MINUTES OF NINETEENTH MEETING OF "TECHNICAL COMMITTEE FOR IMPLEMENTATION OF FRAMEWORK ON RENEWABLES AT THE STATE LEVEL"

Venue	:	Hotel Polo Towers, Shillong, Meghalaya
Date	:	16-04-2018
List of Participants	:	At **Annexure –1(Enclosed)**

1. The Nineteenth meeting of Technical Committee on Implementation of Framework for Renewables at the State level was held on 16th April 2018. Shri P.K Pujari,Chairman, CERC & FOR and Dr. M.K Iyer, Member, CERC also attended the meeting.ShriP.K Mishra, Member Secretary, NERPC welcomed ShriPujari, ShriBakshi and all the participants of the meeting. ShriBakshithanked the NERPC for hosting this meeting.

2. ShriBakshi briefed the participants about the background and scope of the Technical Committee and highlighted various activities which have been carried out by the Committee. He highlighted that over the period of time, the mandate of the committee has evolved and has been expanded and the present meeting has been convened with focus on Non-RE rich States. He underscored that Non-RE rich States, including NE States should implement the ABT at the earliest.

3. Dr. Sushanta.K.Chatterjee, Joint Chief (RA), CERC welcomed all the participants and special invitees and highlighted the agenda items scheduled for the meeting.

Discussions on the Agenda

1. Agenda Item No. 1: Status of implementation of SAMAST Report

- **Update by Consultant**
- **Update in respect of other States by respective Members**

a. The Consultant (Idam Infra) made a presentation**(Annexure-II)** on the status of implementation of SAMAST in Haryana, Punjab and West Bengal. Further, the consultant highlighted that most of the State Commissions were busy with other activities like ARR during February- March .

b. **Haryana:** The Consultant briefed the Committee that DPR for SAMAST implementation in Haryana has been approved by the management of HVPNL and has been submitted before Appraisal Committee.

c. **Punjab:** DPR preparation is under process.

d. **West Bengal:** DPR was submitted before the appraisal committee in December 2017. The Committee has scrutinized the DPR and has given some comments which need to be addressed in 2 weeks' time.

Update in respect of other States by respective Members:

e. **Kerala:** DPR submitted to the Appraisal Committee in March 2018. Total cost estimation of Rs. 75 Crores. Tendering process is expected to begin from June 2018

f. **West Bengal:**Shri KVS Baba, CMD, POSOCO informed that some clarifications have been sought from State on DPR

g. **Telangana**: DPR has been submitted and the Appraisal Committee and the committee have examined the same. However, Telangana is re-working on the numbers of meters and has requested for 2 months' time period to provide the final cost, which is expected to be lower than what has been submitted.

2. Agenda Item No. 2: Presentation on:

- **Need for ABT and DSM Mechanism**
- **Analysis of Pre and Post ABT Mechanism**
- **Preparedness of North-East region**

a. The Consultant (Idam Infra) made a presentation **(Annexure-III)**on the need for SAMAST (Scheduling, Accounting, Metering and Settlement of Transactions in Electricity) implementation, ABT (Availability Based Tariff) and DSM (Deviation Settlement Mechanism) in North Eastern States. The consultant explained the background, mechanism, objectives and benefits of SAMAST implementation and ABT system. The objective of DSM mechanism at State level, like, secure and reliable grid operations, forecasting and load management discipline amongst DISCOMs, despatch discipline amongst generators, serving as balancing mechanism and facilitating energy accounting and deviation settlement were discussed.

b. The experiences of Madhya Pradesh in implementation of ABT system with the help of pre ABT and post ABT deviation settlement graphs (quantum and amount) was discussed. Graph representing deviation volume and deviation amount for MP and monthly average capacity drawal, average deviation MW, monthly deviation Units and Charges were shared in the presentation.The benefits of having intra-state ABT, like, Improvement in regional UI (payable/receivables) management, identification of deviation causer, causer pays principle etc were discussed at length.

c. It was underscored that with implementation of ABT, the Deviation Charges could be reduced significantly.The consultant also highlighted that the new system (balancing & settlement) will promote the development of market, i.e., encourages participation by multiple buyers and sellers. Quality of supply and the efficiency of various entities/institutions will also improve and will not be favorable to any Participant.

d. Based on the SAMAST report, the State level status of NE region for DSM implementation was shared. Steps for implementation of DSM and roadmap for implementation of SAMAST framework was also highlighted. It was highlighted thataction plan for each State should be evolved which should be futuristic and forward looking. DPR should be prepared and submitted to PSDF.

e. Dr. Chatterjee summarized the presentation and stressed on the need of implementing ABT, DSM and SAMAST implementation at the State level for ensuring proper energy accounting of all grid participants, and for bringing the grid discipline and security. The framework is required irrespective of whether the State is RE rich in or not. Further, ShriBakshi underscored the role of regulators in implementing ABT, DSM and SAMAST at the State level.

Action points/ Decisions

i) The Committee decided that each State Commission of NE region will formulate regulations to facilitate DSM and ABT mechanism.

3. Presentation by NERPC on Preparedness of North-Eastern State-LDCs for SAMAST implementation

a. Presentation on preparedness of North-Eastern State-LDCs for SAMAST implementation **(Annexure-IV)**was divided into two parts i.e. Technical and Commercial. Shri. R. Sutradhar, DGM-NERLDC, started the presentation covering the Technical aspects of NE States in preparedness for SAMAST implementation.

b. Shri. Sutradhar gave a brief background on the SAMAST group formed for NE region in June 2017 post receiving advice from ShriBakshi and Dr. Iyer. Further, he informed that the Draft DPR template was discussed with all States, SLDCs, and STU. States prepared their DPR with support from the SAMAST group formed for NE region.

c. Shri. Sutradhar updated the status of each State of NE region and highlighted that most of the activities like, Assessment of Main, Check & Standby meters, IT infrastructure, Utility Software identification, preparation of BOQ & DPR has been completed for almost all the States except Arunachal Pradesh (only BOQ & DPR for Nagaland and Tripura is pending).All the seven States will submit the

final BOQ and DPR to NERPC Secretariat by 30th April 2018. A committee has been formed by NERPC which involves representatives from all seven States, POSOCO and NERPC and will do the final check of DPR before forwarding the same to PSDF. The Committee will ensure to have common IT infrastructure for all NE States and finalize Technical specs for the meters.

d. Shri B. Lyngkhoi, Director-NERPC presented on the commercial part. He highlighted that the tentative project cost for seven States of NER is ~Rs.100 Crores and underscored the need for having a common tendering, procurement and implementation. Further, he proposed to have a central agency/committee consisting of representatives from each State to ensure that based on BOQ, funds are transferred to individual State.

e. Shri KVS Baba, CMD, POSOCO informed the members that 100% funding is available from PSDF for NER States for SAMAST implementation.Shri S.C Das, Chairperson, AsSERC, underscored that during the R-APDRP implementation also, Single tendering process was carried out for NER States.

f. Further, Shri Baba presented on the Pre-requisite for effective implementation of SAMAST in States (Attached as Annexure-IV). He stressed upon the need for Ring fencing of SLDCs, adequate requirement of human resources and Certification of LDC personnel and providing incentives to them, Power System Visualization including Telemetry limitations and Communication infrastructure

g. He underscored that the Pradhan Committee report had identified requirement of minimum 70 personals at an LDC but in actual there are only 20-30 personals. On the training part of the employees, most of the LDCs are not ready to incur expenditure (including TA/DA for employees) for providing training to them.

h. Shri Baba highlighted that without proper visualization and communication system, the beneficiaries are not aware if they are over drawing or under drawing and are paying high DSM charges.

Action points/ Decisions

i) NERPC will act as a Nodal Agency to finalize the DPR and also to carry out bulk/single tendering for NER States as it was done in the context of R-APDRP scheme.

ii) NERPC will interact with each State so that they get approval of the respective Govt. of that State to carry out bulk/single tendering.

iii) On the issue of SLDC Ring Fencing, a Working-Group of FOR will be formed to examine the institutional, operational, financial and HR related issues at States and make suitable recommendations for ensuring independence of SLDCs.

4. **Agenda Item No. 4: Status of implementation of Regulations on Forecasting, Scheduling and Deviation Settlement:**

   - **Update by Consultant**
   - **Update in respect of other States by respective Members**

a. The Consultant made a presentation **(Annexure-II)**on the status of implementation of Regulations on Forecasting, Scheduling and Deviation Settlement in Tamil Nadu, Punjab, Haryana and Telangana.

b. **Haryana:**The Consultant apprised the Committee that HERC is currently scrutinizing public comments received on draft F&S Regulation and will publish the final regulations soon.

c. **Punjab:** More than 20 comments received on the Draft F&S Regulations. Commission is scrutinizing them and will soon finalize the regulations.

d. **Tamil Nadu:**TNERC is currently scrutinizing public comments received on draft F&S and DSM Regulations. TNERC, in consultation with the Consultant will finalize the Draft F&S and DSM Regulations.

e. **Telangana:** The Consultant apprised that the comments received on the Draft F&S regulations have been addressed and SOR preparation is underway.

Update in respect of other States by respective Members:

f. **Kerala:** KSEB Ltd is the State Transmission Utility and incumbent distribution licensee in the State. KSEB Ltd has been generating and procuring electricity for the entire consumers of the State. The electricity for entire consumers (except to the extent of open access availed by limited number of (about 22 HT&EHT consumers) is being done by KSEB Ltd. Accordingly, there was no requirement of introducing intra-state ABT and Deviation Settlement within the State. Hence this Commission yet to notify Regulations on intra-state ABT and Deviation Settlement Mechanism (DSM) in the State of Kerala.

   On F&S Regulations, the Commission is in the final round of discussions on finalizing the State Level Forecasting and Scheduling Regulations.

g. **Madhya Pradesh:ShriMukulDharival, Member, MPERC informed that r**egulation on F&S will be notified soon.

h. **Assam:**Shri S.C Das, Chairperson, AsSERC informed the Committee that Assam will start working on the F&S Regulations at the earliest.

i. **Gujarat:**Shri P.J Thakkar, Member, GERC highlighted that the Commission was occupied with tariff related matters and will soon notify the final regulations.

Further, Shri K.M Shringarpure, Member, GERC informed that Regulations is ready and only SOR is being finalized.

j. **Andhra Pradesh:**Shri P. Rama Mohan, Member, APERC informed that the software at SLDC for F&S is already in place and trial for first month has been conducted for about 800MW of capacity.

k. **Maharashtra:**Shri Deepak Lad, Member, MERC informed the Committee that regulations have been prepared and SOR preparation is underway.

5. Agenda Item No. 5: Presentation by POSOCO on Hydro Resources in NE Region/FRAS for Hydro

Discussion

Shri S C Saxena, DGM, POSOCO presented on Introduction of Fast Response Ancillary Services (FRAS) from Hydro Generating Station **(Annexure-V).**The following key-points were highlighted in the presentation by POSOCO:

a. The important statistics pertaining to the implementation of the Reserve Regulation Ancillary Services (RRAS) were presented and the benefits derived from ancillary services in terms of improved frequency profile and reliability support were mentioned. The key learnings during the last two years were also highlighted.

b. The improvement in Frequency Profile over the years was highlighted.Further, it was underscored that about 80-85% of time, the frequency is remaining within the desired range.

c. The challenges being faced included the need for revision of the DSM price vector, expanding the ambit of the ancillary services, gate closure provisions, need for implementation of ancillary services from hydro stations, performance monitoring and IT/automation requirements.

d. Thermal generation is a 'ramp limited' resource whereas hydro is a 'energy limited' resource with other constraints (other than power generation constraints). Hydro generators can provide fast response and peaking support.

e. Fast responding ancillary service from hydro stations was primarily being proposed for 'regulation service' from storage/pondage based hydro stations for example to handle the hour-boundary frequency spikes.

f. Scheduling is proposed to be carried out at 5-minute interval which would be dovetailed into 15-minute existing scheduling.

g. All constraints declared by the hydro stations would be honored and the total energy delivered over the day would be maintained as declared by the hydro station. The total energy dispatched under FRAS is proposed to be squared off by the end of the day.

h. Triggering of FRAS would be based on a stack prepared based on the balance energy available in the hydro station (marginal cost of hydro is zero), whereas the despatch in the case of thermal generators was based on variable charges of the station

i. Schedules of the beneficiaries would not be disturbed in the despatch of FRAS.

j. Payment for FRAS would be based on 'mileage' basis similar to the methodology adopted for AGC pilot implemented.

k. Fast communication of triggering instruction, incorporation in the schedules and response by hydro generators required fast communication between NLDC and hydro generating stations.

l. Further, ShriSaxena underscored the advantages of utilizing the Hydro as FRAS. A list of Hydro Stations which could be potential candidates for FRAS was also presented.

m. It was informed that in the last FOR Meeting, held on 9th April 2018, POSOCO requested for implementation of a pilot project in at least one hydro station each in Northern, Eastern and North-Eastern Regions with 5-minute scheduling, metering and accounting was deliberated. It was mentioned that this would help gain experience in not only the ancillary services but also provide valuable learnings regarding 5-minute scheduling, metering, accounting and settlement. This pilot will also provide learnings for implementation of other competing resources like Battery Storage, Demand Response as Ancillary Services.

n. ShriSaxena also informed about the various meetings held at CERC and NLDC with CEA and other central hydro generators on the same subject and the data/information which has been requested from these generators. He underscored that a broad consensus has been achieved among the generators on implementation hydro as FRAS.

o. On further steps, it was mentioned that Order by CERC for pilot projects is required with Detailed procedure. Other requirements being software up gradation, communication infrastructure augmentation and capacity building.

p. Dr. Chatterjee inquired about the issues pertaining to the downstream projects. Shri Baba informed that POSOCO will carry out an analysis on the same in few days.

Decisions

i) Hydro as FRAS has been presented before FOR and consensus has been achieved on operationalizing the framework. It was clarified that storage based hydro projects or RoR with minimum of 3 hours pondage can be utilized as FRAS.

ii) CERC would be requested for suitable order for implementation of Pilot project on 3 regions.

iii) POSOCO to undertake analysis of cascading effect on downstream projects and submit its feedback to CERC for suitable action.

6. Agenda Item No. 6: Presentation on:

(i) Implementation of 5-Minute Scheduling, Metering, Accounting and Settlement

Discussion

a. Shri S C Saxena, DGM, POSOCO presented the Sub-Group Report for Implementation of 5-Minute Scheduling, Metering, Accounting And Settlement **(Annexure-VI).**

b. Mr. Saxena highlighted the CERC ABT Order dated 4th Jan 2000 under which the 15 Minutes time interval was introduced for the first time which was debated against 30 Minutes and 1 hour time interval. Further, the CERC order (December 2017) on AGC Pilot provides for 5 minutes accounting for ramp management.

c. Benefits of 5 minutes scheduling Vs 15 minutes scheduling were underscored. It was highlighted that introduction of shorter time period for scheduling/market (like 5 minutes) has the potential of reducing reserves requirement, robust price discovery closer to real time. This will also help in identifying the time value of flexibility.

d. Various Policy/Regulatory mandates like, NITI Ayog Report - India's Renewable Electricity Roadmap 2030 (2015), SAMAST, FOR Model DSM Regulations, etc which highlights the importance of 5 minutes scheduling, metering and accounting were highlighted.

e. Requirement of total number of interface meters and the associated cost at national level was also deliberated. Cost of replacement of about 6000 meters at inter-state level was estimated to be ~Rs 30 Crores

f. Action plan and Timelines of activities from carrying out Pilot project in June 2018 to Going live by April 2020 was also highlighted as a PERT Chart.

g. Further, POSOCO listed the regulations which will require amendments for implementing 5-minutes Scheduling, Metering, Accounting and Settlement. Recommendations of the report and the Action plan for implementing it was also provided.

(ii) RPO Webtool

a. Dr. Chatterjee briefed the Committee about the background of RPO webtool which is essential for RPO monitoring and highlighted that Rajasthan was the first State where web-based RPO monitoring tool was created. This tool was created by the consultant (Idam Infra) to FOR Technical Committee. Similar webtool was created for Gujarat and Andhra Pradesh and is ready for launch.

b. Further, Dr. Chatterjee informed that in the last FOR Meeting, held on 9th April 2018 at CERC, TERI in consultation with MNRE made a presentation on developing a generic webtool and it was decided that each State will interact with MNRE and MNRE will assist State Commissions in formalizing the webtool.

c. Dr. Chatterjee underscored that MNRE will provide the technical and financial support to the States and requested State representative, to utilize this opportunity.Dr. P C Maithani, Advisor at MNRE and ShriShirishGarud, Senior Fellow at TERI can be approached for the same.

7. Agenda Item No. 7:Discussion on Technical Minimum of 55% for State/IPP Generating Stations

a. Shri S.C. Srivastava, Chief Engg. CERC, initiated the discussion on the Technical Minimum for 55% for State/IPP Generating Station. He gave a background on how 55% Technical Minimum is scheduled by LDCs to integrate RE into the grid. Further, he highlighted the various Regulations and amendments pertaining to Regulations and Grid Code which have paved ways for implementation of 55% Technical Minimum.

b. The CERC Order on Reserve Shutdown and Compensation Mechanism for thermal plants was deliberated. It was informed that the Technical minimum of 55% was implemented from 15th May 2017. Post one year of this implementation, i.e. 15th May 2018, actual data will be reviewed and based on that the Compensation part will be further studied.

c. ShriShrivastava underscored the need of similar mechanism at the State level and to initiate it as early as possible. Shri P.K Pujari, Chairperson, CERC, emphasized that with the learning experience available with the CERC, States should take benefit out of it and facilitate it at the earliest for national interest.

Decisions

i) It was decided that States should come up with their respective roadmaps on 55% Technical Minimum at the earliest. This issue will be taken up in the next meeting of FOR.

8. General Discussion

a. Dr. Chatterjee updated about the action items of the last meeting of Technical Committee.

b. Gujarat State Commission has volunteered to hold second capacity building program for North-Eastern States in Gujarat. GERC will bear all the local expenses (accommodation and transport). The travel cost will be borne by the participants of NE States themselves. The proposed dates for this capacity building program are 4th& 5thMay, 2018.GERC is in process of issuing letter to respective States.

c. It was agreed that the services of the Consultant, M/s Idam have been very useful to the committee and the states in preparing DPRs and state level Regulations. Since the mandate of this committee has been enlarged, it is essential that the services of the Consultant remain available to all states. This would require extension in the tenure of the Consultant. It was agreed that USAID would be requested for extension of the tenure.

The meeting ended with a vote of thanks to the Chair. The arduous efforts made by NERPC in organizing the meeting were also appreciated.

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Annexure-1

LIST OF PARTICIPANTS AT THE NINETEENTH MEETING OF THE TECHNICAL COMMITTEE FOR "IMPLEMENTATION OF FRAMEWORK ON RENEWABLES AT THE STATE LEVEL" HELD ON 16.04.2018 AT SHILLONG, MEGHALAYA

1	Mr. P.K. Pujari, Chairperson	CERC, FOR
2	Mr. A. S. Bakshi, Member	CERC
3	Dr. M.K Iyer, Member	CERC
4	Mr.VishwanathHiremath, Chairperson	Rajasthan
5	Mr. Ismail Ali Khan, Chairperson	TSERC
6	Mr. S. Akshaya Kumar, Chairperson	TNERC
7	Mr. RabindraNathSen, Chairperson	WBERC
8	Mr. S.K.B.S Negi, Chairperson	HP
9	Mr. R.P Singh, Chairperson	Arunachal Pradesh
10	Mr.W. M. S. Pariat, Chairperson	Meghalaya
11	Mr. Preman Dinaraj, Chairperson	Kerela
12	Mr. S.C. Das, Chairperson	Assam
13	Mr. D. Chakravorty, Member	Assam
14	Mr. Deepak Lad, Member	Maharashtra
15	Mr. K.M Shringarpure, Member	Gujarat
16	Mr. P. Rama Mohan, Member	APSERC

17	Mr .P.J. Thakkar, Member	GERC
18	Mr. R.P. Barwar, Member	Rajasthan
19	Mr. Mukul Dhariwal, Member	Madhya Pradesh
20	Mr. S.K Jha, Secretary	CERC
21	Mr. S.C. Srivastava, Chief Engg.	CERC
22	Dr. S.K. Chatterjee, JC(RA)	CERC
23	Mr. P.K.Mishra, Member Secretary	NERPC
24	Mr. K.V.S Baba, CMD	POSOCO
25	Mr. S.C Saxena, DGM	POSOCO-NLDC
26	Mr. TS Singh, ED	POSOCO
27	Mr. R Sutradhar, DGM	POSOCO
28	Mr. A.G. West, CMD	NEEPCO
29	Mr. V.K Singh, Director(Technical)	NEEPCO
30	Ms. Debjani Dey, GM Commercial	NEEPCO
31	Mr. S.N. Kalita,MD	AEGCL
32	Mr. D.S. Yadav, ED	NERTS
33	Mr. iA.Choudhury, ED	PGCIL
34	Mr. AjitPandit	Consultant
35	Mr. H. Shanti Kumar, GM	Manipur SLDC

36	Mr. N. Parme, EE	Ar Pradesh SLDC
37	Mr. Lalbiaksanga, SE	Mizoram SLDC
38	Mr. Z.A. Choudhury,,CGM	Assam SLDC
39	Mr. Khose Sale, EnC	Nagaland SLDC
40	Mr. Shikato, SE	Nagaland SLDC
41	Mr. Nitovi A Wotsa, EE	Nagaland SLDC
42	Mr. SiddharthArora, RO	CERC

Idam Infrastructure Advisory Pvt. Ltd.

Agenda Item-1 & 4

Status update on SAMAST implementation and draft F&S/draft DSM Regulations in Tamil Nadu, Haryana, Punjab, Telangana and West Bengal

19th Meeting of FOR Technical Committee

April 16, 2018

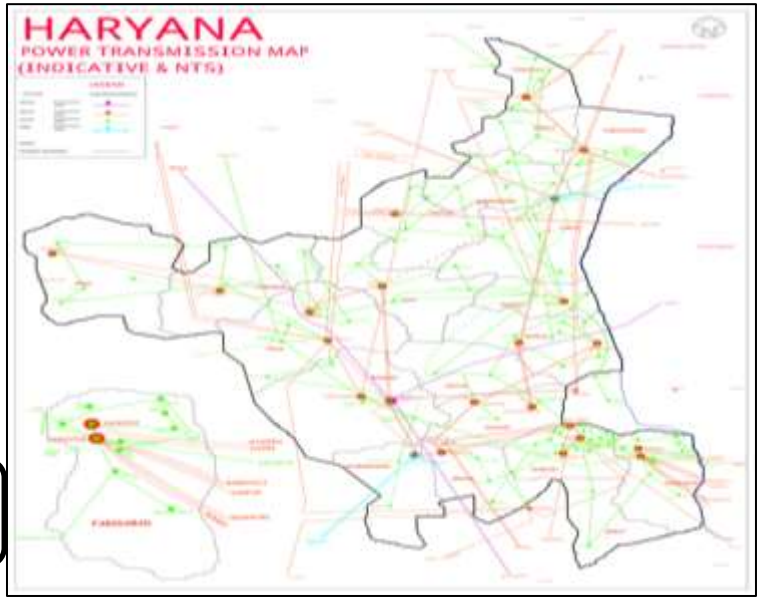
The engagement of Consultant for support to FOR and its Technical Committee is supported under USAID/GTG-RISE initiative through Deloitte.

Overview of Activities for TA support for States

States	Activities
Haryana	- DPR for SAMAST implementation in Haryana - Draft F&S Regulations - Draft DSM Regulations - Draft Scheduling & Despatch Code for Haryana
Punjab	- DPR for SAMAST implementation in Punjab - Draft F&S Regulations
Tamil Nadu	- Draft F&S Regulations - Draft DSM Regulations
Telangana	- Draft F&S Regulations
West Bengal	- DPR for SAMAST implementation in West Bengal

Haryana

- Based on discussions with the Consultant, SLDC Haryana revised their DPR. The DPR is approved by the management of HVPN and the same has been submitted to PSDF Secretariat.
- The Consultant circulated draft F&S Regulations, draft DSM Regulations and Draft Scheduling & Despatch Code for Haryana.
- HERC published the draft F&S Regulations, public comments were invited upto 12.2.2018.
- HERC is scrutinizing the public comments. Consultant is assisting HERC for finalizing F&S Regulations



Next Steps:

- After scrutinizing comments, HERC shall publish final F&S Regulations

Summary of Key Cost Components (INR in Lakh)	
Hardware component-I	1494.35
Hardware component-II	233.00
Software component	544.00
Communication component	475.00
Infrastructure component	25.00
Training, Capacity Building & Annual Operating Cost	216.00
Contingency (est @ 3% on Metering and @5% on other cost)	119.48
Project Management and consultancy	186.41
GRAND TOTAL	**3293.24**

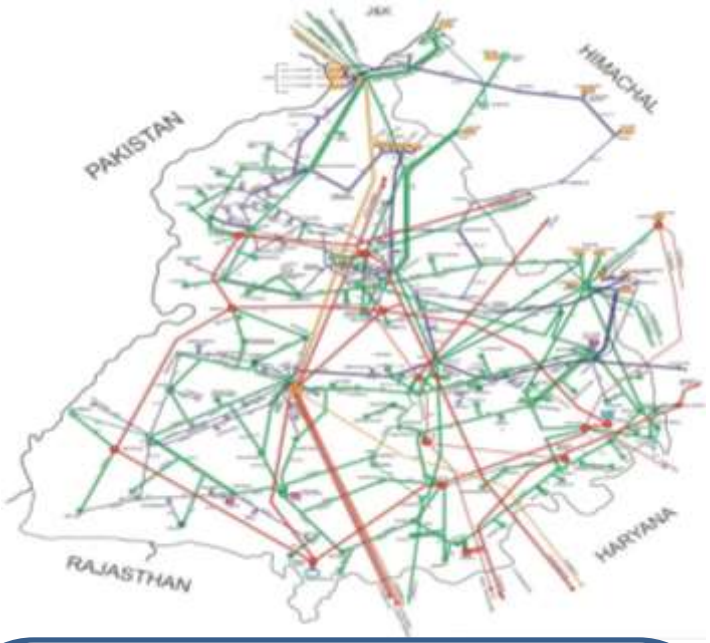
Cost-Estimate - Hardware-Metering infrastructure	1539.17
Cost-Estimate - Communication Component	498.75
Cost-Estimate - Software, Hardware-II, Infrastructure, Training & Capacity Building – SAMAST	1068.90
Project Management and consultancy	186.41
COST ESTIMATE GRAND TOTAL(INR in Lakh)	**3293.23**

Regulatory Developments:

- Haryana falls under **Category 'B'** of SAMAST report (Deviation Settlement only for Open Access Consumers)
- Generators payment on actual basis
- MYT Tariff Regulations, 2012 specifies determination of Capacity Charge and Energy Charge of generators
- State Electricity Grid Code,2009 and its amendments
- HERC Open Access Regulations 2012, specifies treatment to the Deviation of OA generators/consumers

Punjab

- Based on discussions during the special meeting at Chandigarh on 19.1.2018, Punjab SLDC is revising their DPR. The revised DPR will be submitted for management approval.
- The Consultant prepared and shared draft F&S Regulations and DSM Regulations. Draft F&S Regulations was discussed with PSERC.
- PSERC, published the draft F&S Regulations for public comments (last date 22.2.2018)
- PSERC has received public comments and currently scrutinizing the comments.
- Further, they will share the comments to the Consultant for their inputs on the issues raised by the stakeholders



SLDC	G-T	RES-T	ISTS -InSTS	D-T	HT-T	OA-T	Total
Punjab	64	4	66	407	19	0	**560**

Next Steps:

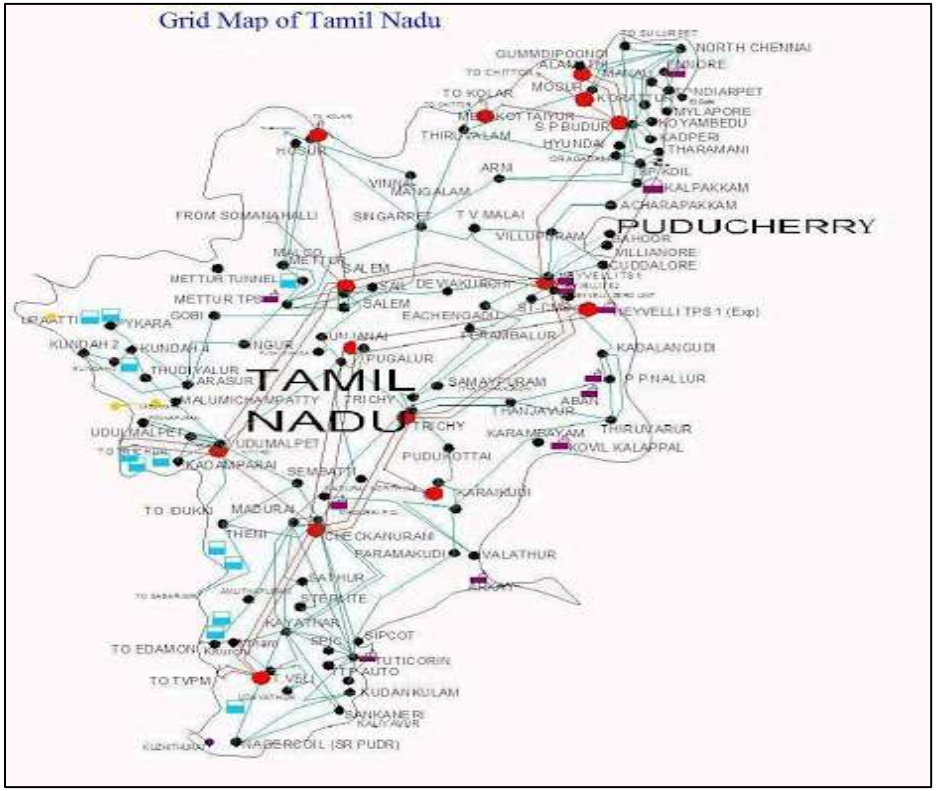
- PSERC will finalize draft F&S Regulations after addressing public comments.
- Regulatory process to be initiated by PSERC for publishing draft DSM Regulations for public consultation process
- DPR preparation by PSTCL/SLDC is currently underway.

Regulatory Developments:

- Punjab falls under **Category 'B'** of SAMAST report
- Generators payment on actual basis
- MYT Regulations, 2014 specifies provision determination of Capacity Charge, Energy Charge and Deviation Charges of generators
- State Electricity Grid Code, 2013 specifies Scheduling and Despatch code
- Intra-State Open Access Regulations, 2011, specifies treatment to the Deviation of OA generators/consumers

Tamil Nadu

- The Consultant prepared the draft F&S and draft DSM Regulations and discussed with the Commission during couple of meetings.
- Various issues related to higher Wind and solar penetration and Open Access were discussed during the meetings.
- Based on the inputs of the Commission, the consultant revised the draft F&S and DSM Regulations.
- The Commission published the draft F&S and DSM Regulations on 28.12.2017 for public comments.
- Last date for receiving comments was 27.1.2018.



Next Step:

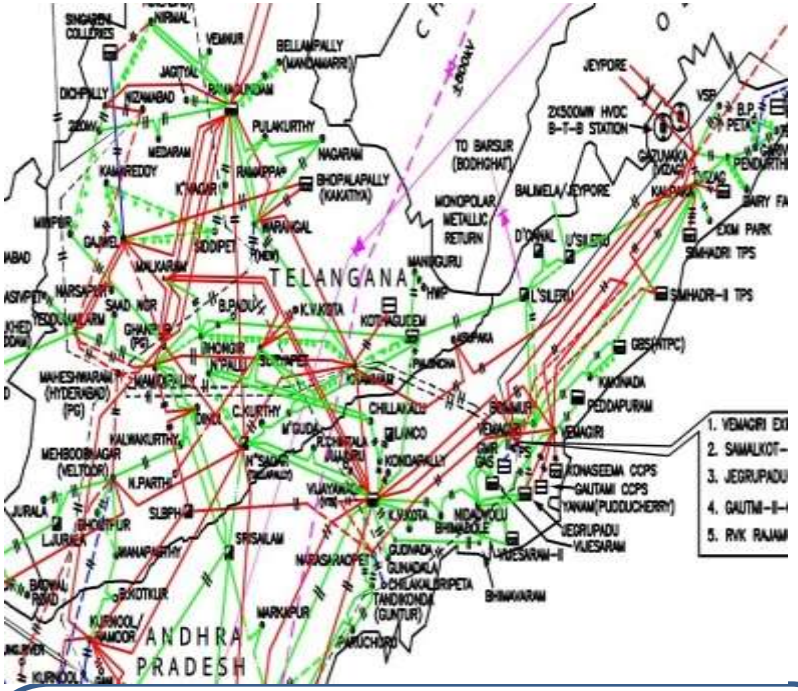
- TNERC is compiling comments received on draft F&S and DSM Regulations,
- The Consultant will assist the Commission to address the public comment and finalise the F&S and DSM Regulations for Tamilnadu.

