14th Capacity Building Programme for Officers of Electricity Regulatory Commissions

Regulatory Approach to Tariff Setting in the Power Sector – Power Procurement and Renewable Energy

March 1 – 3, 2021 | IIT Kanpur

Organised by
Centre for Energy Regulation
Department of Industrial and Management Engineering
Indian Institute of Technology Kanpur
Real Time Market and Emerging Market Development

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Disclaimer

The views and opinions expressed in this presentation are mine alone and do not necessarily reflect those of the Commission.
Content

- Development of Power Sector in India
- Current Contracts and practice in India
- Real Time Market
- Emerging Market Development
  - Market based economic dispatch
  - Ancillary Service Market
Development of Power Sector in India

Until 1990

No Competition
- No choice
- Government makes decision

G

T

D/R

Consumers

1990s ….

Generation Competition
- Single buyer has choice

G G G G

T / SB

D/R

Consumers

2003 onwards

Wholesale Competition
- Distribution/retail companies have choice

G G G G

Trdr./PX

T / MO

D/R

Consumers

Retail Competition
- Consumers have choice

G G G G

T / MO

D

D/R

R R R R

Consumers

Future – under Discussion

Future – under Discussion
Electricity Transactions in India

For April to Nov 2020

- Long Term Transactions: 89%
- Bilateral Through Traders: 5%
- Bilateral Discoms: 2%
- Through Power Exchanges: 1%
- Through DSM: 3%
RE development in India

India follows unique approach of judiciously combining Policy and Regulatory for RE development.
Real Time Market

-opportunity to buy-sell closer to delivery period
Real Time Market – Rationale

- Existing Mechanism and their Issues
  1. Intra-day bilateral contingency transactions
  2. Intra-day segments of the power exchanges
  3. Rescheduling by using Right to Recall
  4. Deviation Settlement Mechanism (DSM) and Ancillary Services (AS) Mechanism

Treatment of DSM
- DSM is meant for last mile imbalance management and frequency control.
- DSM used as an avenue for real time energy procurement and sale;

Liquidity in Power Exchanges
- Volume traded under intra-day market approx. 0.1% of total generation
- Price discovery methodology of “Pay as you bid” instead of “Uniform Clearing price”

Absence of Gate Closure
- Right to Recall: Non participation of URS in intra day market due to right to recall prior to 4 time blocks.
- Absence of gate closure prevents firmness of schedule.
- Ancillary services are being for longer period

Real time market with Gate Closure to meet Real time imbalance with increase in RE penetration was need of an hour
### Real Time Market- Rationale

**Larger Pool**
- Organised platform with access to a larger pool for buyers and sellers

**RE Integration**
- Market mechanism closer to real time to handle RE variability

**Avenue for Merchant plants**
- Avenue for merchant / un-tied capacities to sell power

**Managing demand in real time**
- Option for managing real time load variation

**Organized market vis-à-vis DSM**
- RTM to induce generators / discoms to organized energy market and reduced dependence on DSM

**Collective vs. Continuous bids**
- Collective transaction expected to bring in confidence of stakeholders in RTM

**Introduction of gate closure**
- Provision of right to recall 4 time blocks before delivery affects firmness of schedules and in turn liquidity in the market. Hence the need for Gate closure.

*Future power markets would be characterized by huge demand-supply variability leading to grid reliability issues. There is a need for designing of organized real time market in the country.*
Real Time Market – Features

• Delivery Period- Half hourly market – 48 Market Runs in a day

• Price Discovery mechanism – double sided closed auction with uniform price – same as day ahead market

• Introduction of Gate Closure - Gate closure implies the closure of the gate for trading in real-time market after which the bids submitted to the Power Exchange cannot be modified for a specified delivery period.

