Challenges for Indian Power Market

- Opportunities for Global Partnership between India and Japan
  Infrastructure, the Environment, and Finance

September 13, 2010

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Executive Director
J-POWER
1. Profile of J-Power (in Japan)

- Only one large-scale electric wholesaler – 6th largest in generation capacity (17GW)
- Established as SOE in 1952, but 100% privatized through IPO in 2004.
- In terms of generation capacity, largest for coal-fired (8.4GW), 2nd largest for hydro (8.6GW) and wind (269MW).
- Owner of transmission trunk lines 2,400 km that link Japanese electric power networks.

Major electric power companies in Japan

<table>
<thead>
<tr>
<th>Region</th>
<th>Hydro</th>
<th>Thermal</th>
<th>Nuclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kansai</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Chubu</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Kyusyu</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tohoku</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J-POWER</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chugoku</td>
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<td></td>
<td></td>
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<tr>
<td>Hokuriku</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Shikoku</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hokkaido</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Okinawa</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

J-POWER’s facilities in Japan

- Coal-fired power plant: 7
- Hydroelectric power plant: 59
- Nuclear power plant (*): 1
- Geothermal power plant: 1
- Transmission line

(*) Currently under construction with plans for start of operations in 2014.

Note: As of March 31, 2009

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1. Profile of J-POWER (in Japan)

Location of Coal-fired power plant in Japan

Takehara
1# 250MW(1967)
2# 350MW(1995)
3# 700MW(1983)

Takasago
1# 250MW(1968)
2# 250MW(1969)

Ishikawa
1# 156MW(1986)
2# 156MW(1987)

Matsuura
1# 1,000MW(1990)
2# 1,000MW(1997)

Matsushima
1# 500MW(1981)
2# 500MW(1981)

Takehara
1# 1,050MW(2000)
2# 1,050MW(2000)

Isogo
New 1# 600MW(2002)
New 2# 600MW(2009)

Tachibanawan
New 1# 600MW(2002)
New 2# 600MW(2009)
Cf. Isogo Power Plant *(Typical Project applying latest USC technology)*

### Isogo Coal-Fired Power Plant
- Commissioned in 1967

### New Isogo Coal-Fired Power Plant
- Unit #1 in 2002 and Unit #2 in 2009

#### 3 objectives
- Repowering
- Cleaner Environment
- Efficiency Improvement

#### Generation Capacity
- **Isogo Coal-Fired Power Plant**
  - 530MW
  - **2 units**
- **New Isogo Coal-Fired Power Plant**
  - 1200MW
  - **600MW**
  - **2 units**

<table>
<thead>
<tr>
<th></th>
<th>Isogo Coal-Fired Power Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOx ppm</td>
<td>60</td>
</tr>
<tr>
<td>NOx ppm</td>
<td>159</td>
</tr>
<tr>
<td>PM mg/m3N</td>
<td>50</td>
</tr>
<tr>
<td>Steam Condition</td>
<td>Sub Critical</td>
</tr>
<tr>
<td>Efficiency (gross %LHV)</td>
<td>40%</td>
</tr>
<tr>
<td>CO2 emission intensity (Net)</td>
<td>100 (base)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>New Isogo Coal-Fired Power Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOx ppm</td>
<td>10ppm (20)</td>
</tr>
<tr>
<td>NOx ppm</td>
<td>13ppm (10)</td>
</tr>
<tr>
<td>PM mg/m3N</td>
<td>5mg/m3N (10)</td>
</tr>
<tr>
<td>Steam Condition</td>
<td>Ultra Super Critical</td>
</tr>
<tr>
<td>Efficiency (gross %LHV)</td>
<td>45%</td>
</tr>
<tr>
<td>CO2 emission intensity (Net)</td>
<td>83 (base)</td>
</tr>
</tbody>
</table>

Numbers in () are for Unit #1.

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1. Environment protection measures
SOx and NOx are also important to improve the air quality in India. The emissions levels in Japan are much lower than other developed countries.