Regulatory Developments:

- Tamil Nadu falls under **Category 'C'** of SAMAST report
- MYT Tariff Regulations, 2005 and its amendments, TNERC MYT Regulation specifies provision determination of Capacity Charge and Energy Charge of generators
- State Electricity Grid Code, 2005 and its amendments
- Grid Connectivity and Intra-State OA Regulations, 2014, specifies treatment to the Deviation of OA generators/ consumers

Telangana

- The Consultant Prepared the draft F&S Regulations and discussed with the Commission during the meeting at TSERC, Hyderabad.
- Based on the inputs of the Commission, the consultant revised the draft F&S Regulations and circulated to the Commission
- The Commission finalized the draft F&S Regulations and published on 17.2.2018 for public comments.
- Last date for receiving comments was 12.3.2018.
- The Consultant has compiled and addressed public comments received on draft regulations.



Next Steps:

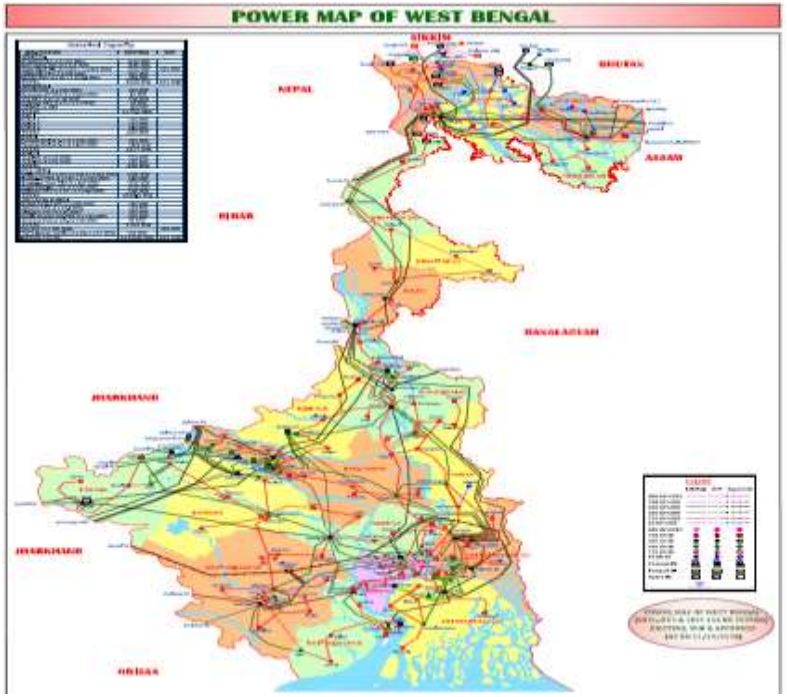
- Based on the Public comments TSERC will finalise the F&S Regulations

Regulatory Developments:

- Telangana falls under **Category 'B'** of SAMAST report
- Generators payment on actual basis
- Intra state DSM is yet to implemented in the State
- TSERC Grid code is in draft stage

West Bengal

- The Consultant attended various meetings/ discussions held in West Bengal with WBSLDC and WBERC for discussion on the steps required to be taken for implementation of SAMAST
- Draft DPR for SAMAST implementation in West Bengal has been prepared and submitted to WBSLDC for their management approval.
- During the month of December 2017, WBSLDC have finalized the DPR upon due management approval and submitted the same to Appraisal Committee to avail grant/funding support through PSDF.



(INR in lac)

Cost Component	West Bengal
Cost-Estimate - Hardware-Metering infrastructure	1290
Cost-Estimate - Communication Component	213
Cost-Estimate - Software, Hardware-II, Infrastructure, Training & Capacity Building - SAMAST	1093
COST ESTIMATE GRAND TOTAL	**2596**

Next Steps:

- Awaiting response/ comments of Appraisal Committee on DPR submitted by WBSLDC

Regulatory Developments:

- West Bengal falls under **Category 'A'** of SAMAST report
- Generators payment on actual basis
- WBERC Tariff Regulations, 2011 and its amendments, WBERC tariff Regulation specifies provision determination of Capacity Charge and Energy Charge of generators
- State Electricity Grid Code, 2007 and its amendments
- WBERC Open Access Regulations, 2007, specifies treatment to the Deviation of OA generators/consumers

Thank You

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Need for SAMAST Implementation in North Eastern States

Agenda Item - 2
For Discussions at 19th FOR Technical Committee Meeting

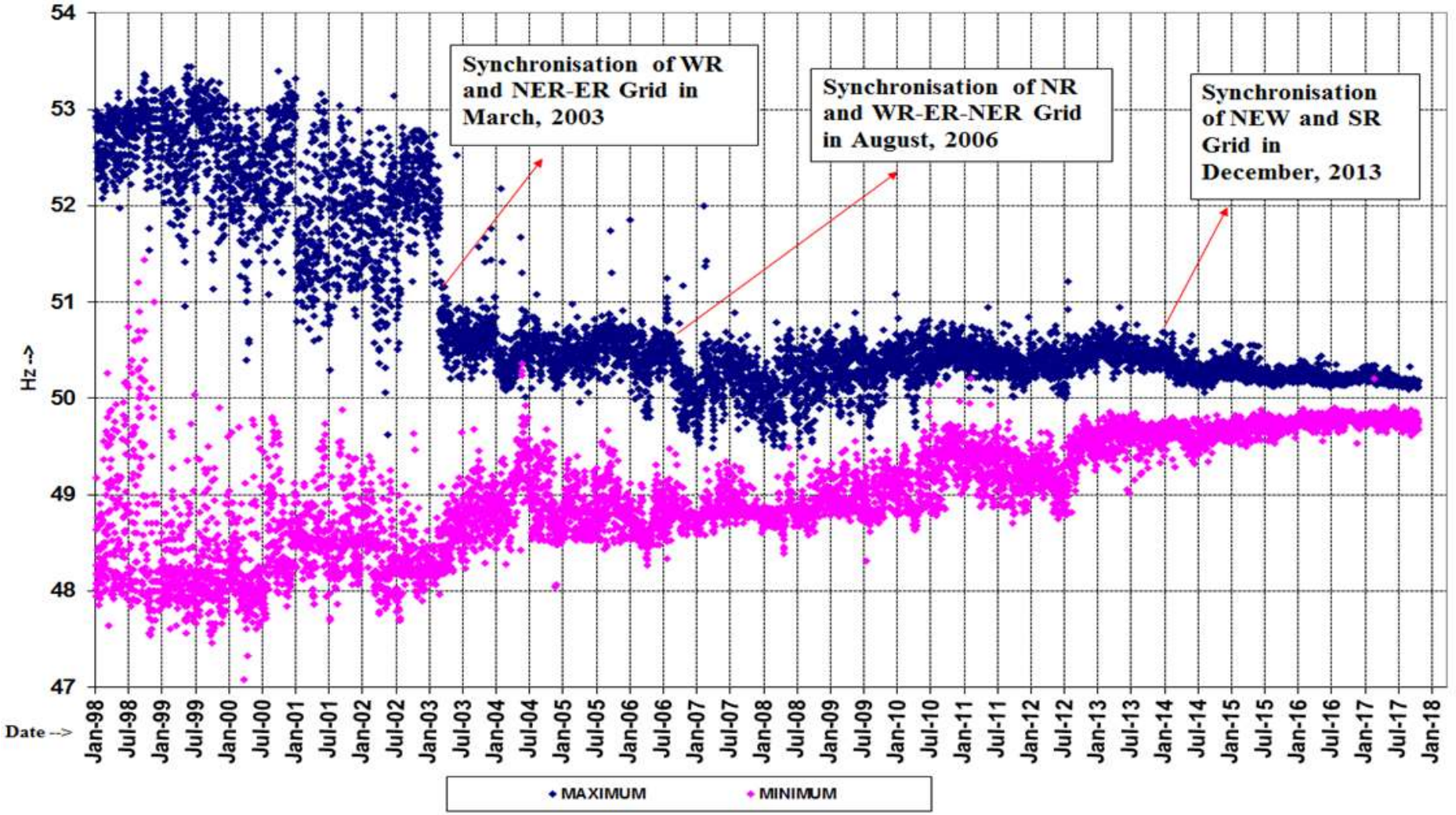
April 16, 2018

The engagement of Consultant for support to FOR and its Technical Committee is supported under USAID/GTG-RISE initiative through Deloitte.

DSM framework at regional level : historical developments

- **DSM mechanism was introduced in various regions in stages**
  - Western (1-Jul-2002), Northern (1-Dec-2002), Southern (1-Jan-2003), Eastern (1-Apr-2003) and North-Eastern (1-Nov-2003)
- **The main objectives of introduction of DSM mechanism at regional level have been:**
  - Encourage grid discipline
  - Economic load dispatch
  - Accounting of exchange of energy and capacity
  - Encourage higher availability
- **Key benefits of DSM mechanism at regional level**
  - Improved grid frequency
  - Reduced frequency variations
  - Reduction of number of interruptions/grid failures
- **Successful implementation of DSM at regional level has firmed up belief that DSM mechanism (similar to mechanism at regional level) should be introduced at the State level.**

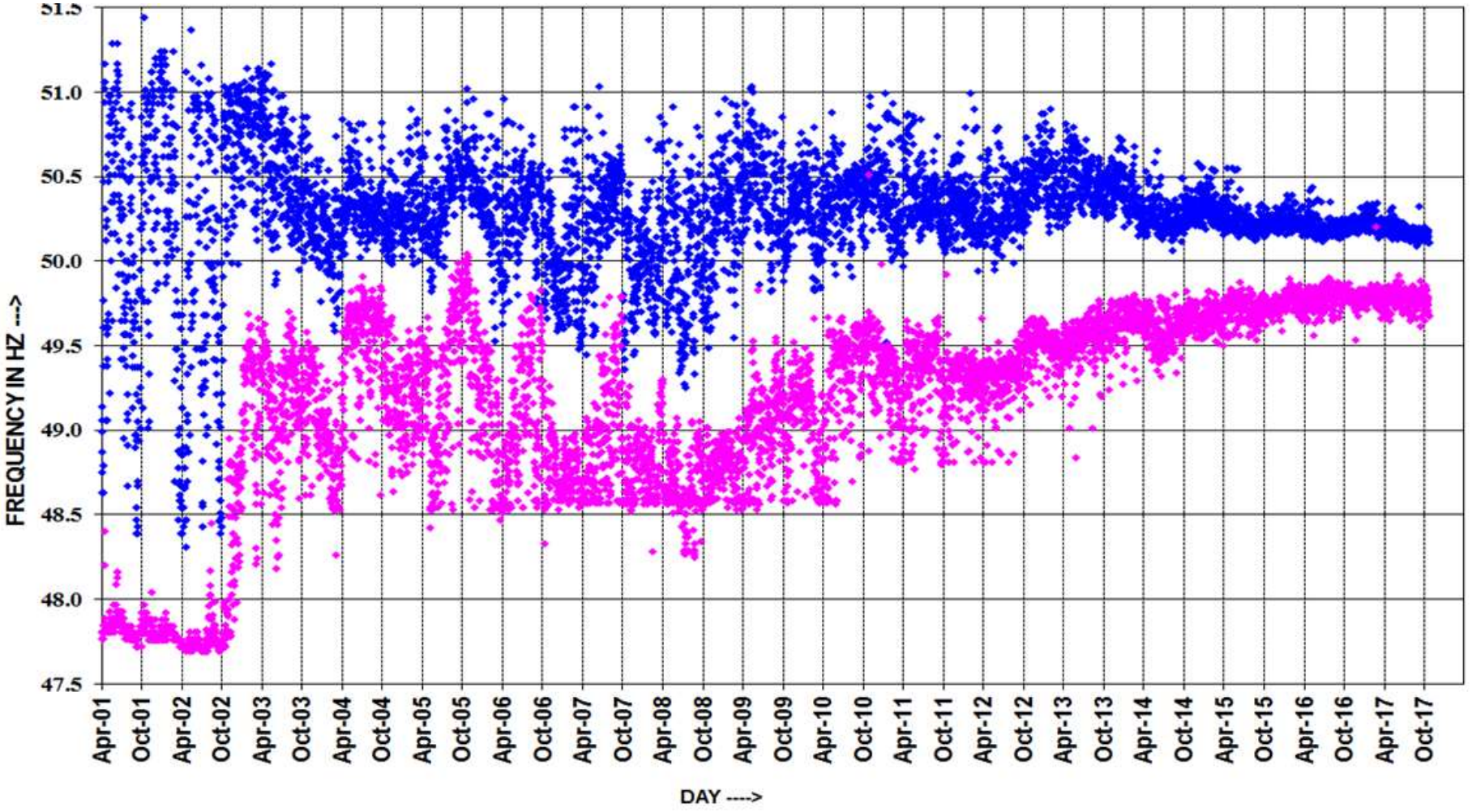
Maximum and Minimum Frequency Profile[7]



[7] – Based on ER / NEW Grid Data

Source : POSOCO and CERC

Maximum and Minimum Frequency Profile Southern Region[8]

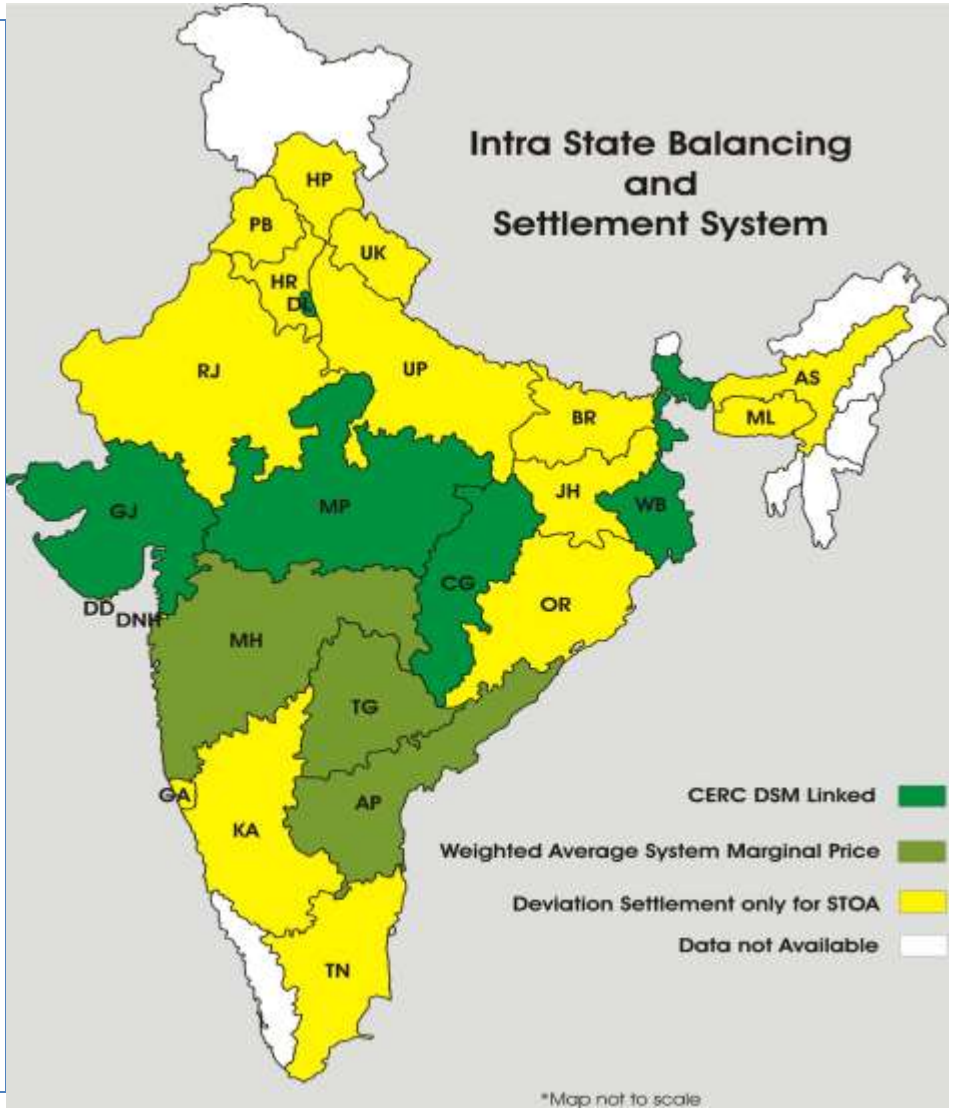


[8] – Based on SR Grid Data till Dec'14 and All India Grid data thereafter

Source : POSOCO and CERC

Intra-state Balancing & Settlement : Mandate and status update

- Section 32 of the Electricity Act 2003
- Section 5.7.1 (b) of National Electricity Policy 2005
- Section 6.2 (1) of Tariff Policy 2006 & 2016
- Recommendations of the Forum of Regulators – June 2006 and 2008
- Regulation 6.4.1 of Indian Electricity Grid Code 2010
- Recommendations of Niti Ayog for Renewable Integration – Feb 2015, Dec-2015
- Para 2.3.2 of the Pradhan Committee – 2008
- CERC Order on Roadmap for Reserves – Oct 2015
- CERC Framework for Forecasting Scheduling and Imbalance Handling for RES- Aug 15



DSM mechanism at State level

– Objectives

- To ensure **secure and reliable grid operations** while bringing in more generation in the system
- To instill **forecasting and load management discipline** amongst Discoms, load serving entities and OA consumers
- To ensure **despatch discipline amongst generators** based on economic/ merit order principles
- To **serve as a balancing mechanism** within the state
- To **facilitate energy accounting and deviation settlement** of transactions in transparent manner

– Key Considerations

- Ensuring Grid discipline – Share of scheduled capacity mgmt at state periphery is ~ 18% to 40% of total capacity/volume handled for intra-state entities. Deviation management (by Volume) for intra-state entities is crucial.
- Cost Principle – Should not have significant **impact on Cost of power** in the state power system as a whole.
- Market Development Principle – The new system (balancing & settlement) should promote the development of market, i.e., **encourage participation by many buyers and sellers**
- Quality and Efficiency Principle - Quality of supply and the **efficiency of various entities/institutions** should improve.
- Should not be prone to Gaming – The devised mechanism **should not be favourable to** any Participant.

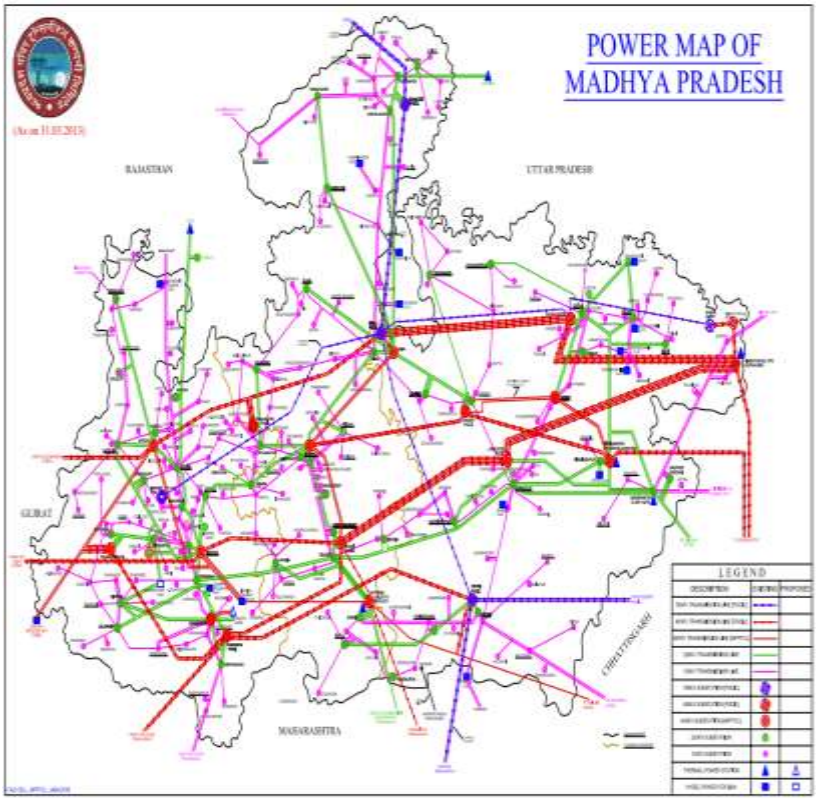
DSM : Experience of other States

- State Specific Details
- Profile of Madhya Pradesh
- Analysis of Deviation Charges for MP

Overview of State Experience: Entities, Deviation Mgmt and costs

State	Madhya Pradesh
Introduction of ABT at State level	Nov 2009
Intra-State Entity Profile	SGS (4080 MW), Hydel (3223 MW), Private generators (9390 MW), RE (3800 MW)
No. of Intra State Entities (As per SAMAST Report)	214
Peal Demand FY16-17 (in MW)	11512
Power share from CGS/ISGS (in MW)	5033 (43.76%)
Deviation limit	150 MW
Total ARR for FY 16-17 (INR Crore)	26,508
Net Deviation Charges for FY16-17 (INR Crore)	(120.56)
Total Deviation charges payable for FY 16-17 (INR Crore)	3.14
Total Deviation Charges Receivable for FY 16-17 (INR Crore)	(123.66)

Profile of Madhya Pradesh



Profile of State

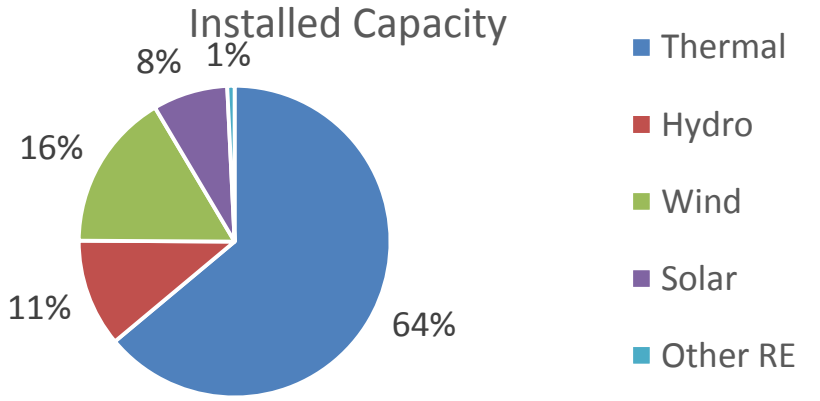
Generation sources	Installed Capacity in MW
Thermal	9754
Hydro	1703
Wind	2498
Solar	1186
Other RE	116

Total Gen Cap. : 15257 MW
IPPs: 2776 MW

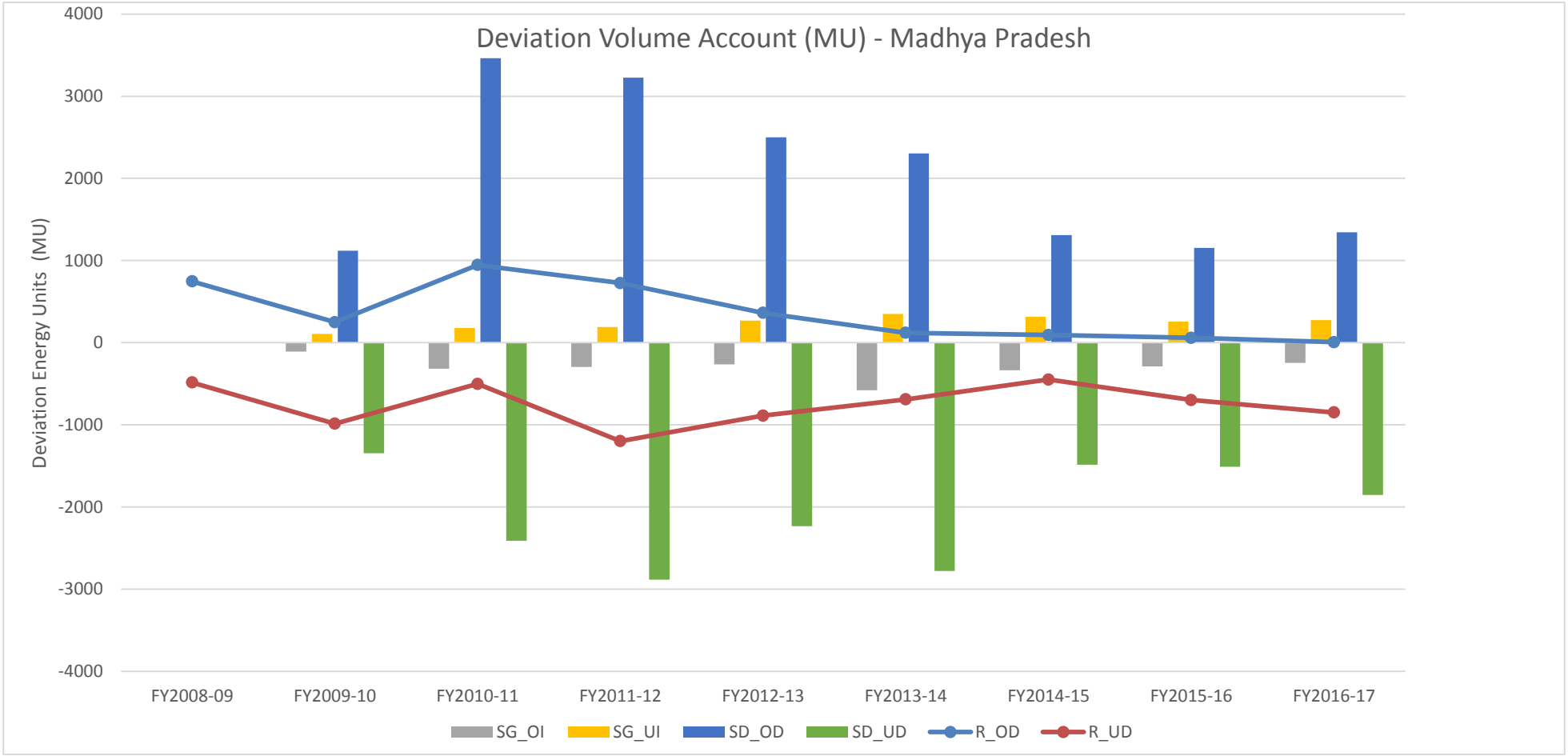
(Ref.: CEA Executive Summary Oct 2017 and Madhya Pradesh Power to All, MoP Report, 2016)

No. of Distribution Licensees /SEZ: 3 no. (MPPKVVCL, MPPKVVCL & MPMKVVCL)
No. of Transmission Licensees: 1 no. (MPPTCL)
No. of OA Consumers : 61 no. (LTOA/MTOA/STOA)
(Ref.: FOR - SAMAST Report, 2016)

Peak Demand: 11512 MW
Supply: 11501 MW
No. of Transmission S/s: 335 no. of Substations
(Ref.: LGBR 2017-18 Report & MPTRANSCO website)

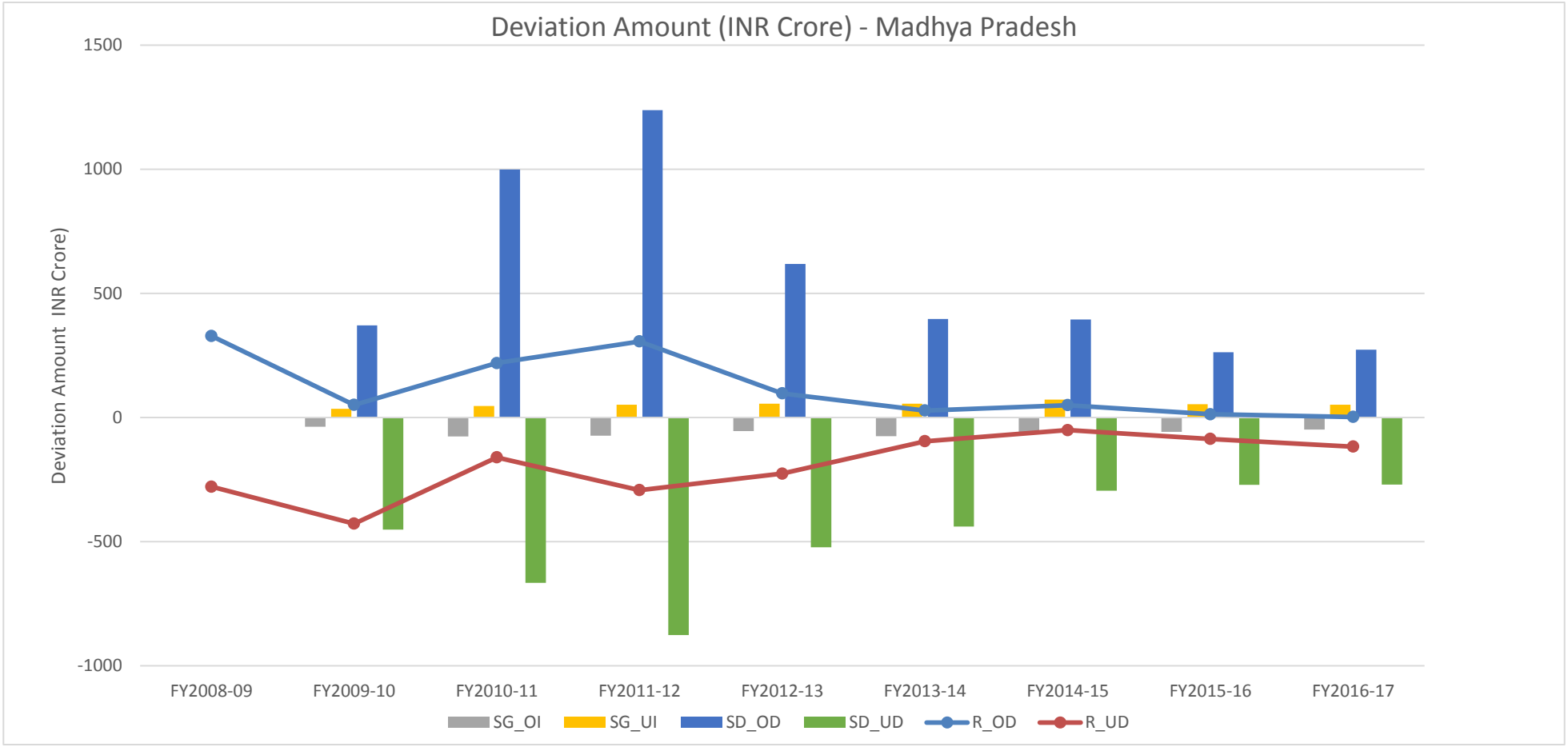


Madhya Pradesh : Deviation Account (MU) FY09 to FY17



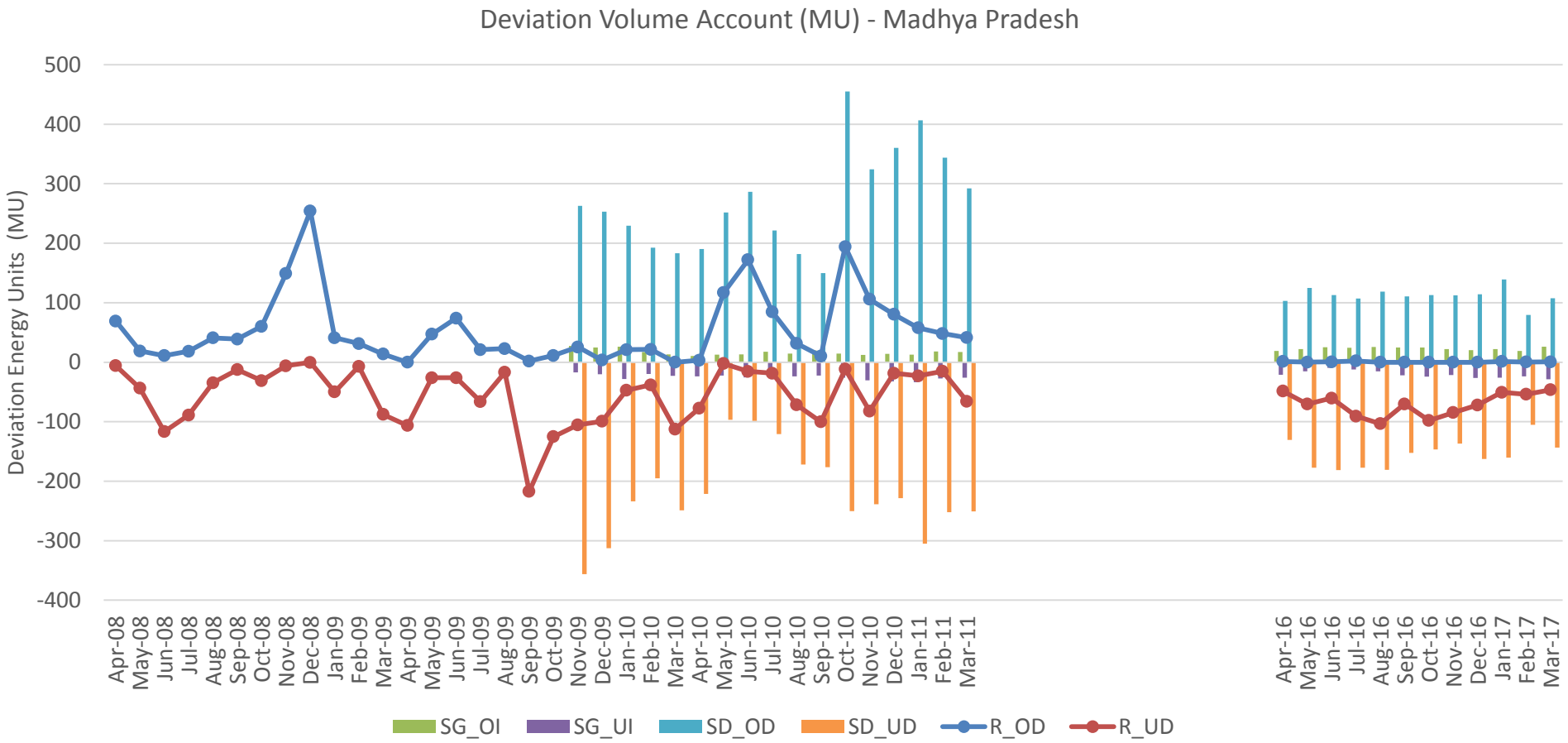
- Pre DSM and Post DSM (at state level) : significant improvement over the period
- Improvement in Balancing/Deviation management by Intra-state entities over the period
- Share of energy units handled at state periphery is ~ 35% of total energy units handled for intra-state entities

Madhya Pradesh : Deviation Amount (INR Cr) FY09 to FY17



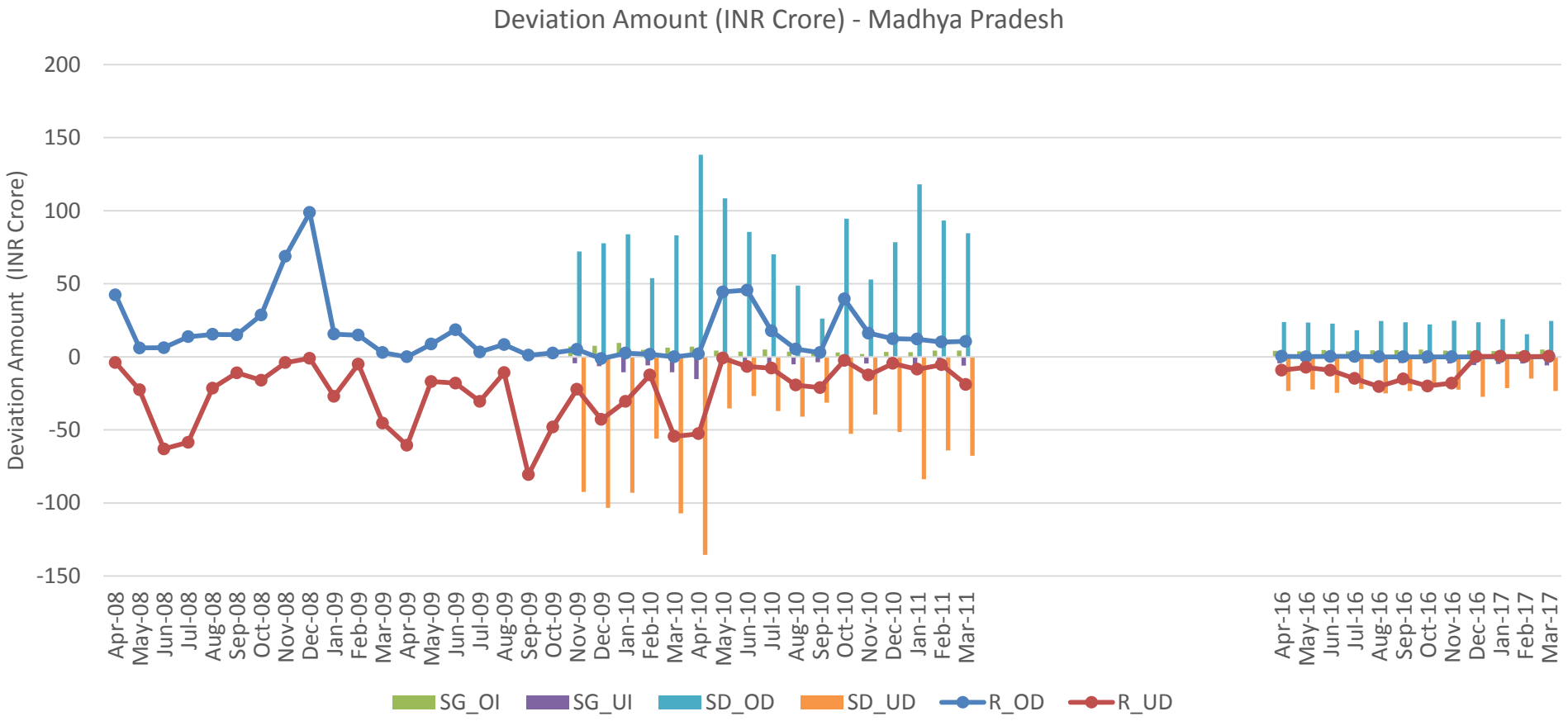
- Pre DSM and Post DSM (at state level): Improvement in Regional UI (payable/receivables) management
- No significant cost implications for Intra-state entities.
- Causer pays principle well established.