• Right To recall - shall end seven /eight time block prior to the delivery period

• Generator having long term contract and participating in RTM will be required to share net gains (after accounting for energy charge)

• RTM would be financially and physically bidding market

• Any deviation would attract charges as per DSM Regulations
Real Time Market – Features

<table>
<thead>
<tr>
<th>RTM auction start time</th>
<th>RTM auction end time</th>
<th>RTM clearing interval</th>
<th>Schedule prep and Communication</th>
<th>Delivery period (MCP and MCV will be discovered for each 15 minute block)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22:45 Hrs (of the previous day)</td>
<td>23:00 Hrs (of the previous day)</td>
<td>23:00-23:15 Hrs (of the previous day)</td>
<td>23:15-24:00 Hrs</td>
<td>00:00-00:30</td>
</tr>
<tr>
<td>23:15 Hrs (of the previous day)</td>
<td>23:30 Hrs (of the previous day)</td>
<td>23:30-23:45 Hrs</td>
<td>23:45-00:30 Hrs</td>
<td>00:30-01:00</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>22:15 Hrs</td>
<td>22:30 Hrs</td>
<td>22:30-22:45 Hrs</td>
<td>22:45-23:30 Hrs</td>
<td>23:30-00:00</td>
</tr>
</tbody>
</table>
Real Time Market – Features

Any Revision in the odd time block will be effective from 7th time block, counting the time block in which revision is made to be the first one.

Any Revision in the even time block will be effective from 8th time block, counting the time block in which revision is made to be the first one.
Real Time Market – Features

<table>
<thead>
<tr>
<th>Buyers – Participation</th>
<th>Sellers – Participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distribution Companies : around 50</td>
<td>Distribution Companies : around 40</td>
</tr>
<tr>
<td>Generating Companies : around 22</td>
<td>Thermal Genco : around 140</td>
</tr>
<tr>
<td>Open Access/ Captive : around 350</td>
<td>Hydro Genco: around 25</td>
</tr>
</tbody>
</table>

- Discoms are in RTM participating as portfolio manager to balance RE power in its control area.
Real Time Market – Features

**RTM: June-December, 2020**

### Real Time Market Features

<table>
<thead>
<tr>
<th>Highest Daily Cleared</th>
<th>53090.25</th>
<th>MWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Daily Buy</td>
<td>67861.48</td>
<td>MWh</td>
</tr>
<tr>
<td>Highest Daily Sell</td>
<td>113130.4</td>
<td>MWh</td>
</tr>
<tr>
<td>Maximum Buy</td>
<td>5595</td>
<td>MW</td>
</tr>
<tr>
<td>Maximum Sell</td>
<td>7552</td>
<td>MW</td>
</tr>
<tr>
<td>Maximum Cleared</td>
<td>4203</td>
<td>MW</td>
</tr>
</tbody>
</table>
Market Based Economic Despatch
Market Based Economic Despatch – Rationale

Key issues in current dispatch

- State Discoms resort to **self scheduling** of generation plants without visibility of low cost generation in nearby States
- **Costlier generation** plants are run in a state whereas cheaper and efficient low cost plants in nearby states are not utilized fully – increase in inefficiency and cost of generation
- **Lack of system marginal cost** - No obligation on discoms to reveal price of contracts
- **No** incentive to move towards **organized power market**

Market Based Economic Dispatch (MBED)

- To use the efficient / cheaper generators to its fullest capacities
- With increase in cheaper renewable generation this will further optimized the dispatch
Market Based Economic Despatch – Framework

- All generation plants (State, Central, IPPs) would declare their availability on a day ahead basis and all discoms would declare their day-ahead requirement.
- Gencos and Discoms will submit bids for quantum of power to be sold / procured.
- Market Clearing Price (MCP) - uniform price based system marginal cost - would be discovered for each time block.

