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

POSOCO-ERLDC

Constitution of Sub-Group

- 11th Meeting of the “FOR Technical Committee for Implementation of Framework on Renewables at the State Level" - Chennai - 28th March 2017

- Members
  - Shri S.K. Soonee, Advisor, POSOCO
  - Representative of all RPCs and NPC
  - Representative of CEA
  - Representative of POSOCO
  - Representative of CTU
  - Representative from one RE rich state each in NR, WR and SR

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

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

Historical Perspective…

- **Pre – ABT era**
  - Daily energy booking
  - Joint Meter Reading (JMR) based Monthly accounting
  - Overlay accounts, frequency taken from SCADA
- **ABT Reforms**
  - 15-minute scheduling, despatch, metering (SEMs), accounting and settlement
  - 15-minute deviation (UI) accounts
- **Bilateral transactions**
  - 15-minute trading in power and settlement

1994: M/s ECC Report

1995-98: National Task Force, Regional Task Force

2000: CERC ABT Order

2002-03: ABT Implementation

2004: Open Access

Inadequacies

- No incentives for generators/utilities to respond for frequency control
- Absence of merit order operation, Grid indiscipline
- No signal for power trading
- Perpetual operational & commercial disputes
- Poor supply quality , Overall economy lost

Systemic Transformation

- Multi-Part Performance based Tariff
- Day Ahead Scheduling
- System of incentives and penalties

Recent Times…Near Future

2008: Power Exchanges

- **Collective transactions**
  - Hourly bidding
  - Intrapolation to 15-minutes for aligning with existing scheduling
  - Hourly clearing and settlement of trades (energy)
  - Deviation accounting at 15-minutes

2012: 15 Minute Bidding

- **Sub-hourly Bidding**
  - 15-minute clearing and settlement (energy)
  - Aligning the Power Exchange markets with scheduling, despatch & settlement

2016: Ancillary Services

- **RRAS**
  - Aligned with existing scheduling, despatch & settlement practice
  - Need for ‘fast’ / ‘quick’ response from generators

2017: AGC Pilot Project

- **Petition with CERC in April, 2017**
  - Stakeholder consultations on implementation plan
  - Secondary Control recommended as an Ancillary Service.

2022: ???

Imperatives for moving to ‘Fast Markets’…(1)

- **Learning from implementation of Ancillary Services**
  - Requirements under Ancillary Despatch are
    - Quick / Fast response & turnaround time
    - Despatch for short durations
      - Example: hour boundary changeover
  - A costly resource, to be used in limited manner for system reliability
    - Increasing granularity would optimize cost of despatch
  - Earliest possible implementation of RRAS despatch instruction is 16 minutes – Fast Tertiary control at best

Imperatives for moving to ‘Fast Markets’…(2)

- **Re-scheduling of resources**
  - 4-blocks of 5 minutes (20 min) vs 4-blocks of 15-minutes (60 min)
- Future Technologies
  - Smart Grids, Storage, Demand Response, Electric Vehicles
- Short despatch intervals and sub-hourly energy markets
  - Economic signals for conventional generators and flexible generators to respond to short term fluctuations in load and variable generation
- The suite of day-ahead, intraday, real-time (balancing) and ancillary services markets are the place where prices optimise the system in the short run, and reveal the value of electricity (and thus investments in the long run).

Imperatives for moving to ‘Fast Markets’…(3)