Madhya Pradesh : Deviation Account (MU) FY09 to FY17



- Pre DSM and Post DSM (at state level) : significant improvement over the period (Monthly Deviation)
- Improvement in Balancing/Deviation management by Intra-state entities over the period
- Share of energy units handled at state periphery is ~ 35% of total energy units handled for intra-state entities

Madhya Pradesh : Deviation Amount (INR Cr) FY09 to FY17



- Pre DSM and Post DSM (at state level) : Improvement in Regional UI (payable/receivables) management
- No significant cost implications for Intra-state entities.
- Causer pays principle well established.

Key Inferences

- With introduction of DSM at state level, there has been overall improvement in system operations and it has facilitated SLDCs to ensure **secure and reliable grid operations** while bringing in more generation in the system
- It has helped SLDC to instill **forecasting and load management discipline** amongst Discoms, load serving entities and OA consumers
- **Cost implications** for the sector is not significant as it has ensured **despatch discipline amongst generators** based on economic/ merit order principles. (*SGS deviations receivables/payouts are not significant, Regional Deviation Cost management has improved)*
- DSM framework at state level has **served as a balancing mechanism** within the state
- It has facilitated **energy accounting and deviation settlement** of transactions in transparent manner

Overview of North Eastern States

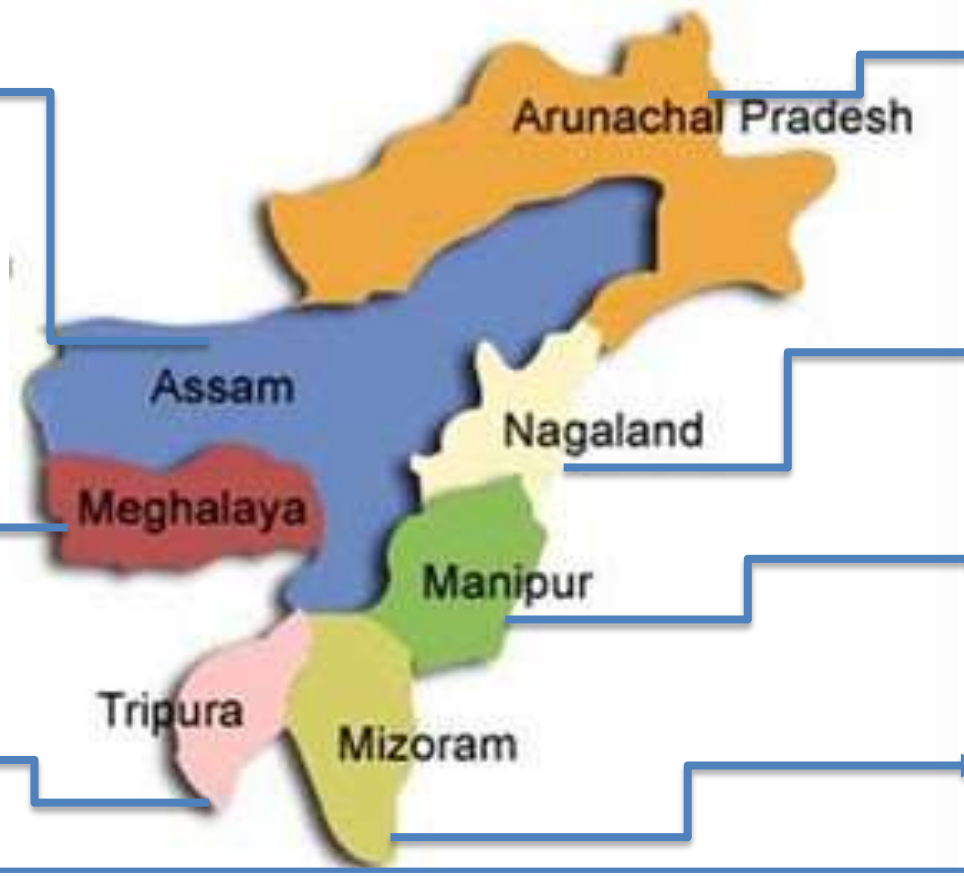
- Comparison of Deviation Charges paid by NE states (Value and Quantum)
- DSM Charges as a percentage of ARR/ Power Purchase

North Eastern Region: Overview

1505 MW (APGCL, NTPC, NEEPCO; SLDC, Kahelipara, Guwahati)

558 MW (NEEPCO, MECL; SLDC, Shillong

727 MW (NEEPCO, OTPC, TSECL; SLDC, Agartala)



278 MW (NEEPCO; SLDC, Itanagar)

155 MW (NEEPCO; SLDC, Dimapur)

235 MW (NHPC, MPDC; SLDC, Imphal)

192 MW (NEEPCO; SLDC, Aizawl)

- Total installed capacity of North Eastern Region is 3916 MW, which includes 265 MW of Central – Unallocated share.
- Regional Peak Demand: 2487 MW; Peak met: 2475 MW

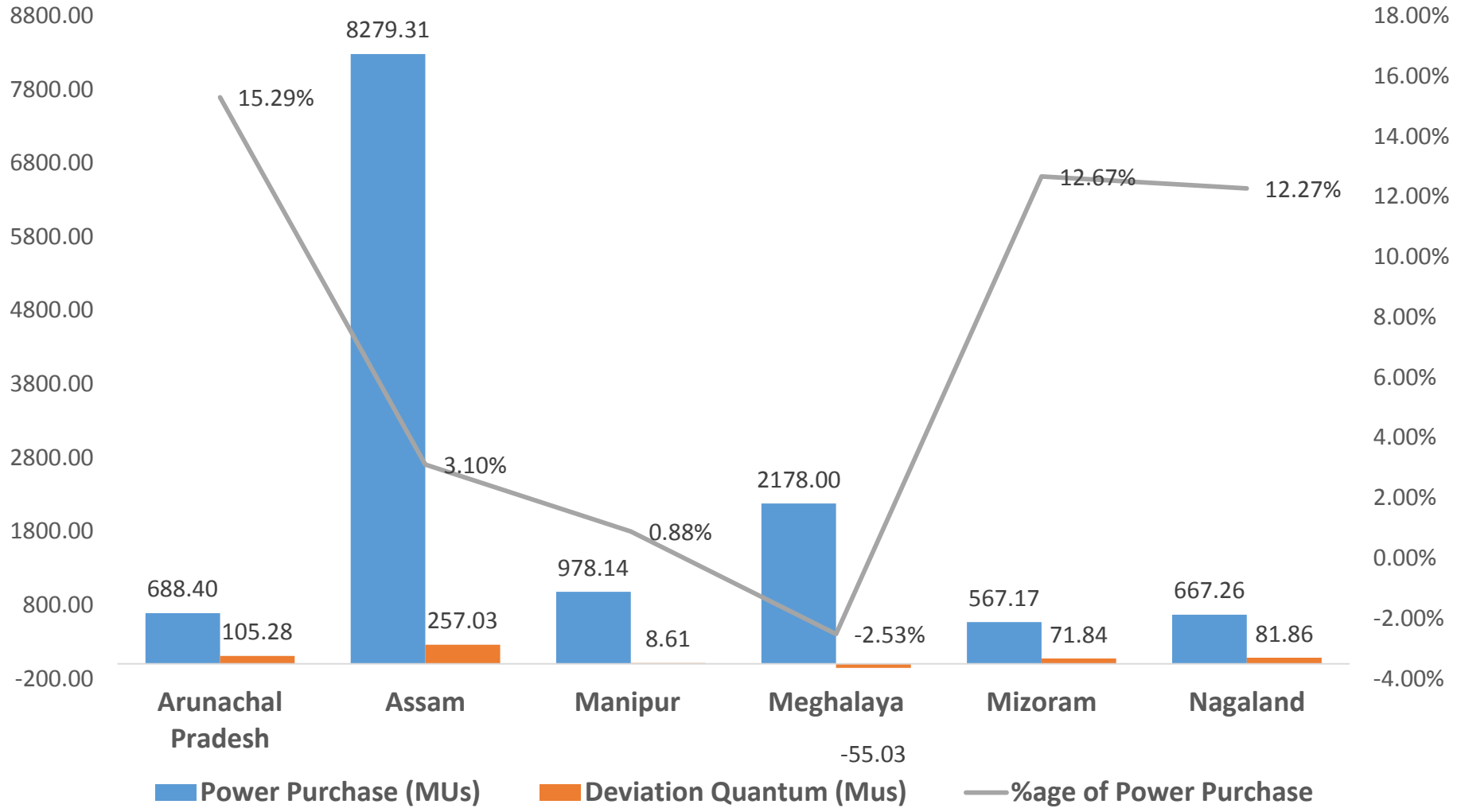
Salient features of North-East Region Power System

- Constituent states : Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland and Tripura, so called the Seven Sisters of NER.
- Central Sector agencies : NEEPCO, NHPC, POWERGRID, OTPC, NETC.
- Total installed capacity of the region : 3916 MW *(As on 31.01.2018)*
- **Hydro : Thermal ratio- 37:63 (Hydro-1342 MW & Thermal-2292 MW)**
- Regional Peak Demand: 2487MW |Peak met: 2475 MW *(LGBR-2017-18 Report)*

S No.	State	Under Management/Control of	SLDC
1	Assam	Assam Electricity Grid Corporation Limited (AEGCL)	SLDC, Kahelipara, Guwahati
2	A. P.	The Dept. of Power, Govt of Arunachal Pradesh	SLDC, Itanagar
3	Meghalaya	Meghalaya Power Transmission Corporation Limited (MePTCL)	SLDC, Shillong
4	Manipur	Manipur State Power Company Limited (MSPCL)	SLDC, Imphal
5	Mizoram	The Power & Electricity Dept., Govt of Mizoram	SLDC, Aizawl
6	Nagaland	The Dept. of Power, Govt of Nagaland	SLDC, Dimapur
7	Tripura	Tripura State Electricity Corporation Limited (TSECL)	SLDC, Agartala

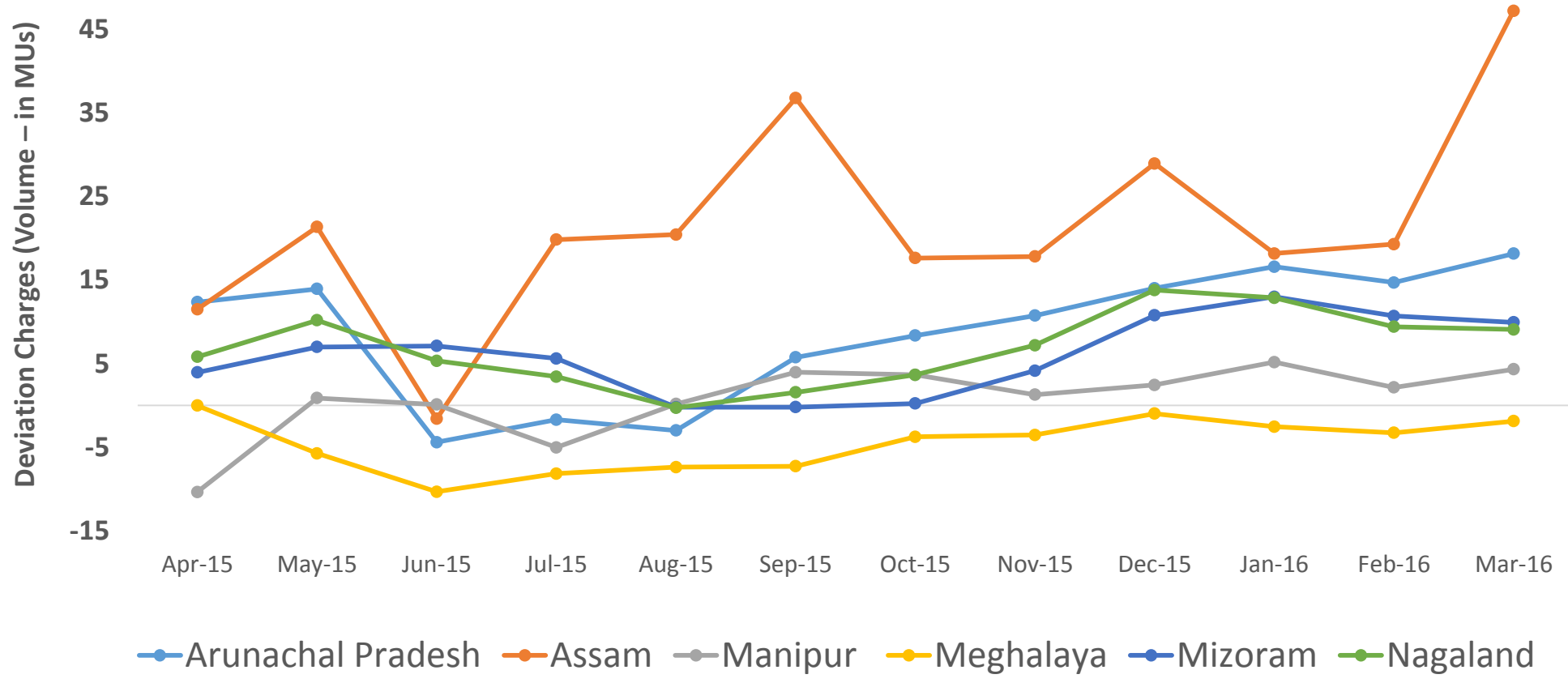
Source: NERLDC Website

Deviation Quantum as a percentage of Power Purchase



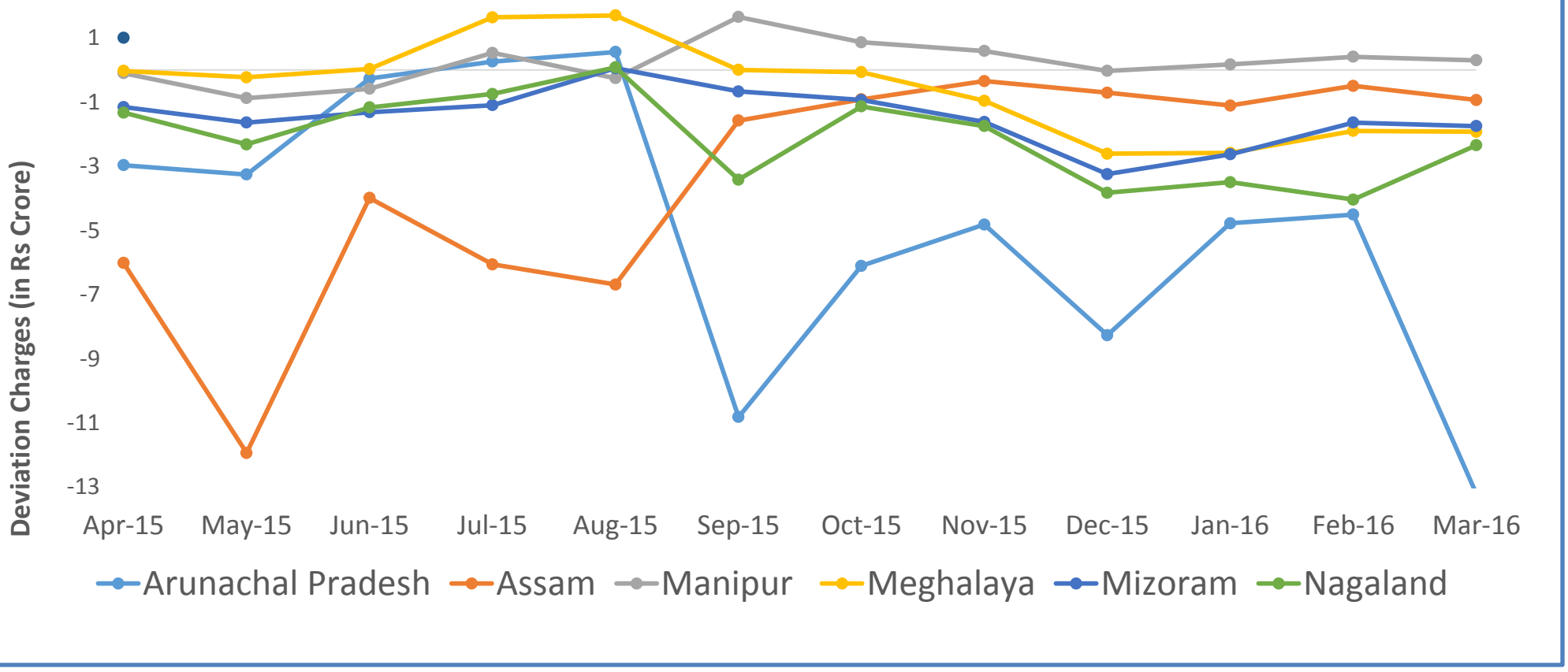
- Deviation quantum is significantly high (12% to 15%) for some states, in annualized terms.

Monthly variation of Deviation Units (Volume – in MUs)



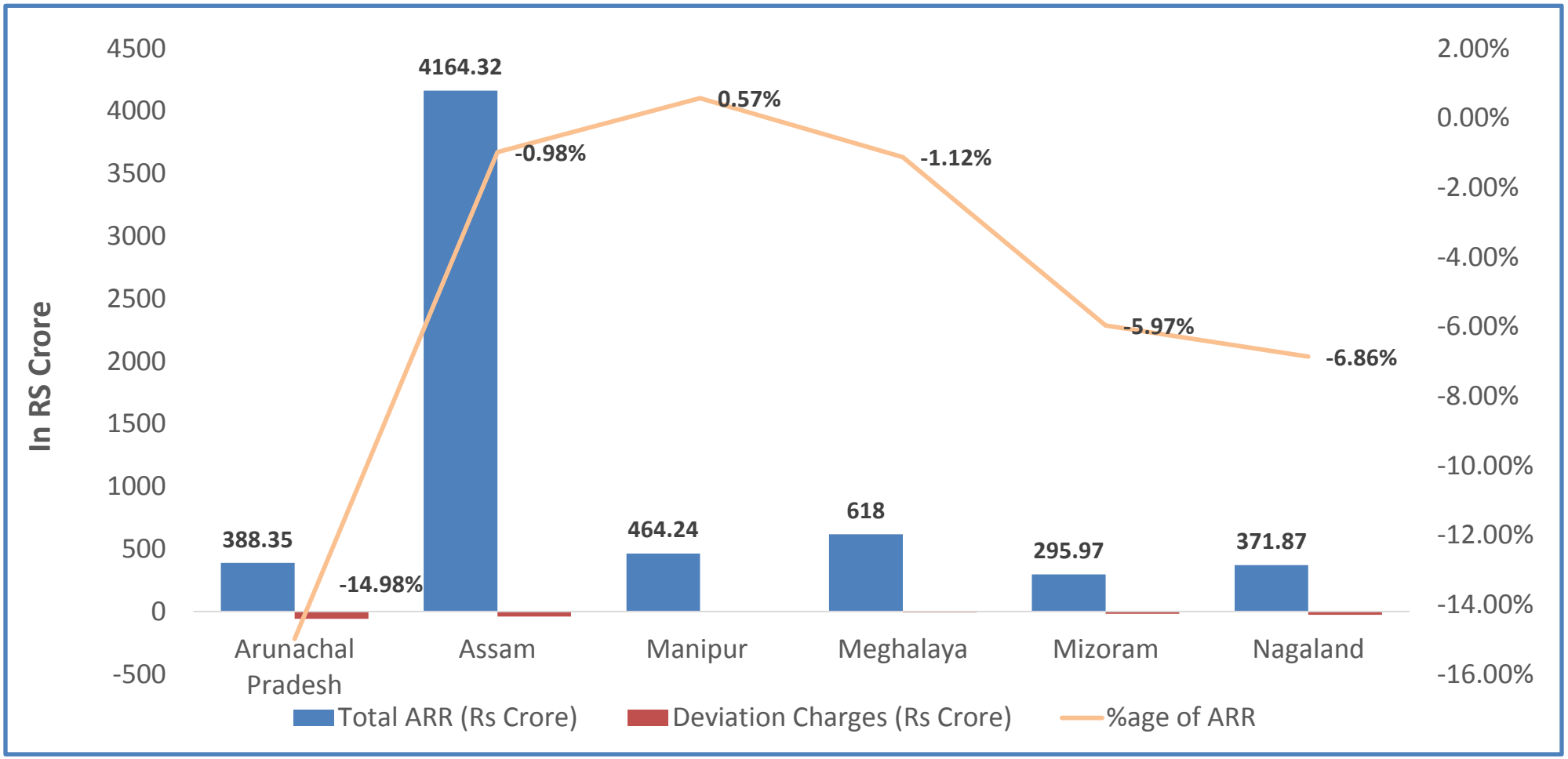
- Total Deviation Quantum for North Eastern Region is **469.59 MUs** as against total Power Purchase of **13358.28 MUs** for the year 2015-16 **(3.52%).**

Monthly variation of Deviation Charges (Value – in Rs Crore)



- Total Deviation Charges for North East Region are **Rs (-) 146.49 Crore** as against total **ARR of Rs 6302.75 Crore** for the year 2015-16 **(-2.32%)**.

DSM Charges as a percentage of ARR



- Imbalance handling and Management of Deviation charges would have impact on overall ARR of Utility

Important Steps for implementation of DSM at state level

- Identification of Intra-State Entities (SGS, IPPs, CPP/Merchant, DISCOMs, OA Users)
- Identification of interface boundary points (inter-utility and intra-utility, G<>T and T<>D)
- Establishment of metering and communication infrastructure.
- Enabling forecasting, scheduling and load generation balancing systems and information exchange protocols amongst various participants
- Establishment of IT systems for data acquisition, registry and framework architecture for hardware, software and data management
- Development of Energy Accounting and Settlement systems
- Capacity building and training of manpower
- Managing deviations of intra-State entities within volume cap of (12%, 150 MW to 250 MW), and enabling flexible resources / demand response.

Ascertaining preparedness of North Eastern States for DSM implementation at state level

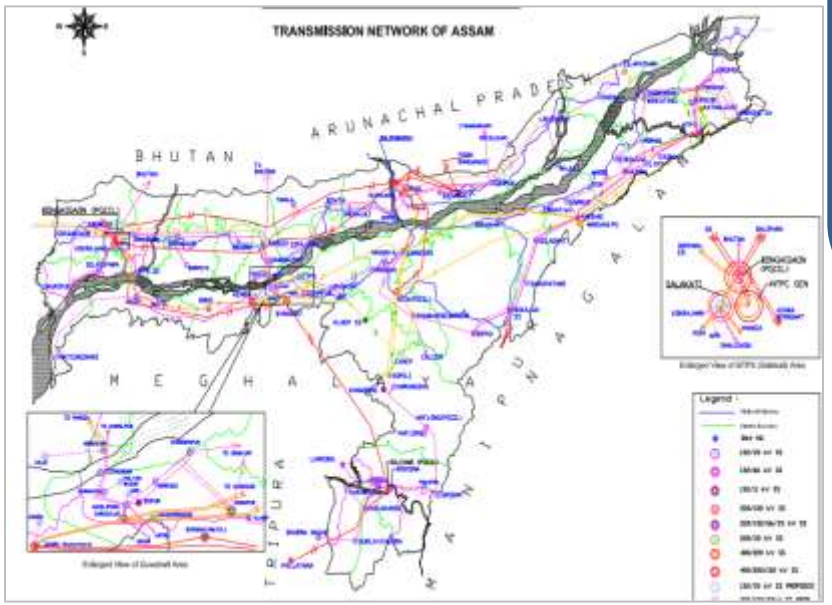
- **Profile of the State**
- **Regulatory developments at state level**

North - East States Overview (SAMAST Report)

S No.	State	G-T	RES-T	ISTS-InSTS	D-T	HT-T	OA-T	Total	Utilization of Energy meter data for load forecasting	Utilization of Energy meter data for load forecasting
1	Assam	16	1	36	284	11	11	359	No	No
2	Meghalaya	4	3	5	16	6	7	41	No	No

S No.	State	Main Meters	Check Meters	Standby Meters	Total Interface meters	AMR
1	Assam	300	0	0	300	No
2	Arunachal Pradesh					
3	Meghalaya	47	3	7	57	No
4	Manipur					
5	Mizoram					
6	Nagaland					
7	Tripura					

Profile of Assam…. (1/2)



Peak Demand: 1673 MW
Annual Avg. Supply: 1633 MW
No. of Sub-stations: 63 no. of Substations
(Ref.: LGBR 2017-18 Report & AEGCL website)

Profile of State

Generation sources	Installed Capacity in MW	No. of Units
Coal	279.02	3
Gas	748.51	
Hydro	431.23	
Solar	11.11	1
Other RE	34.78	

Total Gen Cap. : 1505 MW
IPPs: 40.38 MW

(Ref.: CEA Executive Summary Jan 2018; APDCL & AEGCL Website)

No. of Distribution Licensees /SEZ: 1 no. (APDCL - Assam Power Dist. Co. Ltd)
No. of Transmission Licensees: 1 no. (AEGCL - Assam Electricity Grid Co. Ltd.)
No. of OA Consumers : 11 no. (LTOA/MTOA/STOA)
(Ref.: FOR - SAMAST Report, 2016)

Regulatory Developments:

- Assam falls under **Category 'C'** of SAMAST report
- Thermal Gen. payment on **actual** basis and Hydro gen. on **scheduled** basis
- MYT Tariff Regulations, 2015 and its amendments, AERC MYT Regulation specifies provision of determination of Capacity Charge and Energy Charge of Hydro generators, & provision of determination of Annual Fixed Charges and Energy Charges for thermal generators
- State Electricity Grid Code, 2004
- AERC (Terms and Conditions for Open Access) Regulations 2005, specifies treatment to the Deviation of OA generators/consumers

Profile of Assam…. (2/2)

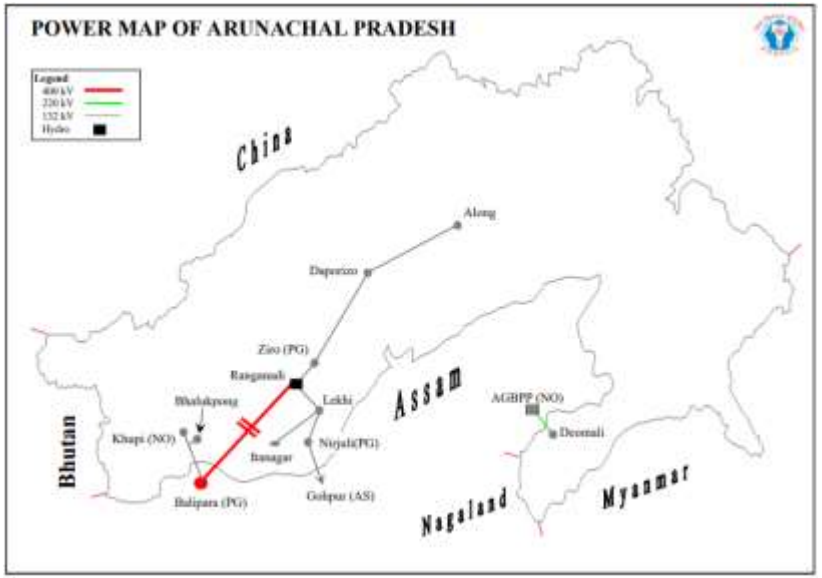
FY	Quantum (MU)	Total Charges (Rs Crore)	Rate (Rs/kWh)
2016-17	393.56	97.79	2.48
2015-16	257.37	79.17	3.08
2014-15	282.77	96.66	3.42
2013-14	181.85	19.70	

State	Main Meters	Check Meters	Standby Meters	Total Interface meters	AMR
Assam	300	0	0	300	No

G-T	RES-T	ISTS-InSTS	D-T	HT-T	OA-T	Total	Utilization of Energy meter data for load forecasting
16	1	36	284	11	11	359	No

- **Intra State ABT / DSM yet to be implemented in Assam.**
- There is a plan for installation of around 600 nos. of TOD meters at 359 identified (interface points) locations which will be ABT compliant.
- It was proposed to be done out of the PSDF funding (Rs. 300 crores) received by AEGCL. This will pave way for intra-state ABT in Assam. Meter installation will be done within one year.
- At present about **300 SEMs** are in place (L&T make) installed about 8 years back. Due to various issues, **only monthly readings from these meters are used for accounting.**
- Regional Deviation charges liability is being paid by DISCOM (APDCL)
- Weekly Deviation account not prepared but cumulative deviation energy accounted on monthly basis.
- State generators are being scheduled by SLDC and scheduling is done on 15 minute time block basis.
- Load forecasting and Generation scheduling coordinated by SLDC. **Scheduling has no commercial implication**

