Annexure-I

IL&FS Energy Development Company Ltd's (IEDCL) Comments / Suggestions on Draft CERC (Ancillary Services Operations) Regulations, 2015

S.No	Proposed in Draft CERC (Ancillary Services Operations) Regulations, 2015	IEDCL's Submission
1	**1. Short title and commencement** 1.1 These regulations may be called the Central Electricity Regulatory Commission (Ancillary Services Operations) Regulations, 2015.	**Suggestion-** (i) If the Commission retains the title of these Regulations as Central Electricity Regulatory Commission (Ancillary Services Operations) Regulations, 2015, then all other forms of Ancillary Services (such as Network Control and System Restart) need to be specified in these Draft Regulations, *OR* (ii) Since the Objective and Scope of these Draft Regulations has been restricted to Frequency Control Ancillary Services/ Reserves Regulation Ancillary Services, the Commission may consider re-designating these Regulations as Central Electricity Regulatory Commission (Frequency Control Ancillary Services Operations) Regulations, 2015 **Rationale for Suggestion-** • If option (i) or (ii) is not taken into consideration, then the intent of addressing the other forms of Ancillary Services (AS) that have been articulated in the Background Note (Network Control AS, System Restart AS) become unclear. • With the passage of time, maintaining voltage and reactive power support and maintaining generation and transmission reserves in a regulated manner will become essential and at that time it will be required to introduce separate Regulations to incentivize generators to provide this service. • By including these other forms of AS in this primary Draft Regulation will eliminate the complexity of introducing separate Regulations.

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2	**Other type of Ancillary Services**	**Suggestion -** It is suggested to recognize other types of Ancillary Services which can support and maintain reliable operation of interconnected transmission system. Some of the different types of ancillary services include voltage control ancillary service, scheduling and dispatch, black start ancillary services etc. **Rationale for Suggestion-** • The Commission in its staff paper on "introduction of Ancillary services in Indian Electricity Market" had proposed three types of ancillary services viz. real power support or frequency support ancillary services, voltage or reactive power support services and black start support services. • Many countries throughout the world, including the United States have introduced ancillary service market designs to predominantly address the issue of large-scale penetration of variable renewable energy suppliers in the power system. Different types of Ancillary Services For instance, in US, the Federal Energy Regulatory Commission (FERC) in its order 888 dated 15.02.2007 directed the Transmission provider to arrange ancillary services as follows: *"………The Transmission Provider is required to offer to provide (or offer to arrange with the local Control Area operator as discussed below) the following Ancillary Services only to the Transmission Customer serving load within the Transmission Provider's Control Area (i) Regulation and Frequency Response, (ii) Energy Imbalance, (iii) Operating Reserve - Spinning, (iv) Operating Reserve (v) Supplemental, and (v) Generator Imbalance".*

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		• Also, the Grid Code of UK identifies different types of generators eligible for providing different types of Ancillary services based on the size and accuracy of the generator.
3	**2. Definitions and Interpretation** 2.1 m. 'Reserves Regulation Ancillary Services Provider' means the inter-State Generating Stations (ISGSs) having un-requisitioned surplus and eligible to participate in the Reserves Regulation Ancillary Services	**Suggestion-** 'Ancillary Service Provider' means all the sellers and regional entities which are part of the scheduling and deviation settlement mechanism for real and reactive power with voice and data telemetry facilities in accordance with the regulations framed by the Central Commission and Central Electricity Authority and eligible to participate in the ancillary market. *(Reference: CERC Staff Paper on "Introduction of Ancillary Services in Indian Electricity Market")*
4	**5. Eligibility for participation for Reserves Regulation Ancillary Services** 5.1. All Inter-State Generating Stations whose tariff is determined or adopted by the Commission and are operating on part load and which have not received full requisition shall be eligible to participate for providing the Reserves Regulation Ancillary Services	**Suggestion -** • The Regulations should not restrict the eligibility of generators to participate for providing the Reserves Regulation Ancillary Services (RRAS) to only identified ISGS that are operating on part load and which have not received full requisition. • The regulations should consider allowing all the generators (conventional and non conventional) and the other new emerging energy storage technologies having faster ramp up and ramp down capabilities (and also the capability to provide multiple AS & other supports to the grid) to be eligible to participate as Ancillary Services providers.