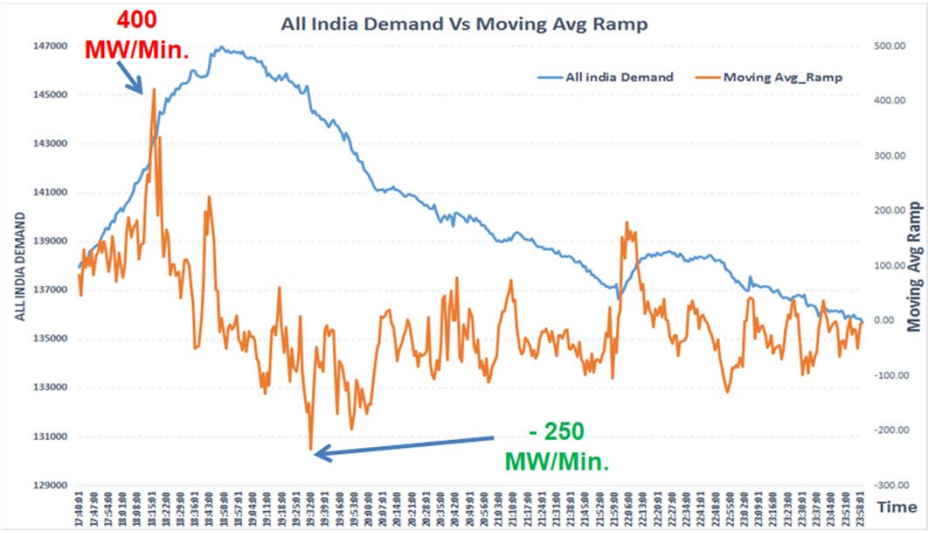
- **Increasing RE penetration**
  - Increased level of variability and uncertainty in power grid operations;
  - Faster response will help to respond to fluctuations in load and variable generation.
  - A need for an additional ancillary service for supplemental ramping or load following when the generation fleet providing energy can’t respond fast enough.
  - Better alignment with the timescale of variable RE resources, enables better utilization of wind and solar forecasts and therefore, lead to reduced wind and solar curtailment.

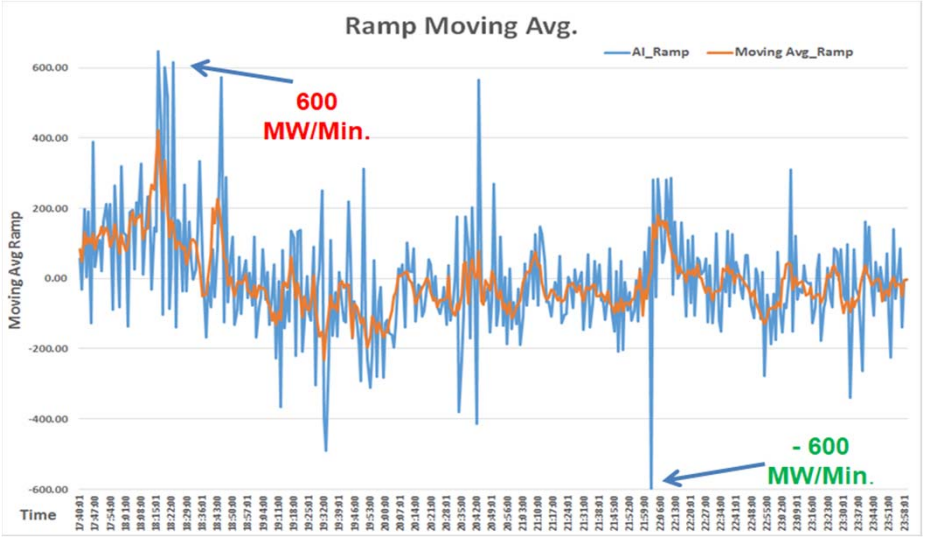
Imperatives for moving to 'Fast Markets'…(3)

- **Lowering of Overall System Operating Costs**
  - Short dispatch intervals allow more frequent re-dispatch of the whole systems.
  - Long dispatch intervals mean that deviations in load and variable generation for the interval for be significantly larger.
  - The timing of solar and wind variability occurs more in the sub-hourly to multiple-hour timeframe.
  - The accuracy of RE forecasts is significantly higher the closer they get to dispatch.
    - **Consequently, the ancillary service requirements will be lower**
  - **Hence, faster dispatch leads to lower overall system operating costs with/without renewable generation.**

Imperatives for moving to ‘Fast Markets’…(3)