Profile of Arunachal Pradesh



Profile of State

Generation sources	Installed Capacity in MW	No. of Units
Thermal	71.52	
Hydro	97.45	
Wind	-	
Solar	4.39	
Other RE	104.61	

Total Gen Cap. : 278 MW
IPPs: 4.39 MW

(Ref.: CEA Executive Summary Jan 2018)

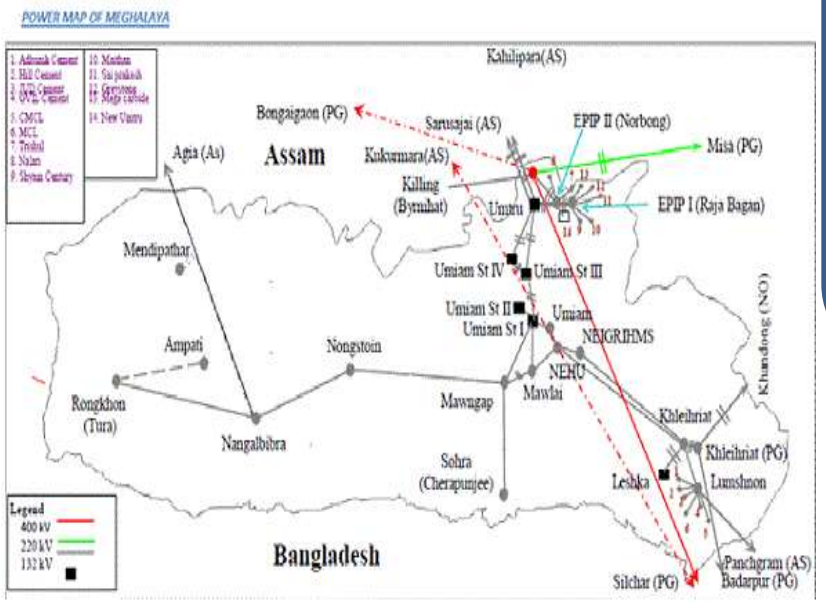
No. of Distribution Licensees /SEZ: 1 no. (Dept. of Power Arunachal Pradesh)
No. of Transmission Licensees: 1 no. (Dept. of Power Arunachal Pradesh)
No. of OA Consumers : no. (LTOA/MTOA/STOA)
(Ref.: FOR - SAMAST Report, 2016)

Peak Demand: 158 MW
Annual Avg. Supply: 152 MW
No. of Sub-stations: no. of Substations
(Ref.: LGBR 2017-18 Report & AEGCL website)

Regulatory Developments:

- Arunachal Pradesh falls under **Category 'D'** of SAMAST report
- Hydro generator payment on **scheduled** basis
- MYT Tariff Regulations, 2013, APSERC MYT Regulation specifies provision of determination of Capacity Charge and Energy Charge of Hydro generators
- State Electricity Grid Code, 2012
- APSERC (Terms and Conditions for Open Access) Regulations 2012, specifies treatment to the Deviation of OA generators/consumers

Profile of Meghalaya



Profile of State

Generation sources	Installed Capacity in MW	No. of Units
Thermal	140.09	
Hydro	387.19	8
Wind	-	
Solar	0.06	
Other RE	31.03	

Total Gen Cap. : 558 MW
IPPs: 0.06 MW

(Ref.: CEA Executive Summary Jan 2018)

No. of Distribution Licensees /SEZ: 1 no. (MePDCL)
No. of Transmission Licensees: 1 no. (MePTCL)
No. of OA Consumers : 7 no. (LTOA/MTOA/STOA)
(Ref.: FOR - SAMAST Report, 2016)

Peak Demand: 346 MW
Annual Avg. Supply: 572 MW
No. of Sub-stations: no. of Substations
(Ref.: LGBR 2017-18 Report & website)

Regulatory Developments:

- Meghalaya falls under **Category 'B'** of SAMAST report
- Generators payment on scheduled basis
- MYT Tariff Regulations, 2014 and its amendments, MSERC MYT Regulation specifies provision determination of Capacity Charge and Energy Charge of generators
- State Electricity Grid Code, 2012 and its amendments
- MSERC Terms & condition of Open Access Regulations, 2012, specifies treatment to the Deviation of OA generators/consumers

Meghalaya SLDC (As per SAMAST Report)

G-T	RES -T	ISTS-InSTS	D-T	HT-T	OA-T	Total	Utilization of Energy meter data for load forecasting
4	3	5	16	6	7	41	No

Main Meters	Check Meters	Standby Meters	Total Interface meters	AMR
47	3	7	57	No

- **SLDC formed in the year 2003**. Single discom and a common holding company for Discom, STU and Genco
- **Predominantly hydro generation in State. Two part-tariff implemented for Hydro.**
- Interstate STOA commenced from 2009. **Presently 7 STOA customers.** DSM applicable to only these STOA customers. Boundary meters for STOA customers is in place.
- Interface meters are of the same specifications as at interstate. Remote reading of Meters through GSM
- **Discom control centre yet to be established**
- Daily MU/day declared by hydro. Schedule prepared by SLDC
- Load forecasting by Discom. SLDC also started.
- Reservoir Hydro gen is regulated for Deviation control
- Settlement period 15 min : Monthly
- Settlement Cycle and billing : Monthly, System for reconciliation in place
- No deviation charges receivable for under-drawal but payable for O/D @ 105% of DSM rate STOA customers. SLDC only prepare deviation account.
- Meghalaya meeting its RPO obligation through REC purchase

Profile of Manipur

Peak Demand: 210 MW
Annual Avg. Supply: 189 MW
No. of Sub-stations: no. of Substations
(Ref.: LGBR 2017-18 Report & website)

Profile of State

Generation sources	Installed Capacity in MW	No. of Units
Thermal	138.97	
Hydro	88.93	
Wind		
Solar	1.33	
Other RE	5.45	

Total Gen Cap. : 235 MW
IPPs: 1.33 MW

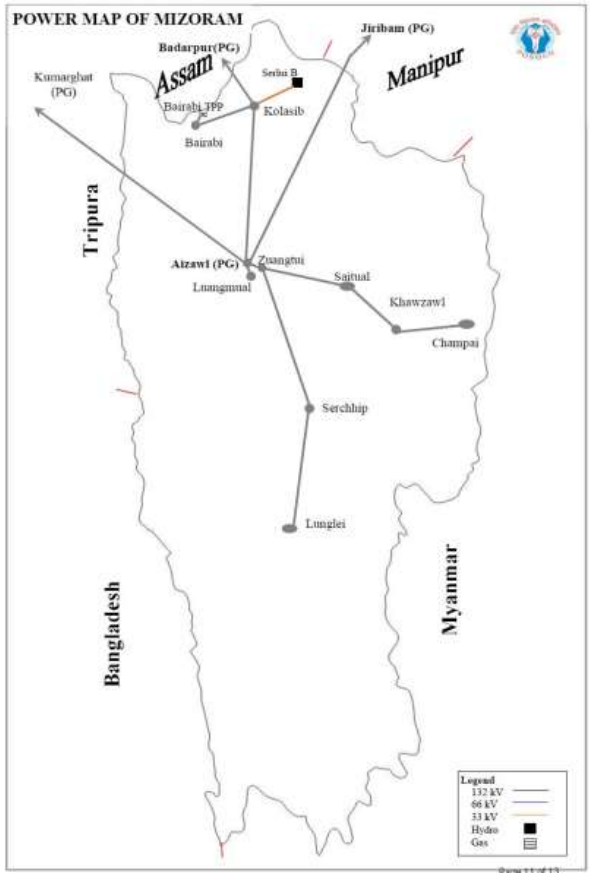
(Ref.: CEA Executive Summary Jan 2018)

No. of Distribution Licensees /SEZ: 1 no. (MSPDCL)
No. of Transmission Licensees: 1 no. (MSPCL - Manipur State Power Co. Ltd.)
No. of OA Consumers : no. (LTOA/MTOA/STOA)
(Ref.: FOR - SAMAST Report, 2016)

Regulatory Developments:

- Manipur falls under **Category 'D'** of SAMAST report
- Thermal Gen. payment on **Scheduled** basis and Hydro gen. on **Actual** basis
- **JERC (Forecasting, Scheduling, Deviation Settlement and Related Matters of Solar and Wind Generation Sources) Regulations, 2016**
- MYT Tariff Regulations, 2014, JERC MYT Regulation specifies provision determination of Capacity Charge and Energy Charge of generators
- State Electricity Grid Code, 2010 and its amendments
- Terms and Conditions of Open Access Regulations, 2010, specifies treatment to the Deviation of OA generators/consumers

Profile of Mizoram



Peak Demand: 108 MW
Annual Avg. Supply: 165 MW
No. of Sub-stations: 52 no. of Substations
(Ref.: LGBR 2017-18 Report and Power & Electricity Dept. of Mizoram)

Profile of State

Generation sources	Installed Capacity in MW	No. of Units
Thermal	61.16	
Hydro	94.19	
Wind	-	
Solar	0.1	
Other RE	36.57	

Total Gen Cap. : 192 MW
IPPs: 0.2 MW

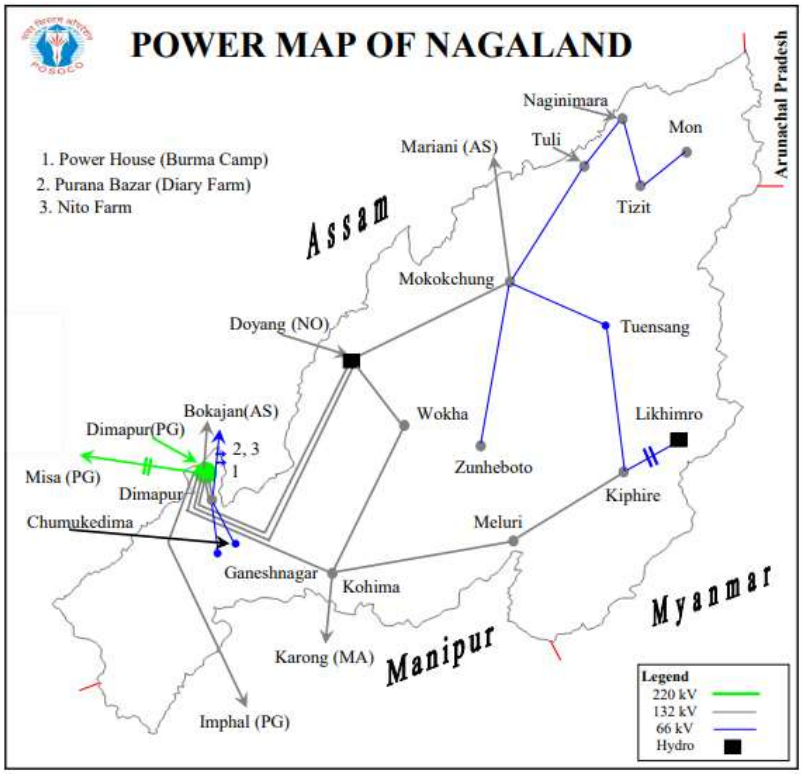
(Ref.: CEA Executive Summary Jan 2018)

No. of Distribution Licensees : 1 no. (Power & Electricity Dept. of Mizoram)
No. of Transmission Licensees: 1 no. (Power & Electricity Dept. of Mizoram)
No. of OA Consumers : no. (LTOA/MTOA/STOA)
(Ref.: FOR - SAMAST Report, 2016)

Regulatory Developments:

- Mizoram falls under **Category 'D'** of SAMAST report
- Thermal Gen. payment on **Scheduled** basis and Hydro gen. on **Actual** basis
- **JERC (Forecasting, Scheduling, Deviation Settlement and Related Matters of Solar and Wind Generation Sources) Regulations, 2016**
- MYT Tariff Regulations, 2014, JERC MYT Regulation specifies provision determination of Capacity Charge and Energy Charge of generators
- State Electricity Grid Code, 2010 and its amendments
- Terms and Conditions of Open Access Regulations, 2010, specifies treatment to the Deviation of OA generators/consumers

Profile of Nagaland



Peak Demand: 149 MW
Annual Avg. Supply: 162 MW
No. of Sub-stations: no. of Substations
(Ref.: LGBR 2017-18 Report & website)

Profile of State

Generation sources	Installed Capacity in MW	No. of Units
Thermal	70.33	
Hydro	53.37	
Wind	-	
Solar	-	
Other RE	31.17	

Total Gen Cap. : 155 MW
IPPs: 0.5 MW

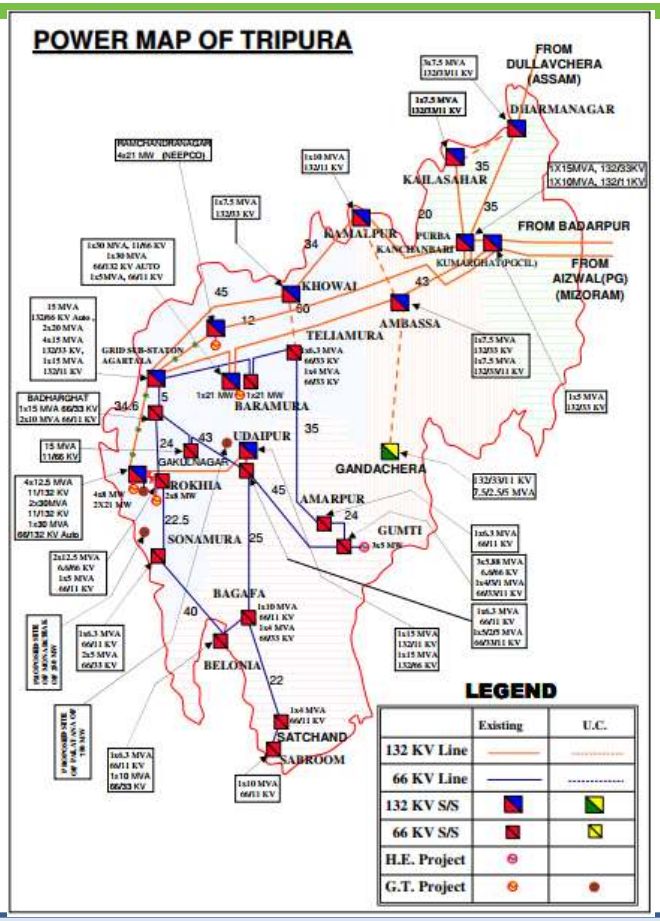
(Ref.: CEA Executive Summary Jan 2018)

No. of Distribution Licensees /SEZ: 1 no. (Department of Power, Nagaland)
No. of Transmission Licensees: 1 no. (Department of Power, Nagaland)
No. of OA Consumers : no. (LTOA/MTOA/STOA)
(Ref.: FOR - SAMAST Report, 2016)

Regulatory Developments:

- Nagaland falls under **Category 'D'** of SAMAST report
- Thermal Gen. payment on **Scheduled** basis and Hydro gen. on **Actual** basis
- MYT Tariff Regulations 2016, NERC MYT Regulation specifies provision determination of Capacity Charge and Energy Charge of generators
- State Electricity Grid Code, 2012
- NERC (Terms and Condition for Intra-State Open Access Reg.), 2012

Profile of Tripura



Peak Demand: 312 MW
Supply: 325 MW
No. of Sub-stations: 36 no. of Substations
(Ref.: LGBR 2017-18 Report & TSETCL website)

Profile of State

Generation sources	Installed Capacity in MW	No. of Units
Thermal	643.85	9
Hydro	62.38	
Wind	-	
Solar	5	
Other RE	16.1	

Total Gen Cap. : 727 MW
IPPs: 0.09 MW

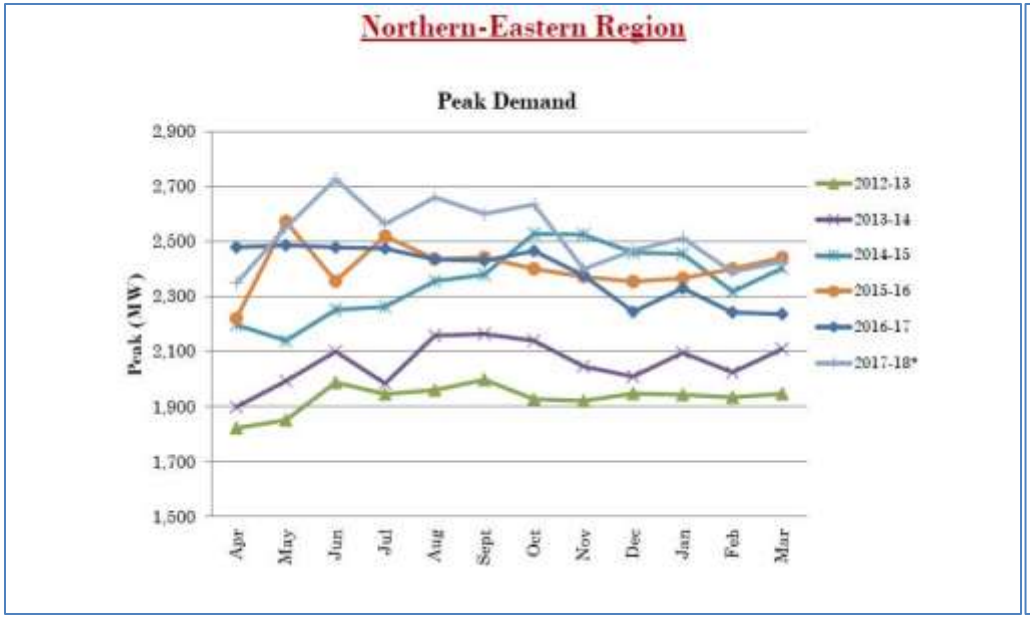
(Ref.: CEA Executive Summary Jan 2018)

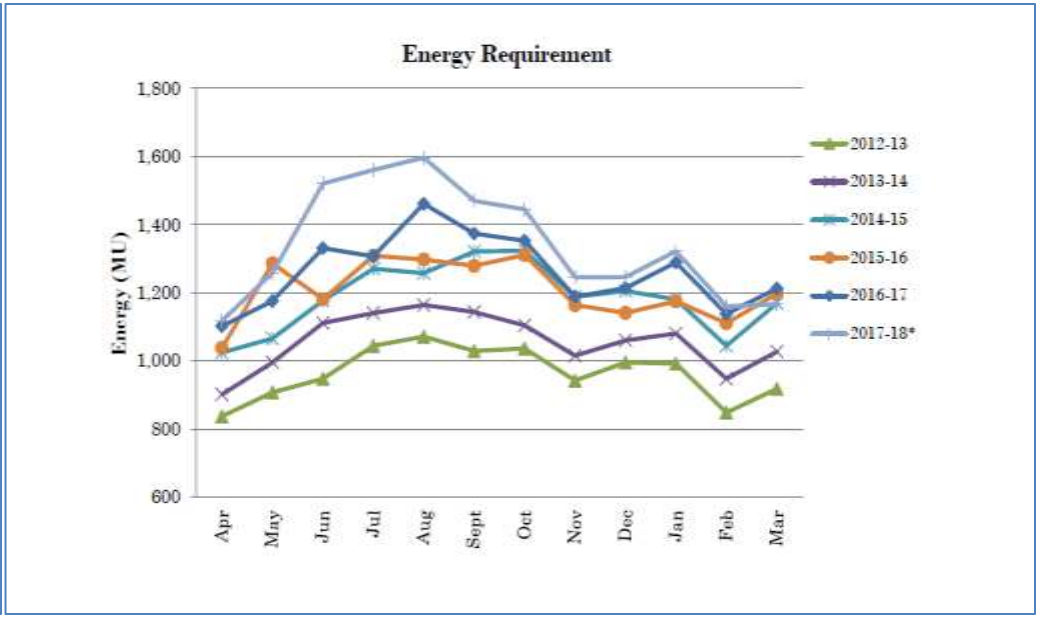
No. of Distribution Licensees /SEZ: 1 no. (TSECL)
No. of Transmission Licensees: 1 no. (TSECL)
No. of OA Consumers : no. (LTOA/MTOA/STOA)
(Ref.: FOR - SAMAST Report, 2016)

Regulatory Developments:

- Tripura falls under **Category 'D'** of SAMAST report
- Generators payment on scheduled basis
- **TERC (Forecasting, Scheduling, Deviation Settlement and Related Matters of Solar and Wind Generation Sources) Reg., 2016**
- MYT Tariff Regulations 2015, TERC MYT Regulation specifies provision determination of Capacity Charge and Energy Charge of generators
- State Electricity Grid Code, 2010
- TERC Terms and condition of Intra-State Open Access Regulations, 2010, specifies treatment to the Deviation of OA generators/consumers

Changing pattern of Demand across North Eastern States





- **Changing pattern** of demand and energy requirement in the North Eastern Region.
- **Emphasizing the need** for use of **advanced tools** for forecasting, scheduling and deviation management of grid resources.
- **Improved visibility** of intra-state entities, facilitating multiple transactions for intra-state, inter-state and inter-region necessitate ramping of infrastructure of **Metering, Communication, Scheduling and Energy Accounting**.

Roadmap for SAMAST implementation

- Detailed stages and steps required for SAMAST implementation
- Components of DPR for SAMAST
- Way forward

Roadmap for implementation of SAMAST framework at State level

Stage-I

Identification of Intra State Entities

Demarcation of Interface boundary for each Intra State Entity

Assessment of Meters - Main, Check and Standby

Assessment of Automatic Meter Reading logistics requirement

Assessment of IT infrastructure (Hardware and Software) requirement

Preparation of Bill of Quantities (considering logistics already in place

Preparation of Detailed Project Report and completion of first stakeholder workshop (T+90 days)

Stage-II

Approval of the State-specific SAMAST scheme by SERC (T+120 days)

Commencement of Load Forecasting by SLDC

Commencement of Interchange Scheduling by SLDC for all the Intra State Entities

Formation of a State Power Committee for preparation of Account

Establishment of State Regulatory Pool Account

Application for funding support from Central Government/PSDF

Inviting tenders and Placement of Award **(T+150 days)**

Adequacy of Human Resources in SLDC

Stage-III

Implementation of the recommended IT infrastructure-Hardware (T+225 days)

Completion of boundary metering and AMR system (as per DPR) (T+240 days)

Implementation of the recommended IT applications- Software (T+300 days)

Computation of transmission losses for each 15-min by SLDC

Preparation of Energy Accounts by SPC/SLDC and Publication of the required documents on SPC/SLDC website **(T+345 days)**

Clearing of Pool A/c Credit / Debit for at least four weeks and its reconciliation **(T+365 days)**

Sample DPR for SAMAST implementation : Key Cost components

Hardware Components-I	Hardware Components-II	Software Components	Communication Components	Training, Cap. Building and Infra Dev. Components
• ABT Meters • Instrument Transformers (CT/PT) • Calibration of Meters • Automated Meter Reading Instruments (CMRI) • Installation & testing	• Servers (database, application, domain, web, anti-virus) • Storage SAN • UPS/firewall/Rack for Server, • Laptops/Desktops Printers, Monitoring Screens • Installation & testing	• Operating Systems and Software Licensing • Scheduling s/f Module • OA s/f Module • Energy Accounting Module • Billing & SLDC Report Module • Financial Accounting and Statutory Compliance • Testing/Trial runs	• Modems • DCUs at field • GPRS/GSM connectivity for sites • MPLS communication lines • Internet & telephone connectivity • Installation & testing	• Training & Capacity Building • AMC for Hardware & Software • Office space within Building/ Premises • Furniture & Fixtures • Air-conditioning system • Project Mgmt/IT consultant

Way forward

- **States Entities** (STU/SLDCs), should **evolve Action Plan** with clear identification of milestones alongwith timelines for SAMAST implementation at state level.
  - Consultation with State level committees (say, Grid Coordination Committee or State Power/Advisory Committee) would be useful.
  - Action Plan to be futuristic / forward looking to cover future developments in state
  - Action Plan to be approved by concerned SERC
- **Identify** Intra-State Entities and interface points for SAMAST implementation at State level.
- **Undertake** AS-IS Analysis and Gap Analysis of existing infrastructure - metering, IT systems, manpower requirement.
- **Initiate** steps for preparation of DPR, seek management approval and submit application for PSDF funding, upon regulatory approval.
- **SERCs to guide** and monitor the implementation with support of state power committee or state advisory committee.

Idam Infrastructure Advisory Pvt. Ltd.

Thank You

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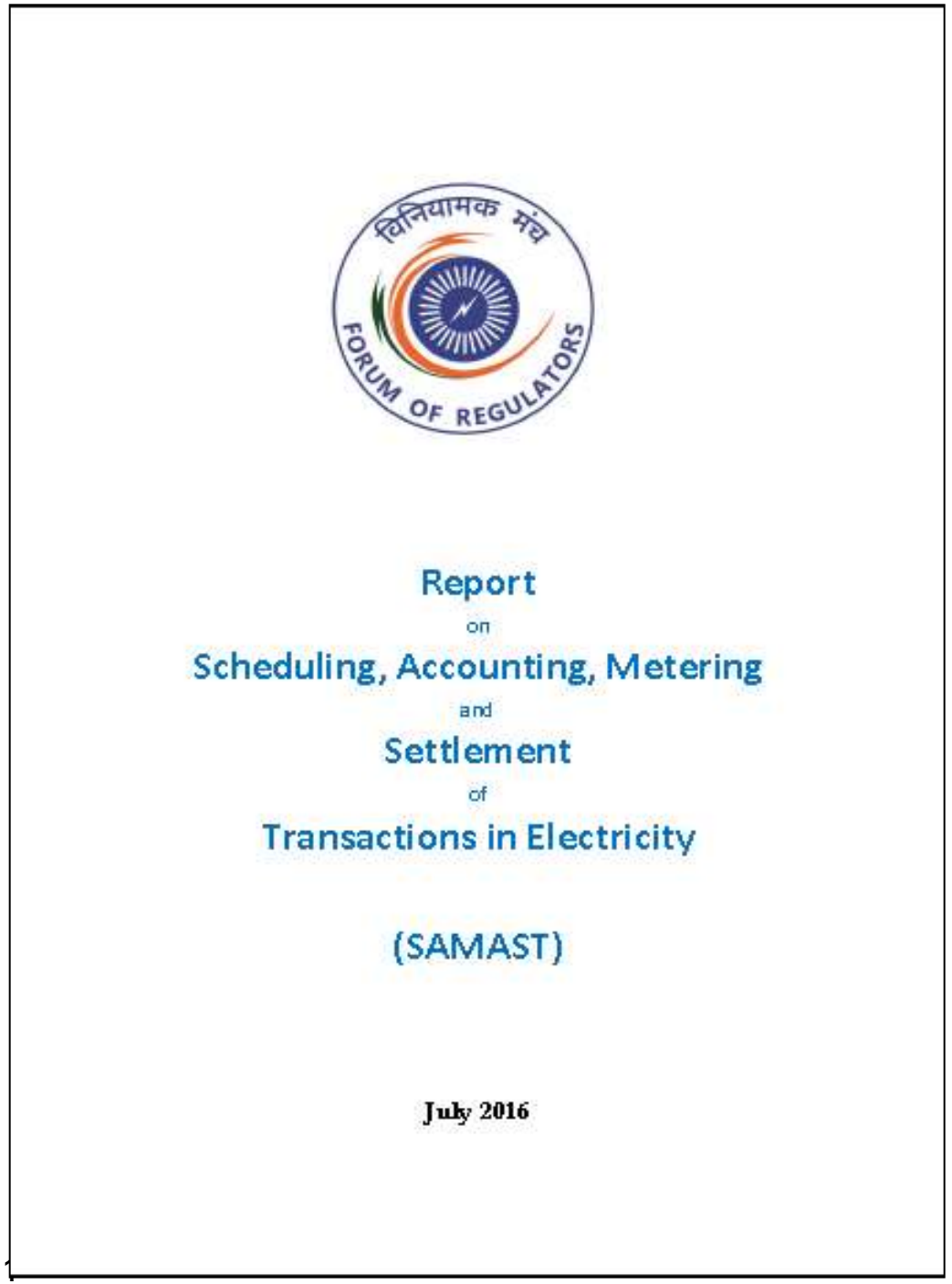


SAMAST

Adopted by the Technical Committee of the Forum of Regulators on 15 July 2016

Endorsed by the Forum of Regulators on 22 July 2016

Implementation; NER States

Presentation by
SAMAST Group, NER
Date: 16.04.2018

SAMAST implementation in NER

- **Hon'ble Members of CERC, Sri A S Bakshi and Dr. M K Iyer, during visit to Shillong on 09.06.2017 advised formation of a group to oversee SAMAST implementation in NER.**

- **SAMAST group formed by MS-NERPC vide letter dated 23.06.2017**

Members of NER SAMAST Group
➢ B. Lyngkhoi, Director-NERPC
➢ R. Sutradhar, DGM-NERLDC
➢ Members from States

SAMAST STATUS IN NER

Part-A

Preparation of BOQ and DPR for seven NER States

SAMAST STATUS IN NER

Regional coordination

1. **Drive by SAMAST Group for implementation in all seven States of NER.**

2. **Series of meetings held with NER States involving vendors M/S Secure Meters, TCS, Kalkitech, MB Controls etc.**

3. **DPR and other related documents from other Regions referred to prepare draft DPR template for NER States.**

SAMAST STATUS IN NER

Involvement of States Personnel

1. **Draft DPR template discussed with all the States.**

2. **SLDCs, STUs familiarized with SAMAST.**

3. **Preparation of DPR by State members with support from SAMAST Group.**

4. **5-minute metering agreed to be implemented as advised by FOR Sub-Group.**

5. **Meter cost proposed to be included for funding from PSDF.**

1. SAMAST Status : Assam

Activities	Status
➢ Meeting with SAMAST Group involving vendors and experts on (1) 24.08.17 (2) 30.08.17 (3) 07.09.17 (4) 22.09.17 & (5) 12.01.18	Completed
➢ Assessment of Main, Check & Standby meters	1190 Nos
➢ Assessment of Automatic Meter Reading Requirement	Completed
➢ **Assessment of IT Infrastructure**	**Completed**
➢ Utility Software identification	Completed
➢ Preparation of BOQ & DPR	Completed

Members of Assam	
○ **Dipesh Ch. Das**	**9954110254**
○ **Ms. Toushita Jigdung**	**9707134351**
○ **Ms. Indrani Borah**	**7896482483**

2. SAMAST Status : Meghalaya

Activities	Status
➢ Meeting with SAMAST Group involving vendors and experts on (1) 22.09.17 & (2) 11.01.18	Completed
➢ Assessment of Main, Check & Standby meters	350 Nos
➢ Assessment of Automatic Meter Reading Requirement	Completed
➢ **Assessment of IT Infrastructure**	**Completed**
➢ Utility Software identification	Completed
➢ Preparation of BOQ & DPR	Completed

Members of Meghalaya	
○ **T. Gidon**	**9774479956**
○ **B. Nikhla**	**9436314163**

3. SAMAST Status : Manipur

Activities	Status
➢ Meeting with SAMAST Group on 08.02.18	Completed
➢ Assessment of Main, Check & Standby meters	500 Nos
➢ Assessment of Automatic Meter Reading Requirement	Completed
➢ **Assessment of IT Infrastructure**	**Completed**
➢ Utility Software identification	Completed
➢ Preparation of BOQ & DPR	Completed

Members of Manipur	
○ **H. Shantikumar Singh**	**8837009146**
○ **Ms. Steela**	**8730831103**
○ **Ms. Ritu**	**7005178772**

4. SAMAST Status : Mizoram

Activities	Status
➢ Meeting with SAMAST Group on 05.01.18	Completed
➢ Assessment of Main, Check & Standby meters	400 Nos
➢ Assessment of Automatic Meter Reading Requirement	Completed
➢ **Assessment of IT Infrastructure**	**Completed**
➢ Utility Software identification	Completed
➢ Preparation of BOQ & DPR	Completed

Members of Mizoram	
○ **Lalbiaksanga**	**9436140932**
○ **T. Benjamin**	**9436151424**

5. SAMAST Status : Nagaland

Activities	Status
➢ Meeting with SAMAST Group on 09.03.18	Completed
➢ Assessment of Main, Check & Standby meters	198 Nos
➢ Assessment of Automatic Meter Reading Requirement	Completed
➢ **Assessment of IT Infrastructure**	**Completed**
➢ Utility Software identification	Completed
➢ Preparation of BOQ & DPR	**Pending**

Members of Nagaland	
○ **Nitovi.A. Wotsa**	**9436004928**
○ **T. Walling**	**9436000098**
○ **Mhonlumo Kikon**	**9436005616**

6. SAMAST Status : Tripura

Activities	Status
➢ Meeting with SAMAST Group on 07.02.18	Completed
➢ Assessment of Main, Check & Standby meters	296 Nos
➢ Assessment of Automatic Meter Reading Requirement	Completed
➢ **Assessment of IT Infrastructure**	**Completed**
➢ Utility Software identification	Completed
➢ Preparation of BOQ & DPR	**Pending**

Members of Tripura	
○ **U. Debbarma**	**9436462842**
○ **Mrinal Paul**	**7005644104**

7. SAMAST Status : Ar. Pradesh

Activities	Status
➢ Meeting with SAMAST Group on 12.04.18	Completed
➢ Assessment of Main, Check & Standby meters	**Pending**
➢ Assessment of Automatic Meter Reading Requirement	**Pending**
➢ **Assessment of IT Infrastructure**	**Pending**
➢ Utility Software identification	**Pending**
➢ Preparation of BOQ & DPR	**Pending**

Members of Ar. Pradesh	
○ **N. Perme**	**9436288643**

SAMAST STATUS IN NER

Submission of DPR to NERPC Secretariat

All seven States to submit BOQ and DPR as finalized by them to NERPC Secretariat.

