

Figure 34: Dadri Gas Schedule Ramp

For a sample day (17th December'2020), 15-minute schedule is converted to 05-minute block due honouring the ramp as per 05-minute time block basis. The same is depicted in Fig. 36.

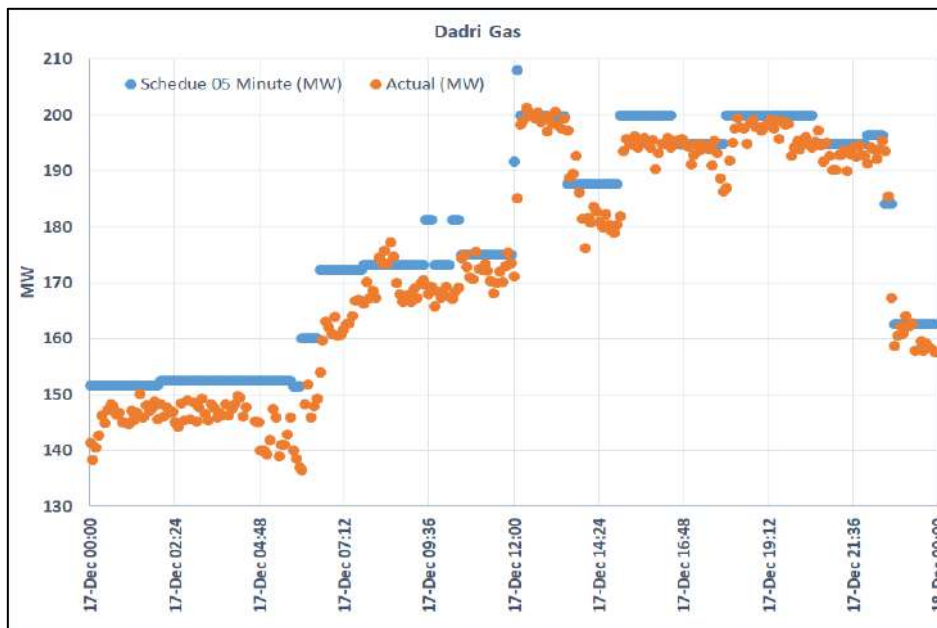


Figure 35: Dadri Gas schedule Vs Actual

The sample deviation is calculated in 05-minute time block basis. The frequency has been considered as recorded by one of the 05-minute IEM installed in the Dadri gas power station. The sample changes in deviation charges computed in 05-minute and 15-Minute time blocks is depicted in Fig. 37

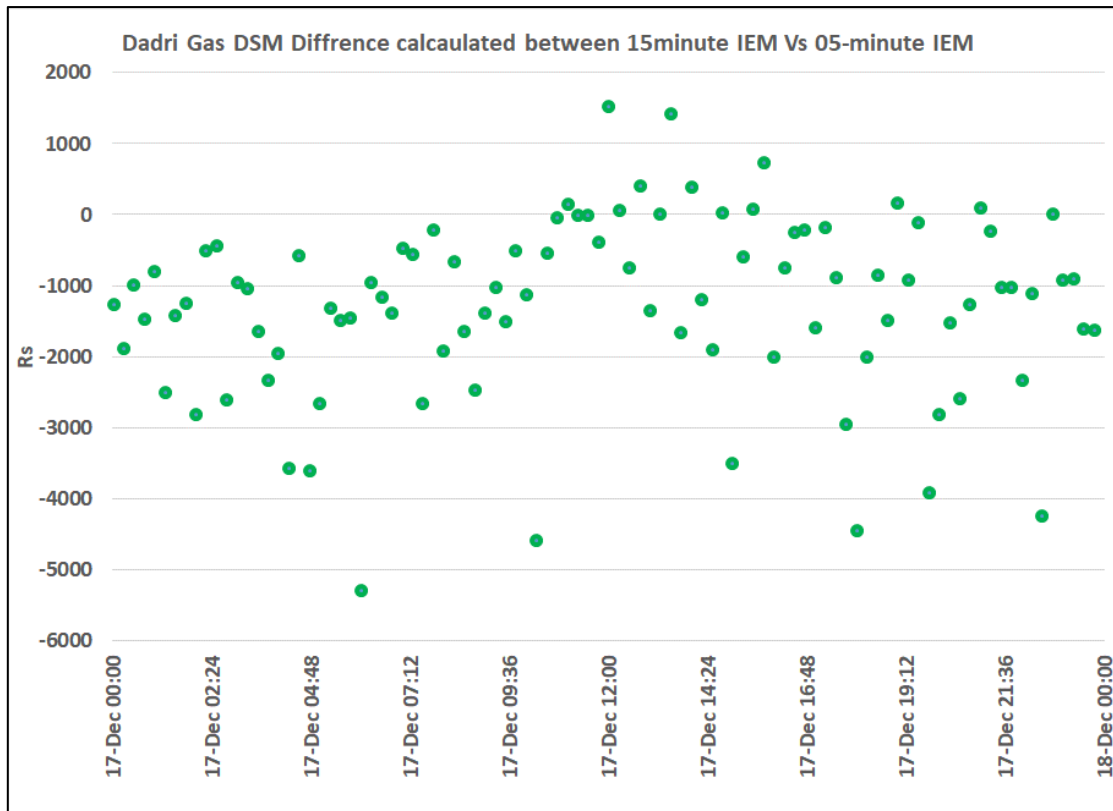


Figure 36: Block wise 05-minute and 15-minute DSM charges (Gas)

It can be inferred that schedule and settlement done at 05-minute basis may provide opportunity for the gas plants, with higher ramp capability compared to thermal plants, may help in better managing their ramp and the deviation from the schedule.

3.11 DATA ANALYSIS OF THERMAL STATION

In southern region, 05-minute IEMs were installed in Simhadri-II Power station [500*2=1000 MW). The declared ramp for scheduling is 72 MW/15-minute time-block. The schedule ramp for a sample week (14th December, 2020 to 21st December, 2020) is graphically depicted in Fig. 38. It can be inferred schedule was prepared as per the ramp declared by the power station.