- Ramping Requirements

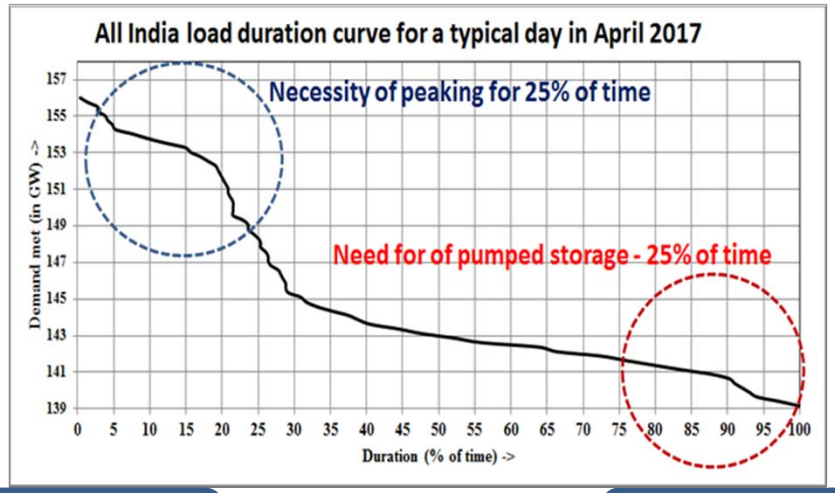




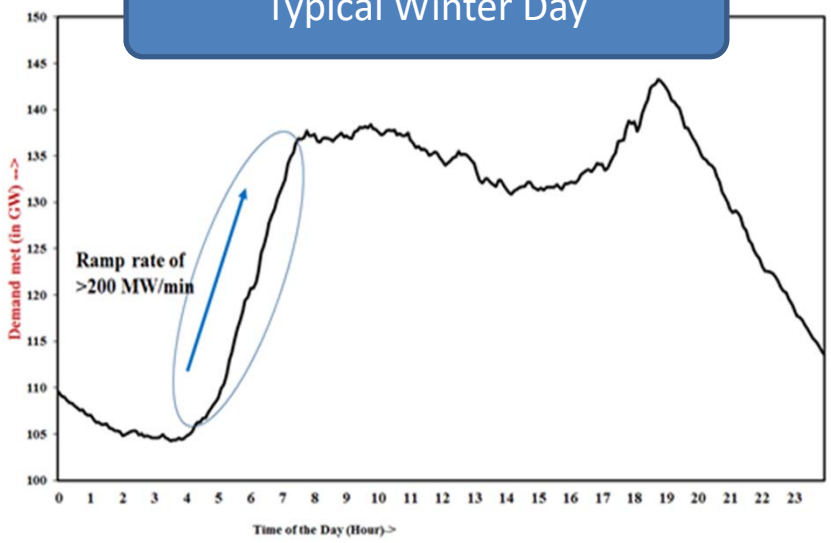
- Faster markets will introduce flexible ramping products to help take care of contingencies and improve the short-term operational flexibility of the electric grid.

Imperatives for moving to ‘Fast Markets’…(4)

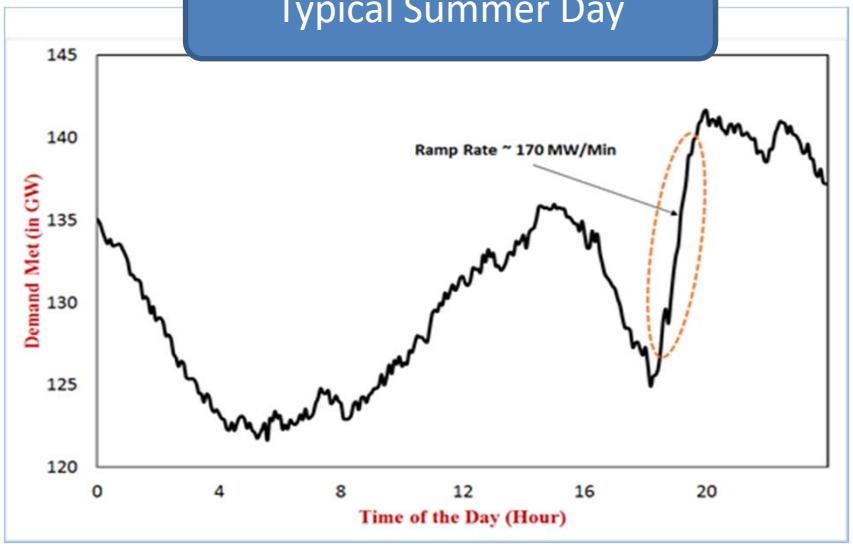
- **Lowering of Overall System Operating Costs**



