The indigenous coal supply to the power sector will be mostly from lower grade coals having high ash content. The power sector shall have to depend on significant quantity of imported coal in the future as the demand cannot be met from indigenous supply.

For blending Homogeneity of Coal Property is always preferred but unfortunately very often the user has no control on the choice of coals which are decided by other factors such as availability and cost.

Compatibility of the imported coal with Indian coal for their non additive properties like grindability, reactivity and burning behavior in a utility furnace is of prime concern in coal blending for efficient power generation.
It is widely acknowledged that blending of coals should be done judiciously taking into consideration the properties of the individual blend components. Since coal is not homogenous, its quality varies and depends on the content of several ingredients.

In disruptive coal market scenario it is important that utilities adopt a proper strategy of coal procurement and coal use to run their plant efficiently with higher degree of reliability while remaining competitive.

Most of the plants in India are normally designed with limited fuel flexibility- are not blend ready design. They may require minor or major modification depending on design and operation history to accommodate wider fuel property variation.
COAL PROPERTY VARIATION

Ranking by MMF Higher Heating Value

Higher Heating Value, Btu/lb - MMF

Lignite B
Lignite A
Sub-bituminous C
Sub-bituminous B
Sub-bituminous A
High Volatile C
High Volatile B
High Volatile A
Medium Volatile
Low Volatile Bituminous
Semi-Anthracite
Anthracite
Meta-Anthracite

Proximate Analysis Comparison

Percent, Ash Free

Low Rank

Fixed Carbon

Volatile Matter

Moisture

Low Rank

0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%

Proximate Analysis Comparison

COAL PROPERTY VARIATION
IMPACT OF COAL PROPERTY DEGRADATION

COAL PROXIMATE ANALYSIS

- Fixed Carbon
- Volatile Matter
- Moisture
- Ash

Increase of Ash → Increased Fuel Consumption, Reduction in GCV
Increase of Moisture → Reduction in Efficiency
**IMPACT OF COAL PROPERTY DEGRADATION**

- **Higher Fuel Consumption**
  - **Mill**
    - Capacity Constraint: Yes
    - Asset Management: Yes
    - Reliability: Yes
  - **ESP**
    - Capacity Constraint: Yes
    - Asset Management: Yes
  - **Draft System**
    - Capacity Constraint: Yes
    - Asset Management: Yes
    - Reliability: Yes
  - **Feeder**
    - Capacity Constraint: Yes
    - Asset Management: Yes
  - **Ash Handling**
    - Capacity Constraint: Yes
    - Asset Management: Yes

**Solution 1:** Blending with High Rank Coal.

**Solution 2:** Boiler Modification to accommodate higher fuel consumption.
BLENDING IMPACT

BLENDING IMPACT

IMPACT

VISIBLE IMPACT

SILENT IMPACT

ISSUES

GENERATION
EFFICIENCY
RELIABILITY
ASSET LIFE
COMPONENT LEVEL ANALYSIS - MILL

MILL PERFORMANCE - FUEL DEPENDENCY

- MOISTURE
- HGI
- VOLATILE CONTENT
- YGP
- FUEL EXPLOSIVITY
- FUEL REACTIVITY
- FUEL FLOWABILITY
## COMPONENT LEVEL ANALYSIS - MILL

<table>
<thead>
<tr>
<th>COMPONENT LEVEL ANALYSIS - MILL</th>
<th>DETORIORATION OF MILL OUTPUT</th>
<th>GENERATION CONSTRAINT</th>
<th>SPECIFIC ISSUES</th>
<th>FORCED OUTAGE</th>
<th>ASSET MANAGEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOISTURE CONTENT</td>
<td>YES</td>
<td>YES (PROBABILITY EXISTS)</td>
<td>DESIGN CHECK REQUIRED TO ENSURE SUFFICIENT HEAT AVAILABLE AT MILL INLET FOR DRYING</td>
<td></td>
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</tr>
<tr>
<td>HGI</td>
<td>YES</td>
<td>YES (PROBABILITY EXISTS)</td>
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</tr>
<tr>
<td>YGP</td>
<td>YES</td>
<td></td>
<td></td>
<td></td>
<td>LESS LIFE OF COMPONENT</td>
</tr>
<tr>
<td>EXPLOSIVITY</td>
<td></td>
<td></td>
<td>MILL OUTLET TEMPERATURE TO BE CONTROLLED</td>
<td>YES</td>
<td>ADDITIONAL SPARE CONSUMPTION</td>
</tr>
<tr>
<td>VM/REACTIVITY</td>
<td></td>
<td></td>
<td>MILL OUTLET TEMPERATURE TO BE CONTROLLED CHECKING REQUIRED RESPECT TO OTHER COAL</td>
<td>YES</td>
<td>PROBABILITY OF COMPONENT DAMAGE</td>
</tr>
</tbody>
</table>
BURNING PROFILE

TGA CURVE function of (FC, VM, MOISTURE, ASH)

FOR A BLENDING OPERATION IT IS IMPORTANT TO COMPARE BURNING PROFILE OF 2 COALS.
COAL HAVING HIGHER HEAT VALUE DOESN’T NECESSIRILY QUALIFY IT WILL HAVE SUPERIOR CHARACTERISTICS IN ALL RESPECT.

