

**CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI**

Petition No. 11/SM/2015

Coram:

Shri Gireesh B. Pradhan, Chairperson

Shri A.K. Singhal, Member

Shri A.S. Bakshi, Member

Dr. M.K. Iyer, Member

Date of Order: 13.10.2015

In the matter of

Roadmap to operationalise Reserves in the country

ORDER

The Electricity Act, 2003 entrusts on the Central Commission important responsibilities inter-alia of regulating the inter-State transmission of electricity, specifying grid code and also enforcing standards with respect to quality, continuity and reliability of service by licensees. Laying down of framework for effective and secure grid operation is thus one of the most important mandates of the Commission. The Central Commission has taken initiatives towards this end through regulations on Indian Electricity Grid Code and Deviation Settlement Mechanism and related matters. The Commission has also issued direction from time to time for enforcing grid discipline.

2. Over the period, reliance of the utilities on the grid for meeting their short term energy demand was increasing. This caused serious threat to grid security. The Commission, therefore, tightened the operating band of grid frequency and made deviation charges stringent enough to discourage the utilities from deviation from their schedule. This has started yielding the desired results in terms of operation of the grid

closer to 50 Hz. The Commission has reiterated time and again that un-scheduled inter-change (UI) mechanism cannot be used as platform for meeting the energy demand of the utilities. Last mile imbalances are inevitable, but for this reliance on grid is not desirable. This need be planned for, and adequate reserves need be contracted to address such last mile imbalances.

3. The National Electricity Policy (NEP) mandates that adequate reserves may be maintained to ensure secure grid operation:

“5.2.3 In order to fully meet both energy and peak demand by 2012, there is a need to create adequate reserve capacity margin. In addition to enhancing the overall availability of installed capacity to 85%, a spinning reserve of at least 5%, at national level, would need to be created to ensure grid security and quality and reliability of power supply.”

4. However, creation of adequate system reserve margin and spinning reserves at national level has not yet materialised. In furtherance to the provisions relating to the requirement of Spinning Reserves in the Electricity Act, 2003, National Electricity Policy and Tariff Policy, and to facilitate large scale integration of renewable energy sources, balancing, deviation settlement mechanism and associated issues, CERC constituted a Committee vide letter No, 25/1/2015/Reg. Aff. (SR)/CT.RC dated 29th May 2015, under the chairmanship of Shri A.S. Bakshi, Member CERC, to examine the technical and commercial issues in connection with Spinning Reserves and evolve suggested regulatory interventions in this context.

5. The Committee submitted its final report to the Commission on 17th September 2015 (annexed as Annexure-I). Major findings of the Committee are as under:

- (a) Spinning Reserves are required to be maintained of requisite quantum depending upon the grid conditions. Operation at constant frequency target of 50.0 Hz with constant area interchange should be the philosophy adopted.
- (b) The Spinning Reserve may be maintained, to start with at the regional level in a distributed manner.
- (c) The respective RLDC should be the Nodal agency at the regional level and NLDC at the country level.
- (d) Each region should maintain secondary reserves corresponding to the largest unit size in the region and tertiary reserves should be maintained in a decentralized fashion by each state control area for at least 50% of the largest generating unit available in the state control area. This would mean secondary reserves of 1000 MW in Southern region; 800 MW in Western regions; 800 MW in Northern region; 660 MW in Eastern region and 363MW in North-Eastern region (total approx. 3600 MW on an All India basis). Primary reserves of 4000 MW should be maintained on an All India basis considering 4000 MW generation outage as a credible contingency. The same should be provided by generating units in line with the IEGC provisions.
- (e) The reserve requirement may be estimated by the nodal agency on day-ahead basis along with day ahead scheduling of all available generating stations.