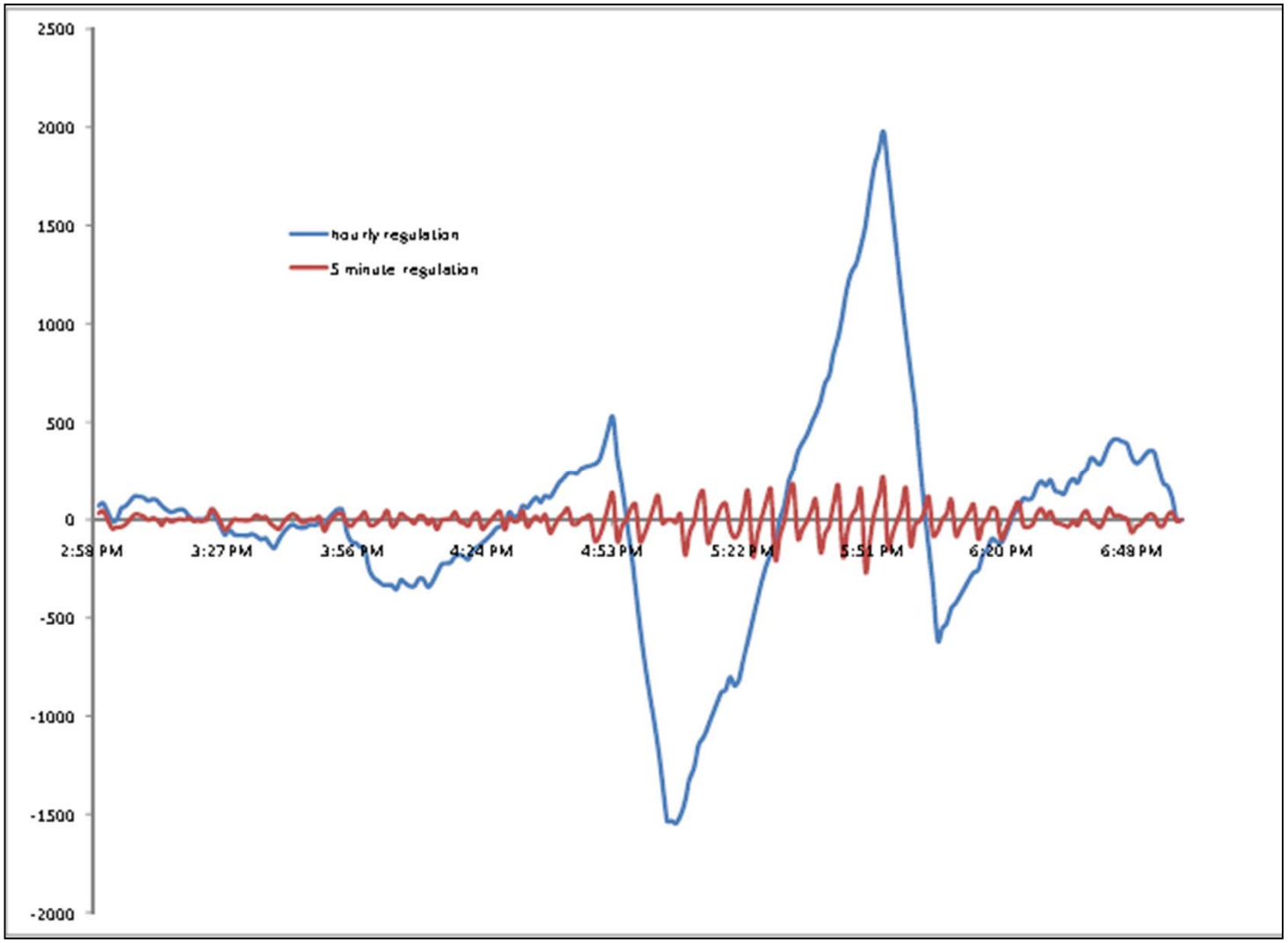
Typical Winter Day



Typical Summer Day



