Date: 30 April, 2015

To
The Secretary,
Central Electricity Regulatory Commission (CERC),
3rd & 4th Floor, Chanderlok Building,
36, Janpath, New Delhi- 110001

Sub: Comments and Suggestions on CERC Proposed Framework on "Forecasting, Scheduling & Imbalance Handling for Renewable Energy (RE) Generating Stations based on wind and solar at Inter-State Level

Dear Sir,

This is in reference to the public notice issued by the Hon'ble CERC on 31st March 2015 inviting views and suggestions from stakeholder on the subject matter

Please find attached our views and suggestions in this regard attached as Annexure-I to this letter for your kind consideration.

We would be happy to provide any further clarification that you may require on our suggestions.

Thanks you.

Yours Truly

Rejsekhar Budhavarapu

(Head Wind- CTO Renewable Business)

Annexure-I

Proposed Suggestions/Comments on CERC Proposed Framework for Forecasting and Scheduling and Imbalance Handling for Wind and Solar PV projects at Inter-State Level

Sr. No.	Issue	Rationale for Suggestion and Proposed Suggestion/Comment
1	***Pre-requisites for successful Scheduling and Forecasting for large penetration of variable wind & Solar PV capacity into the grid***	**Rationale for Suggestion** 1) For any successful forecasting and scheduling of variable wind/solar PV (RE) energy, there is need of mainly four market components • Reserve capacity for balancing wind/Solar PV forecasting errors, • Large power market platform with capacity to trade power forward & futures instruments • The grid ancillary service market and • Well connected large grid infrastructure 2) Forecasting & scheduling is a proven successful model in countries like Germany, Denmark. Spain, etc. which has all the four mentioned market components. Even in these countries with California, Texas, New York and Japan included, the system operator realized that where forecasting and scheduling of Wind/Solar PV is not enough and for system stability perspectives are adopting introduction of energy storage for large scale RE integration. 3) India is a power deficit country with no or limited reserves (in terms of pumped hydro which also may not be totally useful during windy season as all the Dams are full during the same windy season). Further, unlike Denmark, India has very limited gas based capacity and no grid ancillary market. Only by implementing wind/solar PV forecasting and scheduling in itself would not be viable in the absence of balancing reserves, market platform for trading power forwards and futures certificates and vibrant grid ancillary service market in the medium term till 2019) in India for the desired results 4) Currently, the Wind & Solar PV installed capacity in India is just ~27 GW, which may be balanced with current balancing power capacity available (from 23 GW gas based capacity and 40 GW hydro capacity) at regional level. 5) However, as CERC's wind forecasting and scheduling regulations may be adopted by the State Commissions of RE intensive states like Rajasthan, Gujarat, Karnataka &Tamil Nadu, where balancing would be very difficult even in present situation as during Windy months, RE % mix (in energy terms) in these state is already in excess of 20%

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		6) The Catch 22 situation is as follows: With 160 GW of wind and solar PV by 2022, RE mix on annual basis (& all India average) would be in the range of 15%-16% (which during windy months would be much higher than annual average) . Note even at the current 5-6% RE penetration (on an annual and all India basis) during the windy months in Rajasthan, Tamil Nadu, Gujarat & Karnataka etc. % RE mix at DISCOM level is more than 20% . Forecasting and scheduling such huge capacity (160 GW) without above mentioned **four market component** would not be possible at all as illustrated below (for forecasting and scheduling of RE generation is just a signal on which grid management needs to be done): • For example, say in the month of July 2022, during a sunny day, the Wind & Solar PV would be generating at its peak say at 80% PLF, total flow of wind & solar PV into the grid would be ~128 GW. To balance forecasting error of even just 10% would need ~ 13GW balancing power within the particular 15 min time block. It would be very difficult for Indian grid to provide such huge balancing power within such small time period. • The situation would be more severe in the RE intensive states like Andhra Pradesh, Tamil Nadu, Rajasthan, Karnataka and Gujarat much before 2022 as the renewable energy penetration would be very high in these states. The RE mix in Rajasthan and Andhra Pradesh on annual basis by 2019 is estimated considering the planned wind and solar PV capacity in the states as shown below:

Wind + Solar Mix in 2019	Rajasthan			Andhra Pradesh		
	MW Capacity#	PLF (%)	MU Generation	MW Capacity#	PLF (%)	MU Generation
Wind	5,538	23%	11,158	4,795	25%	10,501
Solar	8,226	18%	12,971	5,127	17%	7,635
Total Energy Requirement&&			89,792			90,214
Wind and Solar MIX (Annual basis)	**26.8%**			**20.1%**		

&& CEA 18th EPS ; # 24x7 power to all initiative signed between MoP & state Govt.

