Grid Interconnection Studies of Bagasse Based Co-generation Power Plants in Pakistan

Case Study
Presented by Hassan Jafar Zaidi
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at
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Bagasse Potential in Pakistan

- Bagasse is a fibrous Captive Biomass
- An excellent Raw Material for power generation
- Existing 81 sugar mills with an annual capacity of about six million tons sugar
- The industry crushes about 30 - 40 million tons of sugar cane that yields about 12 million tons of bagasse as an industrial waste
- It has a potential of generating 2000 MW electricity
Bagasse Potential in Pakistan
## Interconnection Studies Completed or Ongoing by PPI

### Bagasse Based

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Sugar Mill</th>
<th>Installed Capacity (MW)</th>
<th>Spillover to National Grid (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Summer</td>
</tr>
<tr>
<td>1</td>
<td>Fatimah Sugar Mills</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Alliance Sugar Mill</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Al-Moiz (Layyah Sugar Mill)</td>
<td>25</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>Al-Moiz (Mianwali Sugar Mill)</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>Chanar Sugar Mill</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Chiniot Suagr Mill</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Etihad Sugar Mill</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Jamal-din-Wali (JDW-II-USM)</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Jamal-din-Wali (JDW-III-GSM)</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Kamalia Sugar Mill</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>RYK Sugar Mill - Unit I</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>RYK Sugar Mill - Unit II</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Shahtaj Sugar Mill</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Hamza Sugar Mills</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Shiekhoo Sugar Mill, Muzaffargarh</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Indus Sugar Mills</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Mirpur Khas Sugar Mills</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Tandlianwala Sugar Mills</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>675</strong></td>
<td></td>
</tr>
</tbody>
</table>
### Agricultural Biomass

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Biomass Mill</th>
<th>Installed Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lumen Energia near Jhang</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Masood Textile Mills Limited Faisalabad</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Shakarganj Energy near Bhone, Jhang</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>SSJD, Gorchanni, Mirpurkhas</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>56</td>
</tr>
</tbody>
</table>
30 MW Power Plant by Alliance Sugar Mills Interconnection Scheme

132 kV Network Near Dharki
With Alliance PP, Year January 2016

Legend:
- 132kV
- 220kV
- 500kV
- Proposed 11kV
- Proposed 132kV

Power Planners International
25 MW Power Plant by Layyah Sugar Mills Interconnection Scheme
20 MW Power Plant by Almoiz Sugar Mills Interconnection Scheme
22 MW Power Plant by Chanar Sugar Mills
Interconnection Scheme
60 MW Power Plant by Chiniot Sugar Mills Interconnection Scheme
74 MW Power Plant by Etihad Sugar Mills Interconnection Scheme
26 MW Power Plant by Jamaldin Wali (JDW)
Sugar Mills Interconnection Scheme
26 MW Power Plant by Jamaldin Wali (JDW) Sugar Mills Interconnection Scheme

132 kV Network Near Sadiqabad
With JDW-II USM Co-Generation PP, January 2014

Legend
- 220 kV
- 132 kV
- Proposed 132 kV
17 MW Power Plant by Kamalia Sugar Mills
Interconnection Scheme
32 MW Power Plant by Shahtaj Sugar Mills
Interconnection Scheme

Legend
- 220 kV
- 132 kV
- Proposed 11 kV
- Proposed 132 kV
6 MW Power Plant by Sheikhoo Sugar Mills
Interconnection Scheme

Network Around Proposed Site of Sheikhoo Thermal PP
(with Sheikhoo 6 MW PP, Year 2016)

Legend

- 66 kV
- 132 kV
- 220 kV
- Proposed 6.6 kV
- Proposed 11 kV
- Proposed 132 kV

Sketch-3
Interconnection Study of 6 MW Sheikhoo PP
Power Planners International
12 MW Biomass Power Plant by Lumen Energia Interconnection Scheme
20 MW Biomass Power Plant by Shakargunj Energy Interconnection Scheme
PPI is conducting Interconnection Study constituting following main components

Load Flow study

Steady State performance

Adequacy of loading limits of circuits affected due to interconnection i.e no overloading on any line/Transformer

Voltage profile to be within the Grid Code ± 5 % off-nominal

Contingency Analysis

No overloading on any line/Trafo under one line out condition (N-1 Criteria of Grid Code)

Voltage Profile to be within ± 10 % off-nominal
Fundamental Studies required for Interconnection Study

• Short Circuit Study
  • 3-Phase and Single-Phase fault currents are calculated:
    • To determine the ratings of the equipment to be installed at the switching station of the power plant i.e. breakers, Isolators, CTs, PTs and other switchgear
    • To confirm if the fault levels on the substations in the vicinity of the new power plant are within the ratings of the equipment already installed there because fault current contributions from the new power plant would increase the fault levels on its neighbouring substations
    • To carry out protection coordination and relay settings of at the proposed power plant and also on the neighboring substations if so required
Fundamental Studies required for Interconnection Study

- Transient Stability Study
- If the system stays stable and does not lose synchronism after any severe fault happens on the system such as 3-Ph or 1-Ph faults by monitoring
  - Rotor angles of generators of the entire system must stay in synchronism
  - Power swings on transmission lines must damp rapidly
  - Voltage on bus bars recover soonest to the acceptable level i.e. within 2-3 seconds
  - Frequency recover after any dips or over-frequency event
Bagasse Power Plant
Bagasse/ Biomass Power Plants
Bagasse/ Biomass Power Plants
Bagasse/ Biomass Power Plants
Thank You
for Your Attention