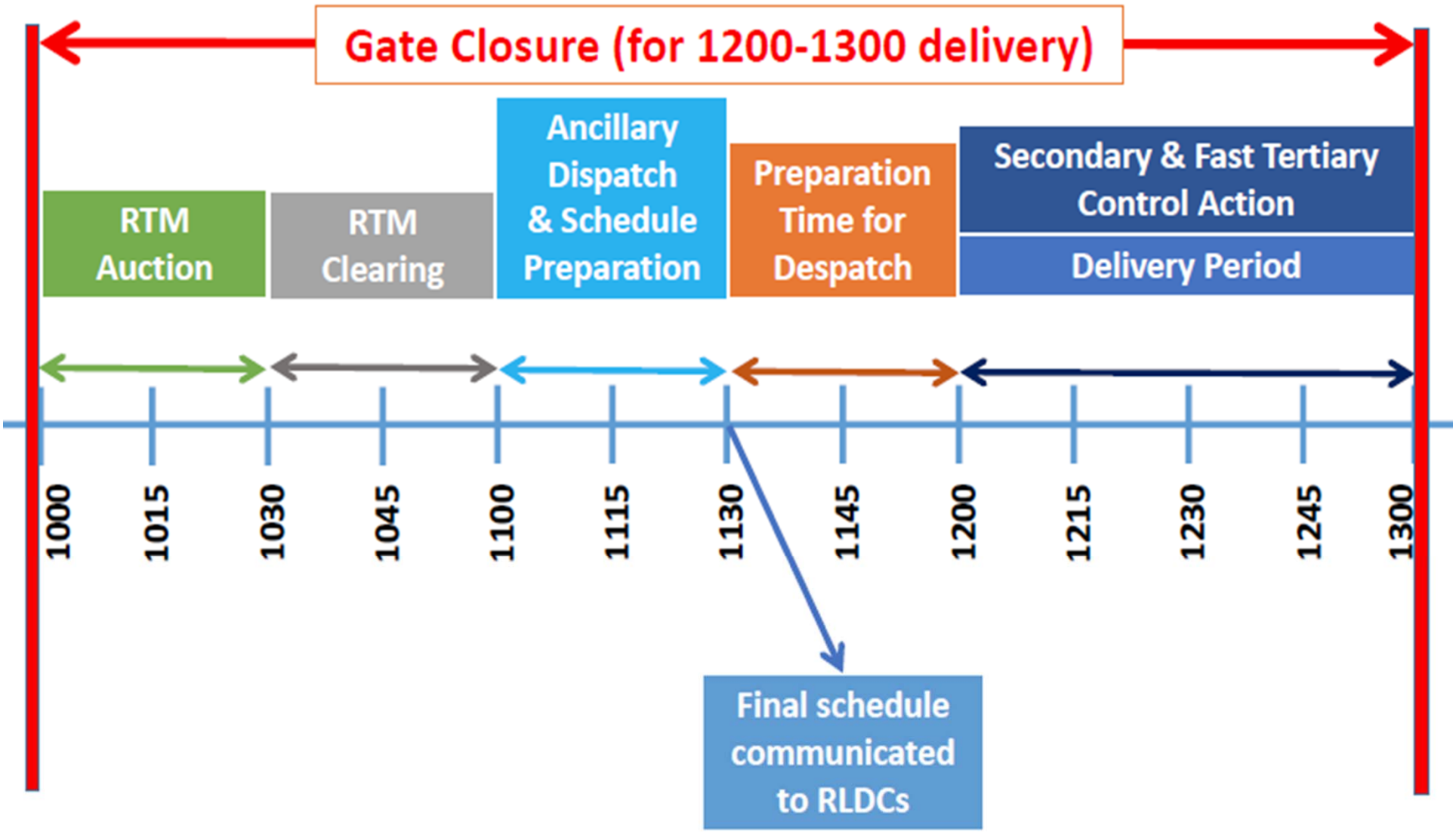
Regulating Reserve Needs for 5-minute scheduling vs. hourly scheduling

