

**Introduction**

Ely Power Station at 38MWe, is the largest straw burning power station in the world generating over 270GWh each year. The plant was developed by EPR, in partnership with Cinergy Global Power. The plant has successfully burned oil seed rape and miscanthus in addition to its usual fuel of cereal straw.

The 200,000 tonnes p.a. fuel demand of the plant is supplied by Ely’s sister company, Anglian Straw. The plant is highly efficient, generating steam at 540°C and 92 bar. Noted for its high reliability, the plant achieves one of the highest load factors of any renewable energy plant.

The power output from the plant is sold under an NF FO contract that terminates in 2013, after which it will be sold at the available market rate. Following shows the preliminary CFD modelling results of the plant.

**The furnace, fuel and operating conditions**

- **Furnace operating parameters:**
  - Total combustion air = 34.7 kg/s
  - Grate + Rear Wall SA = 15.5 kg/s
  - Ignition air = 7.5 kg/s
  - LW Gas Burner Air = 1.95 kg/s
  - RW Gas Burner Air = 1.36 kg/s
  - OFA + SA Front = 8.39 kg/s
  - Air temperature = 174°C
  - Theoretical air = 3.63Nm3/kg
  - Straw feed rate = 20 tonnes/hr
  - Air/fuel stoichiometric ratio = 1.34

- **Grate type:** vibrating grate W 9.2m × L 7.28m

**Table 1: Fuel properties (straw), wt%**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>LCV</td>
<td>13.58 MJ/kg</td>
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<tr>
<td>Mass loss</td>
<td></td>
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<tr>
<td>Moisture</td>
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<tr>
<td>Volatile matter</td>
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<tr>
<td>Carbon</td>
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<td>Ash</td>
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</tbody>
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**Results from FLIC simulation**

- Gas temperature in bed and the immediate area above the bed
- Solid temperature in the burning bed
- Moisture in fuel profile
- Volatile matter in fuel profile
- Carbon in fuel profile
- Mass loss profile along bed length
- Gas composition from bed top
- NO and HCN concentration from bed top

**Results from FLUENT Simulation**

- Preliminary conclusions:
  - Initial intensive combustion of straw on the bed (which is consistent with visual observation).
  - Burning of straw begins approx. 60 seconds after it is admitted into the combustion chamber or 0.5m away from the feed entry.
  - Combustion of the straw on bed is sub-stoichiometric, with large quantities of unburned CO, CxHy, CH4, H2 released to the over-bed chamber, where secondary air is added to complete the combustion. As a result, most of the fuel N is released from the bed as HCN and very little NO is formed inside the bed;
  - In the over-bed combustion region, temperature distribution is very uneven, due to a combination of weak mixing of secondary air and un-burned gases from the bed.

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