

**CENTRAL ELECTRICITY REGULATORY COMMISSION
NEW DELHI**

Petition No. 07/SM/2018 (Suo-Motu)

Coram:

**Shri P.K. Pujari, Chairperson
Shri A. K. Singhal, Member
Shri A. S. Bakshi, Member
Dr. M. K. Iyer, Member**

Date of Order 16th of July, 2018

in the matter of

Pilot Project on 05-Minute Scheduling, Metering, Accounting and Settlement for Thermal/Hydro, and on Hydro as Fast Response Ancillary Services (FRAS).

ORDER

The Electricity Act, 2003 entrusts on the Central Commission the 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. The Act and the policies framed under the Act have also cast on the Commission, the responsibilities of promoting renewable energy.

2. The Government of India has set a target of achieving RE capacity to the tune of 175 GW by 2022. The Commission has taken several initiatives to ensure integration of variable RE generation of this magnitude. The framework for forecasting, scheduling and deviation settlement for wind and solar has been put in place. To enable thermal generators to provide balancing support, necessary



regulatory framework has been provided defining technical minimum for such plants and commensurate compensation for flexing such (thermal) generation up to technical minimum. The Commission has also issued Suo Motu order delineating the road map for operationalizing reserves. Various types of reserves, viz., primary, secondary and tertiary reserves are required to balance variable RE generation. The primary reserves have been ensured through suitable amendments in the (Indian Electricity Grid Code) IEGC which require the generating stations to keep such reserves for system security, by not scheduling beyond their installed capacity. For secondary control also the Commission has approved a pilot project on Automatic Generation Control (AGC). As regards tertiary control, the Commission has issued regulations on Reserves Regulation Ancillary Services (RRAS) which has been in operation for more than a year now.

3. For seamless integration of variable RE generation across the country, it is essential that a framework commensurate with inter-State framework must be implemented at the State level as well. The Forum of Regulators (FoR) has taken an initiative in this context and has constituted a Technical Committee to develop complementary intra-state level regulatory framework for RE integration. The FOR Technical Committee has been deliberating on various issues at stake in the context of implementation framework for renewable at the State level.

4. The FoR in its 63rd Meeting held on 9th April, 2018 considered *inter-alia* some of such recommendations of the FOR Technical Committee. The relevant extracts from the minutes of the FOR meeting are reproduced below:-



“Sub-Group for Implementation of 5-Minute Scheduling, Metering, Accounting And Settlement

.....It was informed that the FOR Technical Committee members appreciated the need to move to 5-minute scheduling and settlement in view of the increasing RE penetration. The international experience evinces that shorter dispatch and settlement period such as 5-minutes offers a lot of advantages, particularly in terms of reduction in the requirement of reserve, robust price discovery and bringing out the value of flexibility. In advanced markets like in Australia and USA, the framework of 5-minute scheduling, dispatch and settlement has already been introduced. The cost benefit analysis of implementation of the 5-minute metering/ scheduling framework at the inter-State level was also presented by POSOCO.

A sub-Group constituted by the Committee has also examined the proposal and suggested that, on a pilot basis, 5-minute capable meters may be installed at say, 4-5 locations in each Region to gain practical experience in 5-minute metering, interfacing requirements/ file interchange formats and develop data analytics/ tools for 5-minute metering, data validation, reporting, etc. It was recognized that pilot project would help in formulation/ refinements of Technical specifications and Software Requirement Specifications (SRS) for Metering Software at RLDCs and Accounting Software at RPCs for 5-minute metering.

The Forum appreciated the initiative and requested CERC and CEA to take the initiative forward with pilot studies as suggested at the earliest. Results may be shared with the Forum to enable the SERCs to take similar action at the State level.

“Introduction of Fast Response Ancillary Services (FRAS) From Hydro Generating Stations

.....The marginal cost for hydro generation is almost zero and the segregation of fixed and variable charges in case of hydro is only notional. Thus, the present model of ancillary services, which relies on payment of fixed charges, variable charges and incentive is incompatible for hydro stations. Therefore, in order to harness the flexibility and fast response provided by storage and pondge hydro, a framework of Fast Response Ancillary Services for providing frequency regulation services was proposed.

