भारत सरकार
Government of India
केंद्रीय विद्युत प्राधिकरण
Central Electricity Authority
नवीकरणीय ऊर्जा उद्भव विकास प्रभाग
R E S Development Division
दूसरी मंजिल,सेवा भवन, आर.के.पुरम,नई दिल्ली-110066 **(ISO: 9001-2008)**
2nd Floor, Sewa Bhawan, R.K. Puram, New Delhi – 110066

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No. CEA/Plg/RES-30/2017/ **Dated: 20th April,2017**

Subject: **First Meeting of the Sub-group of Southern Region formed under the Technical Committee constituted by CEA for study of optimal location of the various types of balancing energy sources /energy storage devices to facilitate grid integration of Renewable Energy Sources and associated issues** – reg.

Minutes of the above mentioned meeting held on 24th March,2017, at SRPC, Bengaluru, under the Chairmanship of Member Secretary, SRPC, are enclosed herewith for your kind information.

(Hemant Jain)
Chief Engineer(RES Dev.)
Convener and Member Secretary
Email: ceaopmwind@gmail.com
Phone : 011-26103867 / (M) - 9818301995

To:

1. Shri S.R. Bhat, Member Secretary, SRPC
2. Shri G. Anbunesan, Additional General Manager I/c, SRLDC, POSOCO
3. Shri B.B. Mehta, Chief Engineer, State Load Despatch Centre, Gujarat
4. Shri Hanumantharayappa, Chief Engineer, Elecy,(Planning & Co- ordination), KPTCL
5. Shri P. Suresh Babu, Chief Engineer, State Load Despatch Centre, TSTRANSCO
6. Shri A K V Bhaskar, SE, State Load Despatch Centre, A.P. Transco
7. Shri P. Rajagunanidhi, Executive Engineer, Grid, SLDC, TANTRANSCO

Copy for kind information to:

1. PPS to Secretary (Power)
2. SA to Chairperson, CEA
3. PPS to Member (Planning), CEA

Minutes of the First Meeting of the Sub-group of Southern Region formed under Technical Committee constituted by CEA for study of optimal location of various types of balancing energy sources /energy storage devices to facilitate grid integration of Renewable Energy Sources and associated issues

The First Meeting of the said Sub-group of Southern Region, was held under the Chairmanship of Shri S.R. Bhat, Member Secretary, SRPC, on **24th March,2017 (Friday)** at **SRPC, Bengaluru**. List of participants is given at **Annexure-A**.

2. Welcoming the participants, Member Secretary, SRPC, mentioned that this Sub-group Meeting had been convened to specifically deliberate issues of Southern Region with regard to grid integration of renewables under the mandate of study assigned to the Technical Committee constituted by CEA. He requested Chief Engineer (RES Development), CEA, to briefly outline the agenda for deliberations. Explaining the background of the constitution of the said Technical Committee of CEA, Chief Engineer (RES Development), CEA, explained the agenda items of the meeting as under:

- Issues in the Grid Integration of Renewables in Southern Region and possible solutions;
- To deliberate on the principles of suitability of location of balancing plants, including cost benefit analysis;

3. After a brief round of introduction, Member Secretary, SRPC, requested SRLDC to present their operational experience in Southern Region and the suggested way forward on the subject of grid integration of renewables. Representatives from SRLDC informed that Tamil Nadu had generated more than 13.25 BU of wind energy in 2016-17, Kamuthi Solar park with installed capacity of around 650 MW had come up in Tamil Nadu while other states also had ambitious RE targets. A pilot project was being undertaken for forecasting of renewable generation, but in real time variations were being observed. For instance, sharp and sudden dip in solar generation of the order of 200-250 MW due to cloud cover were being observed in a 600 MW solar plant. SRLDC was of the view that accurate forecasting of demand and renewable generation is a key parameter in operational planning, for improved real time operation. Further, planning of normal/alert/emergency spinning reserves is also essential and thus mandate would be desirable in this regard.

