Power Portfolio Optimization

12\textsuperscript{th} December’2017
Contents

• Tata Power-DDL Overview
• Significance of Power Procurement Cost
• Tata Power-DDL Demand - Supply curve
• Power Procurement - Long Term & Short term
• Key issues in Power Procurement faced by Discoms
• Mitigation of challenges by Tata Power-DDL.
• Innovative Approach by Tata Power-DDL for optimizing PPC
• Changing Scenario and Challenges ahead
• Power Portfolio Management Solution
Tata Power DDL Overview (2017-18)

- Joint Venture of TATA POWER and Govt. of Delhi (51:49)
- Unprecedented reduction of Losses from 53.1% (FY 02-03) to 8.59%(FY16-17)
- Pioneer in Innovative Technology Adoption with many Firsts: SCADA, DMS, GIS, OMS, Smart Grid deployment; Smart Meters & Automated Demand Response.
- Partner to Technology Leaders like GE, IBM, Honeywell, Microsoft, SIEMENS etc.
- Partner to Distribution Sector Reforms in India: RAPDRP, IPDS, NSGM, Carriage and Content separation
- Founder member for Development and deployment of Smart Grid Maturity model along with APQC (American Productivity & Quality Center) and IBM

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Load Met</td>
<td>1852 MW</td>
</tr>
<tr>
<td>Annual Energy Requirement</td>
<td>9060 MU</td>
</tr>
<tr>
<td>Total Registered Customers</td>
<td>1.58 Million</td>
</tr>
<tr>
<td>Number of Employees</td>
<td>3525</td>
</tr>
<tr>
<td>Area Served</td>
<td>510 Sq Kms</td>
</tr>
<tr>
<td>Population Served</td>
<td>7 Million</td>
</tr>
</tbody>
</table>

Recognized Globally and Nationally

- ICC - Most innovative Discom, Efficient Distribution Award, Quality Service Award, Green Grid
- National Award for Promotion/Facilitation of Roof Top Solar Programs (2016)
- "Utility of the Year" Asian Power Awards (2006-2014)
- "National Award for Meritorious Performance" (2004-05, 05-06, 07-08, 08-09, 12-13)
- "Innovative Implementation of GIS" Edison Electric Institute, USA (2008)

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- "Utility of the Year" Asian Power Awards (2006-2014)
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- "Innovative Implementation of GIS" Edison Electric Institute, USA (2008)
Significance of Power Procurement Cost

- Power Procurement costs represent 80% of a Discom’s cost and has major ramifications on end consumer tariffs.
- Power Procurement costs have increased by 100% in the past 8 years.
**TPDDL Demand-Supply curve:**

<table>
<thead>
<tr>
<th>FORECASTED DEMAND</th>
<th>SCHEDULE</th>
<th>iC</th>
<th>ACTUAL DRAWL</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRA-DAY FORECAST REVISION</td>
<td>P</td>
<td>ipping.</td>
<td>HER SENSITIVE DEMAND</td>
</tr>
</tbody>
</table>

- **SCHEDULE REVISION**
  - Curtailment of Bilateral Power due to Transmission Constraints.

- **AVAILABLE GENERATION**
  - 1800 MW

- **The above graph depicts the intra day challenges and complexities which is only one part of the overall portfolio optimization**

- **Utilities also need to take decision for short term purchase / sale /banking options to optimize power procurement costs which are dependent on extraneous factors**
  - Demand / Supply Pattern of all States
  - Buying/Sell/Banking Pattern
  - Transmission constraints
  - Open merchant capacities
  - Technical constraints of generation units
Power Procurement - Long Term

Demand Projection
As per 18th Electric Power Survey (EPS) by CEA.
CAGR Growth in the licensed area

Estimated availability from Long Term Supply
Latest Information Available from Various Sources like CEA, Meetings, Seminars, Site Visits etc.

Demand Supply Gap Estimated

Planning for Shortfall / Surplus Arrangements

Types of Arrangements
- Allocated
- Contracted
- Competitive Bidding
- Long Term Bilateral
Power Procurement - Short Term

Demand Projection – 1 year Ahead (Reviewed Monthly or Earlier – as required)

Estimated availability from Long Term Supply based on Load Generation Balance Report (LGBR)

Demand Supply Gap Estimated

Planning for Shortfall / Surplus Arrangements

Types of Arrangements through - IDT, Bilateral, Banking & Power Exchange
List of Generators – with allocations