The Forum endorsed the recommendation of the Technical Committee for pilot studies on FRAS for Hydro (along with pilot studies on 5-Minute Scheduling, Metering, Accounting and Settlement) in the States of Andhra Pradesh, Rajasthan, Telangana, Uttar Pradesh and West Bengal.”

5. Subsequently, POSOCO through letter no. POSOCO/NLDC/ASP/2018/47 dated 9th May 2018 has also proposed to implement pilot on FRAS through Hydro projects along with 5-Minutes Scheduling, Metering, Accounting and Settlement and has requested for suitable directions from the Commission. POSOCO has stated that the concept of Fast Response Ancillary Services (FRAS) for hydro as also the 5-Minutes Scheduling, Metering, Accounting and Settlement were discussed in the FOR Technical Committee meetings and at a Special Meeting with various Central Hydro Generators. A broad consensus has been achieved amongst the generators on implementation of FRAS. Both these concepts have also been endorsed by the FOR.



6. The Commission has taken cognizance of the recommendations of the Forum of Regulators (FoR) and the proposal of POSOCO and has decided to initiate suitable actions in this regard.

Analysis & Decision

A. 05-minute- Scheduling, Metering, Accounting and Settlement

7. The Commission observes that there are a number of advantages of implementing 5-minute scheduling. Various studies have recognized that shorter despatch and settlement period such as 5-minute offer advantages, particularly in terms of reduction in the requirement of reserves, reduction in variability, robust price discovery closer to real time and bringing out the value of flexibility. 5-minute scheduling has reportedly helped in reducing regulation requirements to below 1% of peak daily load in many ISO/RTOs.

8. In this context, it would be pertinent to mention the following observations in the NITI Aayog Report of the Expert Group on 175 GW by 2022:-

“Scheduling and Dispatch: Through both practice and theory, it has become evident that grids that are operated in a manner where scheduling and dispatch are implemented over short time durations (e.g., as low as five minutes) have significantly lower overall costs to consumers as the need for ancillary resources decreases.

Currently, in India, scheduling occurs on a day-ahead basis while dispatch occurs on a 15-minute basis. System operations technologies and protocols need to be updated to enable



five-minute scheduling and dispatch of all resources connected to the grid and automated incorporation of RE forecasts.

It should be noted that accuracy of RE forecasts is significantly higher the closer they get to dispatch. Consequently, the ancillary service requirements will also be lower”

9. The Commission recognizes that scheduling closer to real time could help manage power system operation better and facilitate smooth grid integration of RE. Also, the shorter duration scheduling, metering, accounting and settlement would be necessary for fast response technologies like battery storage, demand response, etc. The Commission believes that the framework of 5-minute scheduling is likely to bring in better granularity in grid management. This could reduce reserves requirement, set pathways for newer technologies, robust price discovery closer to real time and bring out the value of flexibility. The Commission appreciates the advantages of closer to real time scheduling and has accordingly decided to introduce the pilot project for implementing 5-minute scheduling, metering, accounting and settlement for Thermal with AGC installations and Hydro Power Stations

B. Fast Response Ancillary Services (FRAS) From Hydro Generating Stations

10. The Commission vide Order dated 13.10.2015 in Petition no 11/SM/2015 charted a roadmap for operationalization of generation reserves in the country. It was envisaged that each region should maintain primary, secondary and tertiary reserves. Primary response of 5% is envisaged from all the generating stations. For Secondary frequency response, it is essential that Automatic Generation Control is provided. The Commission vide Order dated 07.12.2017 in Petition no 79/RC/2017



approved implementation of the AGC pilot project.

11. In so far as tertiary control is concerned, the Commission has introduced the Reserves Regulation Ancillary Services (RRAS). This is primarily a framework for slow tertiary reserves at the ISTS level where actions at the power plant happen after 16-30 minutes as advised by National Load Despatch Centre (NLDC) in coordination with Regional Load Despatch Centres (RLDCs). The Commission recognises the need for introduction of Fast Response Ancillary Services.