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		Rationale for Suggestion- • Integration of variable renewable energy [mainly Wind/ Solar PV (SPV)] in the grid is one of the biggest thrust areas and which would need in any case Energy Storage complementarity for ensuring grid stability. Government of India targets to have add 60 GW wind and 100GW solar PV by 2022. • Considering the high variability and unpredictability of generation from Wind/SPV, the Frequency Support Ancillary Services (FSAS) would be needed to stabilize the frequency into the grid. • As the penetration of Wind/SPV would increase, the grid would need more amounts of FSAS to ensure grid stability[1]. With increasing penetration of variable renewable energy, the required ramping capacity shall be higher than the existing capacity identified by CERC (viz. 4.9 GW). • The frequency control is required for maintaining reliability of the grid. Graph[2]:1 below represents the typical response time for each for various ancillary services. • Emerging Energy Storage (ES) technologies (beyond traditional, but geographically limited, pumped hydroelectric storage) can provide several technical benefits for utilities, power system operations, and users. The traditional

[1] On 28 Feb'14 PJM presented their PJM Renewable Integration Study (PRIS) study (prepared by GE) results. It shows that more regulation will be needed under all future renewable scenarios from low levels of growth to high levels of growth in renewable.

[2] Ancillary Services, Technical & Commercial Insights; Brendan Kirby; July 2007

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<table>
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<tr><td></td><td></td><td>
applications for energy storage are described below:

<table>
<tr><th rowspan="2">Service</th><th colspan="3">Service Description</th></tr>
<tr><th>Response Speed</th><th>Duration</th><th>Cycle Time</th></tr>
<tr><td rowspan="2">Regulation</td><td colspan="3">Power sources online, on automatic generation control, that can respond rapidly to system-operator requests for up and down movements; used to track the minute-to-minute fluctuations in system load and to correct for unintended fluctuations in generator output to comply with Control Performance Standards (CPSs) 1 and 2 of the North American Reliability Council (NERC 2002)</td></tr>
<tr><td>~1 min</td><td>Minutes</td><td>Minutes</td></tr>
<tr><td rowspan="2">Spinning reserve</td><td colspan="3">Power sources online, synchronized to the grid, that can increase output immediately in response to a major generator or transmission outage and can reach full output within 10 min to comply with NERC's Disturbance Control Standard (DCS)</td></tr>
<tr><td>Seconds to <10 min</td><td>10 to 120 min</td><td>Days</td></tr>
<tr><td rowspan="2">Supplemental reserve</td><td colspan="3">Same as spinning reserve, but need not respond immediately; units can be offline but still must be capable of reaching full output within the required 10 min</td></tr>
<tr><td><10 min</td><td>10 to 120 min</td><td>Days</td></tr>
<tr><td rowspan="2">Replacement reserve</td><td colspan="3">Same as supplemental reserve, but with a 30-min response time; used to restore spinning and supplemental reserves to their pre-contingency status</td></tr>
<tr><td><30 min</td><td>2 hours</td><td>Days</td></tr>
<tr><td rowspan="2">Voltage control</td><td colspan="3">The injection or absorption of reactive power to maintain transmission-system voltages within required ranges</td></tr>
<tr><td>Seconds</td><td>Seconds</td><td>Continuous</td></tr>
</table>

Chart :1

- Grid Stabilization: ES can be used to help the transmission or distribution grid return to its normal operation after a disturbance. Energy storage can be used to remedy three forms of instability: rotor angle instability; voltage instability; and frequency excursions.
- Grid Operational Support: In addition to stabilizing the grid after disturbances, ES can also be used to support normal operations of the grid. Four
</td></tr>
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		types of support operations can be performed through the use of energy storage: a. **Frequency Regulation Services**: Energy storage can be used to inject and absorb power to maintain grid frequency in the face of fluctuations in generation and load. b. **Contingency Reserves:** At the transmission level, contingency reserve includes spinning (or synchronous) and supplemental (non-synchronous) reserve units, that provide power for up to two hours in response to a sudden loss of generation or a transmission outage. c. **Voltage Support**: Voltage support involves the injection or absorption of reactive power (VARs) into the grid to maintain system voltage within the optimal range. Energy storage systems use power-conditioning electronics to convert the power output of the storage technology to the appropriate voltage and frequency for the grid. d. **Black Start:** Black start units provide the ability to start up from a shutdown condition without support from the grid, and then energize the grid to allow other units to start up. A properly sized energy storage system can provide black start capabilities, provided it is close enough to a generator. o Power Quality and Reliability: ES is often used to improve power quality and reliability. The vast majority of grid-related power quality events are voltage sags and interruptions with durations of less than 2 seconds, phenomena that lend themselves to energy storage-based solutions.