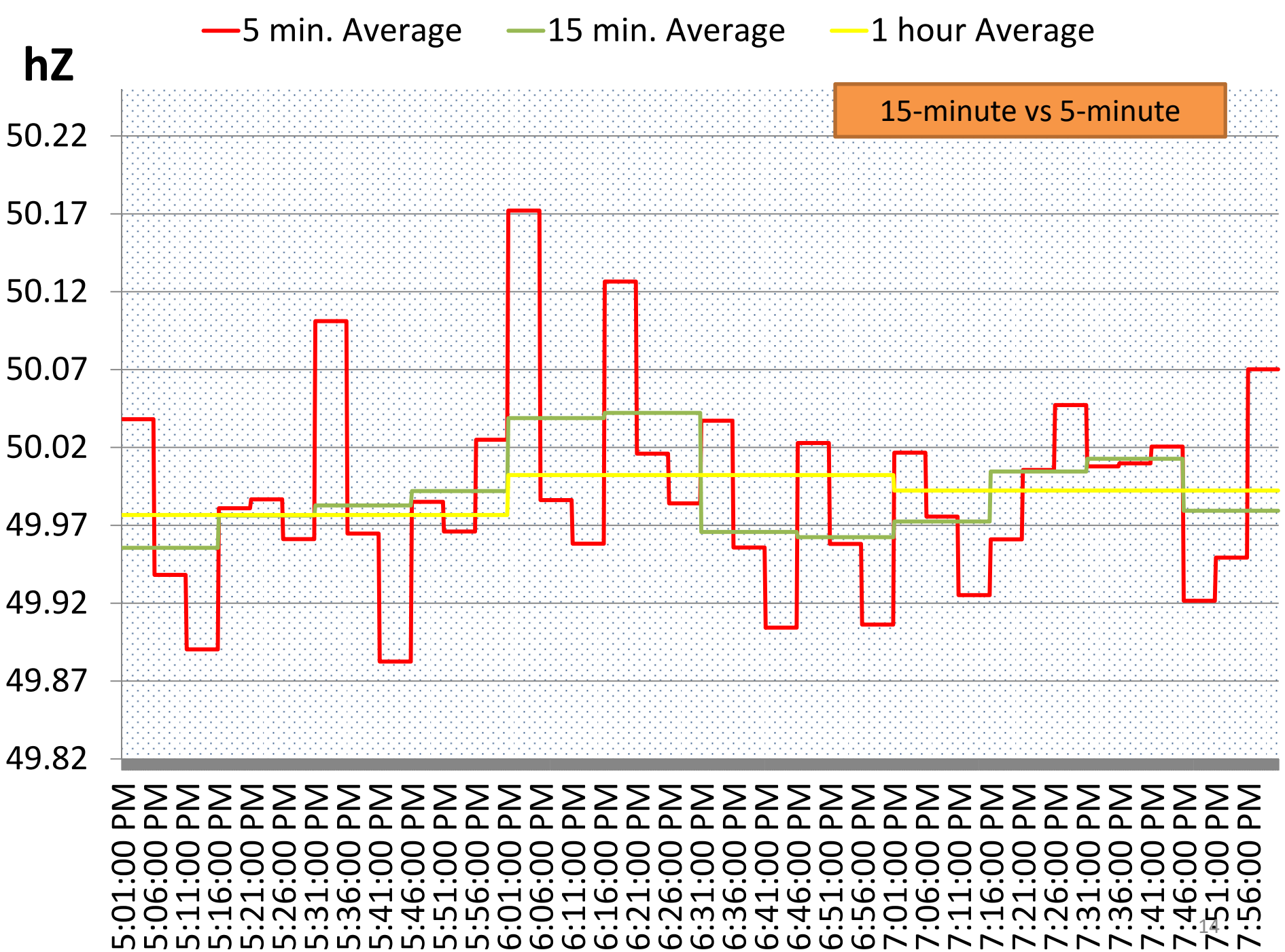


Source: Operating Reserves and Variable Generation, NREL

http://www.consultkirby.com/files/NREL-TP-5500-51978_Operating_Reserves_and_Variable_Generation.pdf

Gate Closure




5 min. Average
15 min. Average
1 hour Average
hZ
15-minute vs 5-minute
50.22
50.17
50.12
50.07
50.02
49.97
49.92
49.87
49.82
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Policy / Regulatory Mandate

- Report of the Expert Group on 175 GW by 2022, NITI Aayog

Interventions to reduce overall system costs [Section 3.23(ii)]

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

- CERC order dated 24-May-2011 in Suo Motu Petition No. 127/2011

"…..Thereafter matter was discussed in the Central Advisory Committee (CAC) meeting held on 29th September, 2010 with the agenda "How to make power markets more efficient". The CAC recommended for modification in the bidding time block from one hour to fifteen minutes….."

- SAMAST Report, Technical Committee of the Forum of Regulators, 2016

"5.6……The States who are about to implement the intrastate accounting and settlement system could leapfrog and go for scheduling and settlement at 5-min interval. The scheduling software and the energy meters specifications could in line with the above. All the other States and the Regional Pools shall also endeavor to have systems and logistics for 5-min scheduling and settlement system…."

