The Electric Power System in Bangladesh
Addressing the Planning, Operation and Training Issues

Professor Saifur Rahman
Director, Virginia Tech Advanced Research Inst., USA
President, IEEE Power & Energy Society, 2018 & 2019
Candidate, IEEE President-elect
Recent Keynote Speeches and Invited Talks

Bangladesh Power Sector Challenges and Opportunities

- Abundant Generation Capacity
- Gas supply intermittency
- Lack of adequate transmission facility
- Distribution network is unreliable
- High diurnal and seasonal load variations
- Trained manpower to run 30 GW+ system
Opportunities for Load Factor Improvements and Fuel Savings

Max Temp 24 deg C
8,963MW

Source: PGCB
04 Aug 2019 Sunday
Max Temp 34.8 deg C
12,655 MW

Source: PGCB

Fuel Mix in Electricity Generation (high)

<table>
<thead>
<tr>
<th>Year</th>
<th>Coal</th>
<th>Gas/LNG</th>
<th>Liquid Fuel</th>
<th>Nuclear</th>
<th>Import</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>4,745</td>
<td>13,187</td>
<td>8728</td>
<td>000</td>
<td>1500</td>
<td>28,390</td>
</tr>
<tr>
<td>2030</td>
<td>24,462</td>
<td>22,803</td>
<td>5894</td>
<td>2232</td>
<td>6121</td>
<td>61,842</td>
</tr>
<tr>
<td>2041</td>
<td>30,166</td>
<td>40,661</td>
<td>2186</td>
<td>6696</td>
<td>14,121</td>
<td>94,160</td>
</tr>
</tbody>
</table>

Source: Bangladesh PSMP
### Fuel Mix in Electricity Generation (low)

<table>
<thead>
<tr>
<th></th>
<th>Coal</th>
<th>Gas/LNG</th>
<th>Liquid Fuel</th>
<th>Nuclear</th>
<th>Import</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2021</td>
<td>2864</td>
<td>13,846</td>
<td>7864</td>
<td>000</td>
<td>1500</td>
<td>26,304</td>
</tr>
<tr>
<td>2030</td>
<td>17,969</td>
<td>23,744</td>
<td>5591</td>
<td>2232</td>
<td>3496</td>
<td>53,262</td>
</tr>
<tr>
<td>2041</td>
<td>25,596</td>
<td>34,165</td>
<td>1840</td>
<td>5580</td>
<td>11996</td>
<td>79,507</td>
</tr>
</tbody>
</table>

*Source: Bangladesh PSMP*

### % Fuel Mix in Generation (high)

<table>
<thead>
<tr>
<th>Fuel (%)</th>
<th>2021</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2041</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas/CNG</td>
<td>46%</td>
<td>42%</td>
<td>37%</td>
<td>39%</td>
<td>43%</td>
</tr>
<tr>
<td>Coal</td>
<td>17%</td>
<td>31%</td>
<td>39.5%</td>
<td>39%</td>
<td>32%</td>
</tr>
<tr>
<td>Liquid Fuel</td>
<td>31%</td>
<td>17%</td>
<td>10%</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>Import</td>
<td>5%</td>
<td>7%</td>
<td>10%</td>
<td>12%</td>
<td>15%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>0%</td>
<td>2%</td>
<td>3%</td>
<td>6%</td>
<td>7%</td>
</tr>
</tbody>
</table>

*Source: Bangladesh PSMP*
% Fuel Mix in Generation (low)

<table>
<thead>
<tr>
<th>Fuel (%)</th>
<th>2021</th>
<th>2025</th>
<th>2030</th>
<th>2035</th>
<th>2041</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas/CNG</td>
<td>52.6%</td>
<td>47.4%</td>
<td>44.6%</td>
<td>43.5%</td>
<td>43%</td>
</tr>
<tr>
<td>Coal</td>
<td>10.9%</td>
<td>24.8%</td>
<td>33.7%</td>
<td>37%</td>
<td>32%</td>
</tr>
<tr>
<td>Liquid Fuel</td>
<td>29.9%</td>
<td>16.9%</td>
<td>10.5%</td>
<td>2.5%</td>
<td>2.3%</td>
</tr>
<tr>
<td>Import</td>
<td>5.7%</td>
<td>7.5%</td>
<td>6.6%</td>
<td>11.5%</td>
<td>15.1%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>0%</td>
<td>2.8%</td>
<td>4.2%</td>
<td>5%</td>
<td>7%</td>
</tr>
</tbody>
</table>