SRLDC added that for the envisaged addition of renewable capacity, there is a need for flexi-operation of thermal units and also optimization of pumped storage units. Further there has to be co-operation between states to handle deviations as contracts. Automatic Generation Control (AGC) as secondary control should also be implemented. They were of the view that RE generation needs to be grid friendly with similar participation in scheduling and forecasting mechanism as other generators. They suggested for flexibility in long term Power Purchase Agreements (PPAs) / Contracts as a step for handling the intermittency of renewable generation.

4. A presentation was made by SRPC on the analysis of deviations from schedule by Southern Region states. It was noted that Tamil Nadu had deviations even during non-windy season (9 months) apart from windy season of three(3) months. Karnataka was able to flex its hydro generation as per requirement depending on the load/renewable generation and Kerala was

stated to be utilizing its hydro resources in a commercially viable manner. Summarizing results of the analysis, Member Secretary, SRPC, observed that balancing requirement could also be due to variation in load forecast versus actual apart from variation in renewable generation. Consequently, accuracy of load forecasting assumed all the more significance in the present context.

5. Member Secretary, SRPC, requested the representatives of the States for their views on the subject.

5.1 Representatives of **Tamil Nadu** informed that the Plant Load Factor (PLF) of their thermal units has consistently declined from 90% to 45% over a period of last five(5) years to facilitate the absorption of renewable generation which is predominantly from wind power. He mentioned that to the extent feasible central sector thermal generation was being flexed by SRLDC as per the permissible regulatory framework. Balancing, if being considered through battery storage, could be near load centres also. Member Secretary, SRPC, mentioned that the additional margins in flexing the generation downward up to technical minimum of 55% or so may be available to the NLDC/RLDCs with the proposed procedure likely to be notified by Hon'ble CERC shortly. There would be a need for similar stipulations for state embedded generators also. In this context, representative of **Tamil Nadu** mentioned that ramping of generation was difficult since old thermal units cannot go below 70%. However, one major area of concern was the 2,000 MW share of the state in nuclear stations of the region. He mentioned that at times the revival time of nuclear units under outage/shutdown is not known with certainty thus affecting day to day operational planning. He suggested that generation planning of nuclear units should be more focused with a level of certainty and the concerned agencies be suitably advised.

5.2 Chief Engineer, SLDC, TSTRANSCO, representing **Telangana** mentioned that load forecasting tools are available in the market. As a first step for balancing, identical load forecasting tool could be offered to all the States so as to have consistency of approach. He was also of the view that for all RE rich states, REMCs (Renewable Energy Management Centres) should be established in a uniform manner and Telangana may also be considered in this scheme. He further expressed that spinning reserve could be maintained as per the highest capacity unit being dispatched in the state system or 3% of the forecasted load, whichever is higher. It was informed that the lift irrigation loads were being considered to be staggered as per availability of RE generation for the purpose of maintaining load generation balance.

5.3 Representatives of **Karnataka** informed that even with reserve shutdown of coal based units and all measures taken to reduce conventional generation, the state had to resort to compulsory under drawal from the grid for absorbing the entire RE generation in the system. This problem could aggravate in the future with further increase in RE generation due to capacity addition. It was stated that under drawal below the minimum value during excess RE generation and low state demand should be allowed. Further, there should be adequate financial protection to Discoms under abnormal conditions.

5.4 Superintending Engineer, SLDC,APTRANSCO representing **Andhra Pradesh** explained that the state was power surplus. Thermal backing down was being undertaken along with reserve shutdown of thermal plants for facilitating absorption of RE generation. He mentioned about the problems of deviation settlement due to variable renewable generation and informed that thermal units in the state were going down up to technical minimum level of 70%.

