Five Minutes Scheduling & Fast Response Ancillary Service

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NLDC, POSOCO
Contents

• Evolution of Indian Power Sector
• Development in other Sector
• Advantage of 5 Minutes Scheduling
  - Increasing Renewable Energy Penetration
  – Harnessing and Incentivizing Flexibility
  – Ramp Management
  – Improved Forecasting, Scheduling & Despatch
  – Reduced Requirement of Reserves
  – Economy in System Operation
• Fast Response Ancillary Service (FRAS)
Looking Back to Look Forward

Pre – ABT era
- Daily energy booking
- Joint Meter Reading (JMR)
- Overlay accounts

Inadequacies
- No incentives for utilities
- Grid indiscipline; No signal for power trading
- Perpetual operational & commercial disputes

ABT Reforms
- 15-minute scheduling, despatch, metering, accounting & settlement

2000: CERC ABT Implementation

2002-03: ABT Implementation

2004: Open Access

Systemic Transformation
- Multi-Part Performance based Tariff
- Day Ahead Scheduling
- Incentives and penalties

Bilateral
- 15-minute trading

1994: GoI ECC Report

1995-98: NTF and RTF
5.9.12 We have also considered the views of some of the beneficiaries to change the time block of 15 minutes. We are convinced that a short time block of 15 minutes can be expected to ensure alertness on the part of the dispatcher to take quick corrective action for maintaining desirable system parameters. If the interval is larger, there may be a tendency to defer the action with possibilities of steep frequency excursions thereby inviting damages to the system.
Looking Forward to Leap Ahead

RRAS
• Utilizing Undespatched surplus

Sub-hourly Bidding
• 15-minute clearing and settlement (energy)

2012: 15 Minute Bidding

2016: Ancillary Services

2018: AGC Pilot Project

Future

5-Minute Accounting
• Granularity
• Ramp management.

Collective transactions
• Hourly bidding

DERs, Electric Vehicles, Storage, Financial Products
Developments in Other Sectors...

Airlines

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

Railways

Banking

Petroleum

Stock Exchanges

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*NSE Annual Data Charges, Capital Market Segment
Advantage for moving to 5-Minute Scheduling & Settlement

- Learning from implementation of Ancillary Services
- Increasing Renewable Energy Penetration
- Harnessing and Incentivizing Flexibility
- Ramp Management
- Improved Forecasting, Scheduling & Despatch
- Reduced Requirement of Reserves
- Economy in System Operation
Increasing Renewable Energy Penetration

Maximum RE day (111 GW), 23 June 2022, 12:15

Sample Day in 2022 (Source: GtG Study Report)
Ramp Management

Typical All India Load Curve in Winter

Typical All India Load Curve in Summer

Ramp rate = 170 MW/Min
Reduced Variability and Reserve Requirement

Hourly Despatch ~ 11,000 MW
15-Minute Despatch ~ 3300 MW
05-Minute Despatch ~ 1400 MW
Scheduling and Bidding in PX

5 Minute, 15 Minute and Hourly Schedules

15 Minute and Hourly Sell Volumes for a Sample Day

15 Minute and Hourly Prices for a Sample Day
Policy / Regulatory Mandate

• CERC Consultations/Orders/Regulations
  – 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)

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International Experience

- 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

- United States of America (USA)

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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 - 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 on AGC as pilot
- FRAS
- RRAS
Pattern of Average Frequency

- DSM Regulation: 17th Feb 2014
- RRAS Regulation implemented from 12th April 2016

Frequency (Hz)

- Jan-13 to Oct-18

Data points indicate a consistent pattern with notable changes at the specified dates.
Present Regulatory Provisions for RRAS

• 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.
Challenges in Hydro Scheduling under RRAS

Need for Fast Regulation Service and Ramping Support

Hydro: Energy limited
Thermal: Ramp limited

Other than Power Generation Commitments

Marginal Cost is Zero

And hence, FRAS...
Regulatory Initiative towards FRAS

- CERC order in Petition No. 07/SM/2018 (Suo-Motu) dtd. 16 Jul’18
  - Pilot on 05-Minute Scheduling, Metering, Accounting and Settlement for Thermal/Hydro
    - Letter of Award to be placed by CTU by Nov’18 end.
  - Pilot on Hydro as Fast Response Ancillary Services (FRAS)

All constraints declared by the hydro stations shall be honoured

Total energy delivered over the day shall be maintained as declared by the hydro station.

The total energy dispatched under FRAS shall be squared off by the end of the day

The schedules of the beneficiaries shall not be disturbed in the despatch of FRAS

RPCs to issue weekly FRAS accounts along with RRAS accounts

Incentive shall be paid from the DSM Pool on mileage basis at the rate of 10 paisa/kWh both for “up” and “down”
Triggering Criteria

- Hour Boundary Frequency Variations
- Sudden Variations in Demand
- Ramp Management
- Grid Contingency
- RE Variation

FRAS Despatch for Every Discrete 5-min Time Block
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.
Operationalization of FRAS...

Sample Hydro Station Data

Chamera-I (I/C = 540 MW)
Unit Size - 180 MW

Ramp Rate Up/Down: 25 MW/min

P1 (7 MW)
0.65 Cumecs/MW

P2 (91 MW)
0.65 Cumecs/MW

P3 (150 MW)
0.65 Cumecs/MW

P (180 MW)
0.65 Cumecs/MW

P4 (198 MW)
0.65 Cumecs/MW

Over Load Capacity for Primary Response

Margin for FRAS

Forbidden Zone
91 MW to 150 MW

Margins for FRAS

MW

0
30
60
90
120
150
180
210

t = 0 Min.


t = 10 Min.
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<th>P2 (MW)</th>
<th>P3 (MW)</th>
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## Validation of Data...(2)

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**FRAS Software**

- **Plant under FRAS**
- **5 min block schedule**
- **Schedule energy up to current block**
- **Block wise available margin for Up regulation**
- **Declared energy of station**
GENERATION OF HYDRO STATION
(NJPC/RAMPUR/EHRI/KOTESHWAR/PONG/DULHASTI/KOPILI/LOKTAK)

ACTUAL GEN
RLDC SCH
FRAS SCH

FRAS

FRAS

FRAS

26th Nov’2018
Accounting & Settlement

Respective RPC to publish FRAS Account along with DSM & RRAS Account

15 min Implemented schedule & SEM data for DSM

5 min FRAS schedule to RPC

No fixed charge or variable charges to be paid

Mark-up on mileage basis

\[ E_m = \sum |E_{up}| + \sum |E_{down}| \times (10 \text{ paisa/kWh}) \]
Thank You