Target : 30.04.2018

SAMAST STATUS IN NER

Part-B

Funding and Implementation

SAMAST STATUS IN NER

Common DPR for all States

- **Common DPR for all NER States.**

- **Committee formed by NERPC to moderate and freeze common DPR**

i. **Ensure common IT infrastructure**

ii. **Verification of Meter requirement**

SAMAST STATUS IN NER

Submission for PSDF Funding

- **NERPC to submit the DPR of all seven States for PSDF funding after final clearance and approval from States.**

- **Target date for submission : 31.05.2018**

SAMAST STATUS IN NER

Software and Meter specs during Tendering:

- **Uniform Technical specs for all utility software (Committee formed by NERPC to finalize SRS):**

1. Scheduling software, **2. Meter data processing software,**

3. Energy Accounting Software, **4. Deviation/Reactive Accounting software,**

5. Open Access software, **6. AMR software.**

- **It will enable implementation of uniform system in all the States across the Region.**

- **Committee formed by NERPC to finalise Technical specs for Meters.**

SAMAST STATUS IN NER

Bulk Tendering / award by single Agency

- **Common tendering by a single agency on behalf of seven States have been agreed in OCC and CCM of NERPC which will enable:**

1. **Optimisation of project cost – cost of utility softwares per State as quoted by Vendors is Rs. 7-8 Crores. In case of common procurement, total saving of about Rs. 14 Crores (Rs. 2 Crores/State).**
2. **Availability of vendors which is difficult in small States**
3. **Better co-ordination**
4. **Smooth implementation (like ULDC scheme)**
5. **Enables hand holding**

SAMAST STATUS IN NER

Tentative Project cost for seven States of NER: Rs. 100 Crores.

Common tendering, procurement, implementation?

To be approved by TCC/RPC of NERPC.

Identification of Agency / formation of Committee to carry out the activity on behalf of States.

Approval of FOR Technical Committee.

THANK YOU!!

19th Meeting of the FOR Technical Committee
Shillong
16 April 2018

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

Reserve Regulation Ancillary Services – At a Glance

(April, 2016 – February, 2018)

RRAS Providers: 55 Nos.

Capacity under RRAS: 56 GW

Highest Variable Charge ~ Rs. 10.24 / Unit (Auraiya LF– NR)

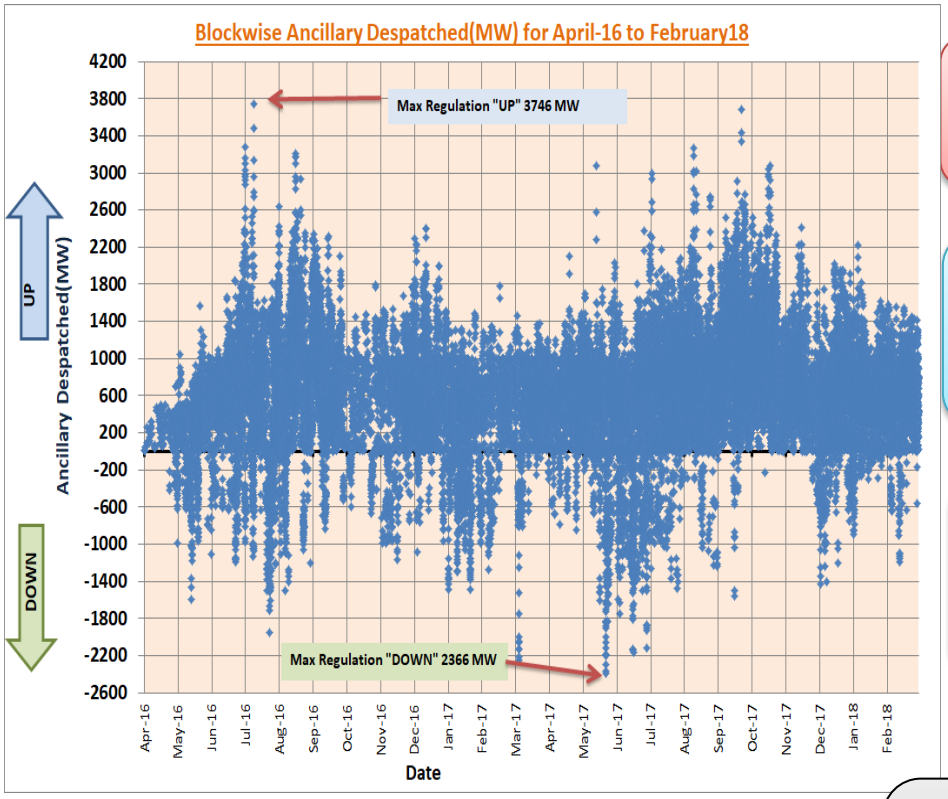
Lowest Variable Charge ~ Rs. 1.18 / Unit (Singrauli – NR)

Maximum 'Up' Regulation : 3746 MW

Maximum 'Down' Regulation : 2366 MW

Energy Despatched: Down – 1 MU / day (0.03 % Energy met)

Energy Despatched: Up – 7 MU / day (0.2 % of Energy met)



Avg. Daily Number of RRAS Instructions : 07 to 08 Nos.

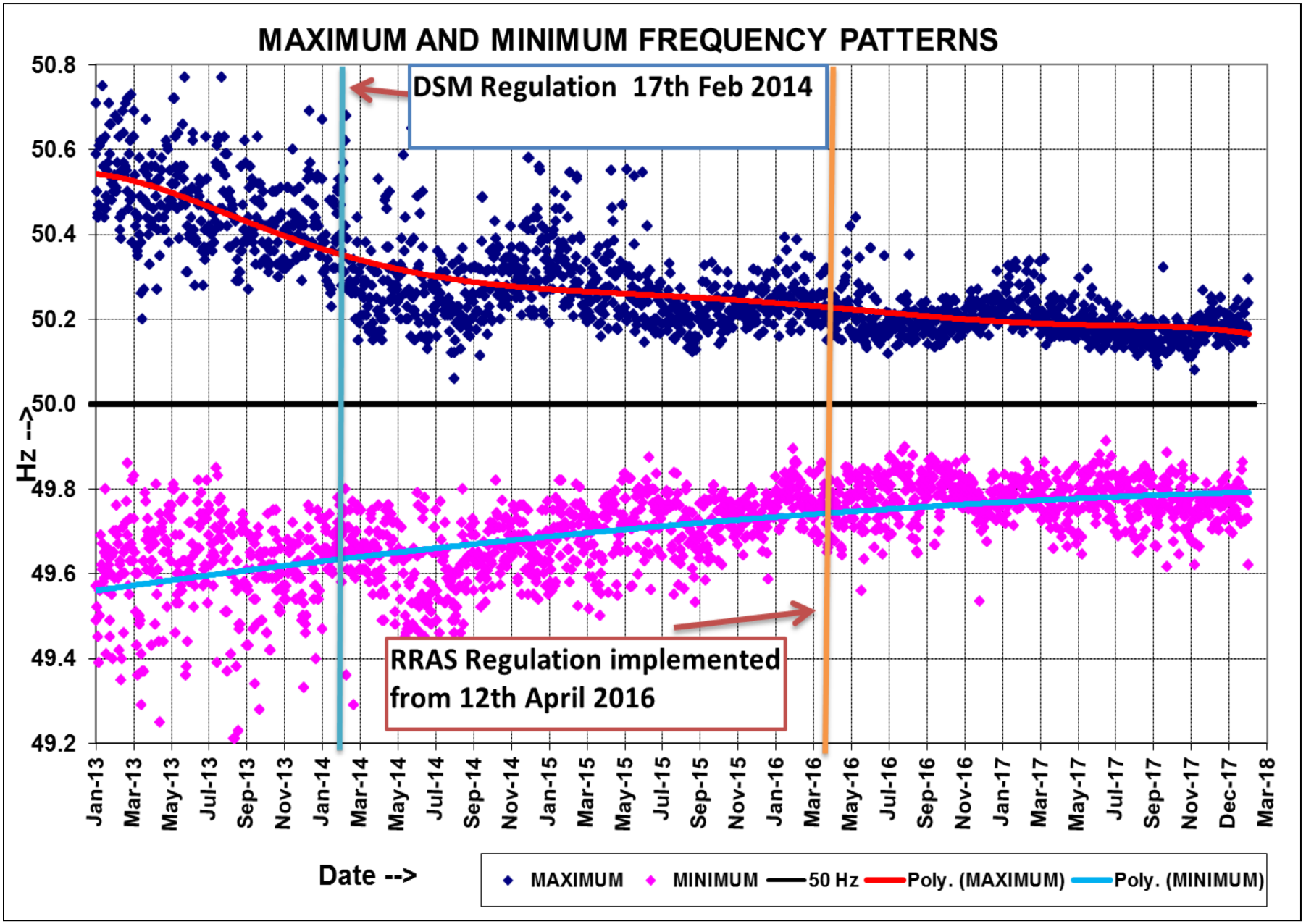
Average Cost for Regulation Up Despatch: ₹ 4.86/ Unit

Mark Up paid to RRAS provider- 50 Paise/Unit

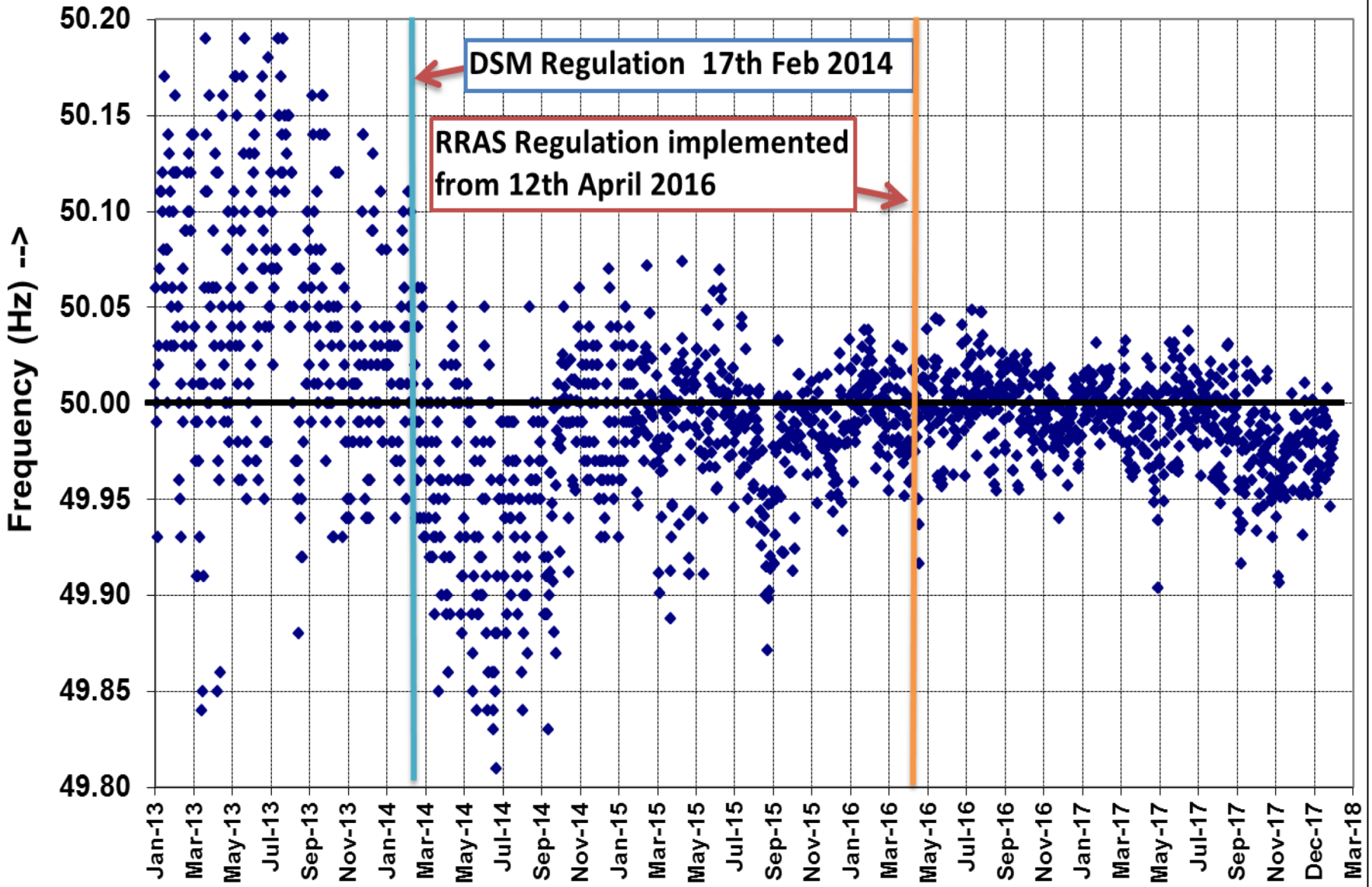
Average variable Charge refunded to DSM Pool for Regulation Down : ₹ 1.78/ Unit

Average Variable charges retained by RRAS providers 59 Paise/Unit

Improvement in Frequency Profile



Pattern of Average Frequency



Key Learnings

- Optimization Layer over Coordinated Multilateral Scheduling
- Improved Frequency Profile
- Ramp Management
- Real Time Congestion Management
- Grid Resilience
- Reliability Support
- Fixed & Variable Costs in Public Domain
- Freedom and Choice Retained

Challenges Ahead

- Revision in DSM vector
- Enlarging the Ambit
- Hydro Scheduling under Ancillary Services
- Gate Closure
- Automation, IT and Manpower
- Performance Monitoring

Hydro Power – A Flexible Solution

- **Hydro Power - a source of Flexibility & Reliability**
  - Overload capability
  - Peaking support
  - Fast ramping
  - Primary Response
  - Voltage Regulation
  - Black Start Capability
- **Need to Increase the Ambit of Ancillary Services**

Recommendations and Mandate

- Ministry of Power, GOI
  - Tariff Policy, 2016
  - Technical Committee on Renewable Integration, 2016
  - Sub-Committee on shifting Hydro power stations from Base Station to Peak Station, 2017
- CEA National Electricity Plan, 2016
- NITI Aayog - India's Renewable Electricity Roadmap, 2015

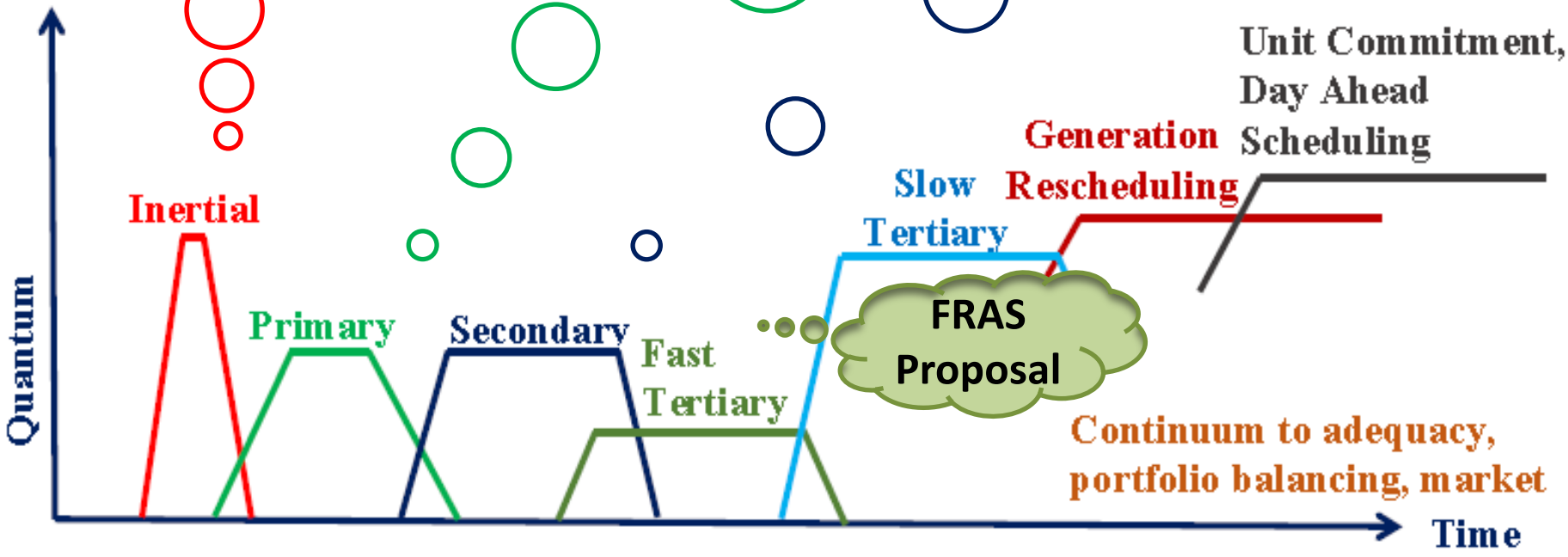
- FOLD-POSOCO Report on Operational Analysis for Optimization of Hydro Resources & facilitating Renewable Integration in India, 2017
  - **Scope for Optimization & Flexible operation along with Economic Gains**
  - **SAMAST - Need for Multi-part Hydro Tariff, Incentive for Flexibility**
  - **Bringing Hydropower Stations under Ancillary Services**

Role of Hydro in System Balancing in India

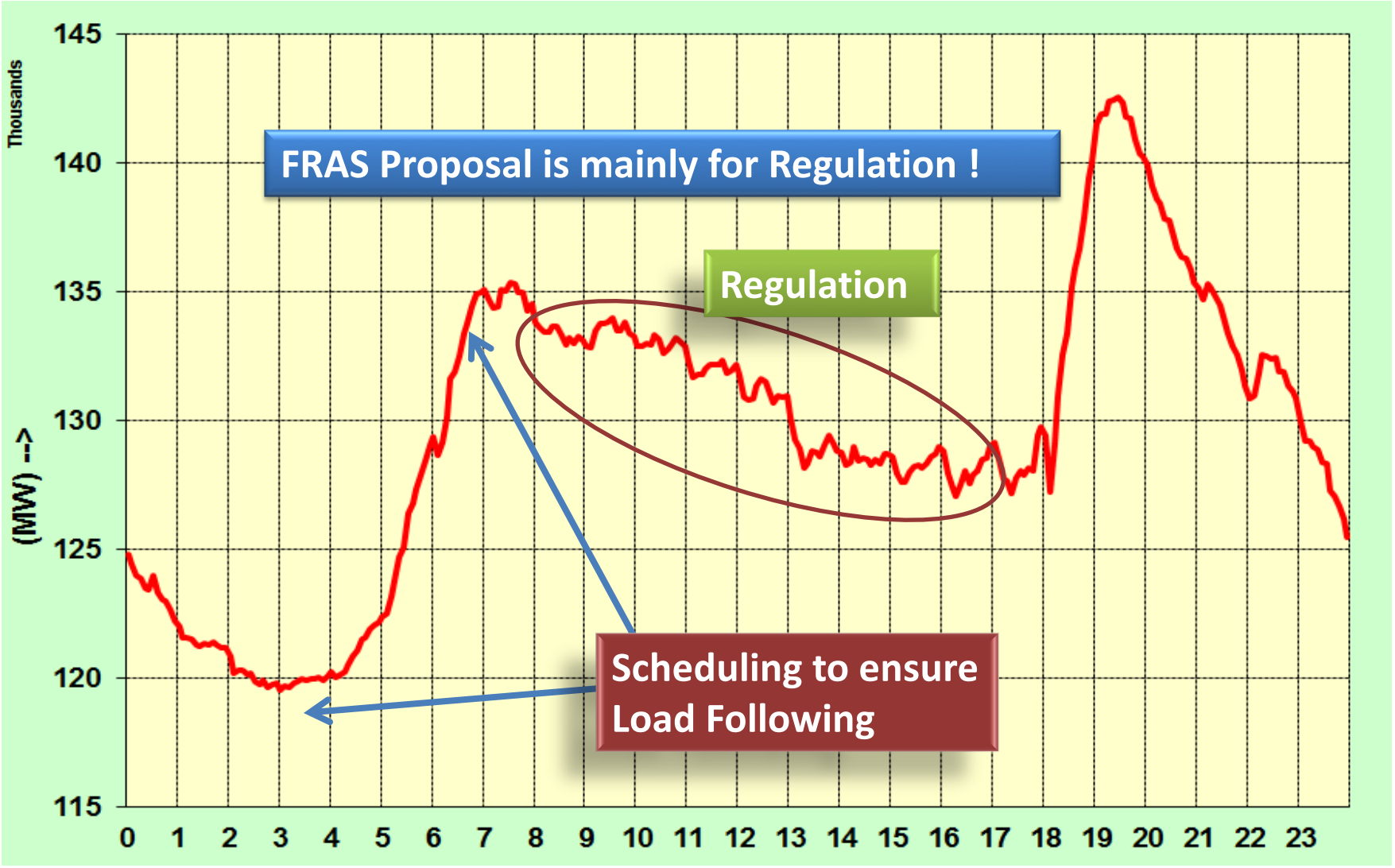
Inertia Decreasing, 175 GW RE, Need to have more hydro machines

Mandated as per Grid Code for all; Need for faster response from Hydro

AGC Pilot Project Operational; Hydro stations may be put on AGC on pilot basis



Load Following and Regulation



Present Regulatory Provisions

- **CERC (Ancillary Services Operations) Regulations, 2015**

5. Eligibility for participation for Reserves Regulation Ancillary Services (RRAS)

5.1. All Generating Stations that are regional entities and whose tariff is determined or adopted by the Commission for their full capacity shall provide RRAS.

- NR and ER Hydro generators provide RRAS data on monthly basis

- **CERC Approved Detailed Procedure for Ancillary Services Operations**

4.9. Hydro generation, within the total energy dispatch constraints, is providing the peaking support including ramping and normally, there is no un-despatched power. However, in case of exigencies or otherwise, the hydro stations would also be considered for despatch under Ancillary Services by the Nodal Agency.

Present Issues in Hydro Scheduling under RRAS

Need for fast regulation service and ramping support

Hydro : Energy limited Resource

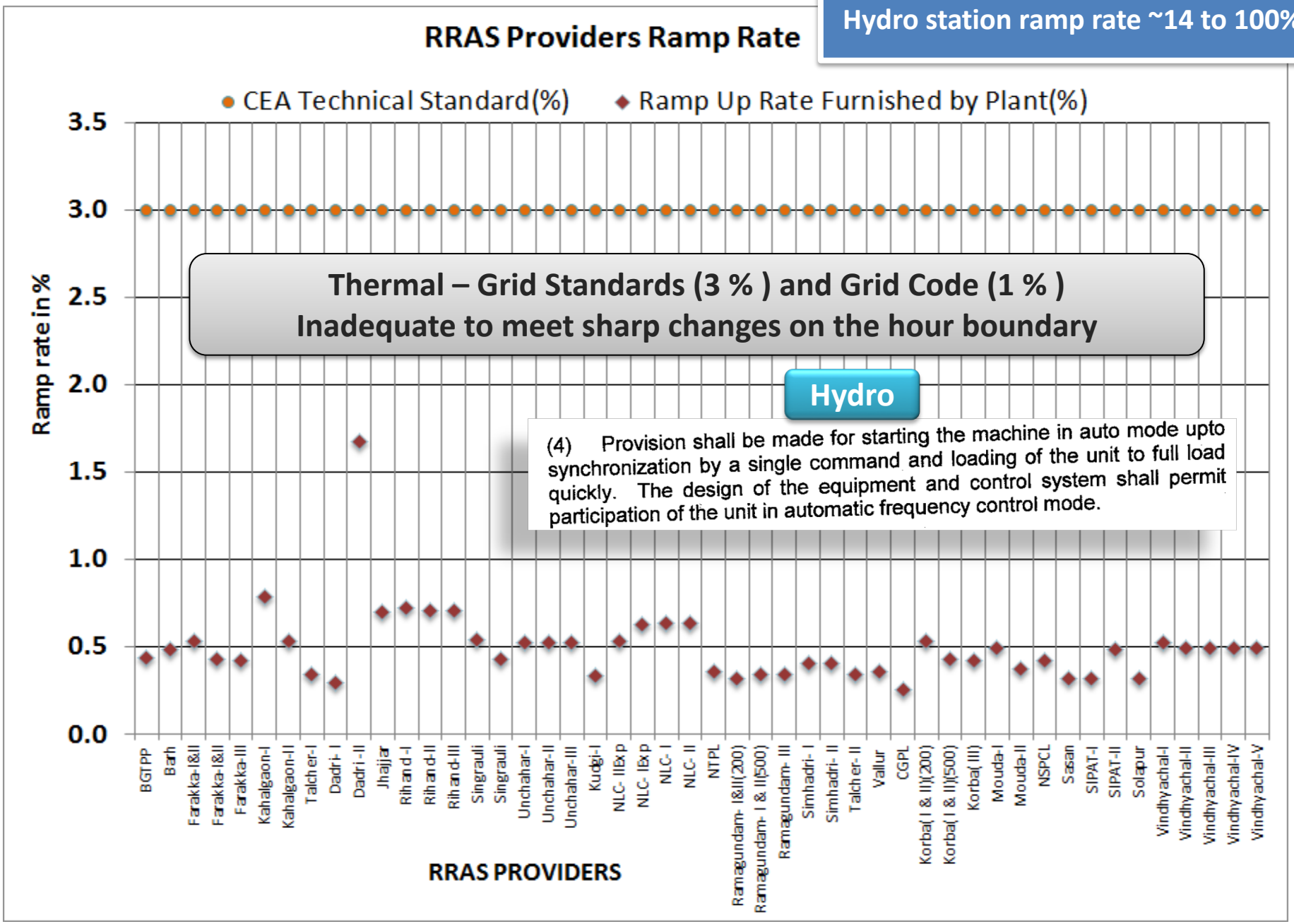
Thermal: Ramp limited Resource

Other than power generation commitments

Marginal Cost is zero

And hence, FRAS Proposal…

Hydro station ramp rate ~14 to 100%



Sl No	Name	Utility	Region	Type (S/R/P)	I/C (MW)
1	Teesta-V	NHPC	ER	R	510
2	Rangit			R	60
3	Bairasiul		NR	P	180
4	Chamera-II			P	300
5	Chamera-I			P	540
6	Uri Stage – I			R	480
7	Salal			R	690
8	Dhauliganga			P	280
9	Tanakpur			R	94.2
10	Chamera-III			P	231
11	Parbati III			P	520
12	Sewa-II			P	120
13	Dulhasti			P	390
14	Uri Stage – II			R	240
15	Naptha Jhakri	SJVN		P	1500
16	Rampur			P	412
17	Tehri	THDC		S	1000
18	Koteshwar			S	400
19	Koldam	NTPC		P	800
20	Kopili	NEEPCO	NER	S	200
21	Kopili-II			S	25
22	Khandong			S	50
23	Ranganadi			P	405
24	Loktak	NHPC		S	105
25	Pong	BBMB	NR	S	396
26	Dehar			R	990
27	Bhakra complex			S	1379
			Total		**12297**

Type	MW
Storage (S)	3555
RoR with Pondage (P)	5678
RoR (R)	3064
Total	12297

Proposal - Fast Response Ancillary Service (1)

- Stack of hydropower stations
  - Based on MW regulation possible by plant, balance energy etc.
  - Factoring congestion

- Despatch Instructions from Nodal Agency
  - FRAS Regulation Up (maximum available balance energy/reserve/MW)
  - FRAS Regulation Down (minimum available balance energy/reserve/MW)

- Net energy squared off for each hydro station same day
  - Combination of FRAS Regulation Up and Down despatch instructions

- Only for short durations

- Reservoir based stations priority over pondage based stations

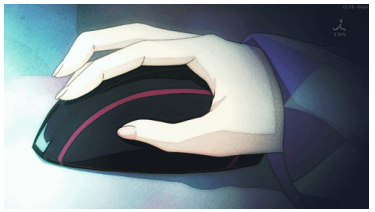
Proposal - Fast Response Ancillary Service (2)

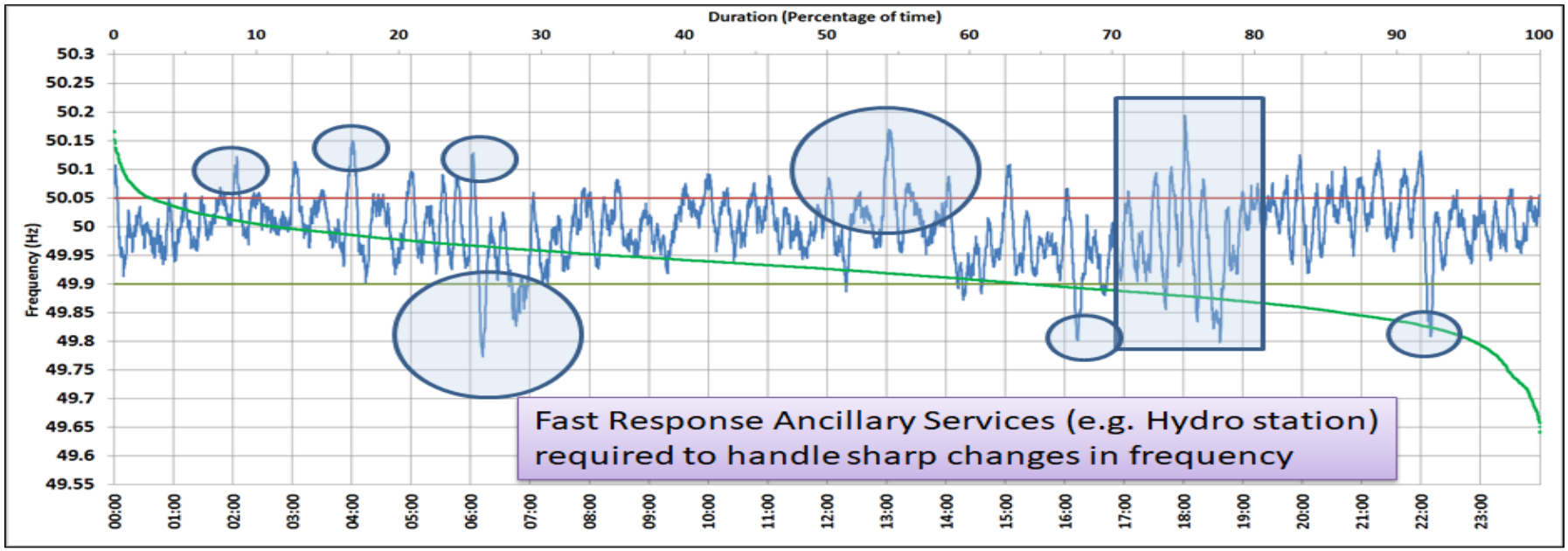
- Scheduling
  - 5 - minute FRAS despatch schedules by Nodal Agency
    - Aggregated (3 five minute blocks)
    - Compatibility with the existing scheduling philosophy
    - Settlement and deviation accounting purposes
  - Regional Virtual Ancillary Entity – Hydro or VAE-H
    - Counterparty to FRAS despatch instructions

- Accounting and Settlement
  - No fixed charge or variable charges to be paid
  - Incentive on mileage basis
    - $E_m = \Sigma \mid E_{up} \mid + \Sigma \mid E_{down} \mid$
    - To be decided by the Commission

Triggering Criteria

- Hour boundary frequency changes
- Sudden changes in demand
- Ramp management
- Grid contingency
- RE Variation





<49.7	<49.90	<49.97	49.7-49.8	49.8-49.9	49.9-50.0	50.0-50.1	50.1-50.2	49.90-50.05	49.7-50.2	49.97-50.03	50.05-50.1	>50	>50.03	>50.05	>50.2
0.00	4.61	29.05	0.21	4.40	44.47	48.37	2.56	79.22	100.00	43.31	13.65	50.86	27.64	16.17	0.00