<table>
<thead>
<tr>
<th>NTPC Stations</th>
<th>TPDDL allocation in MW</th>
<th>NHPC Stations</th>
<th>TPDDL allocation in MW</th>
<th>Other Stations</th>
<th>TPDDL allocation in MW</th>
<th>Other Stations</th>
<th>TPDDL allocation in MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singrauli STPS</td>
<td>42</td>
<td>Bairasul</td>
<td>6</td>
<td>PPCL Stations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rihand STPS-I</td>
<td>28</td>
<td>Tanakpur</td>
<td>4</td>
<td>Pragati</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rihand STPS-II</td>
<td>36</td>
<td>Chamera-I</td>
<td>13</td>
<td>Pragati III</td>
<td>298</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unchahar-I TPS</td>
<td>7</td>
<td>Chamera-II</td>
<td>12</td>
<td>IPGCL Stations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unchahar-II TPS</td>
<td>13</td>
<td>Chamera-III</td>
<td>8</td>
<td>GT</td>
<td>82</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unchahar-III TPS</td>
<td>8</td>
<td>URI</td>
<td>16</td>
<td>THDC Stations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BTPS</td>
<td>161</td>
<td>URI-II</td>
<td>8</td>
<td>Tehri HPP</td>
<td>31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kahalgaon I</td>
<td>14</td>
<td>Dhauliganga</td>
<td>11</td>
<td>Koteshwar HEP</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kahalgaon II</td>
<td>44</td>
<td>Dulhasti</td>
<td>15</td>
<td>SJVNL Station</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Farakka</td>
<td>6</td>
<td>Sewa II</td>
<td>5</td>
<td>Nathpa Jhakri</td>
<td>43</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APCPL</td>
<td>580</td>
<td><strong>NHPC Total</strong></td>
<td><strong>98</strong></td>
<td>LT through PTC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NTPC Total</strong></td>
<td><strong>939</strong></td>
<td></td>
<td></td>
<td>TALA</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Other Total</strong></td>
<td><strong>545</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TPDDL allocation in MW

Approx 2300 MW
### Key issues in Power Procurement faced by Discom

<table>
<thead>
<tr>
<th>Type</th>
<th>Existing Allocation (in MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTPC</td>
<td>939</td>
</tr>
<tr>
<td>NHPC</td>
<td>98</td>
</tr>
<tr>
<td>NPCIL</td>
<td>28</td>
</tr>
<tr>
<td>SJVNL</td>
<td>43</td>
</tr>
<tr>
<td>THDC</td>
<td>43</td>
</tr>
<tr>
<td>Tala</td>
<td>9</td>
</tr>
<tr>
<td>DVC</td>
<td>123</td>
</tr>
<tr>
<td>Delhi Genco</td>
<td>450</td>
</tr>
<tr>
<td>CLP+ Maithon</td>
<td>406</td>
</tr>
<tr>
<td>SASAN UMPP</td>
<td>128</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>~ 2300 MW</strong></td>
</tr>
</tbody>
</table>

#### Major Plants per unit rates (INR/KWh)

<table>
<thead>
<tr>
<th></th>
<th>FY 10-11</th>
<th>FY 11-12</th>
<th>FY 12-13</th>
<th>FY 13-14</th>
<th>FY 14-15</th>
<th>FY 15-16</th>
<th>FY 16-17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dadri 1</td>
<td>3.06</td>
<td>4.11</td>
<td>4.09</td>
<td>4.34</td>
<td>5.93</td>
<td>5.23</td>
<td>5.36</td>
</tr>
<tr>
<td>Dadri 2</td>
<td>3.73</td>
<td>4.42</td>
<td>4.44</td>
<td>4.67</td>
<td>5.79</td>
<td>5.45</td>
<td>5.34</td>
</tr>
<tr>
<td>BTPS</td>
<td>3.83</td>
<td>4.35</td>
<td>4.67</td>
<td>4.88</td>
<td>4.67</td>
<td>5.94</td>
<td>4.71</td>
</tr>
</tbody>
</table>
Key issues in Power Procurement faced by DISCOM

- Rising Power Purchase Costs
- Lower Surplus Disposal Rates

<table>
<thead>
<tr>
<th>FY wise cost in Rs/ Kwh</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 08-09</td>
</tr>
<tr>
<td>2.86</td>
</tr>
</tbody>
</table>

- Power Purchase from Central Generating Stations
- Power Purchase from Delhi Genco
- Bilateral Purchases
- Surplus Sale
- Transmission Costs
- Power Purchase Cost

Lower Surplus Disposal Rates | Rising Power Purchase Costs | 25-30% surplus power
Mitigation of Challenges of Increasing Power Purchase Costs

- Reallocation of costly power
- Sale in Exchange
- Sale/ Banking
- Inter Discom Transfer
- Backing down of expensive power

### IEX Sale Rate FY 2012 - 2017

<table>
<thead>
<tr>
<th>Year</th>
<th>Price INR/Mwh</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY 12-13</td>
<td>3487.47</td>
</tr>
<tr>
<td>FY 13-14</td>
<td>2801.89</td>
</tr>
<tr>
<td>FY 14-15</td>
<td>3511.3</td>
</tr>
<tr>
<td>FY 15-16</td>
<td>2731.93</td>
</tr>
<tr>
<td>FY 16-17</td>
<td>2414.4</td>
</tr>
</tbody>
</table>
A) Initiatives for reduction in cost of Power Portfolio:

1. **Reallocation of Costly Power:** Pursuing reallocation of power from Aravali Jhajjar, Dadri Stage 1 & 2, BTPS. Reallocated complete share of Aravali & Dadri in 2014 & 2015.