12. The present framework of Ancillary Services predominantly utilizes the thermal power stations which have ramping limitations and as such there is a need for a fast response ancillary service. Hydro stations are “energy limited resources” unlike the thermal stations (coal based) which are “ramp limited resources”. Hydro stations are also subject to limitations/constraints in terms of water inflows as well as the quantum of water that can be released based on reasons other than power generation requirements.

13. The CEA (Technical Standards for Connectivity to the Grid) Regulations, 2007 and CEA (Technical Standards for Connectivity to the Grid) Regulations, 2013 mention the following:-

“All generating machines irrespective of capacity shall have electronically controlled governing system with appropriate speed/load characteristics to regulate frequency. The governors of thermal generating units shall have a droop of 3 to 6% and those of hydro generating units 0 to 10%.”

14. Hydro stations can thus respond very quickly and much faster than thermal/gas stations. In



other words, these are more suitable for handling sharp fluctuations such as those observed at the hour boundary. Thus, fast responding ancillary service from hydro stations may be used primarily for ‘regulation service’ from storage/pondage based hydro stations for example to handle the hour-boundary frequency spikes. With increasing quantum of renewable penetration, fast response ancillary can also act as a mechanism to handle the intermittency.

15. In view of the special characteristics mentioned above, the Commission is of the view that the flexibility and fast response provided by storage and pondage hydro could be harnessed under a framework of Fast Response Ancillary Services for providing frequency regulation service. The framework would have the following features.

16. For implementing Hydro Power as FRAS, all constraints and commitments declared by the hydro stations shall be honoured and the total energy delivered over the day shall be maintained as declared by the hydro station. The total energy dispatched under FRAS shall be squared off by the end of the day. Triggering of FRAS shall be based on the balance energy available in the hydro station. The Schedules of the beneficiaries shall not be disturbed in the despatch of FRAS and the Payment for FRAS shall be based on ‘mileage’ basis. The mileage during the day shall be computed as follows:

(a) Net energy $E_{\text{net}} = \Sigma E_{\text{up}} - \Sigma E_{\text{down}}$ (in MWh) (should be zero over the day)

(b) Mileage $E_m = \Sigma |E_{\text{upt}}| + \Sigma |E_{\text{downt}}|$ (in MWh)

No additional fixed charge or variable charges shall be paid for providing FRAS support. Existing fixed charges and variable charges shall continue to be paid by the beneficiaries for the normal schedules as per existing practice. The total energy despatched for hydro under FRAS shall be made zero and



hence, no energy charges shall be payable to the hydro stations.

17. The Commission endorses implementation of a pilot on FRAS for hydro stations with the above features.

Cost Implication

18. POSOCO has provided cost estimation of implementation of pilot study for 5-minute scheduling and use of Hydro Power as FRAS. Some thermal stations where AGC has been implemented or is proposed to be implemented also to be added for this pilot project in addition to Hydro projects. POSOCO has submitted the estimated cost of ₹ 87 Lakhs for implementation of pilot project on 5-minute scheduling, and ₹ 49.75 Lakhs for FRAS, with the following details:-

Cost Estimate for Implementation of Pilot Project on Fast Response Ancillary Service (FRAS) and 05-Minute Metering

Pilot Project for Fast Response Ancillary Service (FRAS) with Hydro Scheduling and Ancillary Services Co-optimization		
At NLDC Control Centre		
S.No.	Title	Approximate Cost (in ₹)
1.	Annual License for Open source, object-oriented web application development platform (Eg. Zend Software)	65,000
2.	Enterprise License for High-level Modeling System for Mathematical Optimization with Solver (Eg. GAMS Optimization Software with CPLEX Solver)	22,75,000

3.	Two Server(s) (Main and Hot Standby) to install all the desired software	24,00,000
4.	Two Workstations	1,70,000
5.	Rack	65,000
Total		49,75,000