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		The Table:1[3], below summaries the technologies suitability for the ancillary services

		Frequency Regulation	Synchronous Reserves	Non Synchronous Reserves	Operating Reserves	Voltage Support / Reactive Power	Load Following / Energy Imbalance
Conventional generation	Coal	25%	100%	0%	0%	25%	100%
	Gas - CC	**100%**	**100%**	**100%**	**100%**	**50%**	**100%**
	Gas - CT	**100%**	**100%**	**100%**	**100%**	**50%**	**100%**
	Nuclear	0%	25%	0%	0%	25%	0%
	Diesel	50%	100%	100%	100%	0%	100%
Hydro	Hydro	**100%**	**100%**	**100%**	**100%**	**50%**	**100%**
Renewable	Wind	0%	25%	0%	0%	25%	0%
	Solar	0%	0%	0%	0%	50%	0%
Energy Storage Technologies	Lead Acid	0%	100%	100%	100%	50%	100%
	Li-Ion	**100%**	**100%**	**100%**	**100%**	**50%**	**100%**
	Flow	**50%**	**100%**	**100%**	**100%**	**50%**	**100%**
	Other	**50%**	**100%**	**100%**	**100%**	**50%**	**100%**
	Flywheel	100%	100%	100%	100%	50%	0%
	Pumped	**100%**	**100%**	**100%**	**100%**	**50%**	**100%**
	CAES	**100%**	**100%**	**100%**	**100%**	**50%**	**100%**

[3] Energy storage Technologies for Ancillary Services in India – Improving Power Quality & Reliability into the Indian grid; India Energy storage Alliance & Shakti-Sustainable Energy Foundation; 2014

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		Table: 1 • It can be concluded from the table above that energy storage technologies are most suitable (given the fact that India has limited gas based generation capacity and is challenged with having higher pumped-storage projects) for providing grid ancillary services in India (especially when compared with coal based capacity).
5	**11. Scheduling of Reserve Regulation Ancillary services-** **11.2.** For Regulation Up service, power shall be scheduled from the generating station to the pseudo-entity "pool" by the concerned RLDC.	**Clarification-** The Draft Regulations do not define "pseudo entity pool", whether it is an existing "pool" or a new pool shall be created by the Commission is not clear. Hence, it is requested to provide clarity in this regard and definition of "Pseudo entity pool" may be included in the final regulations.

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6	**13. Reserves Regulation Ancillary Services Settlement** 13.3. The Reserves Regulation Ancillary Services provider **shall be paid at their fixed and variable charges, with markup as decided by the Commission through a separate order from time to time** in case of Regulation Up services for the quantum of Reserves Regulation Ancillary Services scheduled from the Regional Deviation Pool Account Fund.	**Suggestion (1)-** Payment to the Ancillary service provider should be facilitated through competitive bidding process. **Rationale for Suggestion-** • The Commission in its staff paper dated 10th April 2013 suggested implementation of frequency support ancillary services through bidding in the Power Exchange. A separate product could be constituted for this purpose, comprising of sellers interested in participating in the Ancillary services market and the Commission can provide overall ceiling for charges for services rendered through an order. • Hence, it is suggested not back track (from the position taken in the draft discussion paper for grid ancillary services, April'13) to regulated cost based mechanism. It is also suggested that the set of cost components applicable and relevant be identified to each ancillary service provided (such as the cost of providing regulation, the cost of providing black start capability, the cost of providing spinning reserves, etc.). Payments can also include a lost opportunity cost and payment for performance. **Suggestion (2)-** Ancillary service providers should be **rewarded based on their value of services** i.e. the higher the speed and accuracy of following the dispatch signal from the Nodal Agency, higher the compensation. **Rationale for Suggestion-**

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		• Ancillary services conceptually are required at the time of frequency imbalance in the grid hence these services are expected to be swift and accurate. The Commission should outline clear signals for accuracy and deviation strictness in its final Regulations. The compensation for providing Ancillary Service can include performance related compensation. • The performance of the ancillary service provider can be evaluated by the Nodal agency through a Performance Index that tracks how accurately a resource follows the dispatch signal. A penalty for not following the dispatch signal should be charged as per the Deviation Settlement Mechanism Regulations 2014. • Understanding the importance of the response time for ancillary services, Federal Energy Regulatory Commission (FERC) in US, on 20th Oct'2011 issued Oder 755, wherein FERC mandated that each ISO/RTO market implement a two-part bid/two-part payment compensation structure comprising of: o a capacity (capability) payment for the amount of MWs a resource sets aside to provide regulation, which must include the marginal resource's opportunity cost (the cost associated with providing regulation instead of energy or another service); and, o a performance payment based on the actual amount of movement a resource provides in response to the ISO's regulation signal (otherwise known as "mileage") taking into account the resource's accuracy in following the signal. • Relevant paragraph is reproduced below for reference-

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		"35.28. Non-discriminatory Open access Transmission tariff
		