- (f) Implementation of AGC is necessary along with reliable telemetry and communication. The AGC may be planned to be operationalised in the power system from 1.4.2017.
- (g) It is essential that load forecasting is done at each DISCOM level, at each SLDC/State level and each RLDC/Regional level and finally at NLDC/country level.
- (h) It is also essential to forecast the generation from renewable sources of energy by the generators, and similarly by the DISCOMs, by the SLDCs and by the RLDCs.
- (i) To start with a regulated framework in line with the Ancillary Services Regulations may be evolved for identification and utilising of spinning reserves and implemented with effect from 1.4.2016. This framework may continue till 31.3.2017.
- (j) The reserves at the regional level, should be assigned to specific identified generating station or stations duly considering the various technical and commercial considerations including energy charges of the generating stations. The nodal agency should be empowered to identify the ISGS irrespective of type and size of the generating station for providing spinning reserve services and it should be mandatory for such generating stations to provide spinning reserve services.

- (k) The nodal agency may have the option of carrying such reserves on one or more plants on technical and commercial considerations and may withhold a part of declared capacity on such plants from scheduling. It could be in terms of % of declared capacity or in MW term as deemed fit.
- (l) A framework as specified in the Central Electricity Regulatory Commission (Ancillary Services Operations) Regulations, 2015 may be followed for the Spinning Reserve Services as well. The Central Electricity Regulatory Commission (Ancillary Services Operations) Regulations, 2015 may be amended to incorporate the necessary changes in this regard.
- (m) Going forward, a market based framework may be put in place from 1st April 2017 for achieving greater economy and efficiency in the system. A detailed study is required to be carried out before the market mechanism on spinning reserves is put in place. It is suggested that the NLDC be directed to commission study through a consultant in the context and submit a proposal to the Commission for approval.

The Commission has carefully considered and accepted the findings of the Committee.

6. One of the important components of ensuring grid reliability includes achieving adequacy of supply and maintaining the load-generation balance. This poses a challenge to grid operators on various time-scales: on a daily level as weather varies, for example, on an hourly level as load varies during the day, and on sub-hourly/time-

block level as there are errors in forecasting of load or unplanned outages of generating units or transmission lines. Sudden disturbances in the Power System can initiate a steep fall or rise in the frequency of the Power System, which can be detrimental to the Power System operation, if not contained immediately. Thus, to ensure 24x7 power supply and grid reliability, grid operators must have access to reserves at different locations and factoring transmission constraints, the system operators should be able to increase or decrease power supply on the grid at any time of the day.

7. Three types of reserves are generally considered depending on the timeline of initiation and functional need. Primary control refers to local automatic control available in all conventional generators, which delivers reserve power negatively proportional to frequency change. Such immediate automatic control is implemented through turbine speed governors, in which the generating units respond quickly to the frequency deviation as per droop characteristic of the units. However, this response to arrest frequency drop or rise lasts for short period of up to 30 seconds - 15 minutes, within which secondary control should come into play should the contingency last longer than that. IEGC section 5.2(i) specifies a provision for primary reserves, as under:

“The recommended rate for changing the governor setting, i.e., supplementary control for increasing or decreasing the output (generation level) for all generating units, irrespective of their type and size, would be one (1.0) per cent per minute or as per manufacturer’s limits. However, if frequency falls below 49.7Hz, all partly loaded generating units shall pick up additional load at a faster rate, according to their capability.”

However, this has not been adhered to fully by the generators.

8. Secondary control involves Automatic Generation Control (AGC) which delivers reserve power in order to bring back the frequency and the area interchange programs to their target values. For AGC, units as well as load dispatch centres have to be equipped with necessary communication infrastructure, as it involves sending automated control signals from the LDC to the generator based on grid conditions. AGC has been absent in the Indian power system. Very commonly, this results in 'load shedding' by DISCOMs in case generation is lagging load. The Indian power sector was beset with scarcity for a long time; however, now the scenario is changing and margin for reserves is feasible. With a large interconnected grid meeting a peak load of over 145 GW, both primary and secondary controls are essential components for reliable grid operation.