The following equipments can mitigate SOx and NOx emissions;

- Wet type desulfurization equipment
- Dry type desulfurization equipment *(J-POWER En Tech Inc.*)
- Ammonia selective catalytic reduction process

Source: Federation of Electric Power Companies, Japan (and actual data for Isogo)
Since 1960s, J-POWER has provided consulting services for 306 projects in 63 countries.
J-POWER is aggressively promoting overseas power generation business (IPP) in the key markets of Asia and USA (6 countries, 25 projects, 3.5GW in operation)

### Power Generation Business (IPP)

<table>
<thead>
<tr>
<th>Status</th>
<th>IPP Project No.</th>
<th>Electricity Output</th>
<th>Owned Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Operation</td>
<td>6 countries 25 Projects</td>
<td>13,870MW</td>
<td>3,493MW</td>
</tr>
<tr>
<td>Under Construction</td>
<td>3 countries 4 Projects</td>
<td>1,775MW</td>
<td>271MW</td>
</tr>
<tr>
<td>Planning</td>
<td>1 country 9 Projects</td>
<td>3,980MW</td>
<td>3,980MW</td>
</tr>
<tr>
<td>Total</td>
<td>7 countries 36 Projects</td>
<td>19,625MW</td>
<td>7,744MW</td>
</tr>
</tbody>
</table>

- Poland 1 Prj 22MW
- China 6 Prj 572MW
- USA 10 Prj 1,484MW
- Viet Nam 1 Prj 38MW
- Taiwan 1 Prj 268MW
- Philippines 1 Prj 364MW

Including under construction and planning projects
1 Profile of J-POWER (In India)  Track Record of Consulting Business

- Neemrana Industrial Estates, Thermal Power Plant (JETRO)
- Sipat Coal-Fired Thermal Power Station (NTPC)
- M/P Study on Pumped Storage Hydroelectric Power Development in Maharashtra (JICA)
- Ghatghar Pumped Storage Hydropower Project (GOMID)
- JBIC Pilot Study for Project Formation for Identification of Hydro Power Projects (JBIC)
- Study on Enhancing Efficiency of Operating Thermal Power Plants in NTPC-India
- Anpara "E" Coal-Fired Thermal Power Plant (JETRO)
- Anpara "B" Coal-Fired Thermal Power Plant (UPSEB)
- Purulia Pumped Storage Project (WBSEB)
- Sri Sailam Hydropower Project (APGENCO)
- Kolaghat Thermal Power Station (WBPDCL)

- Assam Gas Turbine Power Station (NEEPCO)
- Umiam Hydropower Project (MeSEB)
- Bakreshwar Coal-Fired Thermal Power Station Unit No.1 to 3 (WBPDCL)
- Bakreshwar Coal-Fired Thermal Power Station Unit No.4 & 5 (JETRO, WBPDCL)
- Bakreshwar Coal-Fired Thermal Power Station Unit No.6 (JETRO, JBIC)
- Haldia Industrial Estates, Thermal Power Plant (JETRO)
- Sri Sailam Hydropower Project (APGENCO)
- Kolaghat Thermal Power Station (WBPDCL)

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Recent Activities in India

1) Study on Enhancing Efficiency of NTPC Coal-fired Power Plants
   a) Scheme : JICA Technical Cooperation
      [J-POWER (Leader), KYUSHU*1, CHUGOKU*2]
   c) Counter Part : Ministry of Power, NTPC
   d) Project overview

   CDM
   Economic / Financial Analysis
   Seminar
   Workshop
   Steering Committee

   Efficiency Improvement
   Review
   Implementation
   Improvement Plan
   Assessment on Plant (OJT)
   Unit selection

   Equipment Condition and Assessment Technology
   Efficiency Management
   Inspection

   Training in Japan

   Feedback

   Project in India

   Present stage

   Selected 5 Units
   Korba #6 (Chatisgar)
   Singrauli #4, #6 (UP)
   Rihand #2, #3 (UP)
   Vindhyachal #7 (MP)
   Unchahar #3 (UP)

*1 KYUSHU : (Kyushu Electric Power Co., Inc)
*2 CHUGOKU : (The Chugoku Electric Power Co., Inc)
Recent Activities in India (continued)

2) Consulting for Bakreswar Coal-fired Power Plant (West Bengal State)
   a) Client : WBPDCL (West Bengal Power Development Corporation)
      5x210MW Coal-fired Power Plant
   b) Scope : FS, BD (Basic Design), DD (Definite Design), SV
   c) Period : 1995- 2009

3) Consulting for Puluria Hydro Pumped Storage Power Plant
   (West Bengal State)
   a) Client : WBSEB (West Bengal State Electricity Board)
      4x225MW Hydro pumped Storage Power Plant
   b) Scope : FS, BD, DD, SV
   c) Period : 1990-92, 1995-2008

