable energy (RE) capacity by 2030. Fluence would like to applaud the initiative and leadership demonstrated by CERC for making a path for Ancillary service market in India with the release of

Draft CERC (Ancillary Services) Regulations, 2021. We believe this step would support further RE penetration and enhance grid stability and further optimization.

Fluence has been at forefront of Ancillary Service market development in many countries including, but not limited to USA , Philippines, Australia, UK and Ireland. We have commissioned projects in USA, Philippines, Australia, UK and Ireland supporting Frequency response ancillary services including very fast response services at <200ms response time. Below Fluence offers comments on the Ancillary Services Regulations 2021 based on our experience in developing Battery solutions globally, other ancillary service markets where we have been consulted and from our experience integrating the 10MW BESS in Delhi.

Please direct any inquiries pertaining to the enclosed submission to me at my contact details below or to my colleague Rupam Raja, Market Director, South Asia, at Rupam.raja@fluenceenergy.com

Sincerely

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Fluence Comments (Our comments are based on reviewing Draft notification standalone document)

We acknowledge that a lot of thought and detail has been put into making the draft CERC (Ancillary Services) Regulations, 2021. Fluence offers any support needed in this process and if required to provide further elaboration on our points below. We applaud the steps taken with this draft paper and look forward to a more robust power grid that is able to support further RE integration as planned under the world leading RE program of India.

The Draft outlines quite a lot of detail on how the SRAS market and TRAS market will work to procure and pay providers. It would be beneficial to share the thinking behind the focus on SRAS and TRAS, the analysis done to determine this focus area and the difference that CERC anticipates in market player as a result of these regulations. . Such sharing of studies and workshops will help align stakeholders across the Indian Power Industry, allowing more detailed feedback on draft regulations with more information.

Many examples of how Ancillary services is procured in other markets can be leveraged and learned from, to adapt to the Indian market. We acknowledge that many aspects of how other markets may operate do not fit for the Indian Power grid and must be modified. Basic principles that shape these markets most likely will benefit the India power sector as well. This is the focus of our comments below:

1) **Details of PRAS**: The Draft paper does not outline details about how PRAS would be met, what would be the required size of procurement and the compensation mechanism for such a service. It would be advantageous to adopt a market mechanism for primary reserve as well:
    a. CERC has indicated that the existing generating stations (lignite, gas, hydro) shall be used for primary response. Existing generating station capacity should be freed up to the benefit of the rate payers and ancillary services should be procured in the market.

    b. CERC should look at the track record of existing generators for primary response to keep the frequency within the band as prescribed in the grid code. The question that needs to be examined is how much existing resource is deployed for primary response and contrast that with how much faster responding resource would have to be deployed and do a cost-benefit analysis.

    c. Our global experience tells us that by including Primary reserve in market mechanism will lead to efficiencies in the market resulting in lower overall system procurement for such reserves. A market for primary reserve will ensure the best technology is procured for the task to be done.
    d. Creating a mechanism for different technologies to participate in this market will ensure higher performing assets are deployed on the grid that will further enhance the grid as more variable renewable energy (VRE) is added.

2) **30 second response capability for SRAS**: The basis for a response time of 30 seconds for SRAS is unclear. What would be the required time of response under PRAS such that SRAS steps in to support? A faster responding asset can be a more effective tool to the grid operators even in the secondary market to prepare for the level of VRE being added to grid so effectively by the Indian

Government and Power Industry. Fluence has worked with the grid operator in Ireland which has a high influx of variable RE, to deploy a BESS with a response time of 150 millisecond's under the country's DS3 program, stating the fast-responding market will enable higher penetration of RE, while maintaining grid stability.

OVERALL COMMENTS FOR 1 & 2: PRAS, SRAS and faster responding assets for grid support as a Grid transforms with more Renewable generation.

Recent study done by USAID GTG for evaluation of BESS in Southern India[1] finds that around 1000MW of BESS as a primary reserve would be able to displace around 3000MW of conventional resource in some scenario thus freeing up capacity for more cost-effective use. By adopting faster and more accurate technologies to help arrest deviations, the economic impact can be significant, as estimated in the study. Such findings are similar to those identified in other power markets and show that effectively more efficient/ faster or higher performing technologies provide benefits to the grid. Currently this maybe Battery energy Storage Solutions (BESS) utilized in these studies, but we want to reflect that the use of a faster responding assets have accretive value to a power grid that is adding more VRE.