Pilot Project for 05-Minute Metering		
5-Minute Main and Check Meters (with AMR feature) to be installed at NTPC Dadri (15 Nos.), THDC Tehri (2 Nos.), NTPC Mouda (14 Nos.), NTPC Simhadri (6 Nos.), NTPC Bongaigaon (4 Nos.), NTPC Barh (4 Nos.), NHPC Teesta (2 Nos.), NHPC Loktak (4 Nos.) generating stations.		
S.No.	Title	Approximate Cost (in ₹)
1.	51x2=102 Meter Nos. (~ ₹ 50,000 /meter)	51,00,000
2.	Spare Meters (20 % of total nos.) = 20 Meter Nos.	10,00,000
3.	Additional costs for installation, upgradation (h/w & s/w) and commissioning (@ 50 %)	26,00,000
Total		87,00,000

Notes:

1. *The pilot project for FRAS would cover all the central sector hydro generating stations.*
2. *The pilot project for 05-Minute metering would cover hydro stations in NR, ER and NER as well as thermal stations in all five regions (identified for AGC installation too).*
3. *The cost of the 05-Minute Pilot Metering (Tendering to Commissioning) to be borne by CTU. The cost may be recovered through filing of tariff petition before CERC.*
4. *At present, AGC is implemented only in Dadri. Hence, pilot project will include NTPC Dadri initially, though the project cost includes five stations of NTPC. For NTPC Mouda & Simhadri, orders have been placed for AGC implementation. For NTPC Bongaigaon & Barh AGC implementation is yet to be initiated. Therefore, for NTPC Mouda & Simhadri, Bongaigaon and Barh, the pilot study will be done along with AGC implementation subsequently.*



19. The Commission notes that the estimated cost for conducting pilot for 5-minute scheduling is about ₹87 Lakhs and for Hydro Power as FRAS is about ₹ 49.75 Lakhs. The cost (estimated ₹ 87 lakhs) for pilot project for 05-Minute scheduling is primarily on account of procurement of meters. CTU shall procure the meters and other equipment and incur costs towards installation, commissioning etc. and claim reimbursement by filing a petition before the Commission. POSOCO has further stated vide its letter dated 5th June, 2018 that as an interim measure until the CEA specifications on 5 minute meters are notified, the “Technical Specification for Interface Energy Meters, Automated Meter Reading System and Meter Data Processing for Inter State System in Western Region”, approved in the 34thTCC/WRPC meeting held on 27-28 July 2017 in Mumbai may be used for the pilot projects. The cost (estimated ₹ 49.75 Lakh) for pilot project for FRAS for hydro stations is largely on account of procurement software. This shall be borne by POSOCO out of the contingency funds available under RLDC Fees and Charges Regulations.

20. The Commission in the Order dated 29.02.2016 in petition No. 01/SM/2016 in the matter of “Determination of mark-up for delivery of Regulation Up Services, under Central Electricity Regulatory Commission (Ancillary Services Operations) Regulations, 2015, has allowed mark up of 50 paise/unit for participation in Ancillary Service. For Regulation Down Ancillary Services, 25% of variable charges is allowed to be retained by a generator.

21. The Commission in its Order dated 06.12.2017 in the Petition No. 79/RC/2017 in the matter of Automatic Generation Control Pilot project has approved mark up of 50 paise/unit for the generating plant through AGC for providing services under secondary reserves in line with the

experience gained on Reserve Regulations Ancillary Services in Indian grid.

22. The Commission observes that triggering of FRAS would be based on the balance energy available in the hydro station (being zero marginal cost for hydro), whereas the despatch in the case of thermal generators is based on variable charges of a station. The variable charges as paid to the thermal generators for providing ancillary services are not trued up for any subsequent fuel price adjustment. The incentive/mark-up provided to them is expected to take care of such adjustments, if any. The marginal cost for hydro generation is zero and the segregation of fixed and variable charges in case of hydro is only notional. There is no case for any fuel price adjustment for hydro stations unlike in the thermal stations. In view of this, incentive could be paid on the basis of 'mileage' a hydro generator is able to provide as FRAS. For this pilot project, an incentive at the rate of 10 paise per kWh both for 'up' and 'down' regulation shall be provided to the hydro station. At this stage, given the fact that it is only a pilot the Commission is not going into a detailed justification for arriving at the mileage of 10 paise. This is as presented by POSOCO to the hydro generators while explaining the concept of FRAS.