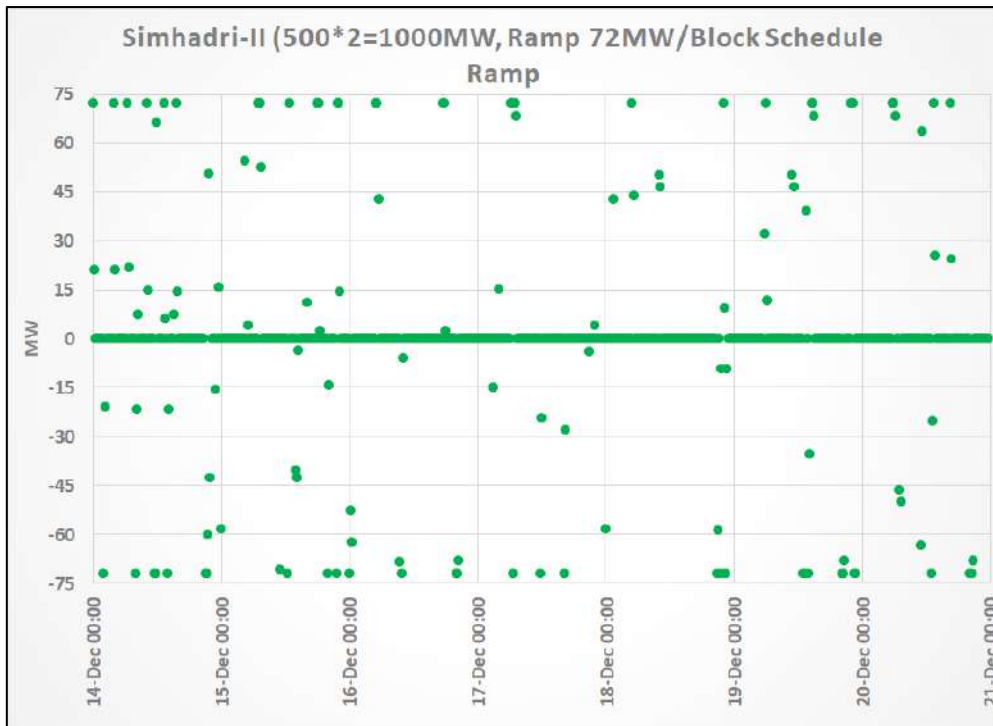


Figure 37 : Schedule ramp of Simhadri-II

The schedule generation and actual generation for a 15-minute time-block was also analysed for the same period. As observed in the Fig. 39, the difference in schedule and actual is observed.



Figure 38: Simhadri-II Schedule Vs actual

Further, deviation charges have been computed for the same week as shown in Table 9. For the sample week, Simhadri-II is payable of net deviation charges to the pool.

Table 8: Simhadri-II Deviation for a sample week

| DATE | Schedule (MWh) | Actual (MWh) | Deviation (MWh) | Deviation Amount (Rs) | Additional Deviation | Net Deviation Amount (Rs) |
|------------|----------------|--------------|-----------------|-----------------------|----------------------|---------------------------|
| 14-12-2020 | 9496 | 8901 | -595 | 1088350 | 239312 | 1327662 |
| 15-12-2020 | 8593 | 8511 | -82 | 74942 | 165754 | 240696 |
| 16-12-2020 | 8417 | 8084 | -333 | 804757 | 55367 | 860125 |
| 17-12-2020 | 7921 | 7927 | 6 | -32735 | 0 | -32735 |
| 18-12-2020 | 9112 | 9207 | 95 | -63706 | 1865 | -61841 |
| 19-12-2020 | 8624 | 8764 | 140 | -233545 | 2839 | -230706 |
| 20-12-2020 | 8323 | 8290 | -34 | 78492 | 4085 | 82577 |
| Total | 60486 | 59683 | -803 | 1716555 | 469222 | 2185777 |

The 15-minute block schedule has been converted to 5-minute block schedule using the same ramp rate as that of 15-minute time block for a sample day 14th Dec 2020. The sum of three consecutive 5-minute block wise deviation charges have been compared with 15-minute block wise deviation charges. Based on the grid frequency recorded by 05-minute IEM, the time-block wise deviation charges of 15-minute block and 5-minute block have been depicted in Fig 40. 05-minute schedule and actual of Simhadri – II is depicted in Fig 41.

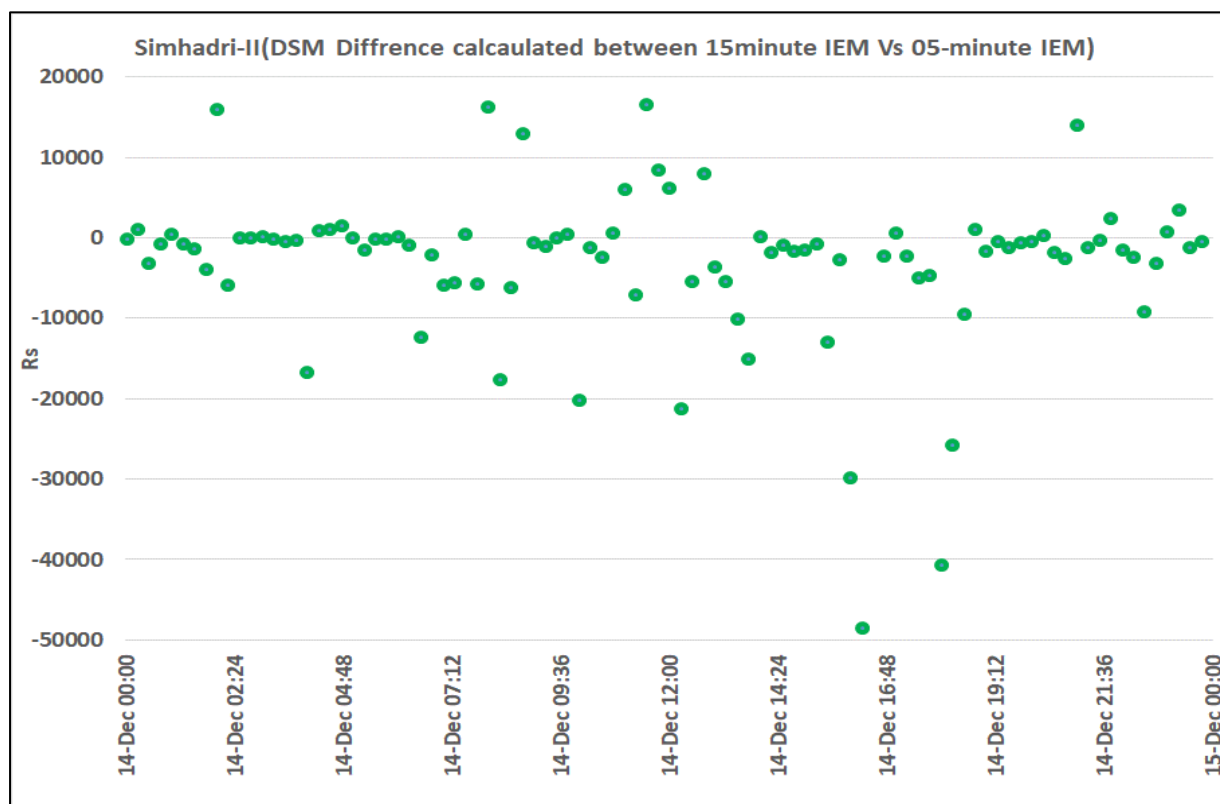


Figure 39: Block wise 05 minute and 15 minute DSM Charges (Thermal)