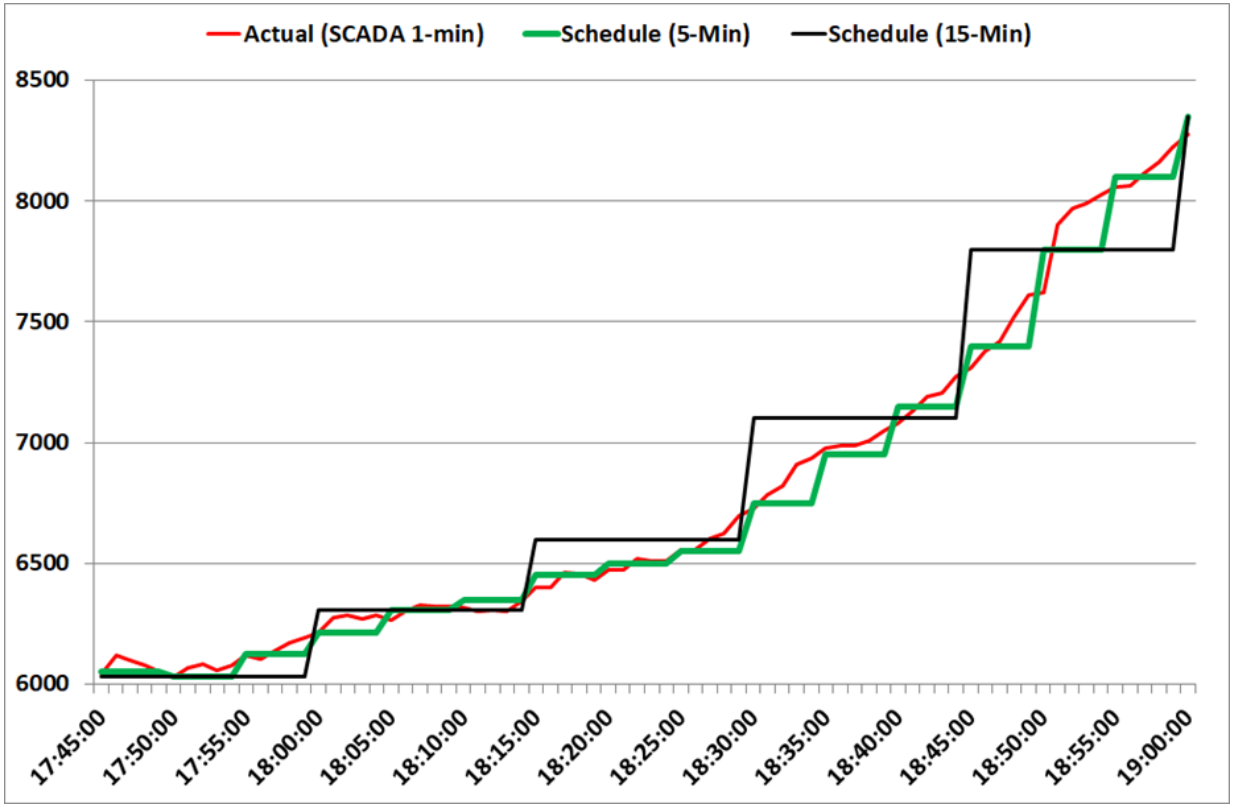
Average Frequency :	49.997	Frequency Variation Index :	0.032	Standard Deviation :	0.056	Mileage	45.61

Honouring Constraints

- Drinking Water
- Irrigation
- Contractual Obligations with State Government
- Weather Phenomena, Monsoon etc.
- Legacy Control System
- Wildlife
- Water level and Head
- High Silt, flash floods, Cloud burst, Land slides
- Shortage of Skilled and Unskilled Manpower
- Acidic Corrosion and Erosion
- Special Occasions like Water Sport activities, Snan, Mela etc.
- Any other…

Scheduling and Settlement

- FOR Technical Committee Sub-Group
  - Introduction of Five Minute Scheduling, Metering, Accounting and Settlement in Indian Electricity Market
  - Pilot Project Envisaged - in Parallel with 15-Minute Framework
- Three Regions (NR, ER and NER) – Central Sector Hydro Stations
  - 05 Minute Scheduling, 05 Minute Metering, 05 Minute Deviation Settlement

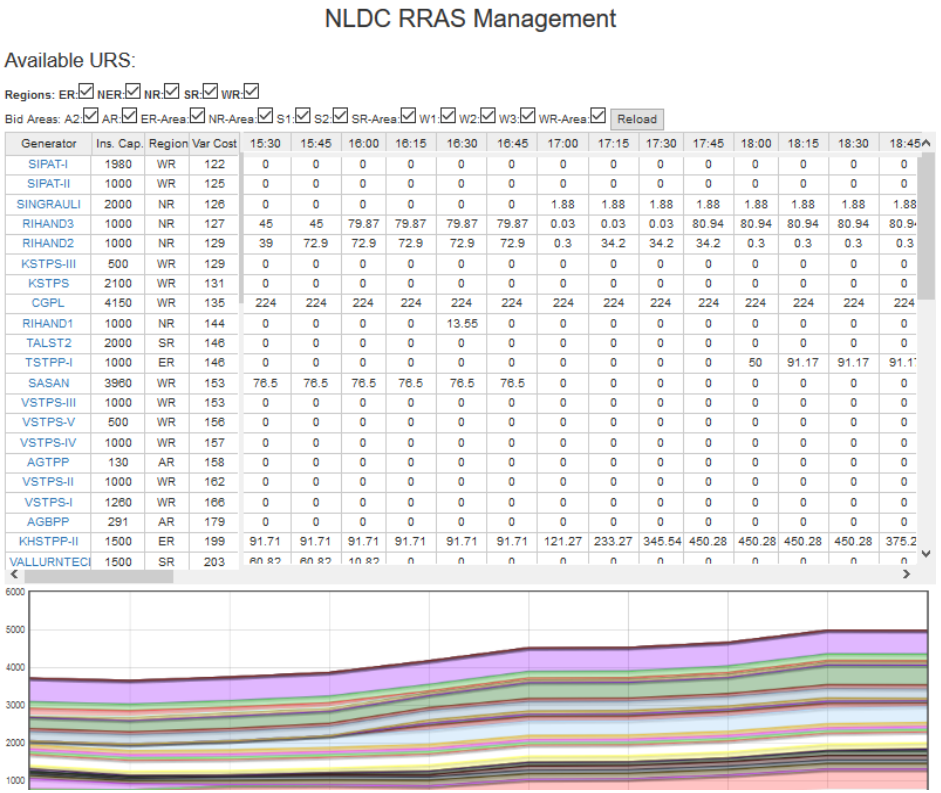


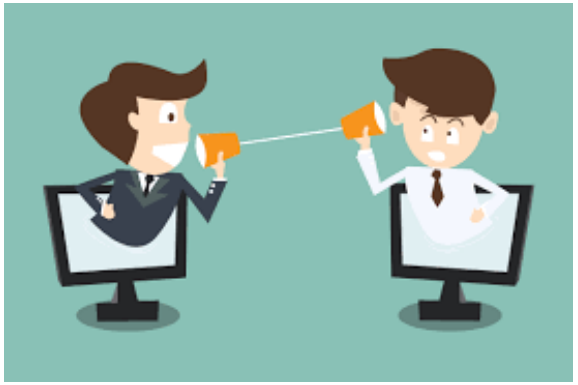
Data Exchanges

- **NLDC/RLDCs with FRAS Providers**
  - Web based Automated Solution
  - Technical Details for FRAS Despatch
  - Telephonic/SMS/E-mail

- **FRAS Providers and RPCs**
  - Ancillary Services information
  - Accounting & Settlement

- **Information on NLDC Website**
  - FRAS Instruction Summary
  - Monthly report
  - FRAS Providers details



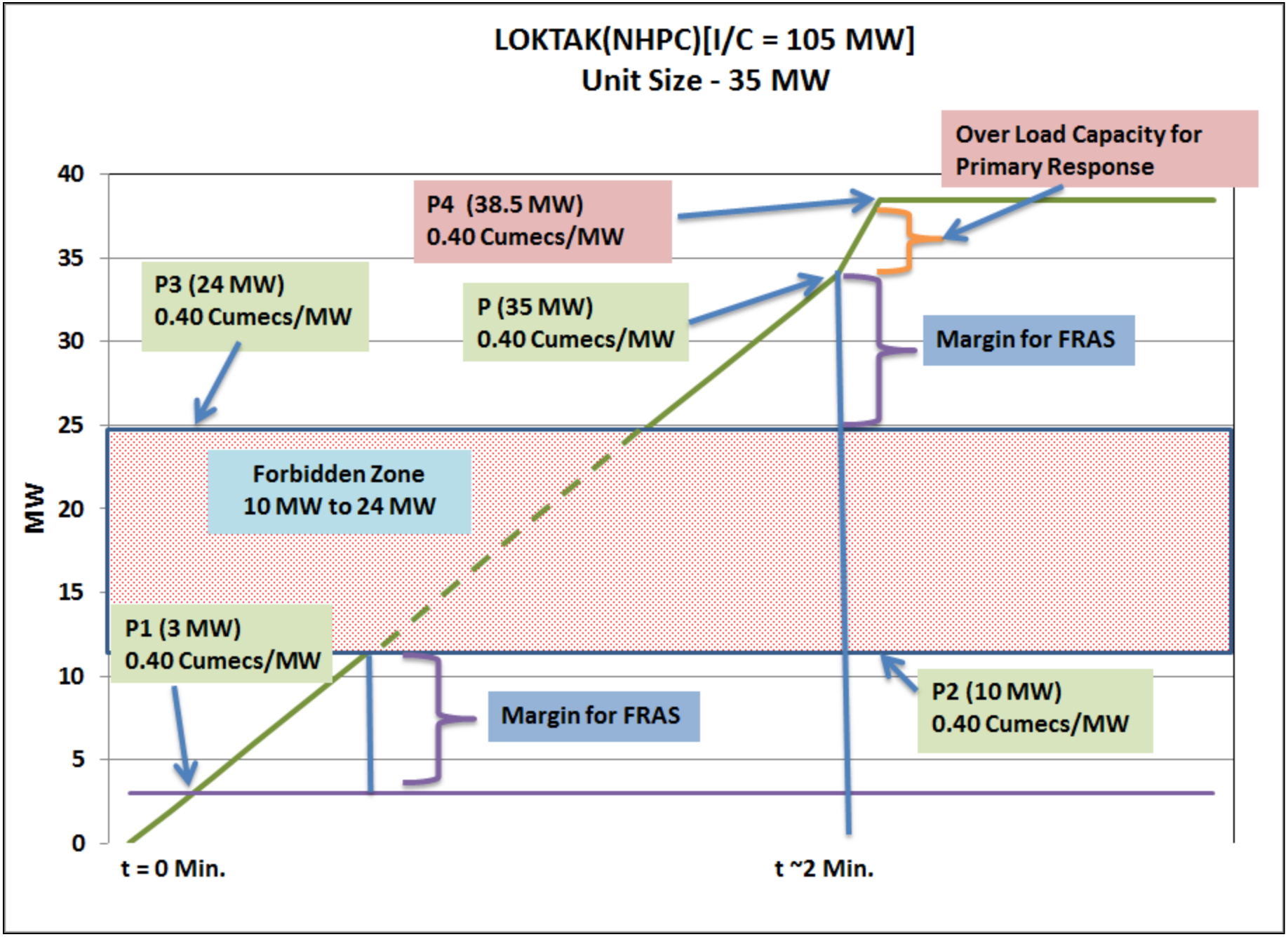


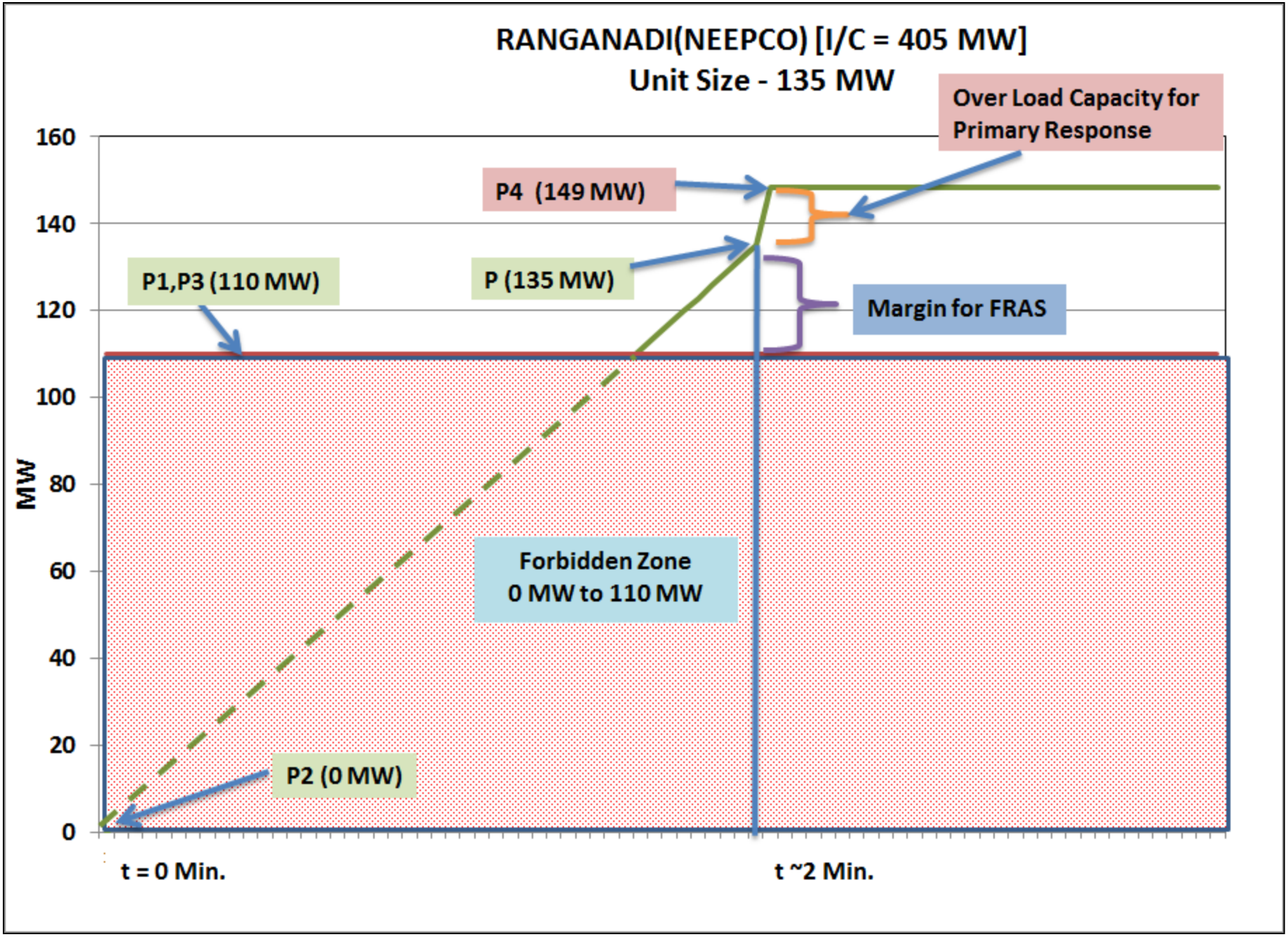
Discussion with Central Sector Hydro Generators

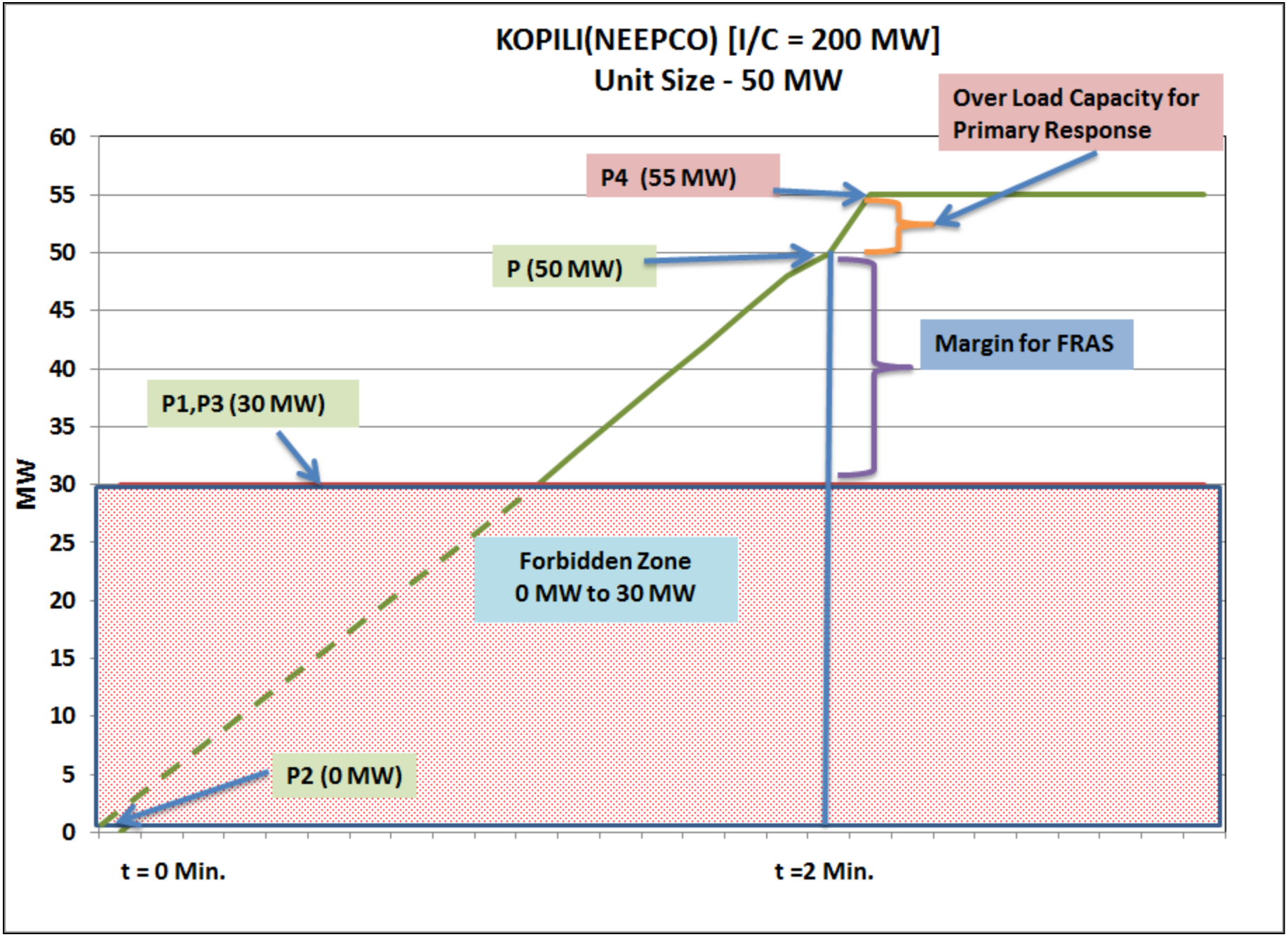
- Meetings
  - 13th March, 2018 at CERC, Delhi
  - 09th March, 2018 at NLDC, Delhi
  - 23rd February, 2018 at CERC, Delhi
- Participants
  - CERC, CEA, NHPC, SJVN, BBMB, THDC, NEEPCO, NTPC & POSOCO
- Deliberations held & broad consensus achieved
  - FRAS Implementation
  - Primary Response improvement through droop settings
  - 5-Minute scheduling, despatch and settlement on pilot basis
  - Other ancillary services – reactive power, black start
  - Need for fast communication of instructions
- Mark up for regulation– to be decided by CERC
- Data template circulated
  - Received data from NHPC, NTPC, BBMB, NEEPCO, THDC & SJVN

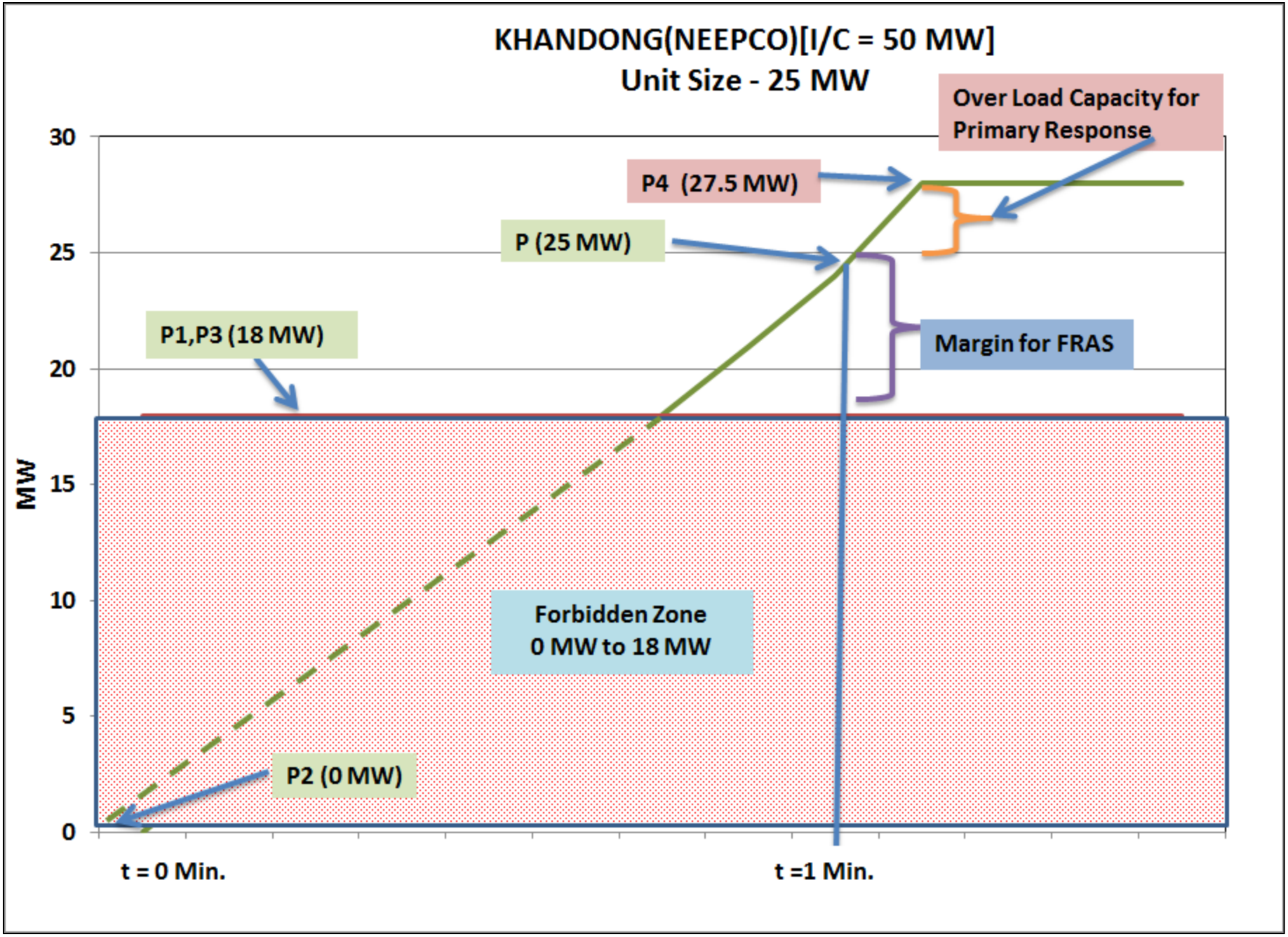
Information Requirement of Hydro Units

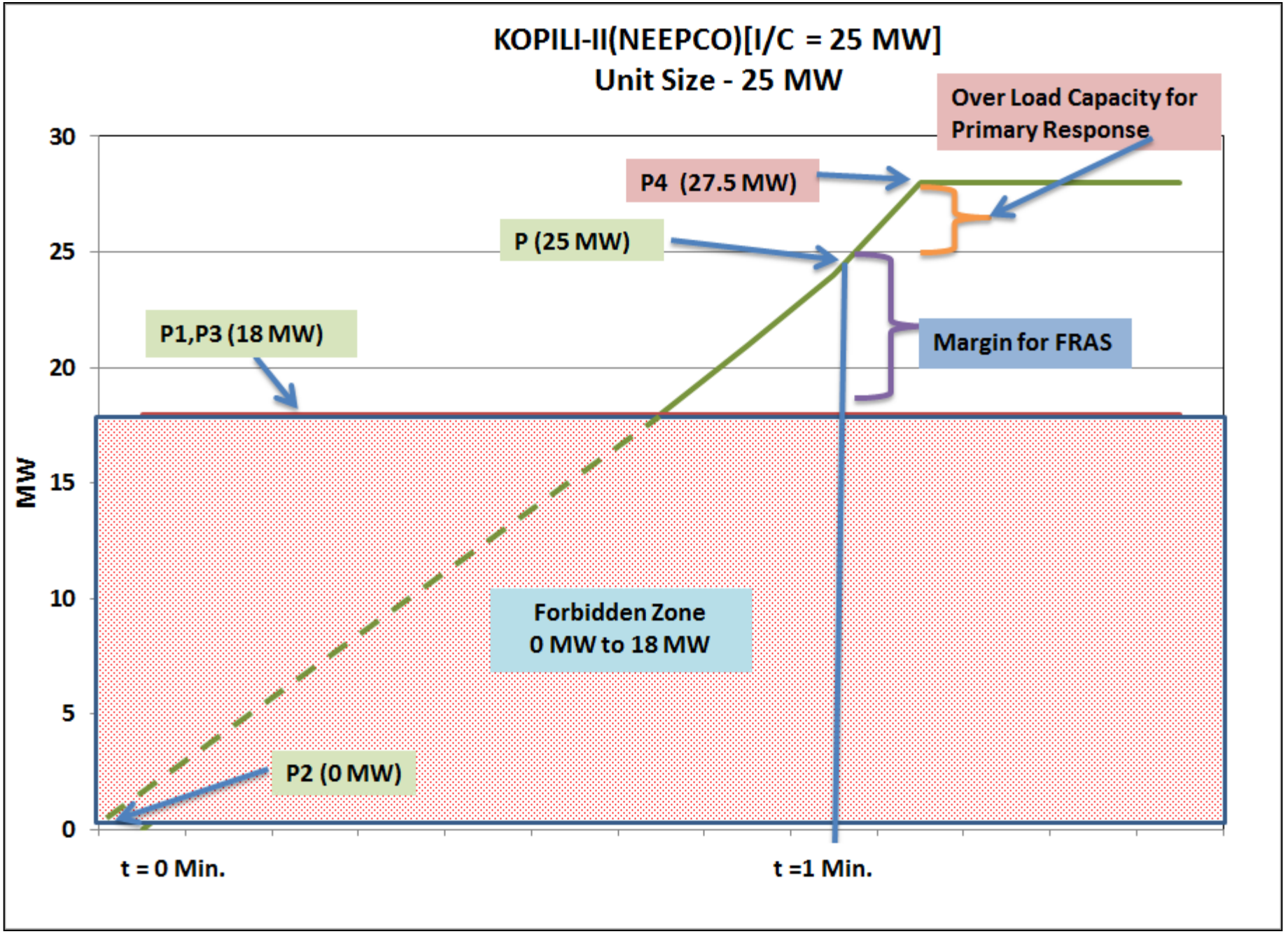
- Installed capacity of unit =P
- Start time; standstill to synchronization of unit to grid (in minutes)
- Minimum load at which unit stably run after synchronization (MW) - P1
- Forbidden zone or high cavitation zone (From MW to MW) - P2 to P3
- Maximum loading possible on unit (continuous) P4 (Note; range from P to P4 should be normally available for primary response unless it is a case of overflowing hydro)
- Cumecs/MW for P1, P3, P and P4 generation level as well as cumecs from standstill to synchronization. Which value is used for declaring MWh capability?
- How many units can be started simultaneously or is it sequential operation? The constraints in this regard.


LOKTAK(NHPC)[I/C = 105 MW]
Unit Size - 35 MW
Over Load Capacity for Primary Response
P4 (38.5 MW) 0.40 Cumecs/MW
P3 (24 MW) 0.40 Cumecs/MW
P (35 MW) 0.40 Cumecs/MW
Margin for FRAS
Forbidden Zone 10 MW to 24 MW
P1 (3 MW) 0.40 Cumecs/MW
Margin for FRAS
P2 (10 MW) 0.40 Cumecs/MW
MW
40
35
30
25
20
15
10
5
0
t = 0 Min.
t ~2 Min.


RANGANADI(NEEPCO) [I/C = 405 MW]
Unit Size - 135 MW
Over Load Capacity for Primary Response
P4 (149 MW)
P1,P3 (110 MW)
P (135 MW)
Margin for FRAS
Forbidden Zone
0 MW to 110 MW
P2 (0 MW)
MW
160
140
120
100
80
60
40
20
0
t = 0 Min.
t ~2 Min.


KOPILI(NEEPCO) [I/C = 200 MW]
Unit Size - 50 MW
Over Load Capacity for Primary Response
P4 (55 MW)
P (50 MW)
Margin for FRAS
P1,P3 (30 MW)
Forbidden Zone
0 MW to 30 MW
P2 (0 MW)
MW
60
55
50
45
40
35
30
25
20
15
10
5
0
t = 0 Min.
t =2 Min.


KHANDONG(NEEPCO)[I/C = 50 MW]
Unit Size - 25 MW
Over Load Capacity for Primary Response
P4 (27.5 MW)
P (25 MW)
P1,P3 (18 MW)
Margin for FRAS
Forbidden Zone
0 MW to 18 MW
P2 (0 MW)
MW
30
25
20
15
10
5
0
t = 0 Min.
t =1 Min.


KOPILI-II(NEEPCO)[I/C = 25 MW]
Unit Size - 25 MW
Over Load Capacity for Primary Response
P4 (27.5 MW)
P (25 MW)
P1,P3 (18 MW)
Margin for FRAS
Forbidden Zone
0 MW to 18 MW
P2 (0 MW)
MW
30
25
20
15
10
5
0
t = 0 Min.
t =1 Min.

Further Steps…

- Regulatory Interventions
  - Order by Central Commission for Pilot Project
  - CERC (Ancillary Services Operations) Regulations, 2015
  - Detailed Procedure
- Software Upgradation
- Communication Infrastructure Augmentation
- Capacity Building
  - LDC and Hydro Generators Personnel

A Small Step for Hydro

A Giant Leap for Indian Power System

Thank You !