Amongst the conventional power plants, hydroelectric plants are the usual resource for frequency regulation due to its fast-acting governor response. Usually still their ramp rates are in integral of seconds to minutes, hydroelectric response is insufficient to arrest the sudden big drop of frequency at contingent events. Availability of MW power is one, but response timeframe in milliseconds is equally important, and shift to the 5-minute interval is not significant.

Without a clear differentiator of a fast-responding generator that participates in the AS from one that does not have the capability, the AS regulations could create an AS market and a regular energy market for the same pool of generators. In such a market there is a risk that more generators move to one market leaving the other one without enough capacity.

Battery Energy Storage System (BESS) can provide highly valued frequency regulation ancillary services to the grid. Due to the inherent characteristics of the BESS, it can provide instantaneous (in the order of milliseconds) increase of electricity supply (discharging mode), or absorb excess electricity supply (in charging mode) much faster than conventional generators like thermal power plants and even hydroelectric power plants (typically in the order of minutes). Specifically, for Primary and Secondary Reserves, BESS is a good alternative to active and dynamic power modulation. This mainly depends on its fast and precise power response at high operational efficiency to grid frequency deviations since a faster response directly implicates a reduced frequency perturbation width. Currently a BESS offers such a performance, but other technologies may as well, but without a market mechanism to encourage such technologies to create efficiencies in our grid, such benefits will not be yielded. Battery Energy Storage System (BESS) is the best resource for fast and accurate response. Given the benefits of the BESS in system performance, maximizing its integration to the grid requires operational adjustments. Technically, the grid can absorb BESS for the whole Ancillary Services requirements particularly for PRAS and

[1] https://www.gtg-india.com/wp-content/uploads/2021/04/Evaluation-of-Battery-Energy-Storage-System-BESS-in-Southern-India.pdf

SRAS. Different control parameters and operation modes (GCM, AGC, and manual) must be evaluated and optimized for a precise and quick response to frequency changes.

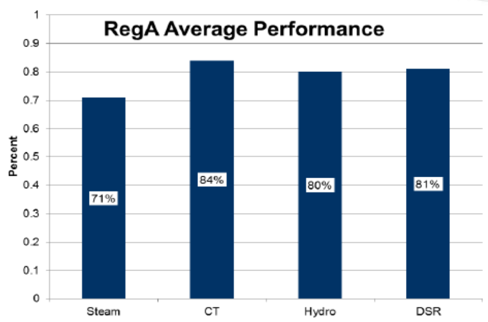
Other examples from other markets are below:

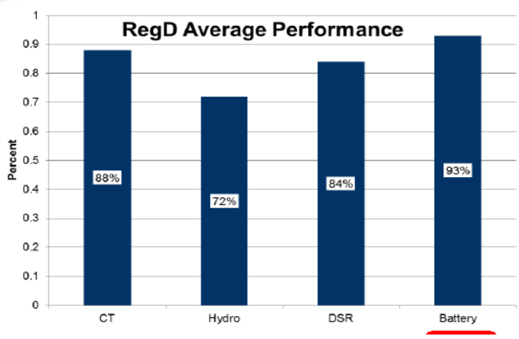
The BESS precise control and very quick response have been proven in various transmission grids globally. Prominent in the use of BESS is the PJM Interconnection in the US. PJM is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of states of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. It operates a competitive wholesale electricity market and manages the high-voltage electricity grid to ensure reliability of the grid.

In the PJM regulating market, the performance of BESS is better than other resources (i.e. steam generation, thermal, hydroelectric and demand side response). PJM identified that using a faster responding and higher performing assets would lower the AS procurement needed. PJM identified that 2.3MW of conventional source (Coal/Gas/Hydro) PRAS could be replaced by 1MW of BESS, due to the performance of a BESS in the reserve market to respond rapidly and accurately.