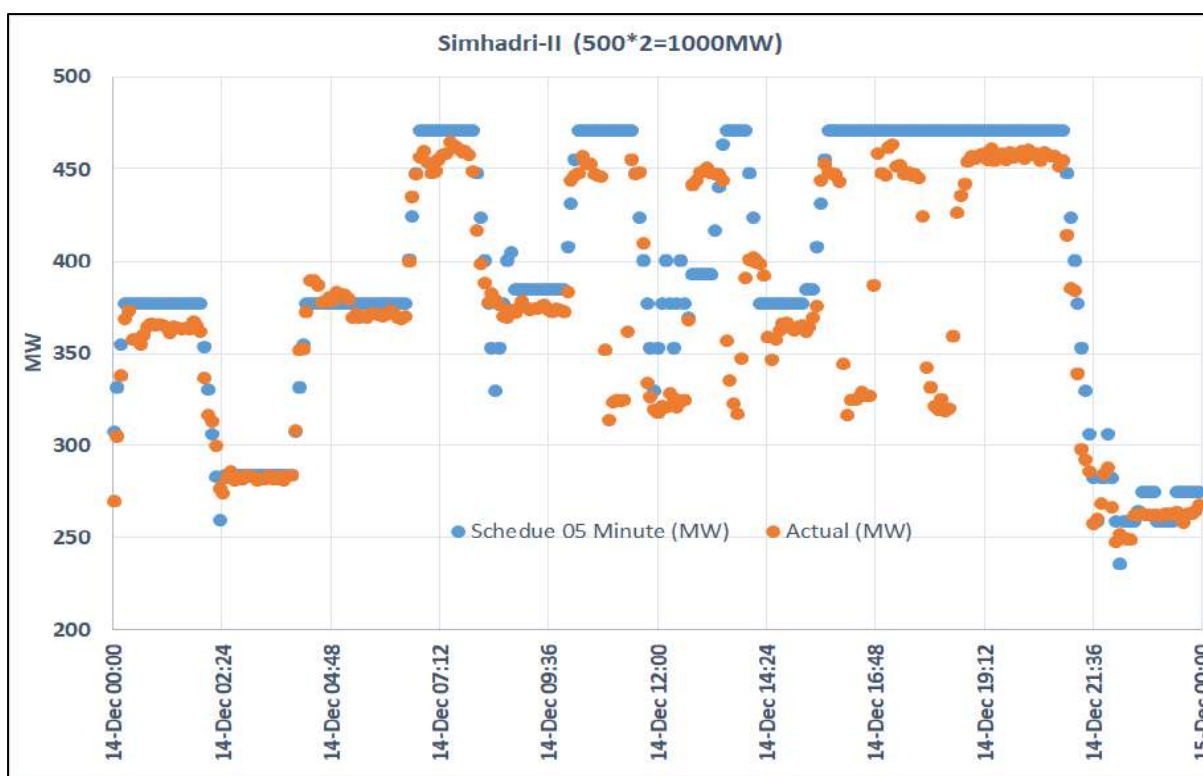


Figure 40: 05-min Schedule Vs Actual (Thermal)

The sample DSM charges for a sample day is depicted in Table-10.

Table 9: DSM Charges 05-minute and 15-minute

| 14-12-2020 | | | |
|---------------------------|-----------|-----------|-----------------------------|
| Subject | 15-Minute | 05-minute | 05-minute (Ramp Considered) |
| Schedule (MWh) | 9496 | 9496 | 9470 |
| Actual (MWh) | 8901 | 8906 | 8906 |
| Deviation (MWh) | -595 | -590 | -564 |
| Net Deviation Amount (Rs) | 1327662 | 994028 | 979805 |

It can be inferred that transition to 05-minute scheduling and despatch would help the thermal power plants to better follow the schedule.

3.12 FREQUENCY DATA ANALYSIS

Presently, the charges for deviations are linked to the grid frequency. While converting the 05-minute to 15-minute frequency, there is scope of difference in frequency from the current 15-minute IEM due to averaging out of three 05-minute block frequency. Data of Mouda-II, NTPC frequency was compared with Master frequency for the week 28th December, 2020 to 03rd January, 2021. The 05-minute frequency was converted to 15-minute frequency. The 05-

minute frequency rounded off to two decimals and truncated to two decimals is depicted in Fig. 42 and Fig. 43 respectively.

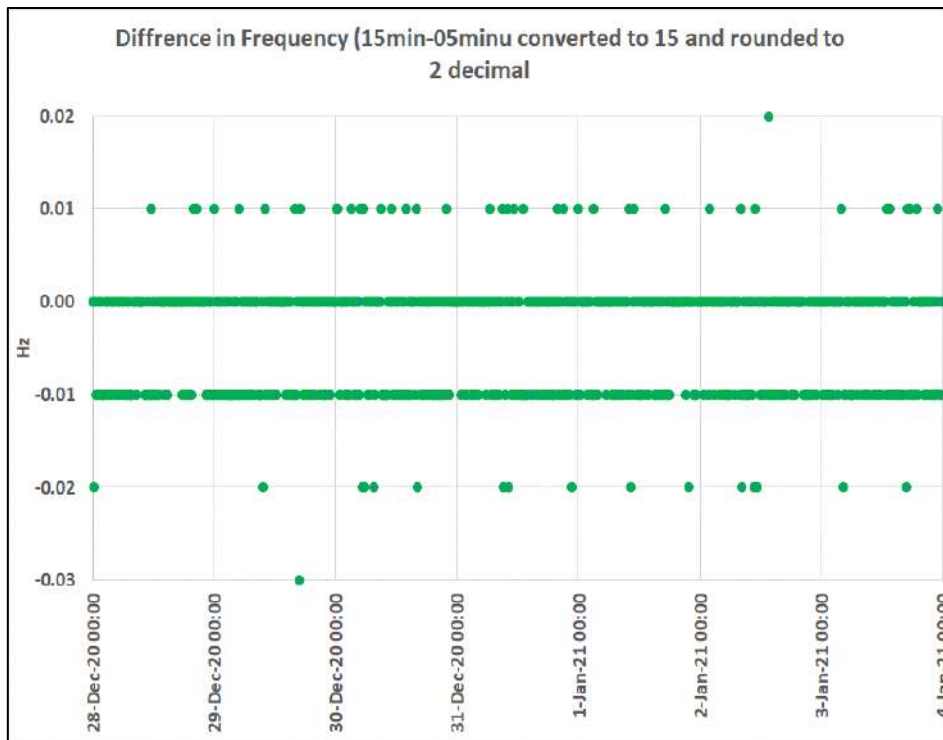


Figure 41: Effect of Rounding-off in Frequency data

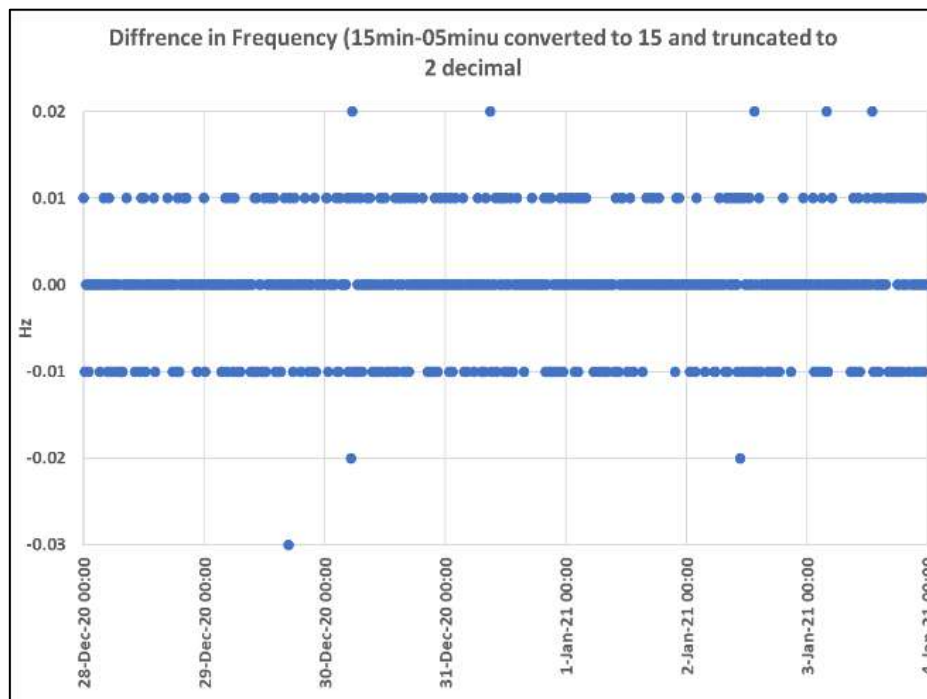


Figure 42: Effect of Truncation in Frequency Data

In order to have hassle free transition there is need to have harmonization of truncation and rounding-off to avoid any DSM price related issues.