FOR Technical Committee Meeting
19th Meeting, Shillong

Sub-Group Report

on

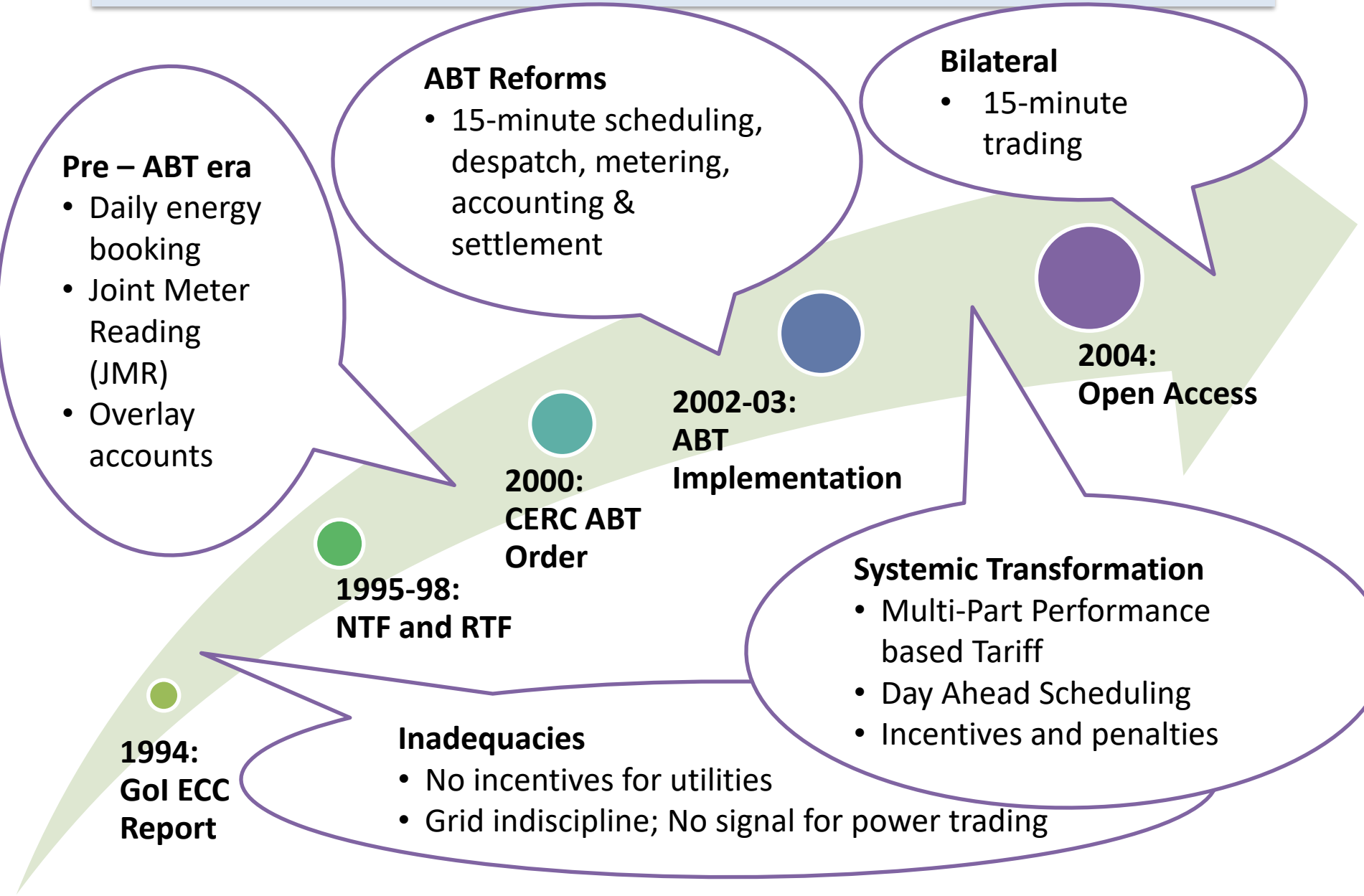
"Implementation of 5-Minute Scheduling, Metering, Accounting and Settlement"

16th April 2018

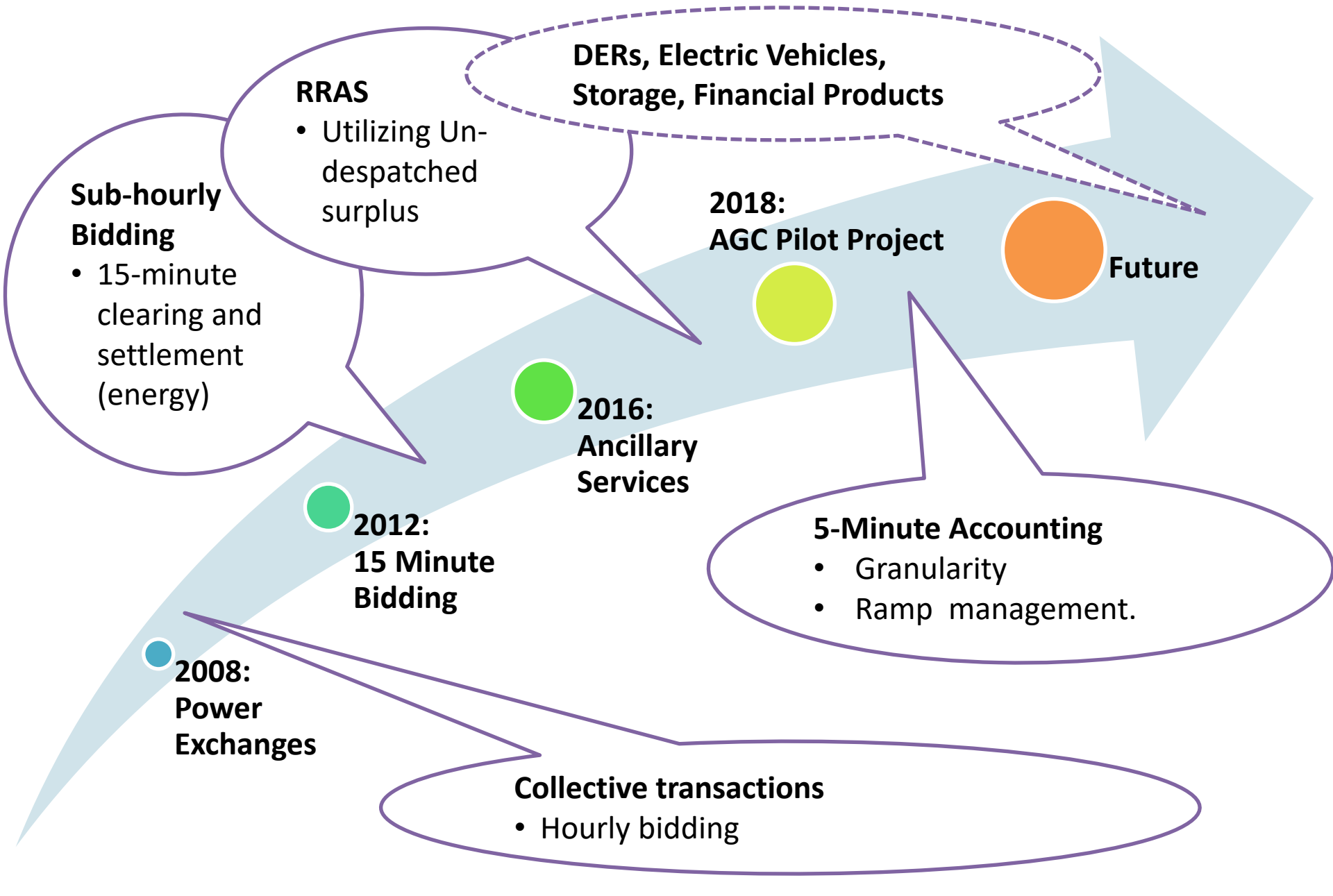
Structure of the Report

- Chapter 1 - Introduction
- Chapter 2 - Imperatives for Fast Markets
- Chapter 3 - Policy and Regulatory Mandate
- Chapter 4 - International Experience
- Chapter 5 - Deliberations and Stakeholder consultations
- Chapter 6 - Meter Capability Demonstration and Testing
- Chapter 7 - Regulatory Provisions to Handle Transition
- Chapter 8 - Action Plan
- Chapter 9 - Metering Infrastructure and Cost Estimates
- Chapter 10 - Handling Transition and Timelines
- Chapter 11 - Recommendations and Way Forward
- Chapter 12 - References

Looking Back to Look Forward



Looking Forward to Leap Ahead



Developments in Other Sectors…

Airlines

Banking

भारतीय रिज़र्व बैंक
RESERVE BANK OF INDIA
www.rbi.org.in

May 08, 2017

National Electronic Funds Transfer (NEFT) system – Settlement at half-hourly intervals

Petroleum

Railways

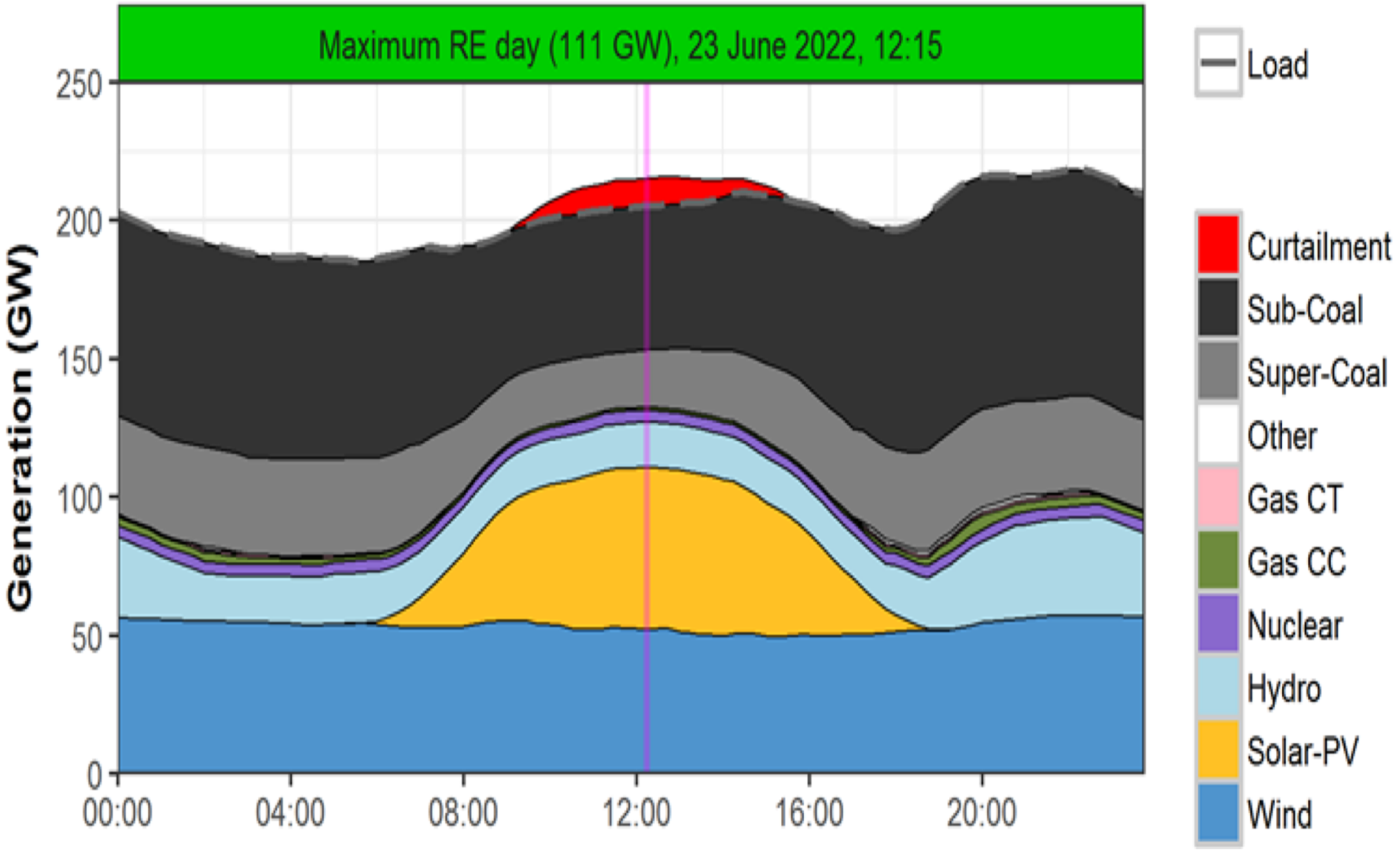
12392*	Shramjeevi SF Expres...*	SF	ECR	6	S M T W T F S	NDLS	13:10
19023	Mumbai Firozpur Jant...	Exp	WR	1	S M T W T F S	NDLS	13:15
12716	Sachkhand Express	SF	SCR	4	S M T W T F S	NDLS	13:20
12483	Kochuveli - Amritsar...	SF	NR	2	F	NDLS	13:25
19566	Uttranchal Express	Exp	WR	--	S	NDLS	13:25
12217	Kerala Sampark Krant...	SKr	NR	3	M W	NDLS	13:25
09566	Haridwar Okha Uttran...	Exp	WR	--	S	NDLS	13:25
19024	Firozpur - Mumbai Ce...	Exp	WR	7	S M T W T F S	NDLS	13:30
12485	Hazur Sahib Nanded -...	SF	NWR	3	M T F	NDLS	13:30

Stock Exchanges

Data Time-Interval	Annual Cost*
1 Minute	Rs. 13,20,000
2 Minutes	Rs. 7,50,000
5 minutes	Rs. 2,75,000
15 Minutes	Rs. 60,000

*NSE Annual Data Charges, Capital Market Segment

Increasing Renewable Energy Penetration



Sample Day in 2022 (Source: GtG Study Report)

Harnessing and Incentivizing Flexibility

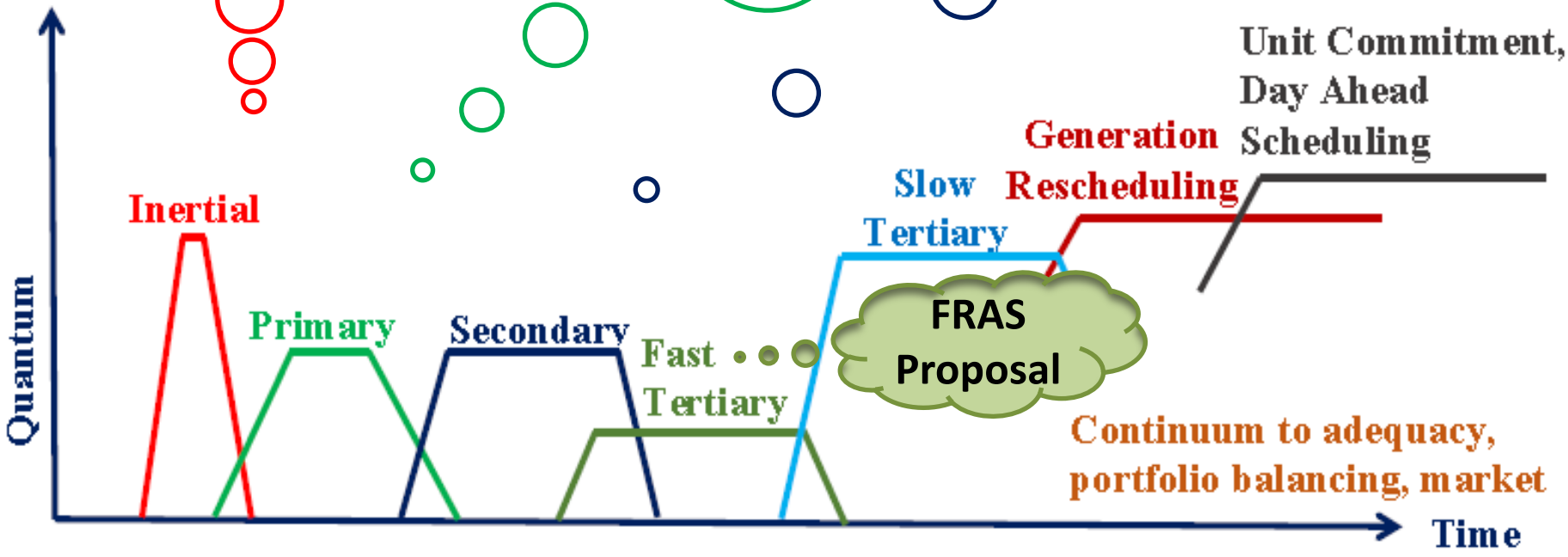
Especially Hydro in Five Minute Timeframe

Fast Response Ancillary Services

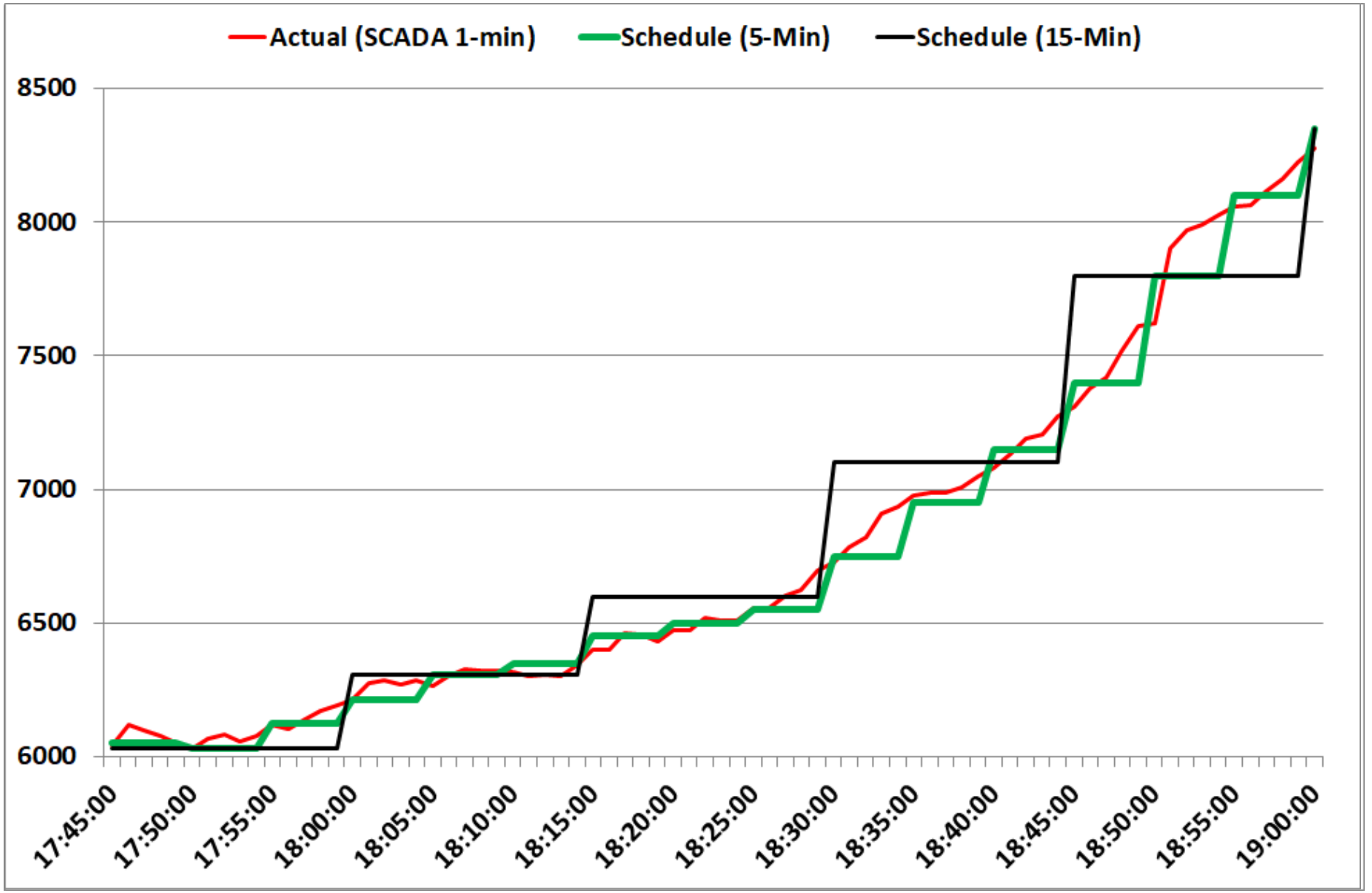
Inertia Decreasing, 175 GW RE, Need to have more hydro machines

Mandated as per Grid Code for all; Need for faster response from Hydro

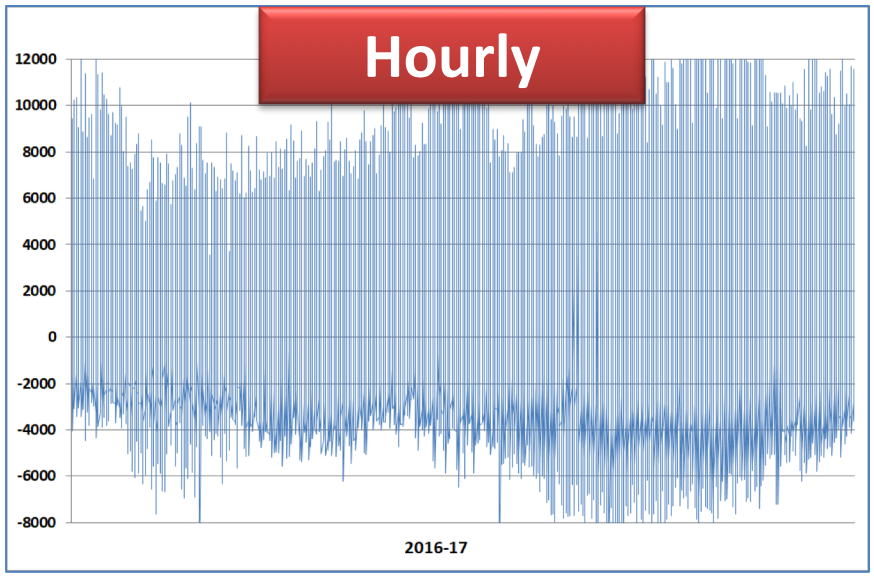
AGC Pilot Project Operational; Hydro stations may be put on AGC on pilot basis