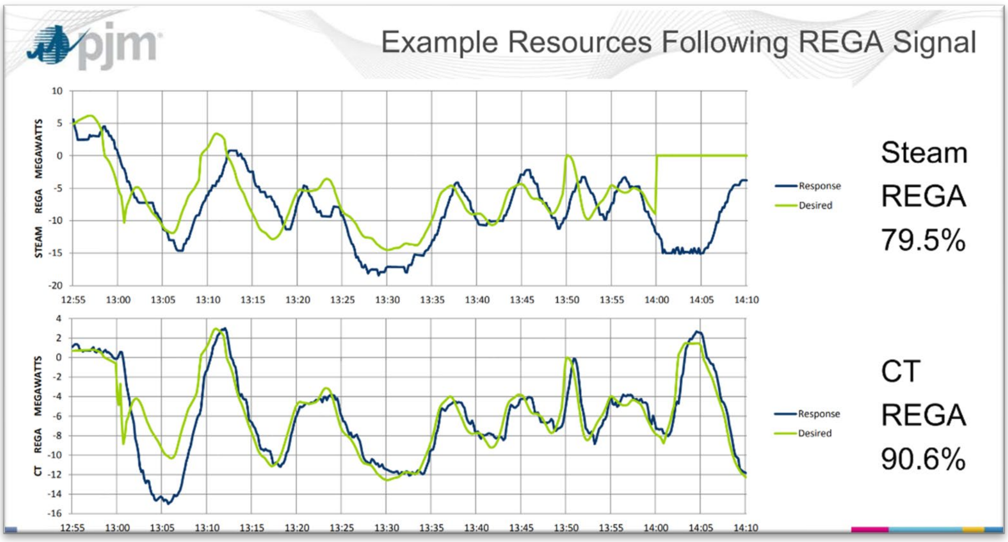
Below is a comparison based on two controls of frequency regulation in the PJM interconnection. Note that RegD is response within 2 secs while RegA within 10 secs.

Average performance of BESS under the RegD fast regulation is better as compared to other resources.

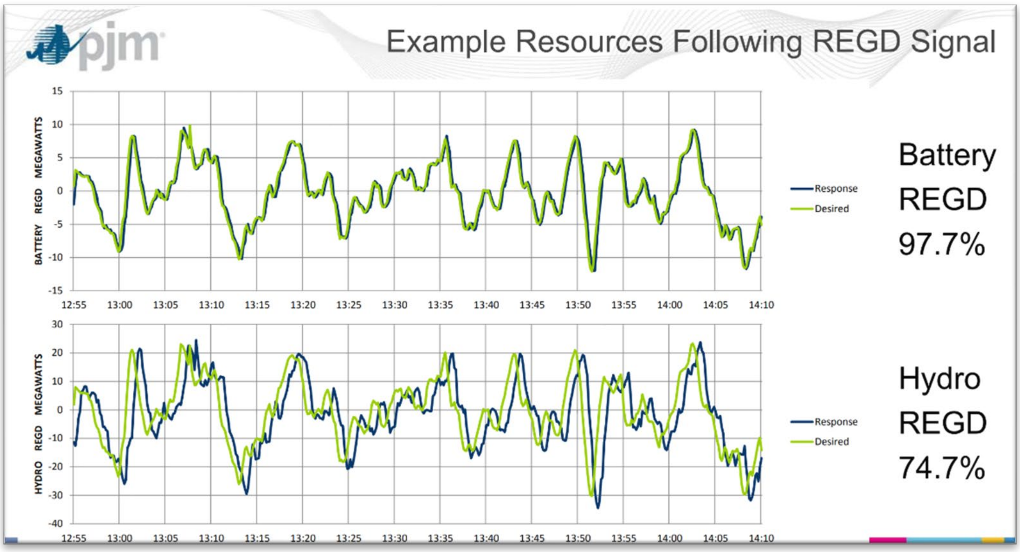




Source: PJM



Source: PJM



Source: PJM

Generators differs dramatically in how well they follow the System Operators commands or how precise they respond automatically on frequency changes. Hydropower units typically track control signals quite well, while thermal units have more difficulty. BESS is the best alternative on precision control.

Energy storage resources can also provide high-quality digital inertia to the grid and increase the ability of generators to tolerate high Rate of Change of Frequency (RoCoF). For example, in a study using data from the Kilroot Energy Storage project in Northern Ireland (which was supplied by Fluence's team), researchers from the Queen's University Belfast found "*360MW of batteries could have provided the same amount of power after 0.1 secs as the inertial response of 3,000 MW of synchronous generators*."[2] The study calculated that in Ireland using batteries for digital inertia could result in up to €19 million in annual savings and 1.4 million metric tons of CO_2 by replacing the inertia typically provided by thermal power plants. This high-quality digital inertia will help support the Irish Single Electricity Market grid as it increases the instantaneous proportion of power being delivered by non-synchronous generation sources, such as wind and solar to more than 70%.