CHAPTER 4: KEY LEARNINGS

The chapter lays down the key learnings from the pilot project

4.1 05-MINUTE SCHEDULING AND SETTLEMENT

For the data analysis of Hydro, Thermal and Gas station it can be inferred that 05-minute scheduling and settlement will help power station to better manage their ramp and help grid during any requirement, especially the fast ramping resources. Hydro station capability has also been tested during pilot project of FRAS in which instruction was given on 05-minute time block basis.

Further, 05-minute scheduling and settlement will discretize the load curve and help in better load ramp management. This may also cause economy in resource utilization.

India is on the way to 175 GW RE by 2022 and 450 GW by 2030. There would be a need of Fast Response Ancillary Services (FRAS). In order to activate these type of services, necessary infrastructure and fast ‘05-minute’ markets framework needs to be in place to harness the fast response capability. It would also help in measurement of the performance and provision of incentive as determined by the Central Regulator.

4.2 VOLTAGE CONTROL

At present, the 15-minute SEMs are only capable to report the reactive high and reactive low data for a day. The new 05-minute IEMs have the capability to record each 05-minute time block reactive energy exchanged and the voltage. In order to implement Voltage Control Ancillary Services, there is need to have proper infrastructure for accounting the support provided during the requirement of MVAR supply/absorb by any generator. Further, it would also help to monitor the provision of ancillary service also.

4.3 AUTOMATED DATA COLLECTION

The new 05-minute IEMs, being DLMS compliant, are capable of recording more parameters compared with the existing 15-minute SEMs. Further, the new 05-minute IEMs can store data up to 15 days instead of present 10 days limit. With the increase in memory of the IEM, the commensurate data collection facility/technology also needs to be upgraded.

In the absence of AMR, data had to be downloaded through HHD and subsequently, transferred to desktop for onward transmission to the respective

RLDCs. As stated earlier, it took around 30-40 minutes per IEM to complete the process.

Normally, maximum acceptable time required for data transfer from SEM to desktop is outside the scope of technical specification. However, considering the time taken for downloading the data, there is need for mentioning this aspect in the technical specification for future procurement of 05-minute IEMs. Further, IEM manufacturers may also explore new technologies for fast data transfer which can be adopted in reliable and secure manner.

With the experience from pilot project, it is felt that in case of any replacement of 15-minute SEM with new advanced 05-minute IEM, implementation of robust AMR and communication infrastructure is necessary. Further, during the outage of AMR due to any reason, an option may be available at the site for fast data transfer from IEM to desktop for further transmission of meter data to respective RLDCs. The volume of data would get tripled and the AMR system is indispensable for 5-min meter data acquisition. Manual data download has to be under exception only.

4.4 TIME SYNCHRONISATION

SCADA is used for real time monitoring and IEM data is used for deviation settlement. In case of any time drift in IEM, deviation may be computed even if the entity is maintaining the drawal as per schedule. The time drift phenomena have also been observed in the 05-minute IEMs installed under pilot project.

The time synchronisation may become more important factor as granularity of scheduling and accounting will change. The new 05-minute IEMs may be required to be in synchronisation using various available technologies such as GPS/NaVIC/AMR/Network Time Protocol (NTP) servers etc.

The time synchronisation activity may also be covered under the scope of installation of IEM as standard practice. Further necessary infrastructure required for handling any security attack like "Time Synchronization Attacks (TSA)" shall also be in place.

4.5 TRANSITION OF ELECTRICITY MARKET PRODUCTS

The sample calculation of deviations based on 05-minute and 15-minute intervals for hydro, gas and thermal plants have been done. The charges for deviation would be based on the 05-minute IEM recorded frequency. The transition to 05-minute scheduling, despatch and settlement of deviation may

help the power plants to manage their generation profile and follow the schedule in better manner. Further, the available market product may have to be migrated from 15-minute time despatch to 05-minute time block despatch to have efficient demand-side and supply-side management.

4.6 OTHER CONSTRAINTS

In some of the plants like Mouda/Simhadri thermal power plants, there was space constraint in the existing panel to install the 05-minute IEM in parallel with the existing 15-minute SEM. Failure of accessories provided along with the IEM was also a concern that led to delay in providing data by some power station to RLDCs.

In future, during the migration to 05-minute metering, space related constraints at site may also be verified. The scope for providing additional panels may be taken up for fast implementation. Further, multiple DCDs at a site with multi-fuel power plants/stages may be provided to avoid any constraints for data collection.

4.7 LIVE-STREAMING AND CYBER SECURITY

In reference to the telemetry of real time active power data to SLDC, there is no such provision in CEA (Installation and Operation of Meters) Regulations, 2006 and amendments thereafter up to Dec'2019. The same has also not been considered in "Technical Specification for Interface Energy Meters, Automated Meter Reading System and Meter Data Processing for Inter State Transmission System. There are associated issues such as time stamping, skewedness & data alignment, online data validation, information overload in real-time, data security, legal aspects etc. The IEMs are installed for accounting purpose and any other functionality should not affects its operation and new metering system shall be made safe and secure.

In case of specific requirement by SLDCs for telemetry of meter data (MW) to SLDC control centre for real time despatch, the same may be considered separately and separate infrastructure could be planned.

The requirement of real time telemetry has already been discussed by high level sub-committee in Forum of Regulators (FOR) and the recommendation is available in their report "CABIL" wherein they have mentioned that the streaming of meter data to control centre is not desirable for the following reasons:

- Automation of Bad data detection in Energy Meter yet to mature unlike SCADA

- Operator stress due to information overload and incorrect data
- Operators to be protected from being vulnerable to legal-commercial disputes

Regarding provision of Cyber Security, as the meter data is having commercial implications, all the required protection should be taken to ensure cyber security and data should be protected at all respect.