% wise Fuel Mix Generation Plan (Low Scenario)

Source: Bangladesh PSMP

Maximum Target of Nuclear Electricity Generation Proposed in the PSMP as

- **2024/25**: 2 Units (about 24,00)
- **2031/32**: 2 Units (2000-2400 MW)
- **2041/41**: 2 Units (2000 - 2400 MW)
Global Warming Issues

- Combined share of gas (LNG) and coal based generation will be more than 75% from 2030
  - Over dependence on imported coal is risky, not only from cost perspective also from availability perspective
  - All gas-based power plants need to be operated with imported gas (LNG) beyond 2035 - Gas based power generation will become an expensive option

- Nuclear in both the scenarios is about 5% beyond 2030, more addition may consider

  Source: Dr. Md. Shakwat Akbar, MD NPCBL

<table>
<thead>
<tr>
<th>Year</th>
<th>Hydro/Solar/Wind (%)</th>
<th>Thermal (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>25.56</td>
<td>73.47</td>
</tr>
<tr>
<td>2016</td>
<td>33.80</td>
<td>63.77</td>
</tr>
<tr>
<td>2018</td>
<td>37.00</td>
<td>60.00</td>
</tr>
<tr>
<td>2030</td>
<td>52.00</td>
<td>42.00</td>
</tr>
</tbody>
</table>

IAEA DG, Mr. Amano Visiting the RNPP Site

Source: Dr. Md. Shakwat Akbar, MD NPCBL
Comparing 100MW Gas Turbine vs BESS

Source: Q. Zaman

Source: Dr. Md. Shawkat Akbar, MD NPCBL, 2019

Start of Works – November 2017

Source: Dr. Md. Shawkat Akbar, MD NPCBL

2019
Nuclear Reactor Vessel and Steam Generator
Finished Plant 2024/2025: Artist’s Rendering

Coal-fired Power Plant: Challenges

By 2030 33-40% of power generation will come from Coal

- Rampal Coal-fired 660 x 2 = 1320 MW
- Payra Coal-fired 660 x 2 = 1320 MW
- Matarbari Coal-fired 600 x 2 = 1200 MW
- Maheshkhali Coal-powered Generation Hub
The Rampal Power Station is a proposed 1320 megawatt coal-fired power station at Rampal Upazila of Bagerhat District in Khulna, Bangladesh.[1] The proposed project, on an area of over 1834 acres of land, is situated 14 kilometres north of the world's largest mangrove forest Sundarbans which is a UNESCO world heritage site.
Reliability and Power Quality Improvements

Short term challenges

- Over-dependence on coal-fired generation
- Abundant (partly unused) generation
- Stabilize gas supply
- Build more transmission and distribution facilities
- Trained manpower challenges
- Over-dependance on consultants
Modernization of the BD Power Grid

- Bangladesh power generation mix & load shape
- Opportunities for load factor improvement
- Garment sector demand dynamics
- Battery Energy Storage System as backup
- Reliability and power quality improvement
- A roadmap for hardening the BD power grid

What Does Bangladesh Need?

Grid Modernization
A Hardened Power Grid

- Pays attention to Generation, Transmission and Distribution
- Maintains Voltage, Frequency, Power Quality
- Minimizes Outage and Recovers Quickly
- Optimizes the Cost of System Operation
- Allows Seamless Renewables Integration
- Allows Smooth Interconnection with Neighbours

Thank You

Virginia Tech

Professor Saifur Rahman

www.ari.vt.edu
www.srahman.org