Country Scenario - Pakistan

SAARC Perspective Workshop on the Past, Present and Future of High Voltage DC (HVDC) Power Transmission
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Overview of Power System of Pakistan
• Two electric power utility systems operating in Pakistan since 1958:
  - Water and Power Development Authority (WAPDA)
  - Karachi Electric Supply Corporation (KESC)

• Pakistan Power Sector Strategic Plan was approved in 1992 for restructuring the power sector and introducing reforms. In the late 90’s, the Power wing of WAPDA was unbundled into:
  - 1 National Transmission and Despatch Company (NTDC);
  - 4 Generation Companies (GENCOs); and
  - 10 Distribution Companies (DISCOs)
Two Power Grid Systems Currently in Operation

1. **National Transmission and Despatch Company Limited (NTDCL)**
   - Public limited Company and incorporated in 1998.
   - National Grid Company. Operates all over the country except Karachi.
   - Responsible for planning, design, construction, maintenance and operation of 500kV and 220kV network.
   - Purchases power from Hydro Power Stations, GENCOs, IPPs etc. and Sells power to Distribution Companies (DISCOs) through its network.
   - Exports power to K-Electric.
   - Deals with Cross-border Electricity Trade.

2. **K-Electric**
   (formerly known as Karachi Electric Supply Company (KESC))
   - Private Limited Company. Operating since 1913.
   - Generates, transmits and distributes power in Karachi city & some surrounding areas.
   - Purchases power from IPPs located in its territory.
   - Imports power from NTDCL.
### Existing Generation Capacity of NTDCL System  
(as of August 2015)

1. **Hydro**  
   - **WAPDA**: 6902 MW  
   - **IPPs**: 195 MW  
   - **Sub-Total**: 7097 MW (31.1%)

2. **Thermal**  
   - **GENCOs**: 6001 MW  
   - **IPPs**: 8866 MW  
   - **Sub-Total**: 14867 MW (64.9%)

3. **Nuclear**  
   - 665 MW (2.9%)

4. **Wind**  
   - 256 MW (1.1%)

**TOTAL**: 22,885 MW
<table>
<thead>
<tr>
<th>Years</th>
<th>Available Capability (MW)</th>
<th>Computed Peak Demand (MW)</th>
<th>Surplus/Shortfall (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003-04</td>
<td>11834</td>
<td>11598</td>
<td>236</td>
</tr>
<tr>
<td>2004-05</td>
<td>12792</td>
<td>12595</td>
<td>197</td>
</tr>
<tr>
<td>2005-06</td>
<td>12600</td>
<td>13847</td>
<td>-1247</td>
</tr>
<tr>
<td>2006-07</td>
<td>13292</td>
<td>15838</td>
<td>-2546</td>
</tr>
<tr>
<td>2007-08</td>
<td>12442</td>
<td>17398</td>
<td>-4956</td>
</tr>
<tr>
<td>2008-09</td>
<td>13637</td>
<td>17852</td>
<td>-4215</td>
</tr>
<tr>
<td>2009-10</td>
<td>13445</td>
<td>18467</td>
<td>-5022</td>
</tr>
<tr>
<td>2010-11</td>
<td>13193</td>
<td>18521</td>
<td>-5328</td>
</tr>
<tr>
<td>2011-12</td>
<td>12320</td>
<td>18940</td>
<td>-6620</td>
</tr>
<tr>
<td>2012-13</td>
<td>13577</td>
<td>18827</td>
<td>-5250</td>
</tr>
<tr>
<td>2013-14</td>
<td>14584</td>
<td>20576</td>
<td>-5992</td>
</tr>
<tr>
<td>2014-15</td>
<td>15489</td>
<td>20966</td>
<td>-5477</td>
</tr>
</tbody>
</table>
Existing Generation Capacity & Load Demand of K-Electric
as of June 2014

• Generation Capacity
  1. Thermal
     • Own Plants        2422 MW
     • IPPs & Others     290  MW
     Sub-total           2712  MW (95.1%)
  2. Nuclear
     • Nuclear            137  MW (4.9%)
  Total Installed Capacity  2849  MW

• Load Demand: 2929 MW
• K-Electric imports 650 MW from NTDCL
Government Priorities for Future Generation to Improve Power Supply Position

- Addition of hydropower generation in North.
- Addition of imported-coal based generation in South near coast.
- Development of Indigenous coal based power generation in South at Thar.
- Addition of imported coal based generation at/near mid-country load centers.
- Addition of Renewable Energy:
  - Wind Power Projects near coast
  - Solar power projects near load centers
  - Cogeneration power projects near load centers
- Import of Power through Cross-border Interconnections.
# Summary of Generation Additions up to Year 2019-20

<table>
<thead>
<tr>
<th>Sponsors</th>
<th>Generation Addition (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAPDA Hydel</td>
<td>4023</td>
</tr>
<tr>
<td>IPP Hydel</td>
<td>247</td>
</tr>
<tr>
<td><strong>Sub-total Hydel</strong></td>
<td><strong>4270</strong></td>
</tr>
<tr>
<td>GENCOs</td>
<td>1320</td>
</tr>
<tr>
<td>IPP Thermal</td>
<td>12713</td>
</tr>
<tr>
<td><strong>Sub-total Thermal</strong></td>
<td><strong>14033</strong></td>
</tr>
<tr>
<td>Nuclear</td>
<td>680</td>
</tr>
<tr>
<td>Wind</td>
<td>1500</td>
</tr>
<tr>
<td>Solar</td>
<td>900</td>
</tr>
<tr>
<td>CASA (Import)</td>
<td>1000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>22383</strong></td>
</tr>
<tr>
<td>Years</td>
<td>Available Capability</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------</td>
</tr>
<tr>
<td>2015-16</td>
<td>17820</td>
</tr>
<tr>
<td>2016-17</td>
<td>21285</td>
</tr>
<tr>
<td>2017-18</td>
<td>27932</td>
</tr>
<tr>
<td>2018-19</td>
<td>29039</td>
</tr>
<tr>
<td>2019-20</td>
<td>31756</td>
</tr>
</tbody>
</table>
The voltage levels and technologies used in the existing power grid and proposed for the future grid expansion are as under:

**AC Voltage:**
- 500 kV & 220 kV: Used in the existing and future expansion of NTDCL system. 220 kV is used in the existing and future expansion of K-Electric system.
- 132 kV & 66 kV: Used in existing system and future expansion of Distribution Companies and K-Electric. 66 kV system will be gradually upgraded to 132 kV.

**HVDC Voltage for Future Grid Expansion:**
- ±600 kV: Proposed for South to mid-country bulk power transfer.
- ±500 kV: Proposed for Cross-border Interconnections.
Existing Transmission Networks of NTDCL and K-Electric
**Salient Features of NTDCL Network**

- North to South longitudinal network.
- Hydro generation in North and major thermal generation in South & in lower middle part of network.
- Large load centers are remote from major generation sources.
- Seasonal variation in generation dispatch and in power flows.
Planned Transmission Network of NTDCL (Year 2019-20)
## NTDCL TRANSMISSION SYSTEM - EXISTING AND FUTURE PLAN

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Description</th>
<th>Existing as of 2015</th>
<th>Additions up to 2019-20</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Quantity</td>
<td>Capacity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(No.)</td>
<td>(MVA)</td>
</tr>
<tr>
<td>1</td>
<td>No. of 500 kV Grid Stations</td>
<td>18</td>
<td>18,624</td>
</tr>
<tr>
<td>2</td>
<td>No. of 220 kV Grid Stations</td>
<td>48</td>
<td>24,063</td>
</tr>
<tr>
<td>3</td>
<td>Length of 500 kV Transmission lines</td>
<td>5,197 km</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Length of 220 kV Transmission lines</td>
<td>9,184 km</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>± 500kV HVDC Convertor Station at Peshawar New</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>±500 kV HVDC Bipole Transmission line from Pak-Afghan Border to Peshawar New</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>± 600 kV HVDC Bipole Converters (Matiari &amp; Lahore)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>±600kV HVDC Bipole Transmission line (Matiari - Lahore)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>± 600 kV HVDC Bipole Converters (Port Qasim &amp; Faisalabad West)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>±600kV HVDC Bipole Transmission line (Port Qasim – Faisalabad West)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: In the existing system, the IPPs, Privately Owned, Hydel & GENCO owned generating substations have also been included.
Planned and Under Consideration HVDC Projects

**Domestic Projects**
1. ±600kV HVDC Bipole Transmission line (Matiari - Lahore)
2. ±600kV HVDC Bipole Transmission line (Port Qasim – Faisalabad West)

**Cross-border Interconnections**
1. Import of Power from Tajikistan/Kyrgystan through Afghanistan (CASA-1000 Project)
2. Import of Power from Iran
3. Import of Power from India
Import of 1000-1300 MW Power through CASA-1000 Project
(Pakistan – Afghanistan – Tajikistan – Kyrgyzstan Interconnection)
Transport of surplus power (1300 MW) during 5 summer months from Kyrgyz Republic and Tajikistan to Afghanistan (300 MW) & Pakistan (1000 MW)

**Scope of Work:**
- 750 km ±500 kV HVDC Bipole between Tajikistan and Pakistan via Afghanistan; and Converter Stations at Sangtuda, Kabul & Peshawar
- 477 km 500 V AC link between the Kyrgyz Republic (Datka) and Tajikistan (Khoujand)
- AC system upgrades on existing lines
Pakistan - Iran Interconnections
Pakistan – Iran Interconnection Projects

1. Existing Interconnection Projects:

   Import of 74 MW Power by Pakistan in border areas of Pakistan (in Baluchistan Province):
   
i. 70 MW at 132 kV (continued since 2003. Initially, it was 35 MW)
   ii. 4 MW at 20 kV (continued since 2002)
   iii. (Tariff: US cents 7-10. Contracts is renewed after every 3-years)

2. Planned Interconnection Projects:

   i. Import of 100 MW at Gwadar through 220 kV D/C T/Line (contract signed)

   ii. Import of **1000 MW at Quetta through ±500 kV HVDC Bipole** (MoU signed)

For import of power from Iran, Tariff is linked with International Oil prices.
Pakistan - India Interconnection
Scope of Work:
A pre-feasibility study for import of 500 MW power by Pakistan from India was conducted by consultants (M/s Tetra Tech, USA and M/s Hagler Bailly, Pakistan in 2012-13. The study was funded by World Bank.

In the study report, the following scope of transmission interconnection was proposed:

- 400/220 kV HVDC Back-to-Back Convertor Station in Pakistan
- 400 kV D/C T/Line (approx. 26 km) from Balachak to Pak-India Border.
- 400 kV D/C T/Line (approx. 10 km) from Convertor Station to Pak-India Border
- 220 kV D/C T/Line from Ghazi Road to Convertor Station

Cost Estimates: US$ 119.4 million
Thank You!