4.8 HOLISTIC VIEW

Certain aspects are yet to be tested such as interoperability of meters & DCD, AMR, self-diagnosis feature and exception management feature. The requirement for robust communication, asset management, data acquisition, processing, data management, testing and data security aspects has been felt. Therefore, there is a need for a holistic view on various dimensions of the metering system such as

- Redundant wideband communication
- Jurisdiction and Responsibility
- Hosting of servers
- Data Recovery System
- Metering administration Norms
- Web-based system of complaint logging and management
- Norms for resolution of issues in metering infrastructure
- Availability norms
- Cost recovery through tariff (depreciation etc.)
- Data analytics

CHAPTER 5: PAN-INDIA METERS SUMMARY

5.1 INTERFACE METERS IN NORTHERN REGION

Table 10: Summary of 15-minute SEMs in Northern Region

| Summary of 15-minute SEMs in Northern Region | | | | | | | | | |
|--|--------------|------------------|---------------------|----------------|-----------|-------------|----------|------------|-----------|
| S. No. | Utility Name | Number of Meters | Number of Locations | Type of Meters | | Make | | | |
| | | | | Type-A | Type-B | L&T | Secure | Elster | EDMI |
| 1 | NTPC | 240 | 14 | 235 | 5 | 201 | 0 | 39 | 0 |
| 2 | NHPC | 135 | 15 | 116 | 19 | 103 | 0 | 32 | 0 |
| 3 | Nuclear | 52 | 04 | 0 | 0 | 45 | 0 | 7 | 0 |
| 4 | SJVNL | 32 | 02 | 0 | 0 | 32 | 0 | 0 | 0 |
| 5 | Tehri | 8 | 01 | 0 | 0 | 8 | 0 | 0 | 0 |
| 6 | Koteshwar | 8 | 01 | 0 | 0 | 8 | 0 | 0 | 0 |
| 7 | Ad-Hydro | 4 | 01 | 2 | 2 | 4 | 0 | 0 | 0 |
| 8 | Karcham | 16 | 01 | 16 | 0 | 16 | 0 | 0 | 0 |
| 9 | Shri Cem | 6 | 01 | 6 | 0 | 6 | 0 | 0 | 0 |
| 10 | Sainj HEP | 6 | 01 | 0 | 0 | 0 | 0 | 6 | 0 |
| 11 | BBMB | 269 | 25 | 259 | 10 | 253 | 0 | 16 | 0 |
| 12 | UP | 110 | 58 | 0 | 0 | 97 | 0 | 13 | 0 |
| 13 | Rajasthan | 38 | 32 | 29 | 9 | 34 | 0 | 4 | 0 |
| 14 | PGCIL | 825 | 76 | 825 | 0 | 491 | 0 | 334 | 0 |
| 15 | Sterlite | 24 | 05 | 0 | 0 | 0 | 0 | 24 | 0 |
| 16 | Chandigarh | 6 | 04 | 0 | 0 | 6 | 0 | 0 | 0 |
| 17 | Delhi | 37 | 09 | 37 | 0 | 36 | 0 | 1 | 0 |
| 18 | Haryana | 52 | 15 | 52 | 0 | 47 | 0 | 5 | 0 |
| 19 | Himachal | 34 | 19 | 34 | 0 | 30 | 0 | 4 | 0 |
| 20 | UT J&K | 42 | 09 | 42 | 0 | 39 | 0 | 3 | 0 |
| 21 | Punjab | 01 | 01 | 01 | 0 | 0 | 0 | 01 | 0 |
| 22 | Uttarakhand | 69 | 20 | 69 | 0 | 61 | 0 | 8 | 0 |
| 23 | AREPRL-PSS | 32 | 01 | 32 | 0 | 30 | 0 | 02 | 0 |
| 24 | SUCRL -PSS | 17 | 01 | 17 | 0 | 0 | 0 | 02 | 15 |
| 25 | MSUPPL | 16 | 01 | 16 | 0 | 15 | 0 | 01 | 0 |
| 26 | TPRELChhayan | 01 | 01 | 01 | 0 | 0 | 0 | 01 | 0 |
| 27 | Azure 34 | 01 | 01 | 0 | 01 | 0 | 0 | 01 | 0 |
| 28 | Azure 43-PSS | 01 | 01 | 01 | 0 | 0 | 01 | 0 | 0 |
| 29 | ACME | 01 | 01 | 01 | 0 | 0 | 0 | 01 | 0 |
| 30 | Renew PSS | 01 | 01 | 01 | 0 | 0 | 0 | 01 | 0 |
| | Total | 2155 | 343 | 1855 | 54 | 1625 | 8 | 507 | 15 |

5.2 INTERFACE METERS IN SOUTHERN REGION

Table 11: Summary of SEMs in Southern Region

| Summary of 15-minute SEMs in Southern Region | | | | | | | | |
|--|--------------|------------------|---------------------|----------------|----------|--------------|------------|-----------|
| S. No. | Utility Name | Number of Meters | Number of Locations | Type of Meters | | Make | | |
| | | | | Type-A | Type-B | L&T | Secure | Elster |
| 1 | AP | 83 | 28 | 83 | 0 | 34 | 49 | 0 |
| 2 | GOA | 4 | 2 | 4 | 0 | 4 | 0 | 0 |
| 3 | IPP | 50 | 3 | 50 | 0 | 26 | 24 | 0 |
| 4 | ISGS | 10 | 1 | 10 | 0 | 8 | 2 | 0 |
| 5 | KPTCL | 43 | 17 | 43 | 0 | 17 | 26 | 0 |
| 6 | KSEB | 9 | 7 | 9 | 0 | 8 | 1 | 0 |
| 7 | NLC | 142 | 4 | 138 | 4 | 142 | 0 | 0 |
| 8 | NPC | 76 | 5 | 74 | 2 | 54 | 22 | 0 |
| 9 | NTPC | 159 | 7 | 159 | 0 | 101 | 53 | 4 |
| 10 | POWERGRID | 757 | 59 | 757 | 0 | 395 | 343 | 17 |
| 11 | PUDUCHERRY | 11 | 5 | 11 | 0 | 9 | 2 | 0 |
| 12 | SOLAR | 371 | 2 | 371 | 0 | 342 | 29 | 0 |
| 13 | TANTRANSCO | 57 | 26 | 55 | 2 | 40 | 17 | 0 |
| 14 | TELENGANA | 67 | 31 | 67 | 0 | 26 | 41 | 0 |
| 15 | Wind - | 24 | 4 | 24 | 0 | 5 | 19 | 0 |
| | Total | 1,863 | 201 | 1,855 | 8 | 1,211 | 628 | 21 |

5.3 INTERFACE METERS IN WESTERN REGION

Table 12: Summary of SEMs in Western Region

| Summary of 15-minute SEMs in Western Region | | | | | | | | |
|---|--------------|-------------|-------------------|----------------|----------|------------|------------|------------|
| Sr. No. | Utility Name | Number of | Number of Locatio | Type of Meters | | Make | | |
| | | | | Type-A | Type-B | L&T | Secure | Elster |
| 1 | NTPC | 269 | 10 | 265 | 4 | 42 | 146 | 81 |
| 2 | NPC | 63 | 4 | 63 | 0 | 1 | 50 | 12 |
| 3 | Chhattisgarh | 22 | 8 | 22 | 0 | 7 | 15 | 0 |
| 4 | Gujarat | 116 | 27 | 116 | 0 | 34 | 67 | 15 |
| 5 | Daman & Diu | 7 | 4 | 7 | 0 | 0 | 7 | 0 |
| 6 | DNH | 19 | 8 | 12 | 7 | 2 | 11 | 6 |
| 7 | Madhya | 91 | 27 | 91 | 0 | 9 | 53 | 29 |
| 8 | Maharashtra | 52 | 18 | 52 | 0 | 9 | 22 | 21 |
| 9 | GOA | 2 | 1 | 2 | 0 | 0 | 2 | 0 |
| 10 | IPPs | 336 | 37 | 336 | 0 | 162 | 99 | 75 |
| 11 | POWERGRID | 862 | 49 | 862 | 0 | 340 | 237 | 285 |
| | Total | 1839 | 193 | 1835 | 4 | 606 | 709 | 524 |