SLAGGING AND FOULING ARE IMPORTANT ASPECTS TO BE TAKEN IN CONSIDERATION FOR FUEL CHANGE STUDY AND BLENDING OPERATION.

SLAGGING, FOULING, EROSION HAS SIGNIFICANT IMPACT ON BOILER OPERATION AND ASSET LIFE.

FOULING AND SLAGGING ARE DEPENDENT ON COMPOSITE ASH COMPOSITION
SLAGGING AND FOULING ISSUE

FOULING AND SLAGGING

- IMPACT

OCCURANCE

- ACCUMULATION OF ASH DEPOSIT ON HEAT TRANSFER SURFACE
- UNCONTROLLED ASH DEPOSITION

CONCERN

- REDUCED HEAT TRANSFER
- REDUCED EFFICIENCY
- UNSCHEDULED SHUTDOWN
- PROBABILITY OF EROSION AND CORROSION
NEED ANALYSIS

1. Remain Competitive In Turbulent Coal Market Dynamics
2. Reliable and Efficient operation in Fuel Change Scenario
3. Proper Asset Management

Considering present Scenario Coal Blending / Fuel switches are inevitable during the lifecycle of a Power Station.
BLENDING ANALYSIS FROM OVERALL PERSPECTIVE

- DIRECT COST
- MANPOWER

- FUEL

- GENERATION CONSTRAINT
- ASSET LIFE
- INDIRECT IMPACT
- SAFETY
- RELIABILITY

ASSET LIFE
### BLENDING ANALYSIS FROM OVERALL PERSPECTIVE

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PROBABILITY</th>
<th>PROBABLE DURATION</th>
<th>FINANCIAL IMPACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQUIPMENT DESIGN CONSTRAINT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MOISTURE PICK UP AT RAINY SEASON</td>
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<td></td>
</tr>
<tr>
<td>OTHER-----</td>
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</table>

### GENERATION CONSTRAINT

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PROBABILITY</th>
<th>PROBABLE DURATION</th>
<th>FINANCIAL IMPACT</th>
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<tbody>
<tr>
<td>TUBE FAILURE</td>
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<tr>
<td>FAN STALLING</td>
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<tr>
<td>FLAME FAILURE</td>
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### BLENDING ANALYSIS FROM OVERALL PERSPECTIVE

#### ASSET LIFE

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PROBABILITY</th>
<th>POSSIBLE SOLUTION</th>
<th>FINANCIAL IMPACT</th>
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<tbody>
<tr>
<td>EQUIPMENT WEAR AND TEAR</td>
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<tr>
<td>CORROSION/EROSION</td>
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<tr>
<td>OTHER-----</td>
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#### SAFETY

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>PROBABILITY</th>
<th>EXPECTED SHUTDOWN</th>
<th>FINANCIAL IMPACT</th>
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<tbody>
<tr>
<td>FIRE HAZARD</td>
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<tr>
<td>EXPLOSION</td>
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<tr>
<td>OTHER SAFETY ISSUES</td>
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### BLENDING- DECISION TREE

<table>
<thead>
<tr>
<th>Impact</th>
<th>1</th>
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<tbody>
<tr>
<td><strong>Direct Cost</strong></td>
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</tr>
<tr>
<td>Fuel + Labour + Consumable</td>
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<tr>
<td><strong>Indirect Impact</strong></td>
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<tr>
<td>Revenue Loss due to Constrained Generation</td>
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</tr>
<tr>
<td>Financial Impact due to Reliability Issue</td>
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</tr>
<tr>
<td>Financial Impact on account of Asset Life</td>
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</tr>
<tr>
<td>Financial Impact on account of Safety Issue</td>
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</tr>
<tr>
<td>Total Direct cost + Probable Indirect Impact</td>
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</table>

**FUEL COMBINATION**

**ABOVE DECISION TREE MAY HELP UTILITIES IN FUEL MANAGEMENT AND FUEL PURCHASE POLICY.**