9. Tertiary control refers to manual change in the dispatching and unit commitment in order to restore the secondary control reserve, as loss of generator may cause a system contingency that lasts for several hours.

10. Traditionally, imbalance handling on the Indian grid has been done through the Unscheduled Interchange (UI) or the Deviation Settlement Mechanism (DSM) framework, in which the frequency-linked UI rate gave a signal to the grid participants to correct for instantaneous frequency deviations. However, it led to use not meant for, and further grid indiscipline besides stress/constraints in the transmission network. While measures like tightening of the operating grid frequency band and provision for deterrent deviation charges, have been resorted to and this has resulted in improvement of grid operation, the Commission feels that the power system operation in

the country still needs to mature further. Even now States have been deviating from schedule substantially. For instance, in 2014-15, Rajasthan deviated in the range of (+) 1202 to (-) 1324; UP in the range of 1613 to (-) 2291; Karnataka in the range of 945 to (-) 787 etc.; Tamil Nadu in the range of 546 to (-) 990; Gujarat in the range of 1174 to (-) 1162. These are not only undesirable but also a cause of serious concern. The DSM Regulations provide for a periodic review of the DSM rates and the Commission directs the Staff to undertake a review of the same and submit a proposal for consideration of the Commission.

11. The Commission would like to underscore that grid does not generate electricity and as such cannot be relied upon for meeting energy needs. Reserves and reserves alone can address this and the earlier the stakeholders realise this, the better it is for safe and secure system operation. Reserves assume greater significance additionally in the wake of the goal of integration of large scale variable renewable energy sources. With increasing penetration of variable and intermittent RE generation, flexible generation such as pumped storage hydro plants are needed. There is a need for more flexibility in the operation of conventional generation plants also and flexibility needs to be quantified, measured and duly compensated for. The Commission has already made a beginning in this direction by proposing amendment to the Indian Electricity Grid Code (IEGC) in respect of 'technical minimum' which is expected to be notified shortly. 'Ramp up' and 'ramp down' rates are other important parameters for flexibility which would gradually be introduced through Regulations.

12. The grid operator would now be required to undertake planning exercise to meet Net Load, which is defined as: $\text{Net load} = \text{Load} - \text{RE power}$. This quantum must be met with conventional generation with adequate flexibility at every point in time. To even begin an exercise of planning for ongoing load-generation balance, load forecasting is essential. It is also necessary to ensure conventional generators to generate as per the schedules. Forecasting and scheduling of solar and wind generating stations is the next critical step for the grid operators to estimate the amount of RE power they can anticipate to be injected into the grid, on a day-ahead and hour-ahead basis. Thus, the variability that can be predicted in the forecasts must be accounted for in planning flexible generation as well as tertiary reserves day-ahead and hour-ahead. Furthermore, balancing the uncertainty of RE power on a continuous basis necessitates a streamlined process for deploying spinning reserves. This would be effectively balancing the forecasting error in net load.

13. The Commission notified Central Electricity Regulatory Commission (Ancillary Services Operations) Regulations, 2015 on 19th August 2015 with the objective of utilizing un-requisitioned surplus in ISGS. These regulations are a first step towards the entire gamut of Ancillary Services, starting with tertiary frequency control services. Applicable to regional entities, the regulations outline a framework for both Regulation Up and Regulation Down service by Reserves Regulation Ancillary Services (RRAS) providers. NLDC along with RLDC, operating as the nodal agency, shall call for these services in varying situations, such as extreme weather events, loss of generating unit

or transmission line outage, load-generation imbalance, etc. The RRAS providers shall be paid from the Regional DSM Pools.