5.4 INTERFACE METERS IN EASTERN REGION

Table 13: Summary of SEMs in Eastern Region

| Summary of 15-minute SEMs in Eastern Region | | | | | | | | |
|---|--------------|------------------|---------------------|----------------|-----------|------------|------------|----------|
| Sr. No | Utility Name | Number of Meters | Number of Locations | Type of Meters | | Make | | |
| | | | | Type-A | Type-B | L&T | Genus | Elster |
| 1 | POWERGRID | 711 | 39 | 709 | 2 | 281 | 430 | 0 |
| 2 | DMTCL | 31 | 2 | 31 | 0 | 0 | 31 | 0 |
| 3 | WEST | 59 | 22 | 59 | 0 | 35 | 24 | 0 |
| 4 | DVC | 51 | 16 | 40 | 11 | 43 | 8 | 0 |
| 5 | BIHAR | 87 | 42 | 83 | 4 | 59 | 28 | 0 |
| 6 | GRIDCO | 65 | 23 | 65 | 0 | 54 | 11 | 0 |
| 7 | JUVNL | 36 | 16 | 28 | 5 | 28 | 8 | 0 |
| 8 | SIKKIM | 8 | 4 | 8 | 0 | 0 | 8 | 0 |
| 9 | TRANSNATIO | 53 | 6 | 53 | 0 | 45 | 8 | 0 |
| 10 | NHPC | 21 | 2 | 21 | 0 | 21 | 0 | 0 |
| 11 | NTPC | 205 | 7 | 205 | 0 | 165 | 40 | 0 |
| 12 | OTHER ISGS | 50 | 4 | 50 | 0 | 11 | 39 | 0 |
| 13 | IPP | 71 | 10 | 67 | 4 | 43 | 28 | 0 |
| 14 | Other ISTS | 12 | 2 | 12 | 0 | 0 | 12 | 0 |
| | Total | 1460 | 195 | 143 | 26 | 785 | 675 | 0 |

5.5 INTERFACE METERS IN NORTH EASTERN REGION

Table 14: Summary of SEMs in North-Eastern Region

| Summary of 15-minute SEMs in North Eastern Region | | | | | | | |
|---|--------------|------------------|---------------------|----------------|--------|------|--------|
| Sr. No. | Utility Name | Number of Meters | Number of Locations | Type of Meters | | Make | |
| | | | | Type-A | Type-B | L&T | Elster |
| 1 | AGBPP | 21 | 1 | 21 | 0 | 21 | 0 |
| 2 | AGTPP | 16 | 1 | 16 | 0 | 16 | 0 |
| 3 | DOYANG | 12 | 1 | 12 | 0 | 12 | 0 |
| 4 | KHANDONG | 16 | 1 | 16 | 0 | 16 | 0 |
| 5 | KOPILI | 15 | 1 | 15 | 0 | 15 | 0 |
| 6 | KOPILI-II | 4 | 1 | 4 | 0 | 4 | 0 |
| 7 | RANGANADI | 21 | 1 | 21 | 0 | 21 | 0 |
| 8 | LOKTAK | 12 | 1 | 12 | 0 | 12 | 0 |
| 9 | PALATANA | 15 | 1 | 15 | 0 | 15 | 0 |
| 10 | BgTPP (NTPC) | 22 | 1 | 22 | 0 | 22 | 0 |
| 11 | KAMENG | 13 | 1 | 13 | 0 | 13 | 0 |
| 12 | PARE | 11 | 1 | 11 | 0 | 11 | 0 |
| 13 | Ar. PRADESH | 8 | 3 | 8 | 0 | 8 | 0 |
| 14 | ASSAM | 37 | 23 | 37 | 0 | 37 | 0 |

| | | | | | | | |
|----|--------------|------------|-----------|------------|-----------|------------|-----------|
| 15 | MANIPUR | 10 | 4 | 10 | 0 | 10 | 0 |
| 16 | MEGHALAYA | 12 | 5 | 12 | 0 | 12 | 0 |
| 17 | MIZORAM | 4 | 4 | 4 | 0 | 4 | 0 |
| 18 | NAGALAND | 9 | 3 | 9 | 0 | 9 | 0 |
| 19 | TRIPURA | 18 | 6 | 17 | 1 | 18 | 0 |
| 20 | POWERGRID | 195 | 21 | 195 | 0 | 166 | 29 |
| 21 | STERLITE | 8 | 2 | 8 | 0 | 8 | 0 |
| 22 | KMTL | 8 | 1 | 8 | 0 | 8 | 0 |
| | Total | 487 | 84 | 486 | 01 | 458 | 29 |

CHAPTER 6: WAY FORWARD

The chapter gives the way forward for introduction of 05-minute scheduling to settlement in India

6.1 IMPLEMENTATION

The 05-minute scheduling and despatch would further discretize the load curve and ramping requirements and hence, cause economy and efficiency in the resource utilization to meet the demand. Therefore, the 05-minute scheduling and despatch may be implemented at inter-state level, to begin with and thereafter, after gaining experience, at intra-state level. The benchmarking of ramp rate of generating units is also required.

The enabling provisions, through the amendments in the CEA Metering Standards (latest amendment notified on 23rd December, 2019), would be followed by the pan-India utilities for procurement of 05-minute metering infrastructure. Some other points for consideration include metering arrangement for distributed renewable, coordination at RPC forum and evolving a model standard of performance.

The 05-minute scheduling and settlement arrangements entail regulatory interventions at both inter-state and intra-state level. The amendments to various CERC Regulations have to be put in place. Suitable provisions in the regulatory framework at intra-state level may be replicated to facilitate 05-minute scheduling and settlement. The necessary provisions to facilitate the recovery of meter costs are also required to be incorporated in the regulations keeping in view that meter has to be maintained, periodically checked and if needed replaced also.

The “Scheduling and Despatch” (LTA/MTOA/STOA/RRAS/SCED/ Any other future interventions) has to be aligned with “Settlement” process in 05-minute timeframe too. The new meters may give data, in parallel, in 05-minute new coded format as well as in old meters (present) coded format. Further, accounts for both 15-minutes and 5-minute accounting may be kept in parallel till a specified cut-off date for smooth transition to 5-minute accounting & settlement

In the present Deviation Settlement Mechanism, the step size of frequency is 0.01 Hz which provides greater granularity for the tightening frequency band and DSM price. In the present 15-minute regime, the over-drawal/under-drawal is averaged out in the 15-minute period. Therefore, reducing the

deviation settlement interval to 05-minute interval would facilitate discovery of the 05-minute deviation price.