**Scheduling and dispatch**

- Sell bids
- Buy bids

**Generators**

- MCP

**Market operator**

- MCP

**Discoms**

- MCP

**Settlement of Bilateral contract (BCS)**

- Existing contracts with gencos would continue to be honoured.
- Discoms would continue to pay fixed costs to contracted generators outside of the market.
- Discoms would pay Market Clearing Price (MCP) / Area Clearing Price (ACP) for cost of power procured.
- For portion of demand met through existing contracts, generators would refund difference in MCP and variable costs to discoms.
Ancillary Services - Introduction

- Objective:
  - To restore the grid frequency to desired level and to relieve congestion in the transmission network

- Schematic of Reserves, Balancing and Frequency Control Continuum in India

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Adapted from NREL Report on "Variable Renewable Generation Can Provide Balancing Control to the Electric Power System", incorporating reference frequency of Indian grid

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<table>
<thead>
<tr>
<th>Quantum</th>
<th>response</th>
<th>Time</th>
<th>Local / Manual</th>
<th>Code / Paid</th>
<th>Unit Commitment</th>
</tr>
</thead>
<tbody>
<tr>
<td>First few secs</td>
<td>Inertial</td>
<td>Few sec - 5 min</td>
<td>Local (Automatic)</td>
<td>IEGC / CEA Standard</td>
<td>Load Generation Balance</td>
</tr>
<tr>
<td>~4000 MW</td>
<td>Secondary</td>
<td>~20 min - 30 min</td>
<td>Decentralized (Manual)</td>
<td>IEGC / SLDC on Reserves</td>
<td>Load Generation Balance</td>
</tr>
<tr>
<td>~4000 MW</td>
<td>Slow Tertiary</td>
<td>15 - 60 min</td>
<td>Decentralized (Automatic)</td>
<td>Ancillary Regulations Paid</td>
<td>Load Generation Balance</td>
</tr>
<tr>
<td>~1000 MW</td>
<td>Fast Tertiary</td>
<td>&gt; 60 min</td>
<td>Centralized (Automatic)</td>
<td>IEGC</td>
<td>Load Generation Balance</td>
</tr>
<tr>
<td>~8000-9000 MW</td>
<td>Load Generation Rescheduling</td>
<td>Load Generation Balance</td>
<td>*)</td>
<td>Load Generation Balance</td>
<td></td>
</tr>
</tbody>
</table>

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Source: SERCO

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<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Outline</th>
<th>Response Time</th>
<th>Current Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary response (Frequency Containment)</td>
<td>Automatic response delivering reserve power in negative proportion to grid frequency change</td>
<td>Few sec (able to sustain upto 5 min)</td>
<td>Mandated through IEGC&lt;br&gt;&lt;br&gt;Clause 5.2 (b) of IEGC states :-&lt;br&gt;Coal/ lignite stations&gt; 200 MW, Gas stations &gt;50 MW and hydro&lt;br&gt; &gt;25 MW operating at or up to 100% MCR shall normally be capable of picking up to 105/105/110% respectively of MCR when frequency falls suddenly&lt;br&gt;&lt;br&gt;Generating station / unit not to be scheduled beyond 100% IC</td>
</tr>
<tr>
<td>Secondary response (Frequency Restoration)</td>
<td>Supplementary corrective action needed to bring frequency back to 50 Hz.</td>
<td>30 s (able to sustain upto 15 min)</td>
<td>CERC Order on AGC enablement for ISGS 28th Aug 2019 in Petition No 319/RS/2018</td>
</tr>
<tr>
<td>Tertiary response</td>
<td>All ISGS including Ultra Mega Power Plants (UMPPs), operating on part load and having URS availability on day ahead basis, are to be mandated</td>
<td>Within 15 minutes (able to sustain upto 60 min)</td>
<td>Implemented by POSOCO as per RRAS Regulation, CERC under administered mechanism since 2016&lt;br&gt;&lt;br&gt;(Discussion paper issued by the CERC on Market based procurement for tertiary reserves)</td>
</tr>
</tbody>
</table>
THANK YOU
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cerc.readvisor@gmail.com