2. **Allocation from cheaper UA quota:** Pursuing with GoNCTD/GoI for allocation of cheaper UA quota from CSGS

3. **Advocacy for diversion of coal from inefficient / decommissioned power plants such as** Rajghat to Aravali, Dadri, Badarpur etc.

4. **Advocacy for maximizing indigenous coal usage for Delhi generation:** especially in BTPS, Aravali and Dadri from where TPDDL has maximum allocation; Also pursuing for closure of inefficient BTPS units 1,2,3 (95 MW each)

5. **Advocacy for securing coal from nearer mines to ensure reduction in freight costs** which is as high as 40% of the cost of fuel.
B) Initiatives for Sale Optimization:-
1. Emphasis on maximizing power sale through bilateral contracts.
2. Day ahead sale through exchange preferred over disposing through UI.
3. Information sharing and discussions held with leading traders namely TPTCL, GMR, NVVNL, PTC for sale of surplus power.
4. Surplus power information has been sent to all states and published in leading newspapers, also published on website on regular basis.

C) Emphasis on further contingency procurement through Banking (non cash transactions):-
1. Tenders for banking of power to meet demand during summer and reduce surplus during winters.
D) **Initiatives for optimizing Availability and PPC:**

1. Continuous analysis and schedule based on merit order (must run and projects with lower VC scheduled in priority)
2. Backing down initiated where VC of plants is higher than surplus sale rate in Exchange/UI
3. Backing down of power plants with higher variable costs such as Bawana, Aravali, Dadri 1&2, BTPS etc. during night hours as per requirement.

E) **Demand Forecasting:**

1. Improved demand forecasting through sophisticated forecasting Model which incorporates weather forecasts for optimizing Short term procurement and sale of surplus
2. **Power Manager** - Software develop by in-house team.
TPDDL has developed a solution inhouse for scheduling to address some of the day to day challenges! Experience of the same is being leveraged!
Changing Business Scenario (1/2)

- Renewable Focus
- Separation of Carriage and Content
- Energy Efficiency, DSM Focus
- Rising Fuel Costs
- Smart and Communicating Grid
Challenges and Regulations ahead

Increasing Renewable Penetration to enhance supply side complexities
- 175 GW of Renewable Power by 2022.
- Renewable Purchase Obligation on Utilities. Currently 11.50% in Delhi.
- National target of 40% Renewable by 2030.

Increasing Electric Vehicle Penetration to enhance demand side complexities
- National Electric Mobility Mission
- Target of 5 Million electric vehicles by 2020 and 7 million by 2022
- Utilities responsible for managing charging facilities

Introduction of Ancillary markets

- Levy of Deviation Settlement and Additional Deviation Settlement charges for any inefficient management of Demand and Supply
- Levy of penalties for being unable to meet demand e.g. In Delhi, Discoms are mandated to limit load shedding within 1% of total demand
- Levy of penalties for improper scheduling and violation of merit order
TPDDL has received Regulatory approval for 0.74 Million USD for development of Power Portfolio Management Solution.

Tender was floated and M/s IBM has been selected as the Implementation Partner.

There is no off the shelf solution available in the market and there is a need to develop an innovative solution.

- Scheduling Automation
  - Day Ahead
  - Intra Day

- Demand Forecasting (ST/MT/LT)
  - Historical Demand Patterns
  - Weather Patterns and Forecasts
  - Planning Commission/CEA’s Forecasts

- Supply Forecasting (ST/MT/LT)
  - Historical Availability Data
  - Annual Maintenance Plan (LGBR)
  - Real Time Supply Scenario

- Price Forecasting (ST/MT/LT)
  - Historical Trends in Exchange
  - Demand Supply Pattern across India
  - Bilateral Market Trends

- Transmission Availability Forecasting
  - Congestion Data
  - Corridor Availability
  - Future Transmission Planning Scenarios

- Work flow Automation
  - Billing/Invoice Generation
  - Bill Verification/Reconciliation
  - UI Settlements
  - Contracts Creation and Settlement
  - Payment Reconciliation
  - Seamless data integration with various IT platforms

- Optimization Scenario Planning
  - Risk Appetite Based
  - Contingency Planning

- MIS Generation for Regulatory Compliance

Seamless integration with various IT Platforms

with you Non-Stop
THANK YOU