PROJECT DESCRIPTION

- Simulated coal tests were run in a custom-built LIBS analyzer to determine the capability of the LIBS technology to detect the major elements present in the coal that are likely to have an impact on slagging.
- A coal inventory was assembled and tested for fuels used at utility boilers, with a range of slagging propensities.
- Artificial Neural Networks (ANNs) were created to correlate the LIBS spectral signals to ash fusion temperature.
- Parametric tests will be carried out at a 650 MW utility boiler to create a Database to be used by an advisory expert system.
- An on-line advisory expert software will be deployed at the 650 MW Unit to work along with signals from the LIBS system and plant DCS, to recommend actions for slagging mitigation.

COAL TESTING CORRELATION RESULTS

LIBS+ANN COAL ANALYZER CONCEPT

OPTIMIZATION OBJECTIVE:
Operational and Environmental Constraints

ARTIFICIAL INTELLIGENCE APPROACH:
Artificial Neural Networks
Optimizer
Expert System

LIBS SIGNAL:
Ash and Coal Composition
Coal Proximate Analysis

UNIT OPERATING DATA (DCS):
Fuel flow, FEGT, Excess O₂, OFA, etc.

UNIT HISTORIC DATA:
Parametric Tests Database

Recommendations on Coal Blending, Unit Parameters Settings and Sootblowing Schedule

Coal Analyzer – Slagging Mitigation Advisory

Coal Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al</td>
<td>0.05 % Wt.</td>
</tr>
<tr>
<td>Ca</td>
<td>0.20 % Wt.</td>
</tr>
<tr>
<td>Fe</td>
<td>0.27 % Wt.</td>
</tr>
<tr>
<td>Mg</td>
<td>0.05 % Wt.</td>
</tr>
<tr>
<td>Na</td>
<td>0.05 % Wt.</td>
</tr>
<tr>
<td>Si</td>
<td>0.98 % Wt.</td>
</tr>
<tr>
<td>Ti</td>
<td>0.02 % Wt.</td>
</tr>
<tr>
<td>Cr</td>
<td>77.26 % Wt.</td>
</tr>
<tr>
<td>S</td>
<td>0.68 % Wt.</td>
</tr>
<tr>
<td>K</td>
<td>0.11 % Wt.</td>
</tr>
<tr>
<td>H₂O</td>
<td>11.63 % BTU/lb</td>
</tr>
<tr>
<td>B/A Ratio</td>
<td>0.30</td>
</tr>
<tr>
<td>Slagging Index</td>
<td>0.16</td>
</tr>
<tr>
<td>Ash Fusion Temp.</td>
<td>1,990 °F</td>
</tr>
</tbody>
</table>

UNIT 3 FURNACE TEMPERATURE

Measured FEGT = 2013 °F
Predicted Ash Fusion Temp. = 1990 °F

Furnace / Fusion Temperatures

Advisory Screen
FEGT Exceeding Ash Fusion Temperature:
- Initialize Sootblowing sequences 7, 8, 12
- Bas Mills 34, 35 coal flow rate down
- Increases excess O₂ to 3.5%
- Close OFA to 75%

LIBS TESTS FOR 8 COALS INVENTORY

Load
Gross Load = 638.3 MW
Net Load = 605.3 MW

LIBS+ANN COAL ANALYZER CONCEPT

Carlos E. Romero, Ph.D.
Shen Yao
Ricardo X. Moreno

Arel Weisberg, Ph.D.
Joseph Craparo, Ph.D.
Lawrence Mulligan, Ph.D.
Robert De Saro