Markets like PJM and Ireland recognized that they needed to promote the right technologies to be deployed on the grid to support higher RE penetration, and in order to do so, they would have to compensate assets that are able to provide better performance. Other markets like Taiwan, Australia and UK are also now adopting even faster markets to support RE penetration and ensure grid security. In order to do this, higher payment mechanisms and ability for more

[2] http://s2.q4cdn.com/601666628/files/doc_presentations/2017/Everoze-Batteries-Beyond-the-Spin.pdf

market participation are being considered. We acknowledge that the pay for performance approach as been taken in this draft, but not adopting this for PRAS or setting thresholds too low, will not promote the best providers to be built, leading to inefficiencies that will grow over time. As analyzed in the USAID -GTG study, consider a simple example: assume 500 MW of thermal resources are available in the market to provide for regulation needs, and the market price is INR 1500/MW/hr. These resources are, by design, slower-moving and consequently not as accurate. The overall market then incurs a cost equivalent to 500 MW multiplied by INR 1500/MW/hr multiplied by 8760 hours (in a year); this results in INR 650Cr per year in regulation costs. If the 500MW of thermal resources could be replaced by 250MW of BESS given speed and accuracy of a BESS, but paid 50% more, the overall cost would be 250 MW multiplied by INR 2250/MW/hr multiplied by 8760 hours (in a year); this results in **INR 492Cr per year in regulation costs.** We understand that these are simplistic examples and that these have to be considered in conjunction with the overall causer-pays approach currently employed for frequency-related costs in India

As highlighted earlier, there maybe detailed studies that determined why PRAS is not factored in, or such speed requirements were selected, but without details of this analysis, it seems the markets could drive for higher efficiency.

3) **For SRAS, how is pay for performance/performance incentive structured arrived at?** Fluence appreciates the creative thinking approach to establish a pay for performance structure, which is something seen across the globe as well (mentioned above). We would like to request CERC to share more details on how the speed of response/ formula and structure of incentive were determined. Request also sharing of the studies done to arrive at this result so stakeholders can develop a better understanding. We think the structure and approach is correct, but its effectiveness will not be fully utilized unless applied to PRAS and also requiring faster response times in PRAS and SRAS. Faster responses are commercially achievable, and only provide benefit to grid stability.

4) **SRAS- Down, TRAS-Down and Deviation and Ancillary Service Pool account:** The paper clearly highlights how payments to/from a pool will work for SRAS and TRAS up and down providers. Whats unclear is how the overall market mechanism will work. It seems close to the causer-pay mechanism in Australia for Frequency Regulation, which ensures that systems causing deviation are paying into a Pool and from that pool, systems supporting deviation Up or Down are compensated. Along with our over-arching comment, more sharing of details would enable clarity, to stakeholders and alignment.

5) **Scenario planning:** As more RE penetrates the market, would more ancillary markets be added (example 2 second signals, faster response time etc)? Is there a roadmap of addition of new market structures? If so, can the result of analysis/studies be shared so that developers can plan accordingly because assets like BESS can be adopted to serve new structures as well.

6) **Impact on DSM:** Successful A/S procurement should result in lower deviations, more positive operations/less penalty for DISCOMS, more grid stability and less outages. If this understanding is correct, to achieve this goal, faster response and more coordination around market clearing is

required to ensure the right systems are bid into the market to support the grid and achieve this goal.

7) **Market size uncertainty and merchant risk:**
   a) **No commitment compensation for SRAS:** We believe that as proposed for TRAS, a commitment compensation structure should also be put in place for SRAS to promote adoption of new technologies and to bring efficiency to the market. TRAS procurement can also be optimized if duration of service requirements are right sized and in set in tranches.
   b) **Mechanism/philosophy needed for market sizing**: To determine and plan potential of Ancillary service revenue streams, clarity around how the market sizing is done, and how it will be conducted needs to be established. By establishing such a structure, investor/developers can assess the market better and reduce their merchant risk thereby promoting investments, creating efficient markets and lower overall cost to the system and population. Coordinated response between Primary Reserve, Secondary Reserve and Tertiary Reserve is also key to achieve an ideal system response. For example in another country the role of Ancillary services for Frequency role are as follows:

      *The actions of Frequency Control such as Primary Control, Secondary Control and Tertiary Control are performed in different **successive steps**, each with different characteristics and qualities, and **all depending on each other**. **Primary control starts within seconds** as a joint action of all Synchronized Generating Units involved. **Secondary Control replaces Primary Control** after minutes and is put into action by the System operator only. **Tertiary Control frees Secondary Control** by re-scheduling generation and is put into action by the responsible undertakings/System operator."*

      Succession is key to achieve a coordinated response. On that note, it also explains that **Primary Reserve, Secondary Reserve and Tertiary Reserve responses are <u>not additive</u>** , as when one AS starts responding it releases the preceding AS to make it available for another contingent event.