4) Consulting of Sipat Coal-fired Power Plant (MP state)
   a) Client : NTPC, 3x660MW Coal-fired Power Plant
      (1st Supercritical Power Plant in India)
   b) Scope : FS, BD
   c) Period : 1998-2003

Active in India for more than 20 years
Opportunities

1. Chronic Shortage of Electric Power
2. High Growth Potential for Electric Power Sector in a longer perspective

<table>
<thead>
<tr>
<th>Item</th>
<th>India</th>
<th>China</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP per capita (PPP)</td>
<td>2,762US$</td>
<td>5,962US$</td>
<td>34,115US$</td>
</tr>
<tr>
<td>Population (2008)</td>
<td>1.2 billion</td>
<td>1.35 billion</td>
<td>0.13 billion</td>
</tr>
</tbody>
</table>

- Growth of Power Demand: 6.4% (past 10 year average)  
  - 11th Five-Year-Plan (2007-2011): 62.4GW planned to be developed (about 1/4 of Japan)

3. Dominance of Coal-fired Generation (68% of total amount of electricity generated)
   • Market trend of Coal-fired P/P: leaning to technologies of higher efficiency and clean coal firing.

Large-scale Electric Power Development Plan and Bulk Order for Super-Critical Units
Future prospects

- India will continue to depend on coal to meet strong growth of power demand.
- Capacity of coal-fired plants will grow drastically from 78GW in 2007 to 364GW in 2030. (4.7 times)
- Accordingly, CO2 emission from coal-fired plants is increasing from 0.7 billion ton in 2007 to 1.6 billion ton in 2030. (2.3 times)

- Coal-fired plants are still a major source of CO2 emission
  GoI is committed to a CO2 reduction target (i.e., 20-25% reduction per unit of GDP by 2020 over 2005
  - high efficiency coal-fired plants need to be installed.

Source: IEA World Energy Outlook 2009
Reference scenario
4. Participation of Japanese Heavy Electric Machinery Manufactures in Indian equipment supply market (JV with local partners)

Acceleration of local sourcing of reliable and affordable equipments for high-efficient Coal-fired P/P.

- India offers unique opportunities for J-POWER to take advantage of its experience and expertise accumulated over long time and world-wide, especially in the field of Clean Coal and Clean Air technologies.

Pursuing them is just in line with the Japanese Government’s New Growth strategy.
Challenges

1. **Very limited foreign investment** in Indian power sector
   - More than 80% of generation capacity is owned by national or state companies.
   - IPPs account for only 15% and dominated by Indian capital. (e.g. Tata and Reliance successfully won 4000MW-class Ultra Mega Power Project bids)

2. **Weak financial strength of off takers**
   - Inappropriate cost-benefit sharing of electricity tariff (Cross subsidies among customers, setting low-price for agricultural users)
   - Transmission and distribution loss (Aggregate Technical and Commercial Losses) is still almost 30%!
   - After enactment of the Indian Electricity Act 2003, financial standing of Discoms in some states has improved owing to unbundling of electricity authorities, introduction of Multi-Year-Tariff approval system, e.t.c.
2. Investing in Indian Power Sector (No.4)

3. Land Acquisition and local environmental issues
   - Local partner’s role is important!

4. Complicated systems (Power trading, domestic coal procuring, etc.)
   Power Market system is too much complicated and increases risk profile for foreign investors.
   
   e.g., Intra and Inter state power supply, short term, middle term and long term power supply, Multiple or Bilateral power supply, power transaction in Merchant Power Market, Automatic Settlement Mechanism for the gap of power Supply and Demand, etc.

5. Complicated legal systems (wide-range operation of general rules and guideline, etc.)
   *Unique features of Indian market: Important to accumulate experiences and knowledge*
2. Investing in Indian Power Sector (No.5)

【Going Forward】

・Indian power sector has developed and is developing rapidly, but still dominated by Indian players, and failed to attract foreign capital and finance as it should have.

・There still remains a gap between Indian policy makers and foreign investors and financial institutions on the perception of Indian power market and its business environment.

・Indian power market is simply too huge to be invested and financed by Indian players alone. At the same time, India is a core market for the Japanese government’s New Growth Strategy.

・Indian side should not stick to the recent success stories alone and listen to foreign parties as well. Policy discussions between Indian policy makers and Japanese counterpart is necessary. I welcome JBIC to play a leading role in them.