International Experience (1)

- Australia Energy Market Operator (AEMO)
  - "Scheduling and Despatch" decoupled with "Settlement" from 1998, prior to large scale RE integration
    - Scheduling and despatch at 5-minute interval
    - Settlement at 30 minute interval using average of 5-minute prices in that interval
  - 2016: Debate/Stake holder consultations being held to align "scheduling & despatch" interval and the "settlement" interval
- USA

RTO / ISO	Despatch Interval	Settlement Interval
CAISO	5-minute	5-minute
ISO - NE	5-minute	Hourly average
MISO	5-minute	Hourly average
NYISO	5-minute	5-minute
PJM	5-minute	Hourly average
SPP	5-minute	5-minute

FERC Final Rule on "Settlement Intervals and Shortage Pricing in Markets Operated by Regional Transmission Organizations and Independent System Operators", 16th June 2016

".....We require that each regional transmission organization and independent system operator align settlement and dispatch intervals by:

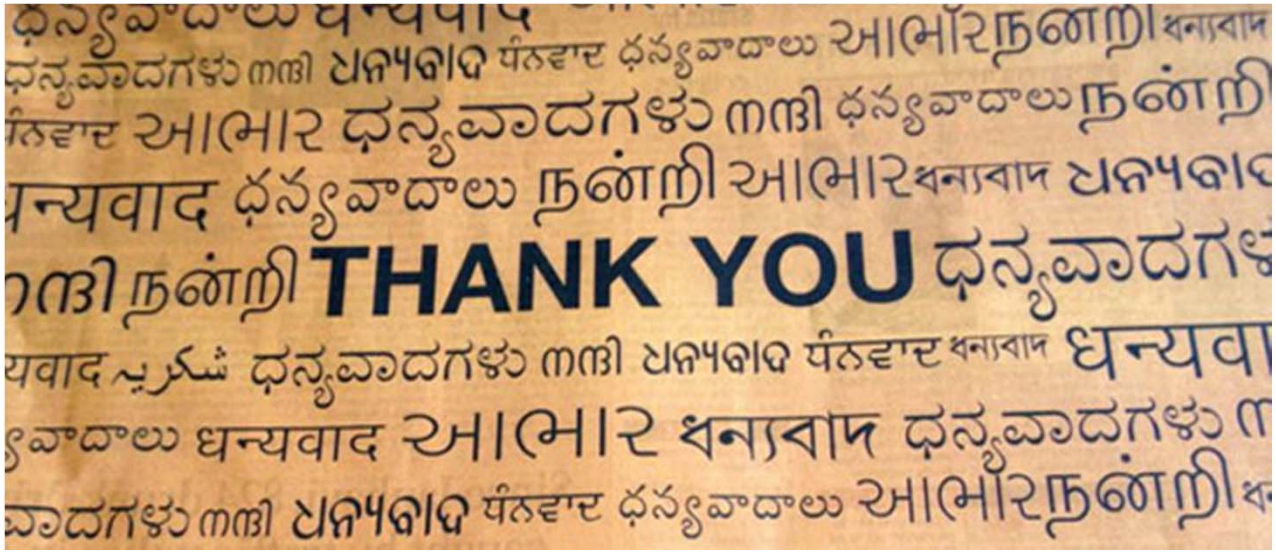
(1) settling energy transactions in its real-time markets at the same time interval it dispatches energy;

(2) settling operating reserves transactions in its real-time markets at the same time interval it prices operating reserves; and

(3) settling intertie transactions in the same time interval it schedules intertie transactions....."

Actions Needed for implementation of Fast Markets in India

- Forecasting, Scheduling & Despatch
- Markets : 5-minute bilateral markets; Power Exchanges – 5 minute price discovery
- Deviation Settlement 5-minute prices in DSM
- Settlement system – energy accounting, financial settlement
- Changes in various CERC/SERC Regulations
- Gate closure provisions
- Changes in CEA Metering Standards
- Replacement of meters
- Software upgrade at the RLDCs/SLDCs – scheduling, meter data processing, accounting, settlement
- Software upgrade at the RPCs
- Holding workshops, dissemination, stakeholder capacity building


THANK YOU


TEAM
WORK