SAARC Workshop on “Load/Power Flow Studies Using PSS/E for Efficient National & Cross Border Interconnected Power Systems in South Asia”

Department of Hydropower & Power Systems
Ministry of Economic Affairs
Royal Government of Bhutan
Thimphu
18-20 July 2018
Outline of Presentation

• Sector Reform
• Energy Sector Structure
• Hydropower Potential
• Hydropower Plants under Operation & Construction
• Power Generation & Demand
• Per Capita Electricity Consumption
• Demand Vs Firm Power
• Existing & Plan Transmission Lines
• Grid Condition
Power Sector Reforms

- DoP, Ministry of Trade and Industry
- Electricity Act in July 2001
- Power Sector was restructured in 2002
- DoE – Responsible for developing the long term policies and plans for the energy sector
- BPC – Transmission & Distribution of electricity & supply functions and also acting as a National System Operator
- BEA- Responsible for Regulation, became fully autonomous in January 2010
- DGPC (Established in Jan 2008) – O&M of all existing hydropower plants owned by RGoB and also tasked with responsibility of developing projects on its own or through JV on behalf of RGoB
- DHPS – Nodal Agency for Hydropower Sector>25MW
- DRE– Nodal Agency for Renewable Energy &
- NCHM-Hydro-met Services
Energy Sector Structure

Ministry of Economic Affairs

- BEA (Regulatory functions)
- DHPS
- DRE Renewable Energy
- NCHM Hydromet services
- DoT Fossil Fuels

Ministry of Finance

- DHI

DGPC

- CHP, THP, KHP & Basochhu

UNDER CONSTRUCTION

- PHPA-I & II
- MHPA

JV Projects

DHP

- THyE

BPC (Trans, Dist. & System Operator)

Other Shareholders
The steep and rugged Himalayan topography and swift rivers promise huge hydropower potential

- 30,000 MW potential
- 23,325MW (64 sites of >25MW) techno-economic potential viable for development
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Power Plant</th>
<th>Installed Capacity (MW)</th>
<th>COD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chukha HPP</td>
<td>336.00</td>
<td>1986-88</td>
</tr>
<tr>
<td>2</td>
<td>Kurichhu HPP</td>
<td>60.00</td>
<td>2001-02</td>
</tr>
<tr>
<td>3</td>
<td>Basochhu HPP (Upper Stage)</td>
<td>24.00</td>
<td>2001</td>
</tr>
<tr>
<td>4</td>
<td>Basochhu HPP (Lower Stage)</td>
<td>40.00</td>
<td>2005</td>
</tr>
<tr>
<td>5</td>
<td>Tala HPP</td>
<td>1,020.00</td>
<td>2006-07</td>
</tr>
<tr>
<td>6</td>
<td>Dagachhu HPP</td>
<td>126.00</td>
<td>2015</td>
</tr>
<tr>
<td>7</td>
<td>Micro/Mini (20 Nos.)</td>
<td>8.00</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1,614.00</td>
<td>~7%</td>
</tr>
</tbody>
</table>
# Under Construction

<table>
<thead>
<tr>
<th>Sl/No</th>
<th>Name</th>
<th>IC(MW)</th>
<th>Firm Power(MW)</th>
<th>Year of Comm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Punatsangchhu-I</td>
<td>1,200</td>
<td>199</td>
<td>2023</td>
</tr>
<tr>
<td>2</td>
<td>Punatsangchhu-II</td>
<td>1,020</td>
<td>164</td>
<td>2020</td>
</tr>
<tr>
<td>3</td>
<td>Mandechhu</td>
<td>720</td>
<td>90</td>
<td>2018</td>
</tr>
<tr>
<td>4</td>
<td>Kholongchhu</td>
<td>600</td>
<td>113.8</td>
<td>2023</td>
</tr>
<tr>
<td>5</td>
<td>Nikachhu</td>
<td>118</td>
<td>22.55</td>
<td>2020</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>3,658</strong></td>
<td><strong>589.35</strong></td>
<td></td>
</tr>
</tbody>
</table>
Power Generation & Domestic Demand

- Annual Generation – 7,709.221MU
- Domestic Load – 2,185.75MU
- Total number of customers -185,130
- Rural Electrification coverage ratio -99.97%
- National Coincidental Peak load – 362.09MW
- Transmission route length – 1,123.664km
- Total transformation capacity – 1,070.5MVA
- Global System loss including Wheeling - 2%
- Transmission Losses including wheeling -1.25%

Source: BPC Power Data Book 2017
## Per-Capita Electricity Consumption

<table>
<thead>
<tr>
<th>Year</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>708,265</td>
<td>720,679</td>
<td>733,004</td>
<td>745,133</td>
<td>757,042</td>
<td>768,577</td>
<td>779,666</td>
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<tr>
<td>Per Capita Energy Consumption</td>
<td>2,419.9</td>
<td>2,572.2</td>
<td>2,625.1</td>
<td>2,798.8</td>
<td>2,804.3</td>
<td>2,613.8</td>
<td>2,877.8</td>
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</tbody>
</table>
Demand vs Firm Power

- Demand Projection (MW)
- Firm Power

Year vs MW:

- 2015: 337
- 2016: 335.87
- 2017: 362
- 2018: 444
- 2019: 452
- 2020: 540
- 2021: 548
- 2022: 557
- 2023: 643
- 2024: 654
- 2025: 665
- 2026: 753
- 2027: 765
- 2028: 777
- 2029: 866
- 2030: 880

- 400kV
- 220kV
- 132kV
Under Construction Transmission Systems
Proposed Transmission Systems from Projects under DPR stage.
Grid Conditions

- Not much of over voltages problems are faced.
- Over voltages occurring in 400kV lines are controlled by 60MVAr shunt reactor at Tala Plant.
- There are 2x5 MVAr shunt reactor in Kurichhu plant to control the over voltage in 132kV systems.
- When the line is lightly loaded, only the required lines are kept in service.