		(3) Frequency Regulation Compensation in ancillary services markets-
		
		Each Commission approved independent system operator or regional transmission organization that has a tariff that provides for the compensation for frequency regulation service must provide such compensation based on the actual service provided including a capacity payment that includes the marginal unit's opportunity costs and a ***payment for performance*** *that reflects the quantity of frequency regulation service provided by a resource when the resource is accurately following the dispatch signal."*
		• The Fig:1 below shows the
		  o What comprises of capacity payment and performance payment in FERC system
		  o Storage has higher mileage then a normal generator due to its fast response and better performance as compared to normal generator

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		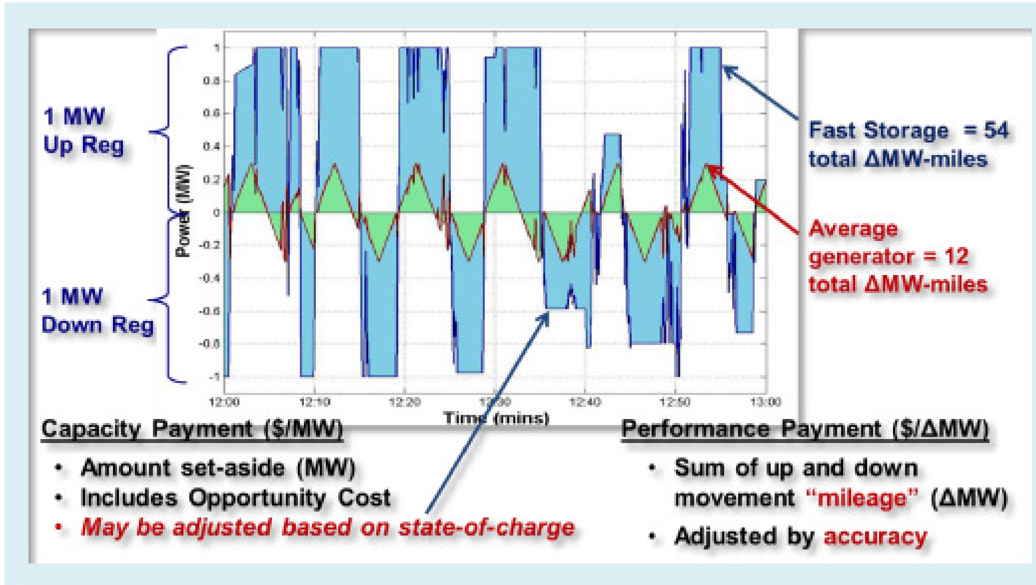 Fig:1[4]

[4] Energy storage Technologies for Ancillary Services in India – Improving Power Quality & Reliability into the Indian grid; India Energy storage Alliance & Shakti-Sustainable Energy Foundation; 2014

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7	**Importance of Energy Storage in Load Following**	• Fast-responding grid storage technologies have several advantages over fossil fuel generation assets, such as gas turbines or coal generation plants. These assets are unable to effectively meet the rapid and sudden frequency regulation and ramp rate control requirements of the modern grid
		• Energy storage solutions reduce dependencies on conventional generation assets, decrease carbon emissions, extract maximum efficiency from existing infrastructure, and minimize costs in new investments. It can best explained with regard to load following- recognized as one of the ancillary services required to operate the electricity grid.
		  ◦ Load following capacity is characterized by power output that changes as frequently as every several minutes. The output changes in response to the changing balance between electric supply (primarily generation) and end user demand (load) within a specific region or area.
		  ◦ Output variation is a "...response to changes in system frequency, timeline loading, or the relation of these to each other..." that occurs as needed to "...maintain the scheduled system frequency and/or established interchange with other areas within predetermined limits."
		  ◦ Conventional generation-based load following resources' output increases to follow demand up as system load increases. Conversely, load following resources' output decreases to follow demand down as system load decreases. Typically, the amount of load following needed in the up direction (load following up) increases each day as load increases during the morning. In the evening, the amount of load following needed in the down direction (load following down) increases as

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		aggregate load on the grid drops.
		• Normally, generation is used for load following. For load following up, generation is operated such that its output is less than its design or rated output (also referred to as 'part load operation'). That allows operators to increase the generator's output, as needed, to provide load following up to accommodate increasing load. For load following down, generation starts at a high output level, perhaps even at design output, and the output is decreased as load decreases.
		• These operating scenarios are notable because operating generation at part load requires more fuel and results in increased air emissions relative to generation operated at its design output level. Also, varying the output of generators (rather than operating at constant output) may increase fuel use and air emissions, and it increases the need for generator variable maintenance.
		• Storage is well-suited to load following for several reasons.
		  • First, most types of storage can operate at partial output levels with relatively modest performance penalties.
		  • Second, most types of storage can respond very quickly (compared to most types of generation) when more or less output is needed for load following. Consider also that storage can be used effectively for both load following up (as load increases) and for load following down (as load decreases), either by discharging or by charging.