5.5 Appreciating the perspective of the issues highlighted by the representatives of the States, Member Secretary, SRPC, expressed that the problem in Southern Region gets aggravated since region has relatively lower demand during the period of high wind generation. Chief Engineer (RES Development), CEA, informed that the availability of conventional generation for balancing the intermittency in renewable generation, is to be ascertained duly considering the proposed retirement of thermal units in view of the implementation of the new environmental norms. Chief Engineer, SLDC, Gujarat, suggested that energy banking between states can be contemplated, but the issue will be in its treatment as short term purchases. Member Secretary, SRPC, mentioned that in the past at times energy banking had not met with success and a workable formulation for the same will have to be evolved. **After extensive deliberations, the Sub-group recommended that Hon'ble Central Commission/CERC may be approached for a real time product of energy trading (banking) between utilities. This needs to be flexible (allowing changes in schedule in 4 time blocks) unlike present rigid STOA regulations. Such contract should also stipulate the precise period for transaction and has to be direction specific.**

5.6 Keeping in view the operational problems being encountered/envisaged in absorption of entire RE generation in the system and the fact that the state is functioning as a control area for the load generation balance, **the Sub-group suggested the following as the way forward**:

(i) State Regulators to consider implementation of Intra-state ABT (Availability based Tariff) on priority. Forum of Regulators (FOR) may need to stipulate a definite time frame for the purpose;
(ii) Implementation of tools for accurate load/demand forecasting by States;
(iii) Demand side response from irrigation/agricultural load could help in integration of renewables; and,
(iv) Staggering of lift irrigation and other loads as is being contemplated in Telangana.

Apart from the above, SRLDC expressed that there needs to be a clear roadmap for implementation of Automatic Generation Control (AGC). Chief Engineer, SLDC, Gujarat, added that availability of primary control/response also needs to be ensured in the state generating units. The Sub-group also felt that even the renewable generators should also provide primary response to grid conditions as is being envisaged in the draft amendment of CEA (Technical Standards for Connectivity) Regulations.

6.0 Issue of visibility of renewables at SLDC level was next taken up for discussion. Chief Engineer (RES Development), CEA, informed that in accordance with the CEA (Technical Standards for Connectivity) Regulations & CEA (Technical Standards for Connectivity of the Distribution Generation Resources) it is mandatory for all the renewable generators to provide and maintain real time data connectivity to SLDCs irrespective of the voltage level at which connectivity with the grid is established. The States were asked to furnish the status in this regard.

6.1 Chief Engineer, SLDC, TSTRANSCO, informed that in the **state of Telangana** the entire 100 MW of Wind projects is integrated with SLDC for real time data, but out of 1,260 MW of Solar only 750 MW is having real time SCADA availability at SLDC. He mentioned that problem was mainly in case of renewable generation connected at 33 kV level and below.

6.2 Representatives of **Tamil Nadu** informed that the state has identified 117 pooling stations for metering and data connectivity to the SLDC. However, presently only 1,000 MW out of the total 7,000 MW of Wind power was stated to be integrated with SLDC for real time data. He informed that by June,2017 all the pooling stations would be integrated with the SLDC for real time data connectivity. By next year, data connectivity of every renewable project through a separate scheme will be established with the SLDC.

6.3 Superintending Engineer, SLDC, AP TRANSCO mentioned that 2,200 MW out of 2,400 MW of Wind capacity and 1,063 MW of the total 1,223 MW Solar capacity, is presently integrated with SLDC for real time data connectivity in the state of **Andhra Pradesh**.

6.4 Representatives of **Karnataka** expressed that the entire 585 MW of Solar and 3,600 MW of Wind projects were 100% integrated with SLDC for real time data. However, it was informed that there was no visibility of Solar roof top at SLDC level.

7.0 **Sub-group also considered forecasting and scheduling of renewable generation as an important factor in smooth integration of renewable with the grid**. Status with regard to forecasting of renewable generation was informed as under by the concerned representatives of the states :

State	Status of Forecasting of Renewable Generation
Andhra Pradesh	• Forecasting for 1,600 MW out of total 2,200 MW Wind capacity is available with 15 to 40% error. • Forecasting for 623 MW of Solar out of total 1,223 MW capacity is available with 8 to 15% error.
Telangana	Forecasting of renewable generation had not yet commenced.
Tamil Nadu	• NIWE is doing forecasting for 100% of Wind Capacity .But as per SLDC the error goes even upto 50% while NIWE claims that there is less than 5% forecasting error. • No forecasting being done for Solar of about 1,500 MW.
Karnataka	Of the 60 Wind Generators, only 34 Generators (1,860 MW) and in case of Solar only 6 Generator (140 MW) out of 24 Nos. were undertaking forecasting of generation.