      Frequency Control Ancillary Services (FCAS) for example under for another market are the following:

      - **Primary Reserve.** Synchronized generating capacity that is allocated to stabilize the system Frequency and to cover the loss or failure of a Synchronized Generating unit or a transmission line or the power import from a single circuit interconnection.
      - **Secondary Reserve** Synchronized Generating capacity that is allocated to restore the system frequency from the quasi-steady state value as established by the Primary Response of Generating Units to the nominal Frequency
      - **Tertiary Reserve (Minute Reserve):** The capacity which can be connected (automatically or manually) under tertiary control, in order to provide and adequate Secondary Reserve. This reserve must be used to contribute to the restoration of the Secondary control range when required. The restoration of an adequate Secondary Control range may take for example, up to 15 minutes, whereas Tertiary Control for the optimization of the network and generating system will both necessarily be complete after this time

FCAS will and should cover the loss of synchronized generation capacity and transmission line tripping (loss of load). Hence, Primary Reserve, Secondary Reserve, and Tertiary Reserve should react to both under-frequency and over-frequency events.

PRIMARY RESERVE A/S (PRAS): RAISE AND LOWER FREQUENCY REGULATION

Primary control should start within seconds after a frequency excursion. This frequency excursion may result from a loss or failure of a generating unit or a loss of load as explained below.

With the crucial responsibility of PRAS of being the “first responder” during and after the occurrence of a significant event to arrest further system frequency excursions, it would be unfounded to say that PRAS is only for under-frequency incidents (Generation tripping). Doing so would expose the system to instability after an over-frequency incident (tripping of lines connected to load centers) or worse, it may result in grid-wide cascaded outages.

Sizing the sufficient and optimum amount of raise and lower PRAS is a challenging task. Other jurisdictions uses a “Reference Event/Incident” as a basis for sizing ancillary services. Reference Event/Incident is a historical tripping (Generation loss and Loss of load) which poses risk to the grid and with a significant probability/likelihood of occurrence. Some countries use, Load of the Largest Unit Online (LLUO) and largest loss of load event .

FREQUENCY CONTROL ANCILLARY SERVICE (FCAS) RESPONSE CONTINUUM: The actions of Frequency control are performed in successive steps, each with different characteristics and qualities and all depending on each other. As such, one could say that Primary Reserve Ancillary Service (PRAS), Secondary Reserve Ancillary Service (SRAS) and Tertiary Reserve Ancillary Service (TRAS) are **equally important** as the absence of the other would break the response continuum.

Primary control in the form of Governor Control Mode (GCM) will serve as the “first responder” and would be supported and replenished by Secondary Control in the form of Automatic Generation Control (AGC). Tertiary control (Manual) will kick-in after several minutes to replenish the secondary control.

With the explanation above on the response continuum of different Frequency Control Ancillary Services, it is imperative to procure equivalent amount of PRAS, SRAS and TRAS for successive and coordinated frequency response.