As the scale of the SEMs installed pan-India is huge, there is need for phase-wise approach for replacement of SEMs. It may be difficult for single manufacturer to supply all the IEMs. Further, the replacement of all the IEMs with new 05-minute IEM may take some considerable time as proper planning and coordination is required with all the stakeholders. Therefore, transition from 15-minute scheduling, accounting and settlement to 05-minute scheduling, accounting and settlement would need considerable time and efforts.

Some scheduling, accounting and settlement may have to be carried out from the recording of 15-minute SEM and some through 05-minute IEM data converted to 15-minute, till complete migration takes over. In order to handle this transition, the current DCD developed for the pilot project has the feature. Further, the parallel 05-minute and 15-minute metering and accounting can also be handled through the conversion software provided by the IEM manufacturer to convert the encrypted data into readable format.

All the issues faced during the pilot project need to be addressed in a suitable manner by CTU before rolling out plan for 5-minute metering system pan India basis. The CTU may plan a meter data collection centre through AMR at their premises and the data should be sent to respective RLDCs for further processing/energy accounting.

The necessary capacity building measures have to be undertaken for increased awareness amongst the utilities to move towards more complex 05-minute bidding format.

6.2 TECHNOLOGY

The preliminary review of the implementation of 05-minute IEM pilot project along with meter data processing software from a technology and IT systems perspective has been done. The replacement of existing 15-minute meters with new 05-minute IEMs may be done in phase-wise manner. The scaling up of existing forecasting, scheduling, despatch, meter data processing, accounting and settlement software applications and associated communication infrastructure is needed across RPCs, NLDC, RLDCs, Utilities, Discoms and other stakeholders.

There would be a need for modification and re-architecture of existing legacy systems. There may be requirement for an external 'off the shelf' solution to perform the metering data management, processing and settlements

functions. It must be plug & play with the existing platforms with seamless hosting, licensing and other platform components to be managed externally, allowing the LDCs to focus on application business functions.

The external solutions would also incur an ongoing cost component that needs to be assessed and weighed against one-off costs. There is a need to build a system that is able to scale effectively with the increased data flows and storage requirements. There should be the ability to be able to have re-usable components and modules for other market initiatives. There may be a need for additional interfaces to send /receive meter data in an aggregated and/or granular level information.

Many of the decision support systems and bidding in the day-ahead/real-time markets will also need to be updated. The solution would also need to make use of existing components where appropriate. The approved guidelines in respect of interfacing requirements of terminal equipment for communication, AMR etc. based on the technical standards have to be notified.

6.3 TECHNICAL SPECIFICATIONS

National Power Committee, CEA has constituted a Joint Committee to prepare the Technical Specification (TS) of the 5/15-minute IEMs with AMR and MDP system for inter-state transmission system. The Software Requirement Specification (SRS) for Automatic Meter Reading (AMR), Meter conversion software (i.e. VINPLUS, SmartGrid, PEARL etc) and software loaded in the DCD/MRI also needs to be standardised.

6.4 SAMAST

In view of SAMAST implementation, the states that are about to implement the intrastate accounting and settlement system could leapfrog and go for scheduling and settlement at 05-minute interval. The scheduling software and the energy meters specifications could in line with the above. All the other states and the regional pools shall also endeavour to have systems and logistics for 05-minute scheduling and settlement system.

6.5 COSTS

Two methodologies for cost recovery of metering infrastructure are in vogue in different regions. One is the one-time reimbursement of the expenditure and the other is through regulated tariff route. There is a need to harmonize through an appropriate regulatory framework by CERC keeping in view the lifecycle maintenance, testing, calibration and replacement of meters.

In the given circumstances, necessary provisions to facilitate the recovery of meter costs are also required to be incorporated in the regulations keeping in view that meter has to be maintained, periodically checked and if needed replaced also.

During the pilot project, cost of per unit of 05-minute IEM was estimated at Rupees Fifty Thousand. Accordingly, for 122 nos. of IEMs under pilot project, the cost of Rupees Sixty-One Lakhs excluding applicable taxes were estimated. Additional cost of Rupees Twenty-Six Lakhs for installation, upgradation was envisaged. The cost of per unit of 05-minute IEM, supplied under the pilot project by the vendors, was around Rupees Thirty-Nine Thousand. The cost of per unit of DCD was around Rupees Forty-Nine Thousand. This cost may vary depending on the scope of work covered under the contract.

In case of pan-India implementation, the number of 15-minute SEMs are of the order of 8000 nos. and installed in around 1000 location. Hence, multi-vendor procurement of 05-minute IEMs for risk diversification and mitigation may be explored. There is a need for benchmarking of 05-minute IEMs costs (may vary with scope of work) as multiple entities pan-India would also like to migrate to 05-minute arrangements to have harmonization with inter-state scheduling and settlement system.

Some of the equipment like DCD, chargers etc are procured by the vendors through some other vendors. In order to avoid any issues related to spare parts especially of equipment's required for data collection, mandatory provision for maintenance of the spare by vendors at different locations may be made as part of contract. The spares must be available till warranty offered by vendor.

The costs for IT and systems development, design, integration and testing; policy development and design; procedure consultation and amendment; program management; internal business readiness; transition planning, readiness and cutover; and stakeholder engagement have to be planned and budgeted. Ongoing costs also have to incorporate costs relating to licensing, databases, application software, hardware, storage and modules.

It is important to note that costs based on externally licensed meter data management modules would be different compared to an internal solution as the proportional breakdown between upfront and ongoing costs would change.

6.6 TIMEFRAMES

The actions and proposed timeframes may be considered as follows:

| Proposed Action | Timeline |
|---|----------------------|
| Submission of the pilot project report by POSOCO | T0 (Zero) |
| CERC Staff Paper on Regulatory Framework for 5-minute Scheduling, Metering & Settlement arrangements | T0 + 05 months |
| Formulation of Technical specifications for new meters/configuration change at RPC/State level | T0 + 06 months |
| Final Regulatory Framework by the Central Commission | T0 + 09 months |
| Software upgradation at RPC/NLDC/RLDCs/SLDCs | T0 + 11 months |
| Procurement process from tendering to commissioning led by CTU at inter-state level and STU at intra-state level | T0 + 13 months |
| Traders, Power Exchanges and Open Access Consumers to migrate to 5-minute markets framework in coordination with Central Regulator and POSOCO | T0 + 13 months |
| One- year Trial Run (Transition) between T0 + 13 months and T0 + 25 months | T0 + 25 months |
| Go Live | T0 + 26 month |

6.7 MARKET READINESS

Given the extent of the changes to all stakeholder systems, it is proposed that the changes are made available for pan-India transition for a period of twelve months prior to go-live. During the period of transition, end-to-end testing would be facilitated through:

- Bidding, Forecasting, Scheduling and Despatch – accepting injection/drawal schedules, bids/offers in the new format, and have these included in the pre and post-despatch processes
- Market information – distribution of despatch-related market information
- Metering data – receipt and processing of existing 15-minute and 05-minute metering data at RLDCs/SLDCs/RPCs
- Settlement – coordinating settlement calculations and delivery of settlement statements and associated data
- Industry-wide testing may need to involve some scripted test cases, particularly for accounting and settlement functions, and for some unusual market circumstances like administered pricing, capping, intervention, market suspension etc. The development of a coordinated readiness assessment process may be required which could be facilitated by POSOCO in coordination with all stakeholders.