8.0 Another important aspect for discussion was utilization of gas based capacity in Southern Region for balancing variability of renewable generation. In this context, representatives of **Telangana and Andhra Pradesh** informed that the two states have a total of 2,500 MW of gas based capacity. Out of this about 1,500 MW shared between Telangana and Andhra Pradesh is not operational on account of non-availability of gas. Further of the 780 MW capacity exclusively for Andhra Pradesh, 380 MW capacity is generating with available APM gas but the

said capacity was operating as base load because of the 'take or pay' contract. Representative of **Tamil Nadu** also informed that of the 550 MW gas based capacity only 200 MW was being operated with available gas on 'round the clock' basis. Chief Engineer, SLDC, **Gujarat,** informed that out of 4,600 MW capacity of gas stations in Gujarat only 100 MW capacity was having gas availability for generation.

After consideration of all facts, **the Sub-group concluded that for smooth integration of renewables in the grid, it would be desirable to utilize the existing gas based capacity as peaking station with suitable amendment of 'take or pay' contracts of GAIL for APM gas**. This may entail a relook at norms of gas based stations for peaking operation and amendment of the operational philosophy by the State Regulators. The station-wise issues were required to be looked into.

9.0 A detailed presentation was made by **Chief Engineer, SLDC, Gujarat,** on the subject of 'Issues in Grid Integration of Renewables & Possible Solutions' and 'Suitability of Location of Balancing Plants with the Way Forward'. **The salient aspects of the presentation are as under**:

- All RE projects, now onwards, to be granted approval/connectivity only after system study and appropriate network strengthening to be carried out in parallel with RE project development. Any issue in RE generation curtailment due to first mile connectivity/transmission constraint should be resolved by the developer.
- Balancing is a must for integration of RE projects in the grid system. Available hydro and gas based capacity should be deployed as balancing plants to overcome under-drawal / over-drawal at state periphery due to intermittency of RE generation. Hon'ble CERC may enhance under-drawal / over-drawal limits as per the variation of RE generation since the Deviation Settlement Mechanism (DSM) was resulting in significant financial loss to the RE rich states for absorption of entire generation from renewables.
- States can be facilitated with cheaper gas or, availability of R-LNG through e-bidding for generation at gas stations which can be a source of balancing the variability of renewable generation.
- Existing idle/inoperative pumped storage projects to be made operational for suitable deployment and sharing between states as a balancing system. Research work may be entrusted to institutions like IITs for converting conventional hydro into pumped storage mode by suitable changes in turbine, additional tail race etc.
- Intra-state RE regulations prepared by CERC should be implemented by State Regulators. To begin with, at least generation forecasting can be mandated by State Regulators for all RE developers. All SLDCs/RLDCs should also undertake centralized accurate forecasting of RE generation for the States/Regions.
- Flexible operation of thermal units and AGC control is to be mandated. Suitable commercial signals to be instituted for the purpose.
- REC market to be increased. Short term open access consumers should also mandatorily purchase RECs so as to fulfill RPO obligations.
- RPO to be compulsorily implemented with penalty provisions.
- Hon'ble CERC may consider a suitable renewable energy framework for interstate flow of power on account of variability of RE generation.

- Ideal location of balancing plants can be nearest to Wind Farm/ Solar Plants having installed capacity of 100 MW & above. However hydro projects and existing gas plants envisaged as balancing plants are location specific.
- Prime solution to manage the gap between forecast and actual RE generation is Pumped Storage Hydro projects which should be the focus. Existing/ new upcoming built/ under construction Pumped Storage Hydro projects to be deployed as multi-state projects for a large size balancing area. Operational policy/guidelines of Pumped Storage Hydro Projects to be developed accordingly.