Summary of Decision

23. The Commission is of the view that there is a need for implementing pilot projects on 5-minute scheduling and Hydro Power as FRAS. The Pilot would help gain experience in ancillary services along with providing valuable learning regarding 5-minutes scheduling, metering, accounting and settlement. This pilot will also provide insight for implementation of other competing resources like Battery Storage, Electric Vehicles, Demand Response as Ancillary Services.



Accordingly, the Commission endorses the recommendations made by the FOR and accords approve to the request made by POSOCO for pilot studies on implementation of 5-minute metering and Hydro as FRAS and accordingly directs as follows:

A. 5-minutes Scheduling, Metering, Accounting and Settlement

- (a) POSOCO shall implement 5-minute metering covering hydro stations in NR, ER and NER as well as thermal stations with AGC installations in all five regions to gain experience which would help in formulation/refinements of Technical specifications and Software Requirement Specifications (SRS) for Metering Software at RLDCs and Accounting Software at RPCs for 5-minute metering.

- (b) As a pilot, 5-minute metering can be in parallel with 15-minute metering. The Scheduling and Despatch has to be aligned with Settlement process in 5-minutes too and the accounts of both 5-minute and 15-minute shall be kept parallel.

- (c) All future procurements of Interface Energy Meters should ideally have recording at 5-min interval and frequency resolution of 0.01 Hz. They should be capable of recording Voltage and Reactive Energy at every 5-min and should have feature of auto-time synchronization through GPS.

- (d) As suggested by POSOCO, the “Technical Specification for Interface Energy Meters, Automated Meter Reading System and Meter Data Processing for Inter State System in Western Region”, approved in the 34thTCC/WRPC meeting held on 27-28 July 2017 in Mumbai may be used for the pilot projects.



(e) As and when CEA Metering Standards for Interface Meters to facilitate 5-minute metering are notified, the same shall be adopted for the pilot projects which have not been taken up till the date of notification of CEA standards. CEA is requested to expedite the notification of amended Metering Standards for interface metering with 05-minute capability.

(f) The Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 mention the following:

“6(1)(a) All interface meters installed at the points of interconnection with Inter-State Transmission System (ISTS) for the purpose of electricity accounting and billing shall be owned by CTU.”

Accordingly, CTU shall facilitate the pilot project with installation of 5-minute meters at the pre-identified locations. CTU is directed to complete the procurement and installation of the 05-minute meters in the pilot project by end of August, 2018 in coordination with POSOCO. The cost of such procurement shall be reimbursed to the CTU, as given in paragraph 19 of this Order

B. Fast Response Ancillary Services (FRAS) From Hydro Generating Stations

(g) POSOCO shall implement pilot project for FRAS covering all Central sector hydro generating stations which would help in gaining experience in regard to FRAS.



- (h) For this purpose, all constraints declared by the hydro stations shall be honoured and the total energy delivered over the day shall be maintained as declared by the hydro station. The total energy dispatched under FRAS shall be squared off by the end of the day.
- (i) FRAS shall be triggered based on a stack prepared based on the balance energy available in the hydro station. The Schedules of the beneficiaries shall not be disturbed in the despatch of FRAS.
- (j) The RPCs shall issue weekly FRAS accounts along with the RRAS accounts based on the data provided to them by the RLDCs/NLDC. Incentive shall be paid from the DSM Pool on mileage basis at the rate of 10 paise per kWh both for 'up' and 'down' regulation provided by the hydro station.
- (k) All Central sector hydro generators are directed to cooperate and assist POSOCO in successfully conducting the pilot project. The Central sector hydro stations shall follow the FRAS instructions issued by NLDC and the performance would be monitored by RLDCs/NLDC.

24. The above pilot studies may be completed by POSOCO within 6 months of issue of this Order.



25. POSOCO is also directed to appraise the Commission regarding the experience gained in the pilot project in the of report covering all the aspects within six months of implementation of the pilot project.

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

Sd/-
[M. K. Iyer]
MEMBER

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[A. S. Bakshi]
MEMBER

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[A. K. Singhal]
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