ACKNOWLEDGEMENT

The efforts and contributions from the stakeholders viz. RLDCs, NLDC, Power Plants, CTU-PGCIL and Vendors in the implementation of Pilot Project on 5-minute Metering and Settlement is duly acknowledged.

REFERENCES

1. CERC Order "Pilot Project on 05-Minute Scheduling, Metering, Accounting and Settlement for Thermal/Hydro, and on Hydro as Fast Response Ancillary Services (FRAS)" dated 16th of July, 2018
<http://www.cercind.gov.in/2018/orders/08.pdf>
2. POSOCO Report on "Fast Response Ancillary Services (FRAS) Implementation in Indian Grid Pilot Project Experience and Feedback"
https://posoco.in/wp-content/uploads/2019/08/POSOCO_FRAS_Feedback.pdf
3. CERC order on Availability Based Tariff (ABT) mechanism in Petition No. 2/99 dated 04th January, 2000
<http://cercind.gov.in/orders/2-1999GOIABT040100.pdf>
4. IEA report on 'Re-powering Markets Market design and regulation during the transition to low-carbon power systems'
<https://www.iea.org/publications/freepublications/publication/REPOWERINGMARKETS.PDF>
5. AEMC Rule Change Information
<https://www.aemc.gov.au/rule-changes/05-minute-settlement>
6. FERC Final Rule on "Settlement Intervals and Shortage Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators", 16th June 2016
<https://www.ferc.gov/whats-new/comm-meet/2016/061616/E-2.pdf>
7. CAISO, flexible ramping product (FRP)
<http://www.caiso.com/initiatedocuments/issuepaper-strawproposal-flexiblerampingproductrefinements.pdf>
8. NITI Ayog in its Report on India's Renewable Electricity Roadmap 2030
https://niti.gov.in/writereaddata/files/document_publication/RE_Roadmap_ExecutiveSummary.pdf
9. Report on **Scheduling, Accounting, Metering And Settlement of Transactions** in electricity (SAMAST) at the intra-state level in 2016
<http://www.forumofregulators.gov.in/Data/WhatsNew/SAMAST.pdf>
10. CERC order for pilot project for AGC
http://www.cercind.gov.in/2017/orders/79_rc.pdf
11. Automatic Generation Control (AGC) implementation in India
<http://www.cercind.gov.in/2019/orders/319-RC-2018.pdf>

12. 18th Meeting of the FOR Technical Committee held at Delhi on 23rd February 2018
<http://forumofregulators.gov.in/Data/Meetings/Minutes/TC/20.pdf>
13. Report of the Sub-Group on Implementation of 5-Minute Scheduling, Metering, Accounting and Settlement
<http://www.forumofregulators.gov.in/Data/Reports/5.pdf>
14. 63rd Meeting of the FOR held on 09th April, 2018
<http://www.forumofregulators.gov.in/Data/Meetings/Minutes/63.pdf>
15. WRPC: 34th TCC/WRPC Minutes
http://www.wrpc.gov.in/wrpc/34wrpc_minutes.pdf
16. Central Electricity Authority (Installation and Operation of Meters) (Amendment) Regulations, 2019
https://cea.nic.in/old/reports/regulation/CEA_metering_regulation_amendment_2019.pdf
17. Forum of Regulators CABIL Report
<http://www.forumofregulators.gov.in/Data/Reports/FOR%20Report%20CABIL.pdf>
18. Ministry of Power Report of the “Technical Committee on Large scale integration of Renewable Energy, Need for Balancing, Deviation Settlement Mechanism and other associated issues
http://powermin.nic.in/sites/default/files/uploads/Final_Consolidated_Report_RE_Technical_Committee.pdf
19. Tariff Policy, 2016, Government of India
<https://powermin.nic.in/en/content/tariff-policy>
20. CERC (Indian Electricity Grid Code) Regulations,
<http://cercind.gov.in/2016/regulation/9.pdf>
21. CERC (Ancillary Services Operations) Regulations, 2015
<http://cercind.gov.in/2015/regulation/Noti13.pdf>
22. Statement of Reason, CERC (Ancillary Services Operations) Regulations, 2015
<http://www.cercind.gov.in/2015/regulation/AncillarySOR-11092015.pdf>
23. CEA - National Electricity Policy 2016
(http://www.cea.nic.in/reports/committee/nep/nep_dec.pdf)
24. NREL-POSOCO report on Ramping Up The Ramping Capability - India's Power System Transition
<https://www.nrel.gov/docs/fy20osti/77639.pdf>

25. RRAS implementation in Indian Grid Half Year Analysis and Feedback, 2016
<https://posoco.in/download/half-year-feedback-tocerc/?wpdmdl=8916>
26. Report on 'Flexibility Requirement in Indian Power System , NLDC, POSOCO
https://posoco.in/download/flexibility_requirement_in_indian_power_system/?wpdmdl=711
27. FOLD-POSOCO Report on Operational Analysis for Optimization of Hydro Resources & facilitating Renewable Integration in India
<https://posoco.in/download/fold-posoco-report-on-operational-analysis-foroptimization-of-hydro-resources/?wpdmdl=14168>
28. Enhancing Intraday Price Signals in U.S. ISO Markets for a Better Integration of Variable Energy Resources - An MIT Energy Initiative Working Paper
<https://energy.mit.edu/wp-content/uploads/2016/06/MITEI-WP-2016-05.pdf>
29. Central Electricity Authority (Installation and Operation of Meters) (Amendment) Regulations, 2019
https://cea.nic.in/wp-content/uploads/2020/02/CEA_metering_regulation_amendment_2019.pdf

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(भारत सरकार का उद्यम)

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(A Govt. of India Enterprise)



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संदर्भ संख्या:पोसोको/एनएलडीसी/2018/190

दिनांक:07th अगस्त, 2018

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विषय: **Technical Specification for Interface Energy Meters for Pilot Project on 05-Minute Scheduling Metering, Accounting and Settlement for Thermal/Hydro**

संदर्भ: CERC Petition No. 07/SM/2018 (Suo-Motu), order dated 16th-July, 2018

महोदय,

This has the reference to CERC Petition No. 07/SM/2018 (Suo-Motu), order dated 16th July, 2018. Based on the above CERC order, discussion held with CTU/POWERGRID at NLDC on 26th July'2018 & discussion with RLDCs, the technical specification for Interface energy going to install as per the above CERC order for pilot project on 05-minute metering is enclosed as Annexure-I for taking necessary action at your end.

The specification is based on 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, barring a few minor modification enclosed at Annexure-II considering the need for expedite commissioning of pilot project.

सादर धन्यवाद,

भवदीय

एस. आर. नरसिम्हन

(एस.आर. नरसिम्हन)

महाप्रबन्धक,

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**Technical Specification for
Interface Energy Meters
“for Pilot Project on 05-Minute Scheduling,
Metering, Accounting and Settlement for
Thermal/Hydro”**

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