10.0 **In the perspective of the deliberations held, the Sub-group decided to suggest the comprehensive way forward as under**:

(i) Implementation of accurate load/demand forecasting tools by the States;

(ii) Intra-state RE regulations in line with those prepared by CERC should be implemented. Generation forecasting/scheduling can be mandated by State Regulators for all RE developers. All SLDCs/RLDCs should also undertake centralized accurate forecasting of RE generation for the States/Regions;

(iii) State Regulators to consider implementation of Intra-state ABT (Availability based Tariff) on priority. Forum of Regulators (FOR) may stipulate a definite time frame for the purpose;

(iv) All the grid connected renewable generators to provide and maintain real time data connectivity to respective SLDCs/RLDC/NLDC/REMC;

(v) Proper system study and network strengthening to be carried out in parallel with RE project development henceforth;

(vi) Hon'ble CERC may consider a suitable renewable energy framework for interstate flow of power on account of variability of RE generation for enabling higher absorption of RE generation;

(vii) Hon'ble CERC may consider a real time product of energy trading (banking) between utilities which needs to be flexible (allowing changes in schedule in 4 time blocks) unlike the present rigid STOA regulations. Such contract should be direction specific and stipulate the precise period for transaction;

(viii) Decision making for RE balancing to be delegated to SLDCs;

(ix) Planning and implementation of normal/alert/emergency reserves;

(x) Strengthening of REC market and effective fulfillment of RPO targets by all the entities;

(xi) Balancing is a MUST for grid integration of Renewables and the available hydro and gas based capacity to be deployed as balancing plants;

(xii) Existing idle/inoperative pumped storage projects to be made operational for sharing between the states as a balancing resource. Institutions like IITs may be entrusted research work for converting conventional hydro into pumped storage mode through suitable changes in turbine, additional tail race etc.

(xiii) Utilize existing gas based capacity as peaking station with amendment of 'take or pay' contracts of GAIL for APM gas;

(xiv) Facilitate states with cheaper gas or availability of R-LNG through e-bidding for generation at gas stations as balancing plants;

(xv) Flexible operation of coal based thermal units embedded in state (55% Technical Minimum) to be mandated with suitable commercial signals;

(xvi) Clear roadmap for availability of primary control/response and implementation of Automatic Generation Control (AGC) for secondary control in all the state generating units;

(xvii) The renewable generators should also provide primary response to grid conditions as is being envisaged in the draft amendment of CEA (Technical Standards for Connectivity) Regulations;

(xviii) Demand side response from irrigation/agricultural and other loads by staggering;

(xix) Ideal location of balancing plants can be near to Wind Farm/ Solar Plants having installed capacity of 100 MW & above wherever feasible;

(xx) Focus should be on development of Pumped Storage Hydro projects and their operational policy/guidelines for deployment as multi-state projects for a large size balancing area. Existing/ new upcoming built/ under construction Pumped Storage Hydro projects to be included for such operation;

(xxi) Battery Storage system as balancing plant may be an expensive proposition as it is still in the developmental stage and can be considered only after exhausting limits of utilization of hydro projects including pumped storage hydro, gas based plants and the flexibility margins of coal based capacity for balancing; and,

(xxii) Technical requirements of CEA/CERC Regulations need to be complied by RE developers for enabling RE Integration.

11.0 **The Sub-group considered the following aspects of operational conditions in the Southern Region system with significant renewable generation in the grid** :

- The demand variability for Southern Region (SR) states during 2016-17 as given in **Annexure-B**. The range (Max-Ave) gives an estimate of the generation planning required to meet the peak demand. The range (Ave-Min) gives an estimate of the backing down/Reserve Shutdown (RSD) requirements to ensure secure grid operation, avoiding under drawal.

- Percentages when deviations were within and beyond the Deviation Settlement Mechanism (DSM) limits for SR states during 2016-17 are furnished in **Annexure-C**.

- As per the Report of the Committee on Spinning Reserve brought out by Hon'ble CERC in 2015, each region should maintain secondary reserve corresponding to the largest unit size in the region. Tertiary reserves should be maintained in a de-centralised fashion by each state control area for at least 50 % of the largest generating unit in the state control area.