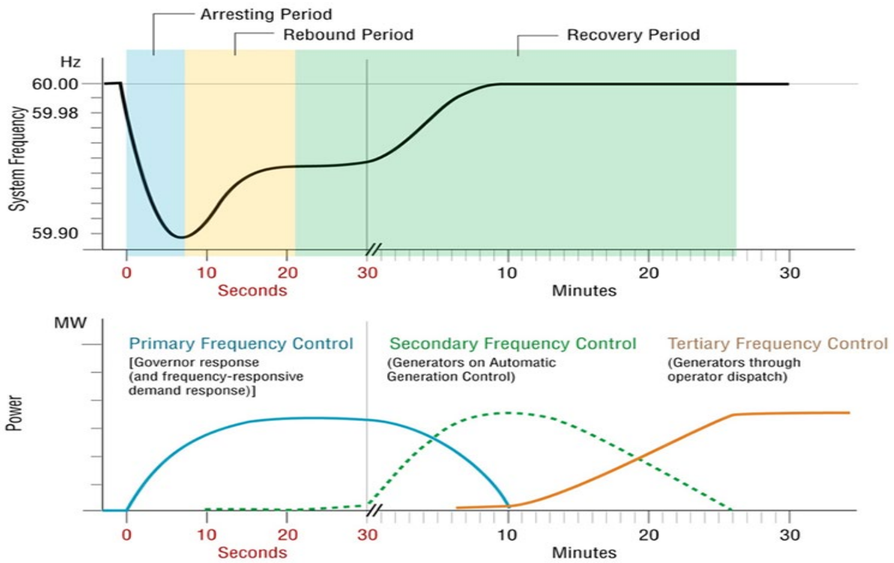
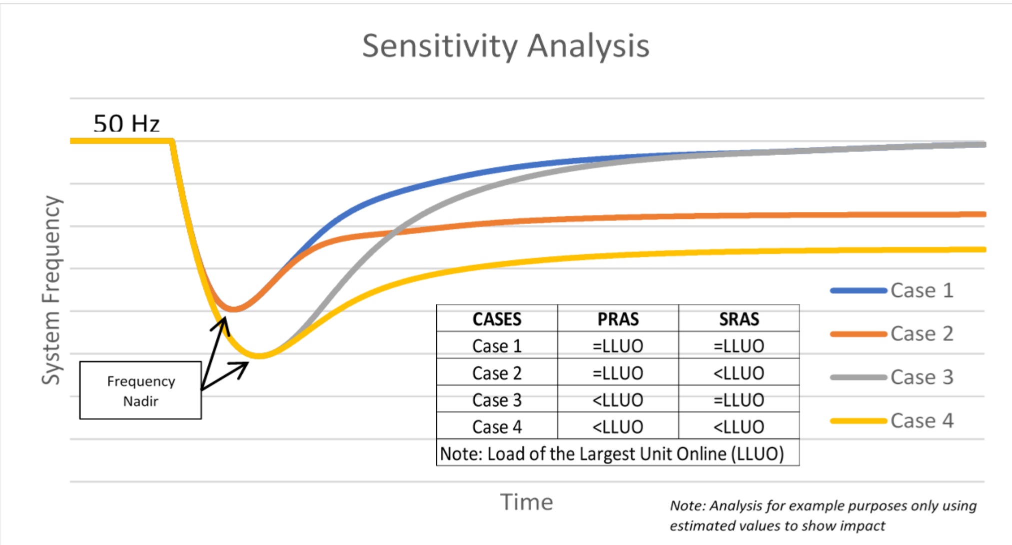


Figure 2. Frequency Control Response Continuum,
Source: Joe Eto, Lawrence Berkeley National

Figure 3 illustrates how the system frequency will be affected by differing amounts of PRAS and SRAS given a generation tripping (largest unit online). Four (4) cases were investigated.

<u>Case 1:</u>
PRAS has a total capacity equivalent to the load of the largest unit online;
SRAS has a total capacity equivalent to the load of the largest unit online;
<u>Case 2:</u>
PRAS has a total capacity equivalent to the load of the largest unit online;
SRAS has a total capacity less than the load of the largest unit online;
<u>Case 3:</u>
PRAS has a total capacity less than the load of the largest unit online;
SRAS has a total capacity equivalent to the load of the largest unit online;
<u>Case 4:</u>
PRAS has a total capacity less than the load of the largest unit online;
SRAS has a total capacity less than the load of the largest unit online;



CASES	PRAS	SRAS
Case 1	=LLUO	=LLUO
Case 2	=LLUO	<LLUO
Case 3	<LLUO	=LLUO
Case 4	<LLUO	<LLUO

Note: Load of the Largest Unit Online (LLUO)

Figure-3: Frequency characteristics under various PRAS and SRAS capacity

Case 1 has the best response as the frequency nadir was arrested by PRAS and the system frequency was able to go back to the nominal frequency of 50Hz with the help of SRAS.

The cases with insufficient SRAS (Case 2 and Case 4) were not able to go back to 50Hz. While the cases with insufficient PRAS (Case 3 and Case 4) resulted in a lower frequency nadir which may trigger the Under-frequency Load Shedding (UFLS).

With all this, it is critical to procure and schedule PRAS and SRAS capacity each equivalent, and this size should be known for investors and asset owners to determine the position of their bid and merchant risk. With less information known, it will be hard for new efficient resources to be deployed to provide beneficial services to the grid. There maybe factors from market to market that may alter this sizing approach, but along with our earlier statement workshops and sharing of analysis will create clarity.