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		7) Indian grid operators would face huge challenges due to frequent very high ramping up/down of generation needs and this would lead to huge disturbance in the grid operation and would bring similar challenges as in California (the Duck Curve syndrome though in India might be a Giraffe Curve) as no amount of Wind/Solar forecasting can help ease this situation. 8) A report entitled " Powering Europe : Wind energy & the Electricity Grid" by European Wind Energy Association in Nov'10 funded by European Commission, has described that for increasing the penetration of wind power into the grid, additional flexibility is required in the power system of Europe through flexible generation from hydro and gas, demand- side management (DSM), energy storage integration, transmission network strengthening and liquid fast power markets (markets with short gate closure) 9) On-site integration of energy storage system with wind/solar PV projects reduces variability of wind/solar power & smoothen the wind/solar power output and thus firms the variable wind/solar generation and ensures grid stability. Large penetration (>~10% on an annual basis and on an all India basis) of variable wind/solar energy in the grid would only be possible by integrating wind /solar projects with energy storage system 10) On-site integration of wind/solar PV projects with energy storage systems integrated with possibly load/generation matching at REMCs (which in itself need to also have load/generation balancing energy storage systems) will alone smoothen the generation output and firms the variable generation and can only be the solution for ensuring Indian grid stability with 160 GW wind & solar PV capacity in the said 2022 timelines **Proposed Suggestion:** • **Assuming that** a. the current regulation amendment proposed by the Hon'ble Commission is framed considering the GoI 2022 target of wind & solar PV capacity and b. as the other market component such as grid ancillary market (which the CERC is underway of framing regulations) and power exchange with capability of trading of power futures and forwards, would be

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		developing slowly It is ***suggest that Hon'ble Commission may introduce the provision for interconnection energy storage technologies with wind & solar PV projects at site, which would enable firming of variable wind & solar power at site coupled with balancing/scheduling at state REMC Level.***
2	**Forecasting Error Band, Penalty/Incentive and RPO fulfillment for obligated entities**	**Proposed Suggestion:** It is proposed that **a. A higher forecasting error band of +/-30 may be allowed (as mentioned under RRF mechanism) but with minor penalties and high incentives mechanism. The band limits may be rationalized progressively based on the actual experiences** **b. There may be additional incentive (in the incremental manner i.e. higher incentive for higher accuracy) over and above RE tariff for forecasting error from +/- 10% to 0% (scheduling with 100% accuracy is feasible only with onsite integration of energy storage systems) , and no incentive/penalty for forecasting error from +/- 15- +/-10% and thereafter there may be small penalty for higher inaccuracy up to +/-30% (say 5 Paise/kWh) and beyond +/-30% deviation higher penalty (say 10 Paise/kWh) may be imposed. This will encourage the developer to improve their forecasting techniques. CERC may rationalize forecasting error band, incentive and penalty later based on actual experiences** **c. Incentive and penalties may be payable in paise./kWh terms and instead of linking the balancing with RECs or linking to UI rates** **d. RPO fulfillment of the obligated entity may be on actual delivered energy basis instead of scheduled energy** **e. Centralized wind solar PV forecasting and scheduling needs to be done at state level, possibly at REMC level at each state (not at SLDC or RLDC)**

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Rationale for Suggestion

1) As per current Draft Regulations, forecasting and scheduling has to be 100% accurate for no impact of penalty. Any error in the forecasting, penalty is proposed to be imposed on the developer and it seems there is no additional incentive for better forecasting as shown in table below

<table>
<tr><th>Ranges</th><th>Below 88% of Schedule</th><th>In between 88% - 100% of Schedule</th><th>In Between 100% - 112% of the Schedule</th><th>Beyond 112% of the Schedule</th></tr>
<tr><td>Settlement for the Energy under DSM Pool Account</td><td>Scheduled power @ PPA - ₹4/kWh of under generation below 88% to DSM pool Account</td><td>Scheduled power @ PPA - ₹3/kWh of under generation DSM pool Account</td><td>Scheduled power @ PPA + ₹4/kWh of over generation from DSM pool Account</td><td>Generator will not receive any amount for excess generation beyond 112% of Schedule.</td></tr>
<tr><td>Settlement for the deviation under REC integration</td><td colspan="2">Generators have to buy the REC for the under generation will extinguish / transfer to the buyer.</td><td colspan="2">Generator would be entitled for issuance of REC for the quantum of energy which would be over generated from the schedule</td></tr>
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2) There is hardly any experience in India (even RLDCs doesn't have) of wind/solar PV forecasting and scheduling. Few developers, who are undertaking the mock exercises of scheduling and forecasting are able to forecast with large errors up to +/- 50%
3) It should not be a situation where Developers don't have the capability of forecasting and due to inefficiency of RLDC of doing accurate forecasting; the Developers end up with paying for cost of forecasting and penalty due to forecasting errors. In fact also the meteorological (meso-scale) weather models used for wind & solar forecasting, needs to be also tailored for Indian atmospheric conditions (which would also take time to refine and converge)

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		4) Also, there was no enforceable regulatory framework on wind/solar PV forecasting and scheduling till date. The only framework was Renewable Regulatory fund (RRF) mechanism which allowed forecasting with error band of +/-30% without any penalty or liability on developer 5) It would be appropriate to have a incentive mechanism for improving the developers capability of forecasting and scheduling 6) Incentive should be proposed for better forecasting and Penalty may be imposed if forecasting error is very high (considering the less experience of Indian Developers/RLDCs/SLDCs in forecasting and scheduling) 7) Having multiple components like penalty or incentive intertwined with REC substitution is a complicated process bound to be difficult to implement or liable for misuse. RPO obligations irrespective of the deviations from scheduled & actual energy should be accommodated at Obligated Entity end on actual only. Obligated Entity then have the option to pay RPO shortage penalty or buy REC from market.

By:

Rajsekhar Budhavarapu

(Head – Wind Business & CTO- Renewable Investments)

IL&FS Energy Development Co. Ltd

Email: rajsekhar.b@ilfsindia.com