  The Sub-group was of the view that the Generation planning can be undertaken, keeping in view demand variability and also DSM behaviour pattern as furnished in **Annexure-C**. Reserves can be maintained as per the above report of Hon'ble CERC. However, these requirements would need to be periodically assessed based on ingress of renewable energy, in different time frames.

- Wind generation in each day based on minute-wise data for 2016-17 is given in **Annexure-D**. It is seen that wind generation starts from 3rd week of May where

generation is above 1,500 MW to 3,000 MW for most of the day. However, there are some days where generation was below 1,500 MW for the entire day. There were few periods where generation had fallen more than 1,000 MW compared to previous days.

- The wind pattern for 96 blocks in the year is given in **Annexure-E**. Wind pattern in a day during wind season can be observed in the table. Wind generation drops from midnight to 8 AM. It picks up from 8 AM and peaks at around 2 to 4 PM with gradual decline upto midnight.
- **Annexure-F** gives the variation in wind generation (for 1 minute and 15 minutes) at varying wind generation levels. It can be seen that variations are less than 150 MW (for 15 Minute interval) for most of the time even at different generation levels.
- **Annexure-G** gives the wind generation profile which has been absorbed at different demand levels of Tamil Nadu. It can be seen that Tamil Nadu absorbs around 2,500 MW to 4,000 MW of wind generation when its demand varies around 11,000 MW to 12,000 MW.
- **Annexure H** gives the day-wise DSM of Tamil Nadu for the year 2016-17. It can be seen that deviations are in the range of +/- 600 MW throughout the year even during non-windy season. In windy season, the under drawal increases by around 100 MW as compared to non-windy season.

12.0. Towards the conclusion of the meeting, Chief Engineer (RES Development), CEA, requested representatives of the States to submit month-wise figures of Deviation settlement on account of RE generation and the loss due to backing down of cheaper thermal stations for absorbing RE generation for the year 2016-17 along with the month-wise loss/curtailment of generation from renewables due to various reasons during the year.

Summing up the discussions, Member Secretary, SRPC, thanked all the participants for active and meaningful deliberations. The Sub-group placed on record the appreciation for participation of Chief Engineer, SLDC, Gujarat, as a Special Invitee to give the benefit of his experience in outlining the way forward.

The Meeting ended with a Vote of Thanks to the Chair.

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Annexure-A

List of participants in the first meeting of the Sub-group of Southern Region under Technical Committee of CEA held on 24.03.2017 at SRPC, Bengaluru

Central Electricity Authority (CEA)

1. Shri S.R. Bhat, Member Secretary, SRPC **- in Chair**
2. Shri Hemant Jain, Chief Engineer (RES Dev.), CEA
3. Shri Asit Singh, Superintending Engineer, SRPC
4. Shri Anil Thomas, Executive Engineer, SRPC
5. Ms. N.S. Malini, Executive Engineer, SRPC
6. Shri M. Sriharsha, Assistant Engineer, SRPC

Central Utilities

7. Shri G. Anbunesan, Additional General Manager I/c, SRLDC, POSOCO
8. Shri V. Suresh, Assistant General Manager, SRLDC, POSOCO
9. Ms. Jane Jose, Assistant General Manager, SRLDC, POSOCO
10. Shri S.P. Kumar, Deputy General Manager, SRLDC, POSOCO
11. Ms. T. Kalanithy, Deputy General Manager, SRLDC, POSOCO

State Utilities

12. Shri B.B. Mehta, Chief Engineer, SLDC, Gujarat - **Special Invitee**
13. Shri Hanumantharayappa, Chief Engineer (P&C), KPTCL
14. Shri P.Suresh Babu, Chief Engineer, SLDC, TSTRANSCO
15. Shri A K V Bhaskar, Superintending Engineer, SLDC, A.P.Transco
16. Shri P. Rajagunanidhi, Executive Engineer, Grid, SLDC, TANTRANSCO
17. Shri A. Thangappan, Executive Engineer, REMC, TANTRANSCO
18. Shri M. Mushtaq, Executive Engineer, Grid, KPTCL
19. Shri Mohan Kumar G., Assistant Engineer (ELE), SLDC, KPTCL