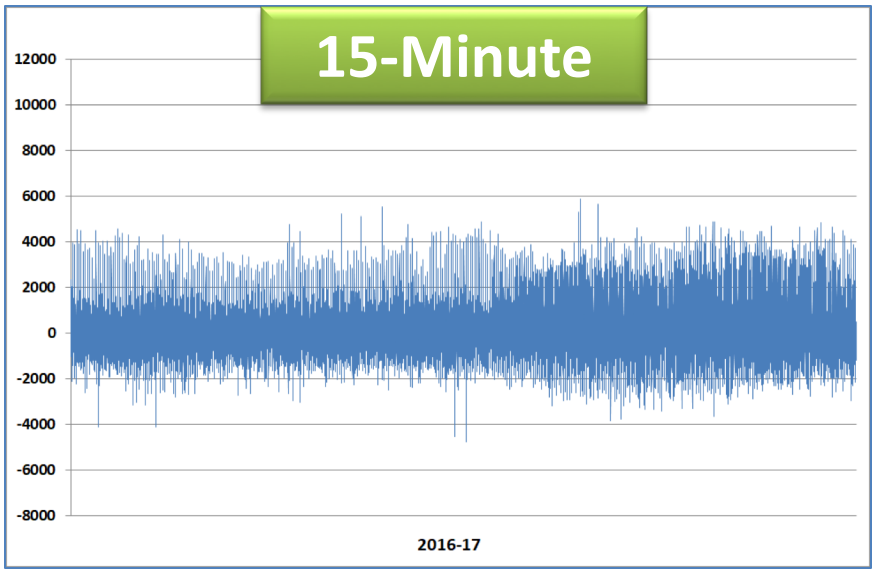


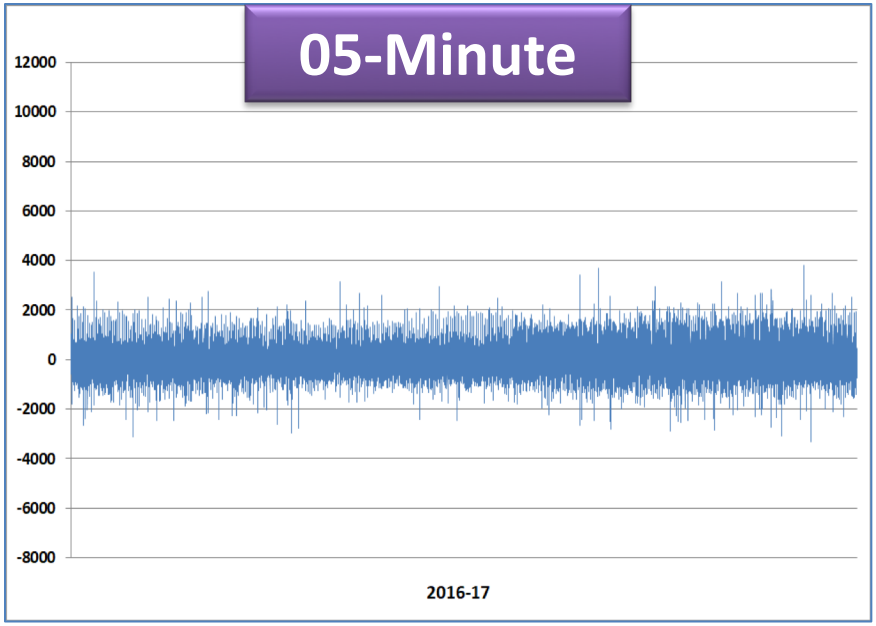
Ramp Management



Reduced Variability and Reserve Requirement







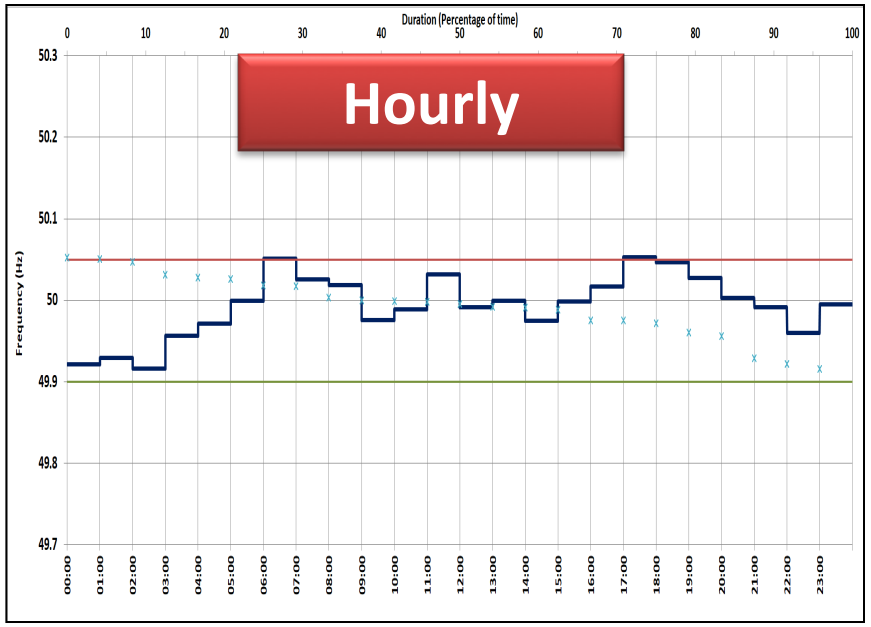
Reserve Requirement
Three Sigma

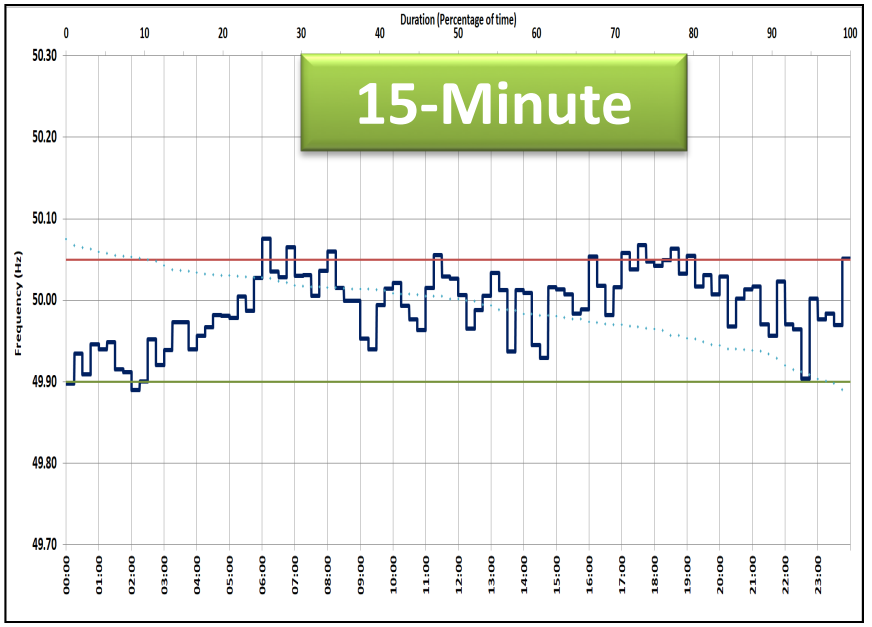
Hourly Despatch ~ 11,000 MW

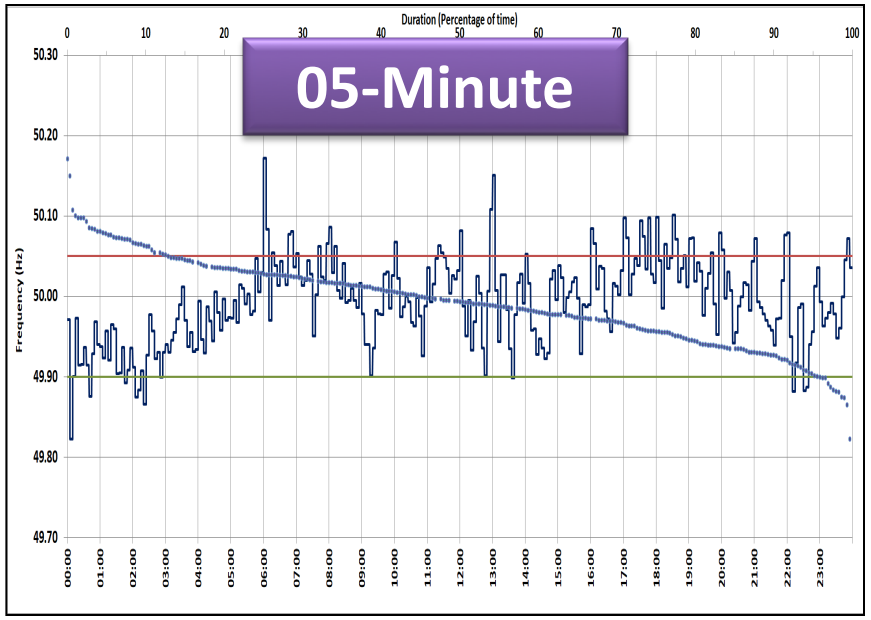
15-Minute Despatch ~ 3300 MW

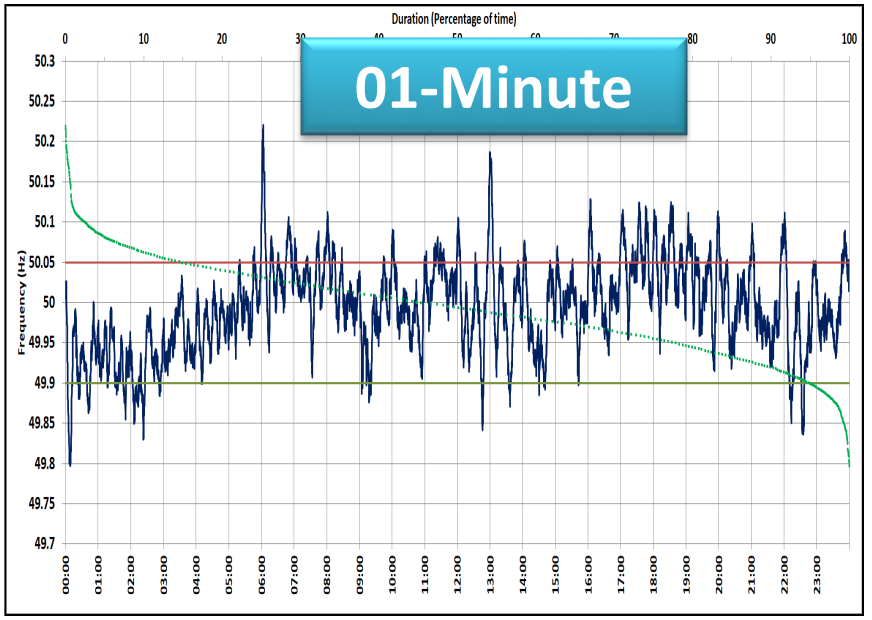
05-Minute Despatch ~ 1400 MW

Frequency Profile – Different Timescales

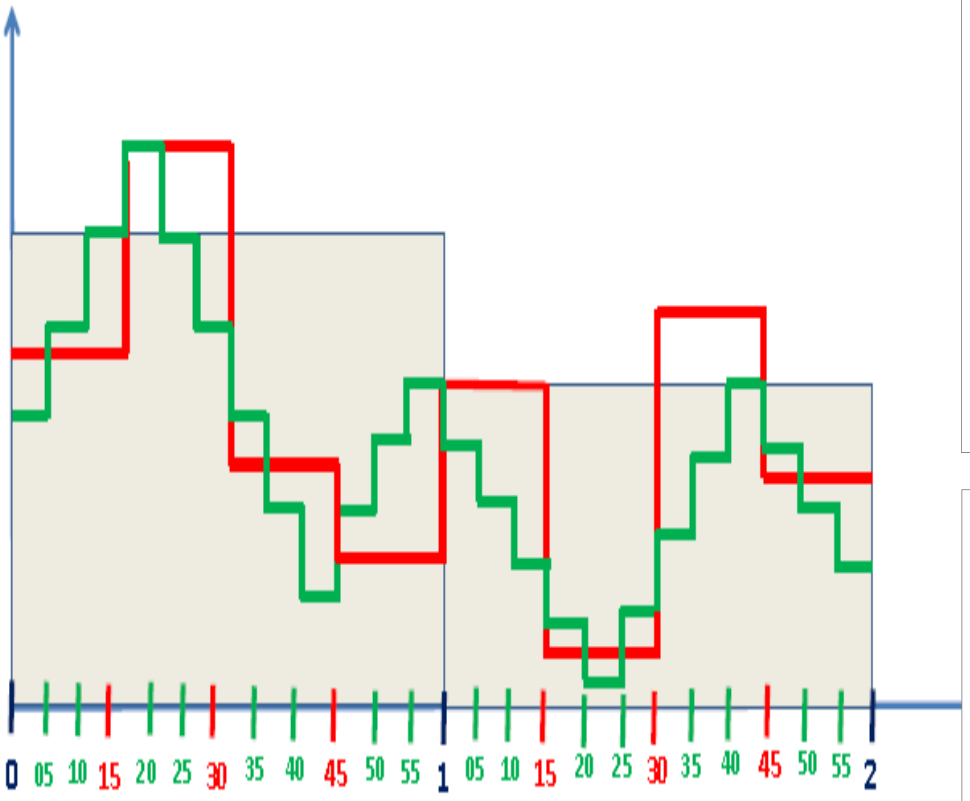




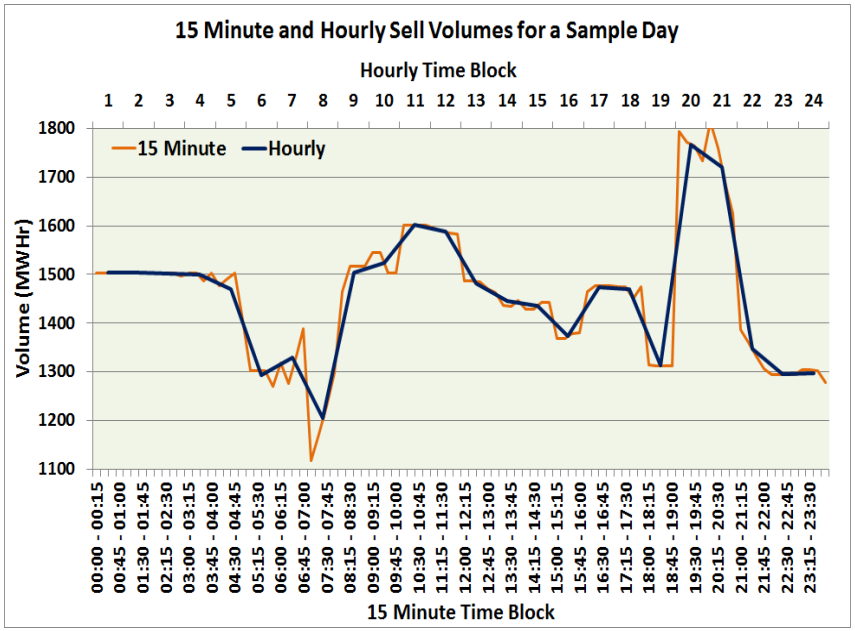


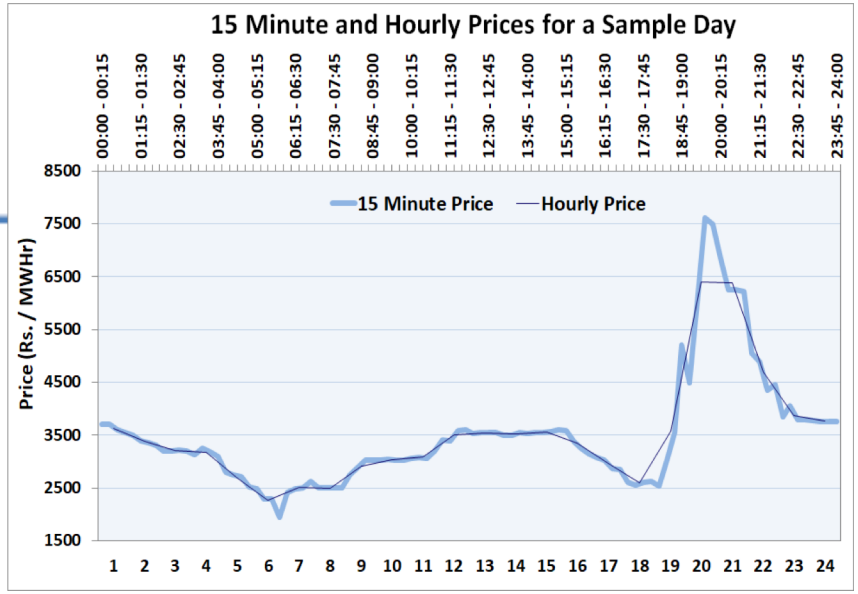


Economic (Price) Signals at Shorter Intervals



5 Minute, 15 Minute and Hourly Schedules





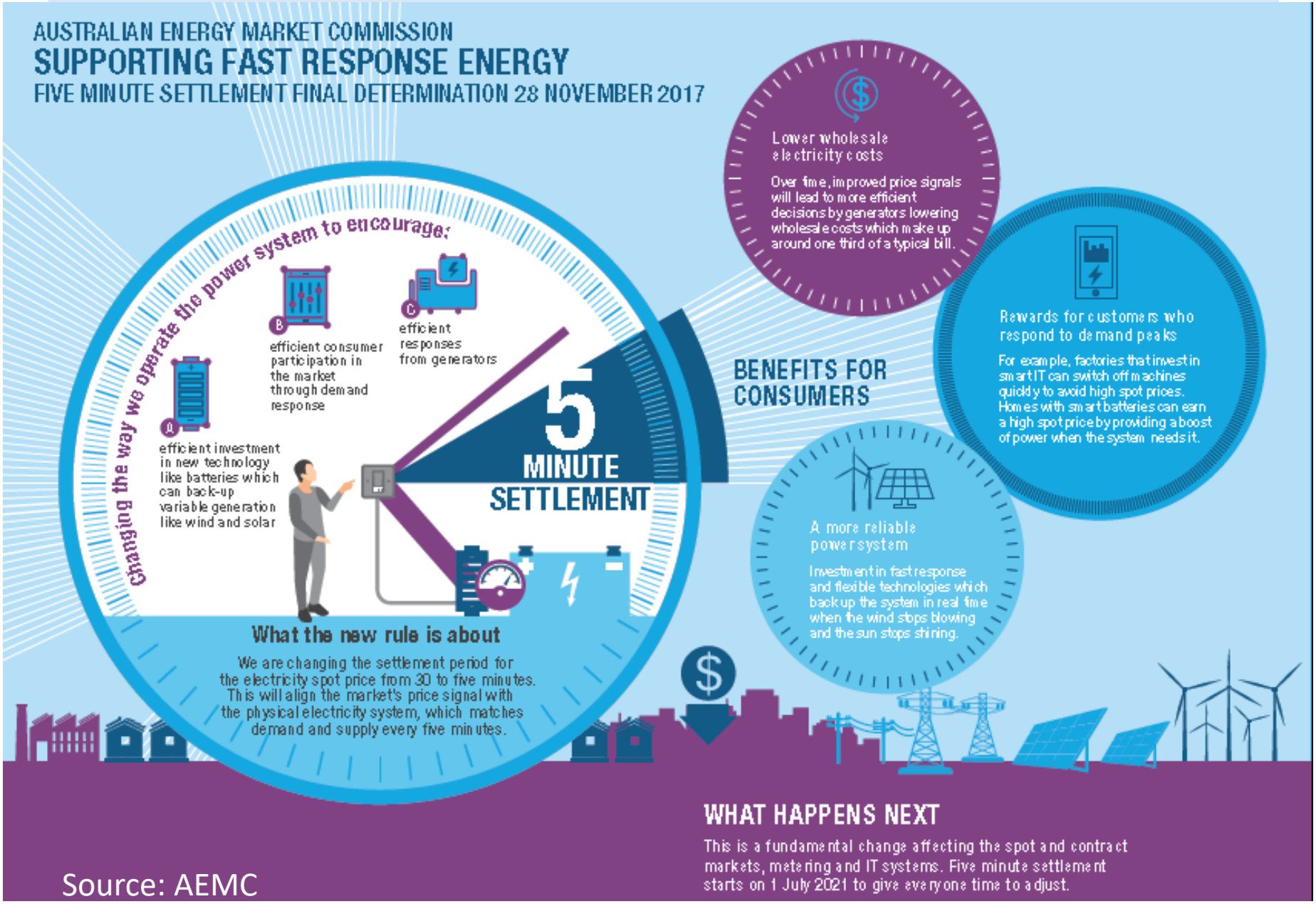
Imperatives & Benefits of Moving to Fast Markets

- Target 175 GW by 2022 – Increasing RE Penetration
- Valuing and harnessing flexibility
- Maintaining reserves for system balancing
- Ramp management
- Need for enabling economic / price signals at shorter intervals
- Need for new products – Fast response Ancillary Services
- Facilitating better portfolio management
- Handling deviations
- New technologies – Storage, Electric Vehicles
- Fast markets (5-minutes) – A catalyst for causing economy
  - A low handing fruit

Policy / Regulatory Mandate

- CERC Consultations/Orders/Regulations
  - Consultation Paper on Modifications in Power Market Design: Evening Market, 15 minute Bidding time block and Ancillary market on PX (2010)
  - Order on Automatic Generation Control (AGC) Pilot Project (2017)
  - Communication System for Inter-State Transmission of Electricity Regulations (2017)
- NITI Ayog Report - India's Renewable Electricity Roadmap 2030 (2015)
- Ministry of Power Technical Committee Report (2016)
- Forum of Regulators (FOR) - SAMAST Report (2016)
- FOR Model Deviation settlement Regulations (2017)
- NITI Aayog - Draft National Energy Policy (2017)

International Experience – Australia (1)



Source: AEMC

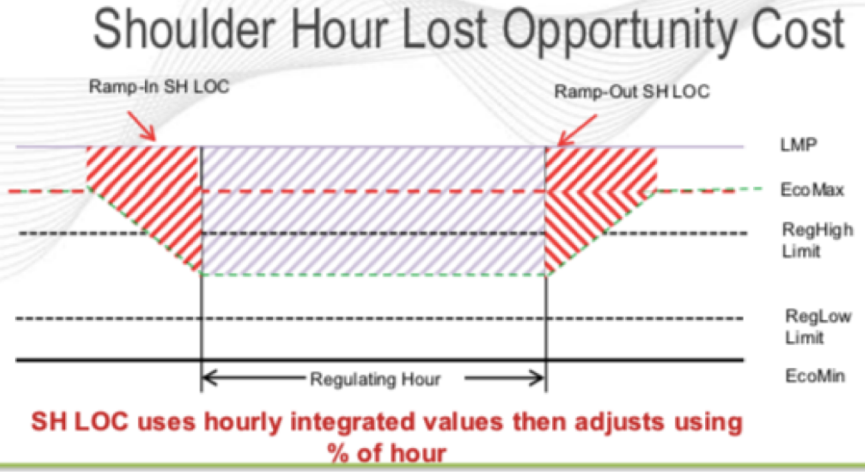
International Experience – Australia (2)

- According to AEMC, the cost of implementing the 5 minute settlement represents mainly one -off costs
  - Relatively small compared with the ongoing annual NEM transactions (AUS$ 16.6 billion in 2016/17) and with an expected medium term generation investment of up to AUS$ 90 billion.
  - benefits of this implementation would outweigh the costs.
  - According to them a reduction of AUS$ 0.50/MWh in average wholesale price would represent savings of around AUS$100 million per year in energy costs which is translated in lower retail prices to consumers (AEMC 2017, p. vi).

Shoulder Hour Lost Opportunity Cost

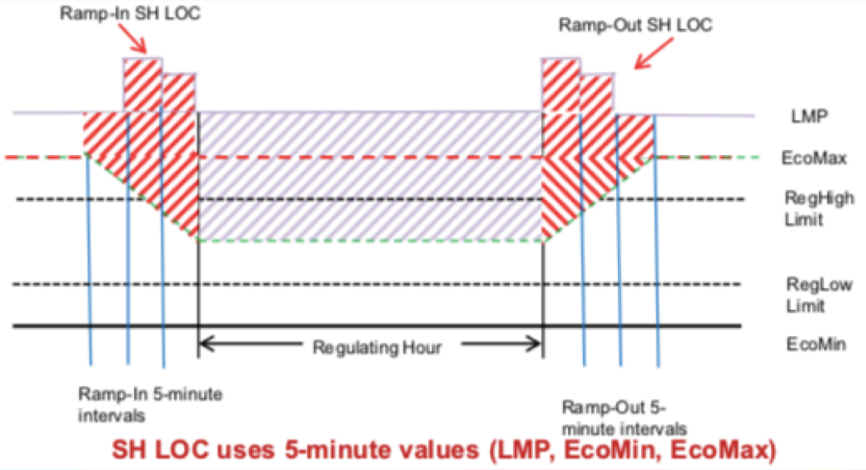
Existing

- SH LOC is cost incurred or revenues lost in ramp-in and ramp-out hour to move uneconomically to regulation assignment
- Determined using hourly LMP and MW values then adjusted by percentage of hour that unit is increased or decreased from its economically desired output using offer ramp rates



5-Minute Settlement

- SH LOC is cost incurred or revenues lost in the 3 ramp-in and ramp-out 5-minute intervals to move uneconomically to regulation assignment
- Determined using 5-minute LMP and 5-minute MW
- Regulation high and low limits and Regulation assigned MW from first or last 5-minute interval of regulating hour
- Ramp-in Shoulder Hour: LOC calculated for last three 5-minute intervals
- Ramp-out Shoulder Hour: LOC calculated for first three 5-minute intervals

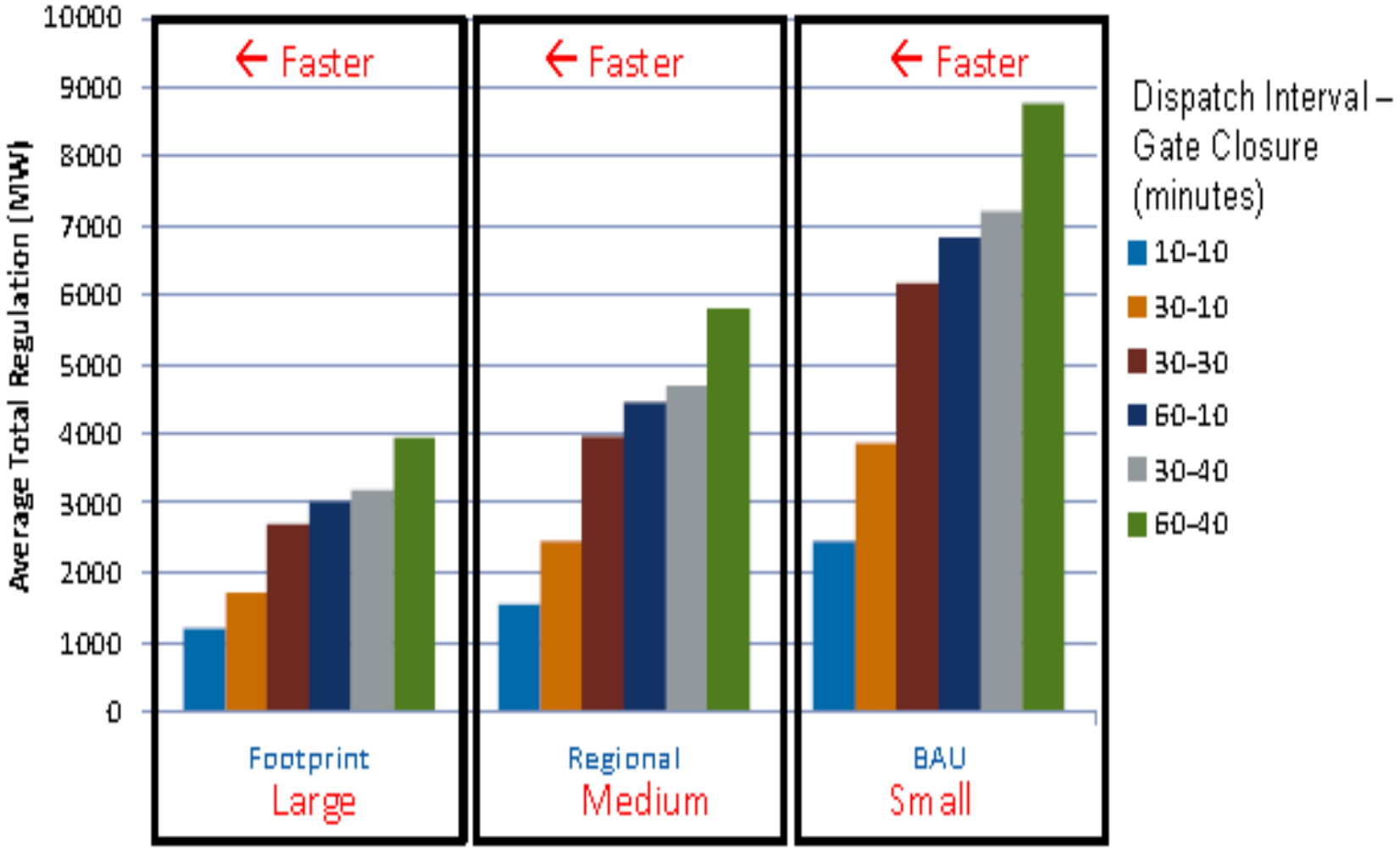


Source PJM: http://www.pjm.com/-/media/committees-groups/forums/tech-change/20180108/20180108-5-minute-settlements-education.ashx

Benefits – US ISOs/RTOs

- Five-minute dispatch - Over 2/3 of the national load
- Five minute scheduling adopted
  - it reduces power system operating costs
  - Enables renewable generation integration.
- Five minute scheduling has helped reduce regulation requirements to below 1% of peak daily load in many ISO/RTOs.
- Studies have shown that integration costs are lower in areas with faster despatch.
  - Eg., integration costs have ranged from $0 to $4.40/MWh with 05-minute dispatch, compared to $7 to 8/MWh with hourly dispatch (WGA 2012)
  - Eg. Western Wind and Solar Integration Study 1 - Sub-hourly scheduling cut in half the amount of fast maneuvering required by combined-cycle plants.
  - Hourly scheduling had greater impact on regulation requirements than the variability introduced by wind and solar power in the scenarios studied.

Despatch Interval and Regulation



Milligan, Kirby, King, Beuning (2011), The Impact of Alternative Dispatch Intervals on Operating Reserve Requirements for Variable Generation. Presented at 10th International Workshop on Large-Scale Integration of Wind (and Solar) Power into Power Systems, Aarhus, Denmark. October

International Experience - USA

Table i. ISO's intraday timeline summary[4]

ISO	Procedure	Frequency	Look-ahead	Commitment	Dispatc	Prices[5]
CAISO	Residual unit commitment (RUC)	Daily	24-168 h	Long start units		Availability[6]
	Short-term unit commitment (STUC)	1 h	4 h	Medium/short		
	Real-time unit commitment and FMM	15 min	60-105 min	Fast start units	✓	✓
	Real-time economic dispatch	5 min	Up to 60 min		✓	✓
ISO-NE	Resource Adequacy Analysis (RAA)	Daily	Oper. day	Non-fast start		
	Additional RAAs	As needed	Oper. day	✓		
	Unit dispatch software	5 min	60 min		✓	Ex-post
MISO	Reliability Assessment Commitment	Daily	Oper. day	✓		
	Intraday RAC	As needed	Oper. day	✓		
	Look-ahead commitment (LAC)	15 min	3 h	✓		
	Real-time SCED	5 min	N/A		✓	Ex-post
NYISO	Supplemental resource evaluation	As needed	Oper. day	✓		
	Real-time commitment (RTC)	15 min	150 min	✓		
	Real-time dispatch (RTD)	5 min	60 min		✓	✓
PJM	Reliability Assessment Commitment	Daily	Oper. day	✓		
	Combustion Turbine Optimizer (CTO)	As needed	Oper. day	✓		
	Ancillary Service Optimizer (ASO)	1 h	60 min	✓		
	Intermediate-term SCED	15 min	60-120 min	✓		
	Real-time SCED	5 min	15 min		✓	✓
ERCOT	Day-ahead Reliability Unit	Daily	Oper. day	✓		
	Hourly RUC	1 h	Oper. day	✓		
	SCED	5 min	N/A		✓	✓

USA ISOs Intraday Timeline Summary (Source: MIT Energy Initiative)

Deliberations in Meetings (1)

- Need to move to “fast” markets
- 5-minute scheduling & settlement and earmarking of the reserves are interwoven processes.
- 5-minute bidding in OTC/PX markets will lead to more granular price discovery.

- 5-minute DSM prices would be a vital indicator for imbalance handling caused especially by renewable generation.
- Provisions for 5-minute may be made mandatory for future procurement of meters.
- Requirement of amendments in the CEA Metering Standards
- 5-minute scheduling & settlement entail regulatory interventions

Deliberations in Meetings (2)

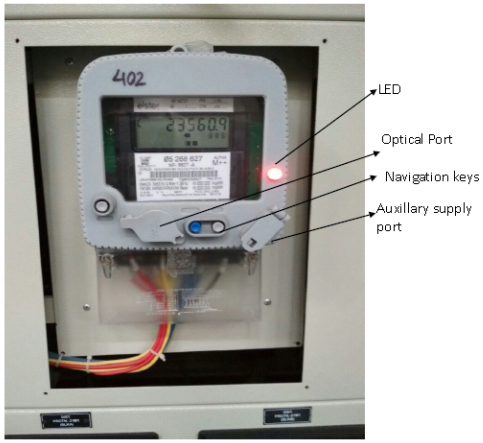
- Handling Transition
  - To begin with, 5-minute metering will be in parallel with 15 minute metering. A changeover date would be applicable
  - “Scheduling and Despatch” has to be aligned with “Settlement” process in 5-min too.
  - To begin with, accounts for both 5-minute and 15-minute accounting may be kept in parallel.
- Capacity building for 5-Minute granular forecasting at state level
- SAMAST implementation would enable states to leapfrog
- Stakeholder Consultations
  - RPC Forum
  - Discoms – Gujarat, Delhi, Tamil Nadu and West Bengal

Meter Demonstration

Main meter: NP-8607 A (Elster)
Model- Alpha M++

Check meter: Y0356046 (Secure)
Model- Apex 150

Main meter: NP-8627 A
Model- Alpha A1640



Check meter: NR-3102 A
Model- Alpha M++

Main Meter – NP 2985A (Secure)
Model E2M021

Check Meter - H 170903 (L&T)
Model ER300P

Meter Testing Witnessed Jointly by Representatives of NLDC, WRLDC, POWERGRID, Gujarat SLDC and Meter Manufacturers

Demonstration of 5-Minute Metering at POWERGRID 400/220 kV GIS Magarwada Station, Daman, 13th Sep 2017

1. List of participants attached
2. Objective:
   a. Demon… ing at 15-minute interval) for record…
   b. Validate… g 15-minute meters
3. Participating M…
   a. M/s Se…
   b. M/s Ho…
   c. M/s L&… the 25th September as the re-configu…
4. Site Description… wing elements:
   a. 400 kV …
   b. 400 kV …
   c. 400 kV …
   d. 400 kV Magarwada Boisar s/c
   e. 315 MVA 40…
   f. 315 MVA 40…
5. Existing Meter Placem…
   a. In 400 kV lines, the main meters are placed at both ends
   b. On the ICTs, main meter on HV side and standby meter on LV side
   c. Drawl of Daman & Diu computed from the HV side meters of the ICTs
   d. All the meters at Magarwada end are of Elster make Model 'Alpha M++'

Magarwada S/s

Meter No.	CT Ratio	PT Ratio	Element Detail
NP-8627-A	1000/1	400/100	400KV Navsari Magarwada - I
NP-8589-A	1000/1	400/110	400KV Navsari Magarwada - II
NP-8598-A	1000/1	400/110	400kv Boisar Magarwada(PG)
NP-8607-A	1000/1	400/110	400KV Kala Magarwada GIS(PG)
NP-8626-A (HV)	600/1	420/110	315 MVA 400/220 kV ICT I
NP-8597-A (LV)	1000/1	245/110	315 MVA 400/220 kV ICT I
NP-8604-A (HV)	600/1	420/110	315 MVA 400/220 kV ICT II
NP-8624-A (LV)	1000/1	245/110	315 MVA 400/220 kV ICT II

WRLDC NLDC SLDC-GJ POWERGRID ELSTER SECURE

Demonstration of 5-Minute Metering at POWERGRID 765/400/220kV GIS Vadodara Station, Gujarat, 10th Oct 2017

1. List of participants attached in annexure-1
2. Objective:
   a. Dem… ling at 15 minu…
   b. Vali… isting 15-minu…
3. Site descrip… following elements
   a. 400…
   b. 400…
   c. 400…
   d. 400…
   e. 765…
   f. 765…
   g. 765/…
   h. 400/…
4. Existing Me…
   a. Spec… ICTs are stand… main meters.
   b. SEMs at Vadod… scription of meters is as below.

Vadodara S/s

S. No	Meter ID	Make	Model No.	Description
1	NP-2979-A	SML	E2M021	765KV Indore(PG) line at Vadodara(PG)
2	NP-2977-A	SML	E2M021	765KV Dhule(BDTCL) line at Vadodara(PG)
3	NP-2981-A	SML	E2M021	400KV Pirana(PG) line-1 at Vadodara(PG)
4	NP-2983-A	SML	E2M021	400KV Pirana(PG) line-2 at Vadodara(PG)
5	NP-2985-A	SML	E2M021	400KV Asoj line-1 at Vadodara(PG)
6	NP-2986-A	SML	E2M021	400KV Asoj line-2 at Vadodara(PG)
7	NP-2978-A	SML	E2M021	765KV side ICT-1 at Vadodara(PG)
8	NP-2982-A	SML	E2M021	400KV side ICT-1 at Vadodara(PG)
9	NP-2980-A	SML	E2M021	765KV side ICT-2 at Vadodara(PG)
10	NP-2984-A	SML	E2M021	400KV side ICT-2 at Vadodara(PG)
11	NP-5446-A	ELSTER	Alpha M++	400KV side of ICT-1 at Vadodara(PG)
12	NP-5448-A	ELSTER	Alpha M++	220KV side of ICT-1 at Vadodara(PG)
13	NP-5447-A	ELSTER	Alpha M++	400KV side of ICT-2 at Vadodara(PG)
14	NP-5449-A	ELSTER	Alpha M++	220KV side of ICT-2 at Vadodara(PG)

SLDC Gujarat WRLDC NLDC POWERGRID LBT-Baroda LBT

Meter Demonstration & Testing Results - Summary

Title	Elster	Secure	L & T
Reconfiguration of existing 15-min meter to 5-min	Possible in Existing meters, Simple, on-site	Not possible in existing meters, possible in new models only, on-site	Not possible in existing meters, new models only, off-site
Reconfiguration Time	Fast	Fast	At factory
Retention of old data	Old data erased	Block wise data erased cumulative data retained	No retention
Conversion software for NPC File	The software for conversion to .npc file is available	Software for converting to NPC format needs upgrade	The software for conversion to .npc file is not available
Wh recording	Acceptable	Acceptable	Acceptable
VARh recording	Variations observed due to integration time difference		Data not available
Storage	Could not be ascertained		Storage upgraded in factory

Required Regulatory Interventions

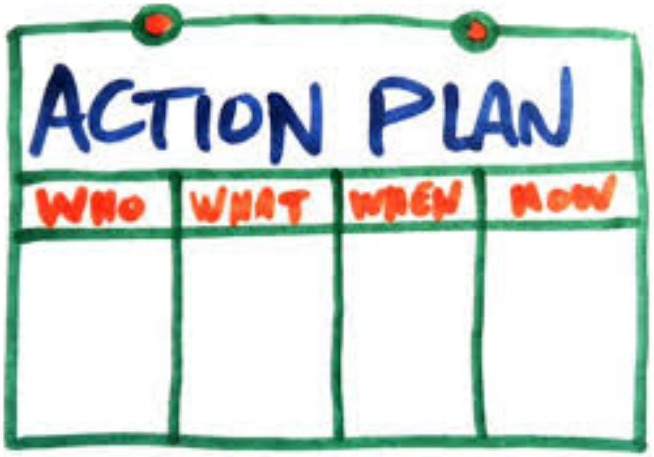
- **CERC Regulations**
  - Terms and Conditions of Tariff
  - Indian Electricity Grid Code
  - Deviation Settlement Mechanism
  - Open Access in inter-State Transmission
  - Ancillary Services Operations
  - Measures to relieve congestion in real time
- **Need for Expert Group:**
  - Technical Specifications for Interface Energy Meters
  - File Interchange Formats
  - Automated Meter Reading System
  - Communication Infrastructure
  - Application software at Central Location
  - Metering System Administration
  - Recovery of CAPEX and O & M charges

Modifications in CEA Metering Standards

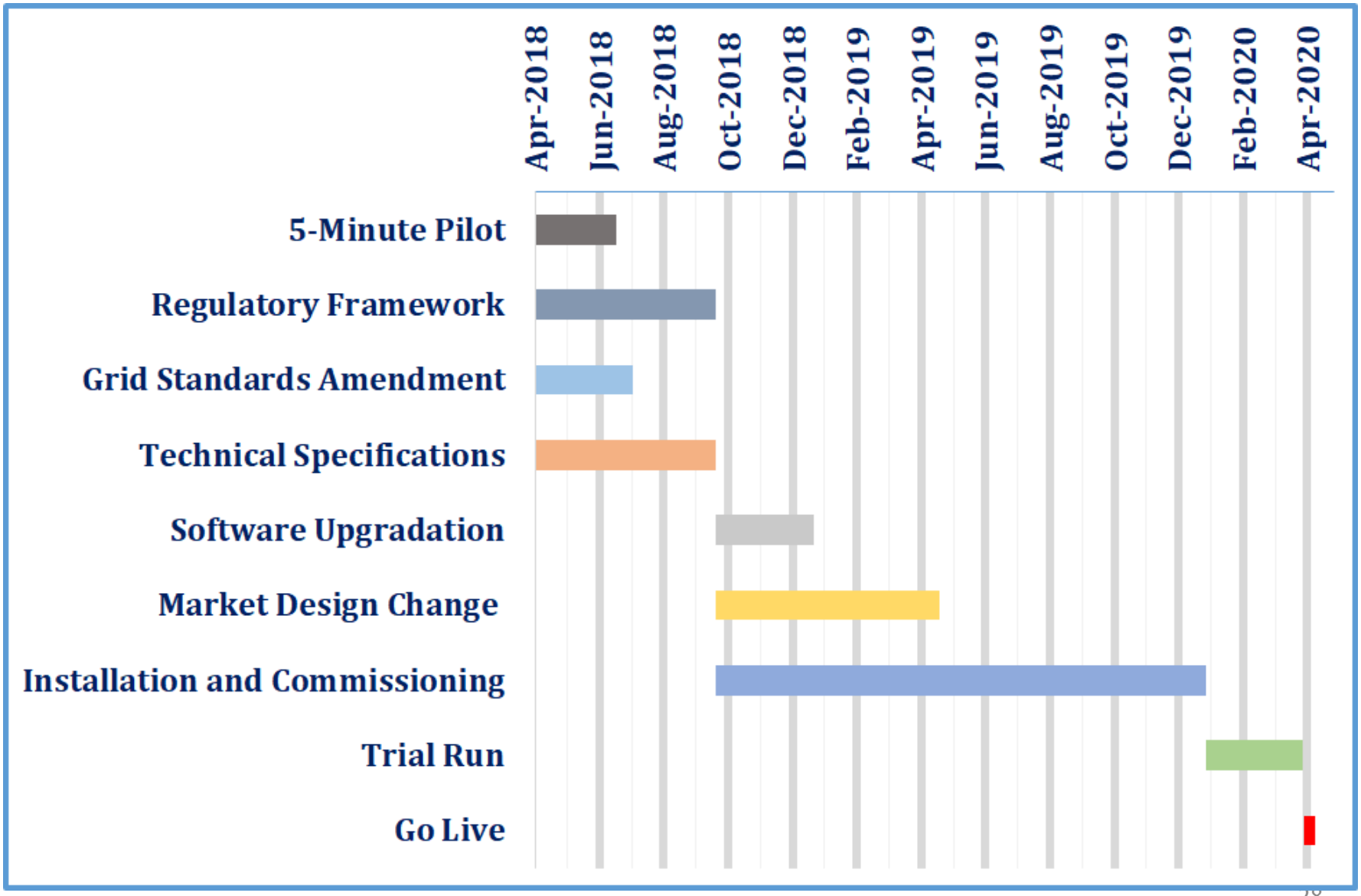
- Record frequency data at 0.01 Hz resolution
- Net VARh and voltage to be recorded for each time block.
- Auxiliary Supply - SEM may normally be capable of operating with power drawn from the VT secondary circuits.
- Provision to operate on control power supply to the SEM from 110V DC / 220V DC.
- Built-in calendar and clock
- Secured software based solution for meter time correction and synchronization with GPS
- DLMS compliant for SEM communication protocol – Indian COSEM standard
- Data security ensured as per IEC-62056-51 standard
- Automated Meter Reading (AMR)
- Uniform protocol for communication for meters of different vendors.
- Optical coupling cable should be compatible with all types of meters.
- Replacement of defective meters within a stipulated time frame

Action Plan

- Forecasting
- Scheduling & Despatch
- Power Exchanges – 5 minute price discovery
- Administration and Treatment of DSM
- Metering and Settlement
- Regulatory Amendments
- Gate closure provisions
- CEA Metering Standards Amendments
- Upgradation/Replacement of meters
- Cost Recovery
- Software upgrade at the RPC/RLDC/SLDC
- Implementation of SAMAST Recommendations
- Stakeholder Capacity Building
- Centre for Power Sector Information Technology Services



PERT Chart of Activities



Cost Benefit Analysis

(~ 6000 meters @ ₹ 30,000/Meter) at inter-state level with 5 minutes integration

S.No.	Item	Estimated cost
1.	Tentative Cost of replacement of all Pan-India Interface Energy Meters	**₹ 20 Crore**
2.	Additional costs for hardware/software upgradation (@ 50 %)	**₹ 10 Crore**
3.	**Total**	**₹ 30 Crore**

- **Method 1**
  - PoC Yearly Transmission Charges (YTC) ~ ₹ 32,000 Crore.
  - **Cost of replacement ~ 0.009 % of YTC.**
- **Method 2**
  - 15-minute despatch - Reserve requirement is of the order of 3300 MW.
  - Daily Average RRAS despatch ~ 8 – 10 MUs
  - 5-minute despatch - Reserve requirement is of the order of 1400 MW
  - Assuming RRAS despatch decreases by say, at least 30 %, on an daily average basis
  - Assuming fairly accurate load forecasting & portfolio management
  - Daily Average RRAS despatch reduces to ~ 5 – 7 MUs -> **Saving of ~ 3 MUs/day**

Recommendations

- Development of Forecasting as a Core Area in System Operation
- Implementation of Five minute Scheduling and Despatch
- Implementation of 5-minute bidding in OTC/PX
- Five-minute Energy Accounting and Settlement System
- Administration and Treatment of the Five-minute Deviation Price
- Pan-India Pilot Project on 5-minute metering
- Change in data exchange file structures and other technical issues
- Regulatory Interventions
- Amendments in CEA Metering Standards
- Upgradation/Replacement of Meter Infra
- Stakeholder Capacity Building
- Implementation of SAMAST Recommendations

Thank You !