14. Furthermore, the Commission notified the Order on Extended Market Session on Power Exchanges on 8th April, 2015, and the power exchanges started operating extended hours for intra-day products by end of July. The trading window is now open round-the-clock for delivery of power on the same day, with a 3-hour delivery time-frame. This can enable to significantly correct for intra-day imbalances in a proactive manner, and not passively rely on the grid for the same. It is expected that the Distribution Control Centres (DCCs) of DISCOMs also operate in a 24 x 7 manner to reap the advantages from these extended market sessions. Depending on the market needs, there is a need for newer products in the electricity market to provide more opportunities to the participants to balance their portfolio. The Commission directs the staff to examine this aspect of market design and submit a proposal for consideration of the Commission.

15. It is also expected that with provision for reserves and harnessing the same through 'controls', the inter area power flows would be manageable and help in optimizing the Transmission Reliability Margin (TRM). This would benefit all stakeholders to a great extent.

16. In due recognition of the above factors, the Commission would like to chart out a road map for introduction of reserves in the country. Accordingly, the Commission directs as under:

(a) For reliable and secure grid operation, to maintain continuous load-generation balance, to counter generation outages as well as unexpected load surges or crashes, and for large scale integration of variable renewable power, it is essential for the grid operators to have access to distributed Spinning Reserves which are dispatched taking due care of transmission constraints whenever required.

(b) The Commission reiterates the need for mandating Primary Reserves as well as Automatic Generation Control (AGC) for enabling Secondary Reserves.

(i) All generating stations that are regional entities must plan to operationalise AGC along with reliable telemetry and communication by 1st April, 2017. This would entail a one-time expense for the generators to install requisite software and firmware, which could be compensated for. Communication infrastructure must be planned by the CTU and developed in parallel, in a cost-effective manner.

(ii) On the other hand, National/Regional/State Load Dispatch Centres (NLDC/RLDCs/SLDCs) would need technical upgrades as well as operational procedures to be able to send automated signals to these generators. NLDC /RLDCs and SLDCs should plan to be ready with requisite software and procedures by the same date.

(iii) The Central Commission advises the State Commissions to issue orders for intra-state generators in line with this timeline as AGC is essential for reliable operation of India's large inter-connected grid.

(c) To start with, a regulated framework in line with the Ancillary Services Regulations would need be evolved for identification and utilising of spinning reserves and implemented with effect from 1st April, 2016. This framework may continue till 31st March, 2017. This may only include generating stations regulated by CERC, which could be started off with a manual process for secondary reserves. The NLDC/POSOCO is directed to submit a detailed procedure in this regard for approval by the Commission within one month from the issue of this Order. The amendments required in various Regulations issued by the Commission would also need to be indicated. As the Renewable Energy (RE) penetration levels increase in the coming years, the impact on the quantum of reserves would need to be separately studied and provided for through further amendments.

(d) In the long term, however, a market based framework is required for efficient provision of secondary reserves from all generators across the country. For this, NLDC/POSOCO is directed to commission a detailed study through a consultant and suggest a proposal to the Commission for implementation by 1st April, 2017, giving due consideration to the experience gained in the implementation of Spinning Reserves w.e.f. 1st April, 2016.

- (e) The States must undertake separate scheduling and energy accounting of all generating and load entities. Deployment of DSM framework shall greatly prepare the State to differentiate between and attribute deviations caused due to various entities involved. Recording of this data shall also give the State grid operator much needed clarity on which entities are responsible for schedule deviations, and to what extent.
- (f) Load forecasting must be undertaken by all DISCOMs. Combined with DSM, it is the foundation on which strong and reliable grid management can be built.
- (g) In order to ensure reliable and secure operation of the grid, in addition to compliance to standards and regulations, adequate defense mechanisms such as Under Frequency Relays (UFRs), df/dt (rate of change of frequency), System Protection Schemes (SPS), etc. must be put in place and which also need to be periodically reviewed and checked for healthiness.

17. The petition is disposed of in terms of the above directions.

sd/-
(Dr. M.K. Iyer)
Member

sd/-
(A. S. Bakshi)
Member

sd/-
(A.K. Singhal)
Member

sd/-
(Gireesh B. Pradhan)
Chairperson